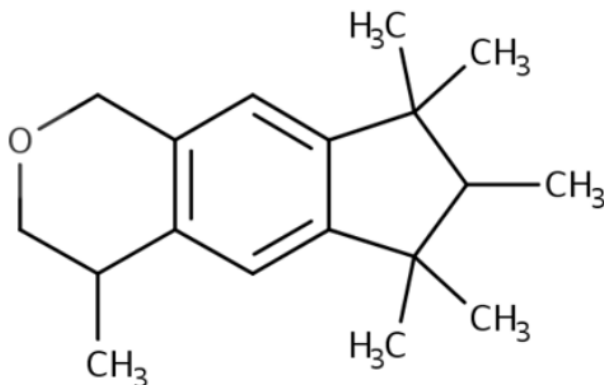


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**Draft Data Quality Evaluation and Data Extraction Information for  
Environmental Release and Occupational Exposure for  
1,3,4,6,7,8-Hexahydro-4,6,6,7,8,8-hexamethylcyclopenta[ $\gamma$ ]-2-benzopyran (HHCB)**

**Systematic Review Support Document for the Draft Risk Evaluation**

**CASRN: 1222-05-5**



*March 2026*

This supplemental file contains information regarding the data extraction and quality evaluation results for data sources that were considered for the *Draft Risk Evaluation for 1,3,4,6,7,8-Hexahydro-4,6,6,7,8,8-hexamethylcyclopenta [g]-2-benzopyran (HHCB)* and that underwent systematic review. EPA conducted data extraction, and quality evaluation based on author-reported descriptions and results; additional analyses (*e.g.*, statistical analyses) potentially conducted by EPA are not contained in this supplemental file. EPA used the TSCA systematic review process described in the *Draft Systematic Review Protocol Supporting TSCA Risk Evaluations for Chemical Substances* (referred to hereafter '2021 Draft Systematic Review Protocol').

Data that met the RESO (Receptors, Exposure, Setting or Scenario, and Outcomes) screening criteria during the full-text screening was extracted by three data types, general facility, occupational exposure, and environmental release, as explained in Section 6.2 of the 2021 Draft Systematic Review Protocol. Five different data quality evaluation forms were used depending on the data type and condition of use (COU), as explained in Appendix M of the 2021 Draft Systematic Review Protocol. All references with data points containing monitoring data (*e.g.*, measured occupational exposures) underwent data quality evaluation as described in Section M.6.1, using the monitoring data quality metrics. All references with data points containing environmental release data (*e.g.*, measured or calculated quantities of chemical release across facility fence line) underwent data quality evaluation as described in Section M.6.2, using the environmental release data quality metrics. All references with data points containing published models for environmental release or occupational exposure (*e.g.*, published models used to calculate occupational exposure or environmental releases) underwent data quality evaluation as described in Section M.6.3, using the published models for environmental release or occupational exposure quality metrics. All references with data points containing completed exposure or risk assessments (*e.g.*, completed exposure or risk assessments containing a broad range of data types) underwent data quality evaluation as described in Section M.6.4, using the completed exposure or risk assessments quality metrics. All references with data points containing reports for data or information other than exposure or release data (*e.g.*, process description) underwent data quality evaluation as described in Section M.6.5, using the reports for data or information other than exposure or release data quality metrics. The extracted data and their data quality evaluation are available in the tables below.

Additionally, each data type and condition of use is evaluated independently within a given study; therefore, each reference may have more than one overall quality determination (OQD) to reflect the quality of each outcome and the exposures and releases more appropriately as described by the study authors. No OQD is determined for each reference, as a whole, if it contains data from more than one evidence stream.

HERO ID	Reference	Page
<b>Occupational Exposure</b>		
<b>Monitoring Data</b>		
1997907	Bauer, A. (2013). Contact dermatitis in the cleaning industry. <i>Current Opinion in Allergy and Clinical Immunology</i> 13(5):521-524.	9
1863036	Correia, P., Cruz, A., Santos, L., Alves, A. (2013). Human dermal exposure to galaxolide from personal care products. <i>International Journal of Cosmetic Science</i> 35(3):299-309.	10
5556411	Fromme, H., Lahrz, T., Piloty, M., Gebhart, H., Oddoy, A., Rüdén, H. (2004). Occurrence of phthalates and musk fragrances in indoor air and dust from apartments and kindergartens in Berlin (Germany). <i>Indoor Air</i> 14(3):188-195.	11
2452666	Gerster, Melchior, F., Hopf, Brenna, N., Wild, Pierre, P., Vernez, D. (2014). Airborne exposures to monoethanolamine, glycol ethers, and benzyl alcohol during professional cleaning: a pilot study. <i>Annals of Occupational Hygiene</i> 58(7):846-859.	12
9551210	Harley, K. G., Calderon, L., Nolan, S., J.E., Maddalena, R., Russell, M., Roman, K., Mayo-Burgos, S., Cabrera, J., Morga, N., Bradman, A. (2021). Changes in Latina women's exposure to cleaning chemicals associated with switching from conventional to "green" household cleaning products: The LUCIR intervention study. <i>Environmental Health Perspectives</i> 129(9):97001.	13
7311740	Lin, N., Rosemberg, M. A., Li, W., Meza-Wilson, E., Godwin, C., Batterman, S. (2021). Occupational exposure and health risks of volatile organic compounds of hotel housekeepers: Field measurements of exposure and health risks. <i>Indoor Air</i> 31(1):26-39.	14
2095404	Lu, Y.,an, Yuan, T.,ao, Yun, S., Wang, W., Kannan, K. (2011). Occurrence of synthetic musks in indoor dust from China and implications for human exposure. <i>Archives of Environmental Contamination and Toxicology</i> 60(1):182-189.	15
3259071	Saito, R., Virji, M. A., Henneberger, P. K., Humann, M. J., Lebouf, R. F., Stanton, M. L., Liang, X., Stefaniak, A. B. (2015). Characterization of Cleaning and Disinfecting Tasks and Product Use Among Hospital Occupations. <i>American Journal of Industrial Medicine</i> 58(1):101-111.	17
4635	Whitmyre, G. K., Driver, J. H., Ginevan, M. E., Tardiff, R. G., Baker, S. R. (1992). Human exposure assessment I: Understanding the uncertainties. <i>Toxicology and Industrial Health</i> 8(5):297-320.	19
3603871	Zhang, X., Yu, Y., Gu, Y., Li, X., Zhang, X., Yu, Y. (2017). In vitro determination of transdermal permeation of synthetic musks and estimated dermal uptake through usage of personal care products. <i>Chemosphere</i> 173:417-424.	20
<b>Published Models for Exposures or Releases</b>		
3222353	Ng, M. G., Tongeren, van, M., Semple, S. (2014). Simulated transfer of liquids and powders from hands and clothing to the mouth. <i>Journal of Occupational and Environmental Hygiene</i> 11(10):633-644.	21
6387321	OECD, (2011). Emission scenario document on the chemicals used in water-based washing operations at industrial and institutional laundries.	22
3602893	Pelletier, M., Bonvallot, N., Ramalho, O., Blanchard, O., Mercier, F., Mandin, C., Bot, Le, B., Glorennec, P. (2017). Dermal absorption of semivolatile organic compounds from the gas phase: Sensitivity of exposure assessment by steady state modeling to key parameters. <i>Environment International</i> 102:106-113.	23
<b>Completed Exposure or Risk Assessments</b>		
9551179	Bello, A. (2008). Assessment of exposures to cleaning product ingredients used in common cleaning tasks.	24
992639	Bello, A., Quinn, M. M., Perry, M. J., Milton, D. K. (2009). Characterization of occupational exposures to cleaning products used for common cleaning tasks—a pilot study of hospital cleaners. <i>Environmental Health</i> 8:11.	25
5155574	ECB, (2008). European Union risk assessment report: 1,3,4,6,7,8-hexahydro-4,6,6,7,8,8-hexamethylcyclopenta- $\gamma$ -2-benzopyran (HHCB).	27

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<b>8404084</b>	ECB, (2008). 1,3,4,6,7,8-Hexahydro-4,6,6,7,8-hexamethylcyclopenta- $\gamma$ -2-benzopyran, (1,3,4,6,7,8-hexahydro-4,6,6,7,8-hexamethylin-deno[5,6- c]pyran - HHCB) summary risk assessment report.	<b>33</b>
<b>5349389</b>	NICNAS, (2019). Cyclopenta[g]-2-benzopyran, 1,3,4,6,7,8-hexahydro-4,6,6,7,8-hexamethyl-: Human health tier II assessment.	<b>34</b>
<b>6387319</b>	OECD, (2010). Emission scenario document on the blending of fragrance oils into commercial and consumer products.	<b>35</b>
<b>10480466</b>	U.S. EPA, (2023). Use of laboratory chemicals - Generic scenario for estimating occupational exposures and environmental releases (Revised draft generic scenario).	<b>37</b>
<b>11182966</b>	U.S. EPA, (2022). Chemical repackaging - Generic scenario for estimating occupational exposures and environmental releases (revised draft).	<b>38</b>
<b>3827195</b>	U.S. EPA, (2014). Generic scenario draft on the use of additives in plastic compounding.	<b>39</b>
<b>6311218</b>	U.S. EPA, (2004). Additives in plastics processing (compounding) – generic scenario for estimating occupational exposures and environmental release – Draft.	<b>40</b>
<b>6385740</b>	U.S. EPA, (1991). Granular detergents manufacture - generic scenario for estimating occupational exposures environmental releases: Draft.	<b>41</b>
<b>6385748</b>	U.S. EPA, (2014). Use of additive in plastic compounding - generic scenario for estimating occupational exposures and environmental releases: Draft.	<b>42</b>
<b>Reports for Data or Information Other than Exposure or Release Data</b>		
<b>9551178</b>	Ashkin, S., Ellis, R. (2006). Cleaning materials and methods. :169-188.	<b>43</b>
<b>9551187</b>	Espinoza, T., Geiger, C., Everson, I. (2010). The real costs of institutional "green" cleaning.	<b>44</b>
<b>9551208</b>	Hsieh, Y. C., Apostolopoulos, Y., Hatzudis, K., Sönmez, S. (2014). Occupational exposures and health outcomes among Latina hotel cleaners. Hispanic Health Care International 12(1):6-15.	<b>45</b>
<b>5443926</b>	Lee, S. J., Nam, B., Harrison, R., Hong, O. (2014). Acute symptoms associated with chemical exposures and safe work practices among hospital and campus cleaning workers: a pilot study. American Journal of Industrial Medicine 57(11):1216-1226.	<b>46</b>
<b>4682850</b>	Nazaroff, W. W., Coleman, B. K., Destailats, H., Hodgson, A. T., Liu, D.,-L, Lunden, M. M., Singer, B. C., Weschler, C. J. (2006). Indoor air chemistry: Cleaning agents, ozone and toxic air contaminants.	<b>47</b>
<b>57058</b>	Nazaroff, W. W., Weschler, C. J. (2004). Cleaning products and air fresheners: exposure to primary and secondary air pollutants. Atmospheric Environment 38(18):2841-2865.	<b>48</b>
<b>11333406</b>	P&G, (2023). Comments of The Procter & Gamble Company on 1,4-Dioxane: Draft Supplement to the TSCA Risk Evaluation Science Advisory Committee on Chemicals (SACC) Meeting.	<b>50</b>
<b>11138808</b>	U.S. BLS, (2023). U.S. Census Bureau of Labor Statistics Data from 2021.	<b>51</b>
<b>13027718</b>	U.S. Census Bureau, (2021). 2021 SUSB Annual Datasets by Establishment Industry.	<b>52</b>
<b>10366189</b>	U.S. EPA, (2020). 2020 CDR: Commercial and consumer use.	<b>53</b>
<b>11224653</b>	U.S. EPA, (2013). Updating CEB's method for screening-level estimates of dermal exposure.	<b>54</b>
<b>6385708</b>	U.S. EPA, (2003). Transportation equipment cleaning - Generic scenario for estimating occupational exposures and environmental releases (draft).	<b>55</b>
<b>3401413</b>	Wei, W., Boumier, J., Wyart, G., Ramalho, O., Mandin, C. (2016). Cleaning practices and cleaning products in nurseries and schools: to what extent can they impact indoor air quality?. Indoor Air 26(4):517-525.	<b>56</b>

Environmental Releases

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<b>7303021</b>	AS., COWI (2018). Screening programme 2017: Suspected PBT compounds.	<b>57</b>
<b>5349126</b>	Balk, F., Ford, R. A. (1999). Environmental risk assessment for the polycyclic musks AHTN and HHCB in the EU. I. Fate and exposure assessment. Toxicology Letters 111(1-2):57-79.	<b>58</b>
<b>5428645</b>	Berding, V., Koormann, F., Schwartz, S., Wagner, J. O., Matthies, M. (2001). Spatial refinement of regional exposure assessment. NATO Science Series IV Earth and Environmental Sciences 2:205-222.	<b>59</b>
<b>8729831</b>	Consulting., Integral (2021). Analysis of monitoring data for HHCB in surface waters of the United States from 2015 to 2021.	<b>60</b>
<b>8802195</b>	FCA, (2021). Site emission survey of fragrance formulation compounders and product manufacturers using HHCB: Information to support the TSCA risk evaluation; with comment, dated 08/05/2021.	<b>61</b>
<b>11360398</b>	Milbrandt, A., Coney, K., Badgett, A., Beckham, G. T. (2022). Quantification and evaluation of plastic waste in the United States. Resources, Conservation and Recycling 183:106363.	<b>63</b>
<b>4682850</b>	Nazaroff, W. W., Coleman, B. K., Destailats, H., Hodgson, A. T., Liu, D.,-L, Lunden, M. M., Singer, B. C., Weschler, C. J. (2006). Indoor air chemistry: Cleaning agents, ozone and toxic air contaminants.	<b>64</b>
<b>5349388</b>	RIVM, (1997). Environmental risk assessment of the polycyclic musks AHTN and HHCB according to the EU-TGD.	<b>65</b>
<b>13027717</b>	U.S. EPA, (2024). Toxics Release Inventory (TRI) data: 1,3,4,6,7,8-Hexahydro-4,6,6,7,8,8-hexamethylcyclopenta-g-2- benzopyran (HHCB), reporting year 2023.	<b>66</b>
<b>46492</b>	U.S. EPA, (1995). AP-42: Compilation of air pollutant emission factors. Volume I: Stationary point and area sources, fifth edition.	<b>67</b>
<b>6385708</b>	U.S. EPA, (2003). Transportation equipment cleaning - Generic scenario for estimating occupational exposures and environmental releases (draft).	<b>69</b>
<b>6385748</b>	U.S. EPA, (2014). Use of additive in plastic compounding - generic scenario for estimating occupational exposures and environmental releases: Draft.	<b>70</b>
<b>7310513</b>	U.S. EPA, (1995). Chapter 6: Organic chemical process industry. Compilation of air pollutant emission factors. Volume I: Stationary point and area sources, fifth edition, AP-42.	<b>71</b>
<b>1970730</b>	Upadhyay, N., Sun, Q., Allen, J. O., Westerhoff, P., Herckes, P. (2011). Synthetic musk emissions from wastewater aeration basins. Water Research 45(3):1071-1078.	<b>74</b>
<b>Published Models for Exposures or Releases</b>		
<b>7349020</b>	ERG, (1998). Air emissions inventories, volume 2: Point sources: Chapter 11: Preferred and alternative methods for estimating air emissions from plastic products manufacturing.	<b>75</b>
<b>6387321</b>	OECD, (2011). Emission scenario document on the chemicals used in water-based washing operations at industrial and institutional laundries.	<b>76</b>
<b>5428093</b>	Schwartz, S., Berding, V., Matthies, M. (2000). Aquatic fate assessment of the polycyclic musk fragrance HHCB - Scenario and variability analysis in accordance with the EU risk assessment guidelines. Chemosphere 41(5):671-679.	<b>77</b>
<b>Completed Exposure or Risk Assessments</b>		
<b>5155574</b>	ECB, (2008). European Union risk assessment report: 1,3,4,6,7,8-hexahydro-4,6,6,7,8,8-hexamethylcyclopenta- $\gamma$ -2-benzopyran (HHCB).	<b>78</b>
<b>8404084</b>	ECB, (2008). 1,3,4,6,7,8-Hexahydro-4,6,6,7,8,8-hexamethylcyclopenta- $\gamma$ -2-benzopyran, (1,3,4,6,7,8-hexahydro-4,6,6,7,8,8-hexamethylin-deno[5,6- c]pyran - HHCB) summary risk assessment report.	<b>80</b>
<b>5079084</b>	OECD, (2009). Emission scenario document on plastic additives.	<b>81</b>
<b>6387319</b>	OECD, (2010). Emission scenario document on the blending of fragrance oils into commercial and consumer products.	<b>83</b>
<b>6393282</b>	OECD, (2009). Emission scenario document on transport and storage of chemicals.	<b>84</b>
<b>6414932</b>	OECD, (2015). Emission scenario document (ESD) on industrial use of industrial cleaners.	<b>85</b>

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<b>10480466</b>	U.S. EPA, (2023). Use of laboratory chemicals - Generic scenario for estimating occupational exposures and environmental releases (Revised draft generic scenario).	<b>86</b>
<b>11182966</b>	U.S. EPA, (2022). Chemical repackaging - Generic scenario for estimating occupational exposures and environmental releases (revised draft).	<b>87</b>
<b>3827195</b>	U.S. EPA, (2014). Generic scenario draft on the use of additives in plastic compounding.	<b>88</b>
<b>6311218</b>	U.S. EPA, (2004). Additives in plastics processing (compounding) – generic scenario for estimating occupational exposures and environmental release – Draft.	<b>89</b>
<b>6385740</b>	U.S. EPA, (1991). Granular detergents manufacture - generic scenario for estimating occupational exposures environmental releases: Draft.	<b>90</b>
<b>Reports for Data or Information Other than Exposure or Release Data</b>		
<b>57058</b>	Nazaroff, W. W., Weschler, C. J. (2004). Cleaning products and air fresheners: exposure to primary and secondary air pollutants. Atmospheric Environment 38(18):2841-2865.	<b>91</b>
<b>General Engineering Assessment</b>		
<b>Published Models for Exposures or Releases</b>		
<b>6387321</b>	OECD, (2011). Emission scenario document on the chemicals used in water-based washing operations at industrial and institutional laundries.	<b>92</b>
<b>Completed Exposure or Risk Assessments</b>		
<b>9551179</b>	Bello, A. (2008). Assessment of exposures to cleaning product ingredients used in common cleaning tasks.	<b>93</b>
<b>5155574</b>	ECB, (2008). European Union risk assessment report: 1,3,4,6,7,8-hexahydro-4,6,6,7,8,8-hexamethylcyclopenta- $\gamma$ -2-benzopyran (HHCB).	<b>94</b>
<b>8404084</b>	ECB, (2008). 1,3,4,6,7,8-Hexahydro-4,6,6,7,8,8-hexamethylcyclopenta- $\gamma$ -2-benzopyran, (1,3,4,6,7,8-hexahydro-4,6,6,7,8,8-hexamethylin-deno[5,6- c]pyran - HHCB) summary risk assessment report.	<b>97</b>
<b>7349020</b>	ERG, (1998). Air emissions inventories, volume 2: Point sources: Chapter 11: Preferred and alternative methods for estimating air emissions from plastic products manufacturing.	<b>99</b>
<b>5079084</b>	OECD, (2009). Emission scenario document on plastic additives.	<b>100</b>
<b>6387319</b>	OECD, (2010). Emission scenario document on the blending of fragrance oils into commercial and consumer products.	<b>101</b>
<b>6393282</b>	OECD, (2009). Emission scenario document on transport and storage of chemicals.	<b>103</b>
<b>6414932</b>	OECD, (2015). Emission scenario document (ESD) on industrial use of industrial cleaners.	<b>104</b>
<b>10480466</b>	U.S. EPA, (2023). Use of laboratory chemicals - Generic scenario for estimating occupational exposures and environmental releases (Revised draft generic scenario).	<b>105</b>
<b>11182966</b>	U.S. EPA, (2022). Chemical repackaging - Generic scenario for estimating occupational exposures and environmental releases (revised draft).	<b>106</b>
<b>3827195</b>	U.S. EPA, (2014). Generic scenario draft on the use of additives in plastic compounding.	<b>108</b>
<b>6311218</b>	U.S. EPA, (2004). Additives in plastics processing (compounding) – generic scenario for estimating occupational exposures and environmental release – Draft.	<b>109</b>
<b>6385740</b>	U.S. EPA, (1991). Granular detergents manufacture - generic scenario for estimating occupational exposures environmental releases: Draft.	<b>110</b>
<b>6385748</b>	U.S. EPA, (2014). Use of additive in plastic compounding - generic scenario for estimating occupational exposures and environmental releases: Draft.	<b>111</b>
<b>Reports for Data or Information Other than Exposure or Release Data</b>		

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<b>10369850</b>	ACA, (2019). Comment submitted by Raleigh Davis, Assistant Director and Riaz Zaman, Counsel, Government Affairs, American Coatings Association (ACA) regarding the proposed 20 high priority candidates for chemical risk evaluation.	<b>112</b>
<b>11360400</b>	APR, (2020). U.S. post-consumer plastic recycling data.	<b>113</b>
<b>7303021</b>	AS,, COWI (2018). Screening programme 2017: Suspected PBT compounds.	<b>114</b>
<b>19035</b>	Aschmann, S. M., Arey, J., Atkinson, R., Simonich, S. L. (2001). Atmospheric lifetimes and fates of selected fragrance materials and volatile model compounds. Environmental Science & Technology 35(18):3595-3600.	<b>115</b>
<b>9551178</b>	Ashkin, S., Ellis, R. (2006). Cleaning materials and methods. :169-188.	<b>116</b>
<b>5349126</b>	Balk, F., Ford, R. A. (1999). Environmental risk assessment for the polycyclic musks AHTN and HHCB in the EU. I. Fate and exposure assessment. Toxicology Letters 111(1-2):57-79.	<b>117</b>
<b>992639</b>	Bello, A., Quinn, M. M., Perry, M. J., Milton, D. K. (2009). Characterization of occupational exposures to cleaning products used for common cleaning tasks—a pilot study of hospital cleaners. Environmental Health 8:11.	<b>118</b>
<b>5428645</b>	Berding, V., Koormann, F., Schwartz, S., Wagner, J. O., Matthies, M. (2001). Spatial refinement of regional exposure assessment. NATO Science Series IV Earth and Environmental Sciences 2:205-222.	<b>120</b>
<b>8729831</b>	Consulting,, Integral (2021). Analysis of monitoring data for HHCB in surface waters of the United States from 2015 to 2021.	<b>121</b>
<b>1863036</b>	Correia, P., Cruz, A., Santos, L., Alves, A. (2013). Human dermal exposure to galaxolide from personal care products. International Journal of Cosmetic Science 35(3):299-309.	<b>122</b>
<b>11360395</b>	ENF, (2024). Plastic recycling plants in the United States.	<b>123</b>
<b>9551187</b>	Espinoza, T., Geiger, C., Everson, I. (2010). The real costs of institutional "green" cleaning.	<b>124</b>
<b>8802195</b>	FCA, (2021). Site emission survey of fragrance formulation compounders and product manufacturers using HHCB: Information to support the TSCA risk evaluation; with comment, dated 08/05/2021.	<b>125</b>
<b>2452666</b>	Gerster, Melchior, F., Hopf, Brenna, N., Wild, Pierre, P., Vernez, D. (2014). Airborne exposures to monoethanolamine, glycol ethers, and benzyl alcohol during professional cleaning: a pilot study. Annals of Occupational Hygiene 58(7):846-859.	<b>126</b>
<b>13027721</b>	International Code Council, (2020). 2021 International Plumbing Code (IPC), Chapter 4: Fixtures, faucets, and fixture fittings.	<b>127</b>
<b>11360398</b>	Milbrandt, A., Coney, K., Badgett, A., Beckham, G. T. (2022). Quantification and evaluation of plastic waste in the United States. Resources, Conservation and Recycling 183:106363.	<b>128</b>
<b>4682850</b>	Nazaroff, W. W., Coleman, B. K., Destailats, H., Hodgson, A. T., Liu, D.,-L, Lunden, M. M., Singer, B. C., Weschler, C. J. (2006). Indoor air chemistry: Cleaning agents, ozone and toxic air contaminants.	<b>129</b>
<b>11333406</b>	P&G, (2023). Comments of The Procter & Gamble Company on 1,4-Dioxane: Draft Supplement to the TSCA Risk Evaluation Science Advisory Committee on Chemicals (SACC) Meeting.	<b>130</b>
<b>13027719</b>	RIVM, (2018). Cleaning Products Fact Sheet: Default parameters for estimating consumer exposure (updated version 2018).	<b>131</b>
<b>5349388</b>	RIVM, (1997). Environmental risk assessment of the polycyclic musks AHTN and HHCB according to the EU-TGD.	<b>132</b>
<b>3259071</b>	Saito, R., Virji, M. A., Henneberger, P. K., Humann, M. J., Lebouf, R. F., Stanton, M. L., Liang, X., Stefaniak, A. B. (2015). Characterization of Cleaning and Disinfecting Tasks and Product Use Among Hospital Occupations. American Journal of Industrial Medicine 58(1):101-111.	<b>133</b>
<b>5428093</b>	Schwartz, S., Berding, V., Matthies, M. (2000). Aquatic fate assessment of the polycyclic musk fragrance HHCB - Scenario and variability analysis in accordance with the EU risk assessment guidelines. Chemosphere 41(5):671-679.	<b>134</b>
<b>13027718</b>	U.S. Census Bureau, (2021). 2021 SUSB Annual Datasets by Establishment Industry.	<b>135</b>
<b>13027720</b>	U.S. Census Bureau, (2024). U.S. Census Bureau QuickFacts: United States.	<b>136</b>

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<b>11328021</b>	U.S. EPA, (2023). Summarized data of the Building Assessment Survey and Evaluation (BASE) Study.	<b>138</b>
<b>13027717</b>	U.S. EPA, (2024). Toxics Release Inventory (TRI) data: 1,3,4,6,7,8-Hexahydro-4,6,6,7,8,8-hexamethylcyclopenta-g-2- benzopyran (HHCB), reporting year 2023.	<b>139</b>
<b>46492</b>	U.S. EPA, (1995). AP-42: Compilation of air pollutant emission factors. Volume I: Stationary point and area sources, fifth edition.	<b>140</b>
<b>6385708</b>	U.S. EPA, (2003). Transportation equipment cleaning - Generic scenario for estimating occupational exposures and environmental releases (draft).	<b>141</b>
<b>7310513</b>	U.S. EPA, (1995). Chapter 6: Organic chemical process industry. Compilation of air pollutant emission factors. Volume I: Stationary point and area sources, fifth edition, AP-42.	<b>143</b>
<b>7315841</b>	U.S. EPA, (1995). Ap-42: Chapter 4.12 - Manufacture of rubber products.	<b>146</b>
<b>1970730</b>	Upadhyay, N., Sun, Q., Allen, J. O., Westerhoff, P., Herckes, P. (2011). Synthetic musk emissions from wastewater aeration basins. Water Research 45(3):1071-1078.	<b>148</b>
<b>3401413</b>	Wei, W., Boumier, J., Wyart, G., Ramalho, O., Mandin, C. (2016). Cleaning practices and cleaning products in nurseries and schools: to what extent can they impact indoor air quality?. Indoor Air 26(4):517-525.	<b>149</b>
<b>3603871</b>	Zhang, X., Yu, Y., Gu, Y., Li, X., Zhang, X., Yu, Y. (2017). In vitro determination of transdermal permeation of synthetic musks and estimated dermal uptake through usage of personal care products. Chemosphere 173:417-424.	<b>150</b>



<b>Study Citation:</b>	Bauer, A. (2013). Contact dermatitis in the cleaning industry. Current Opinion in Allergy and Clinical Immunology 13(5):521-524.			
<b>HERO ID:</b>	1997907			
<b>Conditions of Use:</b>	Cleaning Products			
EXTRACTION				
Parameter	Data			
Worker activity description:	Cleaners are exposed to a variety of allergenic and irritant substances in cleaning agents (floor cleansers; floor maintenance products; daily and periodical restroom, toilet, furniture, glass, window and kitchen cleansers, etc.) associated with cleaning outdoors, cleaning common areas of residential buildings, schools and cleaning building sites.			
Exposure route:	dermal			
Dermal exposure data:	does not explicitly mention HHCB. does not contain dermal exposure data, but contains prevalence of contact dermatitis			
Number of workers:	3485			
Personal protective equipment:	employees in cleaning often use single-use medical examination gloves with a limited material thickness of approximately 0.1–0.18mm for cleaning and disinfection tasks. These gloves are not resistant to chemicals, which break through the gloves within a few minutes up to hours, depending on the material and the thickness of the gloves. In a recent questionnaire-based study of Lynde et al. [37], only a minority of cleaners (21% of male and 16% of female cleaners) were trained.			
EVALUATION				
Domain	Metric	Rating	Comments	
Domain 1: Reliability	Metric 1:	Sampling and Analytical Methodology	Low	Study does not discuss methodology
Domain 2: Representativeness	Metric 2:	Geographic Scope	Medium	Data is from Germany
	Metric 3:	Applicability	High	Use of Cleaning Products
	Metric 4:	Temporal Representativeness	Low	Data from the 80s, 90s, and early 00s
	Metric 5:	Sample Size	Medium	Data presents number of workers and percent of contact dermatitis and no other statistics
Domain 3: Accessibility/ Clarity	Metric 6:	Metadata Completeness	Low	Assessment presents data sources and results, but does not discuss underlying methods or assumptions.
Domain 4: Variability and Uncertainty	Metric 7:	Metadata Completeness	Medium	Presents data from multiple studies but does not go into detail on the variables between the studies. Presents uncertainties with listed data.
Overall Quality Determination		Low		

<b>Study Citation:</b>	Correia, P., Cruz, A., Santos, L., Alves, A. (2013). Human dermal exposure to galaxolide from personal care products. International Journal of Cosmetic Science 35(3):299-309.			
<b>HERO ID:</b>	1863036			
<b>Conditions of Use:</b>	Personal care products			
EXTRACTION				
<b>Parameter</b>	<b>Data</b>			
Exposure route:	dermal			
Dermal exposure data:	an in vitro study with human skin showed low absorption (about 0.4%) of the applied dose [32]. This was confirmed by in vivo studies with human and rat skin that showed some percutaneous absorption (<2%), although low dermal permeation and distribution [42] or negligible skin permeability was verified [43]. Nevertheless, other in vivo studies showed a HHCB absorption of about 40% by human skin [32] and 14% by rat skin [44]. Additionally, it is expected that 22% of the applied dose of HHCB will evaporate from the skin [42].			
EVALUATION				
Domain	Metric	Rating	Comments	
Domain 1: Reliability	Metric 1:	Sampling and Analytical Methodology	Low	Sampling/analytical methodology is not specified.
Domain 2: Representativeness	Metric 2:	Geographic Scope	Medium	Data are from Portugal, an OECD country.
	Metric 3:	Applicability	High	Data are for dermal exposure
	Metric 4:	Temporal Representativeness	Low	Monitoring data are greater than 20 years old.
	Metric 5:	Sample Size	Low	Sample distribution is characterized by no statistics.
Domain 3: Accessibility/ Clarity	Metric 6:	Metadata Completeness	Low	Sample type provided but no other metadata.
Domain 4: Variability and Uncertainty	Metric 7:	Metadata Completeness	Low	Variability and uncertainty are not addressed.
Overall Quality Determination		Low		

<b>Study Citation:</b>	Fromme, H., Lahrz, T., Piloty, M., Gebhart, H., Oddoy, A., Rüden, H. (2004). Occurrence of phthalates and musk fragrances in indoor air and dust from apartments and kindergartens in Berlin (Germany). Indoor Air 14(3):188-195.			
<b>HERO ID:</b>	5556411			
<b>Conditions of Use:</b>	Use of Laboratory Chemicals			
EXTRACTION				
<b>Parameter</b>	<b>Data</b>			
Exposure route:	Inhalation			
Area sampling data:	Indoor air of laboratory: 2.47 ng/m3			
Comments:	Cites Kallenborn et al. 1999			
EVALUATION				
Domain	Metric	Rating	Comments	
Domain 1: Reliability	Metric 1:	Sampling and Analytical Methodology	Low	Sampling or analytical methodology is not specified.
Domain 2: Representativeness	Metric 2:	Geographic Scope	Medium	Germany is an OECD country.
	Metric 3:	Applicability	High	The data are for an occupational scenario within the scope of the risk evaluation.
	Metric 4:	Temporal Representativeness	Medium	the data are more than 10 years but no more than 20 years old.
	Metric 5:	Sample Size	Low	Distribution of samples is qualitative or characterized by no statistics.
Domain 3: Accessibility/ Clarity	Metric 6:	Metadata Completeness	Medium	Monitoring data include most critical metadata, such as sample type and exposure type, but lacks additional metadata, such as sample durations, exposure durations, exposure frequency, and/or worker activities.
Domain 4: Variability and Uncertainty	Metric 7:	Metadata Completeness	Low	The monitoring study does not address variability or uncertainty.
Overall Quality Determination			Low	

Study Citation:	Gerster, Melchior, F., Hopf, Brenna, N., Wild, Pierre, P., Vernez, D. (2014). Airborne exposures to monoethanolamine, glycol ethers, and benzyl alcohol during professional cleaning: a pilot study. Annals of Occupational Hygiene 58(7):846-859.			
HERO ID:	2452666			
Conditions of Use:	Use of Cleaning Products			
EXTRACTION				
Parameter	Data			
Worker activity description:	general description provided for tasks included for the following cleaning categories: intensive floor cleaning, apartment cleaning, industrial cleaning public space cleaning, patient room cleaning.			
Personal sampling data:	personal sampling data collected for: monoethanolamine (MEA), diethylene glycol monoethyl ether (DEGEE), diethylene glycol mono-n-butyl ether (DEGBE), dipropylene glycol monomethyl ether (DPGME), ethylene glycol mono-n-butyl ether (EGBE), ethylene glycol monoethyl ether (EGEE), butoxypropanol (2PG1BE), phenoxyethanol (EGPhE), Benzyl Alcohol (BA), and Formaldehyde (FA)			
EVALUATION				
Domain	Metric	Rating	Comments	
Domain 1: Reliability	Metric 1:	Sampling and Analytical Methodology	High	Sampling/analytical methodology is equivalent to an approved OSHA/NIOSH method.
Domain 2: Representativeness	Metric 2:	Geographic Scope	Medium	Data are from Switzerland, an OECD country.
	Metric 3:	Applicability	Uninformative	The data are for Use of cleaning products, an occupational scenario within the scope of the risk evaluation but extracted monitoring data are for chemicals other than HHCB. Not enough information about the presence of the chemicals is given to consider for surrogate use.
	Metric 4:	Temporal Representativeness	High	Monitoring data are no more than 10 years old.
	Metric 5:	Sample Size	Medium	Sample distribution characterized by limited statistics (e.g., min, max, mean) but discrete samples not provided and distribution not fully characterized.
Domain 3: Accessibility/ Clarity	Metric 6:	Metadata Completeness	High	All metadata provided.
Domain 4: Variability and Uncertainty	Metric 7:	Metadata Completeness	High	Uncertainty is addressed in sampling/analytical methodology. Variability addressed by samples collected at multiple sites.
Overall Quality Determination		Uninformative		

<b>Study Citation:</b>	Harley, K. G., Calderon, L., Nolan, S., J.E., Maddalena, R., Russell, M., Roman, K., Mayo-Burgos, S., Cabrera, J., Morga, N., Bradman, A. (2021). Changes in Latina women's exposure to cleaning chemicals associated with switching from conventional to "green" household cleaning products: The LUCIR intervention study. Environmental Health Perspectives 129(9):97001.
<b>HERO ID:</b>	9551210
<b>Conditions of Use:</b>	Use of cleaning products

EXTRACTION	
Parameter	Data
Worker activity description:	The most common activities were cleaning toilets and wiping surfaces such as counters, cabinets, and appliances, which were performed by more than 90% of women at each visit. Seventy percent of women mopped their floors at both visits, and more than half handwashed their dishes, cleaned their bathtubs or showers, and cleaned glass. At both visits, the median number of cleaning activities done was five and the maximum was eight. The source includes a table that quantifies the prevalence of cleaning activities (page 5 of the pdf)
Exposure route:	inhalation
Personal sampling data:	50 participants, usual geometric mean: 514 microgram/m3 GSD of 4.14; "green" geometric mean: 924 microgram/m3 GSD of 2.25
Exposure duration:	clean their kitchen and bathroom for 30min total
Exposure frequency:	2, 30-min. cleaning sessions, 1 week apart from each other; Almost all participants reported using cleaning products in their homes at least once per week
Number of workers:	[Not workers] 50 women performing household cleaning; Twenty women (40%) reported also using cleaning products at work, but only one participant was a professional housecleaner.

EVALUATION				
Domain	Metric		Rating	Comments
Domain 1: Reliability	Metric 1:	Sampling and Analytical Methodology	Medium	Sampling/analytical methodology appears acceptable, no OSHA/NIOSH method or generally acceptable method for HHCB for comparison.
Domain 2: Representativeness	Metric 2:	Geographic Scope	High	Data are from the U.S.
	Metric 3:	Applicability	Low	Data are for non-occupational scenario, household use, which is similar to the in-scope occupational scenario of using cleaning products.
	Metric 4:	Temporal Representativeness	High	Monitoring data are no more than 10 years old (2020)
	Metric 5:	Sample Size	High	Statistical distribution of samples is fully characterized (discrete sampling data provided).
Domain 3: Accessibility/ Clarity	Metric 6:	Metadata Completeness	High	All metadata provided.
Domain 4: Variability and Uncertainty	Metric 7:	Metadata Completeness	High	Uncertainty is addressed in sampling/analytical methodology. Variability addressed by samples collected at multiple sites and on multiple visits to the same site.

## Overall Quality Determination

High

<b>Study Citation:</b>	Lin, N., Rosenberg, M. A., Li, W., Meza-Wilson, E., Godwin, C., Batterman, S. (2021). Occupational exposure and health risks of volatile organic compounds of hotel housekeepers: Field measurements of exposure and health risks. Indoor Air 31(1):26-39.
<b>HERO ID:</b>	7311740
<b>Conditions of Use:</b>	Use of cleaning products; use of laundry products

EXTRACTION	
Parameter	Data
Worker activity description:	housekeepers cleaned rooms using detergents, cleaning products, and bleaches; laundry workers collected unwashed items throughout the hotel and used cleaning agents and bleaches in the laundry to wash and dry towels, sheets, etc.; maintenance workers checked, cleaned, and performed maintenance on various items throughout the hotel using lubricants, polishes, and other materials; and office staff mainly stayed in the lobby, office, and break room, but left occasionally to supervise room cleaning, fold clean towels, or perform light maintenance.
Exposure route:	inhalation
Exposure duration:	At hotel 1, housekeepers work for 3-8 hrs/d, depending on the workload, and each cleans an average of 14 +- 6 guest rooms daily. Cleaning time requires 20-30 minutes per room. At hotel 2, housekeepers typically work 6-9 hours daily. Cleaning time is approximately 30 minutes per room.
Number of workers:	Hotel 1: Typically, staff include one to two office workers and five to seven hotel housekeepers (including one supervisor and one laundry worker). Hotel 2: unknown number of workers but four participants for the study
Comments:	Contains air exchange and room sizes for different locations within the hotel

EVALUATION				
Domain	Metric		Rating	Comments
Domain 1: Reliability	Metric 1:	Sampling and Analytical Methodology	Medium	The assessment or report uses high quality data and/or techniques or sound methods that are not from a frequently used source and associated information does not indicate flaws or quality issues.
Domain 2: Representativeness	Metric 2:	Geographic Scope	Medium	Data are from the U.S.
	Metric 3:	Applicability	Medium	Data are for use as a cleaning product and use as a laundry product, in-scope occupational scenarios; however not specific to HHCB
	Metric 4:	Temporal Representativeness	High	Report is based on current industry conditions and data no more than 10 years old (2020)
	Metric 5:	Sample Size	Medium	Distribution of samples of extracted data is characterized by a range with uncertain statistics.
Domain 3: Accessibility/ Clarity	Metric 6:	Metadata Completeness	High	All data sources, methods, results, and assumptions are clearly documented.
Domain 4: Variability and Uncertainty	Metric 7:	Metadata Completeness	Medium	The report provides only limited discussion of the variability and uncertainty in the results.

<b>Overall Quality Determination</b>	<b>Medium</b>
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<b>Study Citation:</b>	Lu, Y.,an, Yuan, T.,ao, Yun, S., Wang, W., Kannan, K. (2011). Occurrence of synthetic musks in indoor dust from China and implications for human exposure. Archives of Environmental Contamination and Toxicology 60(1):182-189.			
<b>HERO ID:</b>	2095404			
<b>Conditions of Use:</b>	Office			
EXTRACTION				
<b>Parameter</b>	<b>Data</b>			
Area sampling data: Comments:	(ng/g dust) minimum:0.4 25th percentile:8.36 Median:26.6 75th percentile:54.8 maximum:147 dust samples			
EVALUATION				
Domain	Metric	Rating		Comments
Domain 1: Reliability	Metric 1:	Sampling and Analytical Methodology	Medium	Sampling/analytical methodology is not an approved OSHA/NIOSH method but is an acceptable methodology.
Domain 2: Representativeness	Metric 2:	Geographic Scope	Low	Data are from China, a non-OECD country.
	Metric 3:	Applicability	Medium	Data are for use in office, this is similar to an in-scope occupational scenario.
	Metric 4:	Temporal Representativeness	Medium	Monitoring data are greater than 10 years old but no more than 20 years old. 2009
	Metric 5:	Sample Size	Medium	Sample distribution characterized by limited statistics (min, 25th percentile, Median, 75th percentile, max) but discrete samples not provided and distribution not fully characterized.
Domain 3: Accessibility/ Clarity	Metric 6:	Metadata Completeness	Medium	Sample type and exposure type provided but missing sample location, chemical use in lab, worker activities.
Domain 4: Variability and Uncertainty	Metric 7:	Metadata Completeness	Medium	Uncertainty is addressed in sampling/analytical methodology but variability is not clearly addressed.
<b>Overall Quality Determination</b>		<b>Medium</b>		

<b>Study Citation:</b>	Lu, Y.,an, Yuan, T.,ao, Yun, S., Wang, W., Kannan, K. (2011). Occurrence of synthetic musks in indoor dust from China and implications for human exposure. Archives of Environmental Contamination and Toxicology 60(1):182-189.			
<b>HERO ID:</b>	2095404			
<b>Conditions of Use:</b>	Laboratory chemical			
EXTRACTION				
<b>Parameter</b>	<b>Data</b>			
Area sampling data: Comments:	(ng/g) minimum:2.96 25th percentile:4.65 Median:9.09 75th percentile:10.9 maximum:11.4 dust samples			
EVALUATION				
Domain	Metric	Rating		Comments
Domain 1: Reliability	Metric 1:	Sampling and Analytical Methodology	Medium	Sampling/analytical methodology is not an approved OSHA/NIOSH method but is an acceptable methodology.
Domain 2: Representativeness	Metric 2:	Geographic Scope	Low	Data are from China, a non-OECD country.
	Metric 3:	Applicability	High	Data are for use as a laboratory chemical, an in-scope occupational scenario.
	Metric 4:	Temporal Representativeness	Medium	Monitoring data are greater than 10 years old but no more than 20 years old. 2009
	Metric 5:	Sample Size	Medium	Sample distribution characterized by limited statistics (min, 25th percentile, Median, 75th percentile, max) but discrete samples not provided and distribution not fully characterized.
Domain 3: Accessibility/ Clarity	Metric 6:	Metadata Completeness	Medium	Sample type and exposure type provided but missing sample location, chemical use in lab, worker activities.
Domain 4: Variability and Uncertainty	Metric 7:	Metadata Completeness	Medium	Uncertainty is addressed in sampling/analytical methodology but variability is not clearly addressed.
<b>Overall Quality Determination</b>		<b>Medium</b>		



<b>Study Citation:</b>	Saito, R., Virji, M. A., Henneberger, P. K., Humann, M. J., Lebouf, R. F., Stanton, M. L., Liang, X., Stefaniak, A. B. (2015). Characterization of Cleaning and Disinfecting Tasks and Product Use Among Hospital Occupations. American Journal of Industrial Medicine 58(1):101-111.
<b>HERO ID:</b>	3259071
<b>Conditions of Use:</b>	Use of Liquid/Solid Cleaning Products

## EXTRACTION

Parameter	Data
Worker activity description:	Housekeepers and floor strippers/waxers at hospitals
Exposure duration:	Mean Cleaning duration: housekeepers (151 min/shift), floor strippers/waxers (94 min/ shift). Cleaning tasks (specific for exposure to fragrance)Housekeepers (min)- 43 (5-135)Floor strippers/waxers (min) - 58 (55-60)[Supplementary Table SII; Type of cleaning not specified]cleaning and disinfecting tasks (in general for products)Housekeeping duration (min)- Equipment cleaning: 5-75 Floor cleaning: 61 (10-205)Fixed surface cleaning: 94 (15-305)Mixing cleaning products: 8 (5-20)Floor strippers/waxers duration (min)- Equipment cleaning: 8 (5-10)Floor cleaning: 84 (25-125)Fixed surface cleaning: 9 (5-20)Mixing cleaning products: 10 (5-20)
Exposure frequency:	Frequency of exposure to products containing fragrance (% of shifts)-Housekeeper- 48.1Floor strippers/waxer- 15.4Housekeeping frequency(% of shifts)- Equipment cleaning: 8Floor cleaning: 87Fixed surface cleaning: 96Mixing cleaning products: 42Floor strippers/waxers frequency(% of shifts)- Equipment cleaning: 15Floor cleaning: 100Fixed surface cleaning: 39Mixing cleaning products: 54
Number of workers:	144 workers in study
Comments:	The report discusses multiple occupations, but Supplemental Table SII shows that only housekeeper and floor strippers/waxers used products that contain fragrances. HHCB is expected to be a component of the fragrance therefore extracted data is for housekeepers and floor strippers/waxers specific to fragrance exposure.

## EVALUATION

Domain	Metric	Rating	Comments
Domain 1: Reliability	Metric 1: Sampling and Analytical Methodology	Medium	The assessment or report uses high quality data and/or techniques or sound methods that are not from a frequently used source and associated information does not indicate flaws or quality issues.
Domain 2: Representativeness	Metric 2: Geographic Scope	High	The data are from the United States and are representative of the industry being evaluated.
	Metric 3: Applicability	Medium	The report is for an occupational scenario within the scope of the risk evaluation (use of cleaning products). The report captures operations, equipment, and worker activities expected to be reasonably representative of current conditions but only specifies presence of fragrance use but not necessarily HHCB use.
	Metric 4: Temporal Representativeness	Medium	The report is less than 10 years old but the survey data was collected from 2009 to 2011 more than 10 yearsbut less more than 20 years ago.
	Metric 5: Sample Size	Medium	Distribution of samples is characterized by a range with uncertain statistics. It is unclear if analysis is representative.
Domain 3: Accessibility/ Clarity	Metric 6: Metadata Completeness	High	Assessment or report clearly documents its data sources, assessment methods, results, and assumptions.

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Study Citation:	Saito, R., Virji, M. A., Henneberger, P. K., Humann, M. J., Lebouf, R. F., Stanton, M. L., Liang, X., Stefaniak, A. B. (2015). Characterization of Cleaning and Disinfecting Tasks and Product Use Among Hospital Occupations. American Journal of Industrial Medicine 58(1):101-111.		
HERO ID:	3259071		
Conditions of Use:	Use of Liquid/Solid Cleaning Products		
Domain	Metric	EVALUATION	
		Rating	Comments
Domain 4: Variability and Uncertainty			
	Metric 7: Metadata Completeness	Medium	The report provides only limited discussion of the variability and uncertainty in the results
Overall Quality Determination		Medium	

<b>Study Citation:</b>	Whitmyre, G. K., Driver, J. H., Ginevan, M. E., Tardiff, R. G., Baker, S. R. (1992). Human exposure assessment I: Understanding the uncertainties. Toxicology and Industrial Health 8(5):297-320.			
<b>HERO ID:</b>	4635			
<b>Conditions of Use:</b>	General Dermal Exposure			
EXTRACTION				
<b>Parameter</b>	<b>Data</b>			
Dermal exposure data:	skin surface area: total 1.94 m2 (male), 1.69 (female); arms 0.291 m2, 0.228 m2 (male), 0.210 m2 (female); hands 0.099 m2, 0.084 m2 (male), 0.0746 m2 (female)			
EVALUATION				
Domain	Metric	Rating	Comments	
Domain 1: Reliability	Metric 1:	Sampling and Analytical Methodology	High	Report uses high quality data from frequently-used sources (EPA, state agencies).
Domain 2: Representativeness	Metric 2:	Geographic Scope	High	Data are from the U.S.
	Metric 3:	Applicability	High	Data are for dermal exposure parameters
	Metric 4:	Temporal Representativeness	Low	Report is based on data greater than 20 years old (1992) and industry conditions that are expected to be outdated.
	Metric 5:	Sample Size	Medium	Sample distribution characterized by limited statistics but discrete samples not provided and distribution not fully characterized.
Domain 3: Accessibility/ Clarity	Metric 6:	Metadata Completeness	High	All data sources, methods, results, and assumptions are clearly documented.
Domain 4: Variability and Uncertainty	Metric 7:	Metadata Completeness	Medium	Variability of dermal parameters is discussed but only limited discussion of uncertainty.
Overall Quality Determination			High	

<b>Study Citation:</b>	Zhang, X., Yu, Y., Gu, Y., Li, X., Zhang, X., Yu, Y. (2017). In vitro determination of transdermal permeation of synthetic musks and estimated dermal uptake through usage of personal care products. Chemosphere 173:417-424.			
<b>HERO ID:</b>	3603871			
<b>Conditions of Use:</b>	All			
EXTRACTION				
<b>Parameter</b>	<b>Data</b>			
Exposure route:	dermal			
Dermal exposure data:	The percutaneous absorption rates of HHCB were calculated as 11.4%			
EVALUATION				
Domain	Metric	Rating	Comments	
Domain 1: Reliability	Metric 1:	Sampling and Analytical Methodology	Medium	Based on sound approaches/methods, and uses appropriate equations and parameters.
Domain 2: Representativeness	Metric 2:	Geographic Scope	Low	Data are from China, a non-OECD country.
	Metric 3:	Applicability	High	Data are for an occupational scenario within the scope of the risk evaluation.
	Metric 4:	Temporal Representativeness	Low	Data is based on current industry conditions and based on data no more than 10 years old.
	Metric 5:	Sample Size	High	Statistical distribution of samples is fully characterized.
Domain 3: Accessibility/ Clarity	Metric 6:	Metadata Completeness	Medium	Monitoring data include most critical metadata, such as sample type and exposure type, but lacks additional metadata.
Domain 4: Variability and Uncertainty	Metric 7:	Metadata Completeness	High	The study compares results against other peer-reviewed studies and results expected based on diffusion models.
<b>Overall Quality Determination</b>		<b>Medium</b>		

<b>Study Citation:</b>	Ng, M. G., Tongeren, van, M., Semple, S. (2014). Simulated transfer of liquids and powders from hands and clothing to the mouth. Journal of Occupational and Environmental Hygiene 11(10):633-644.
<b>HERO ID:</b>	3222353
<b>Conditions of Use:</b>	Multiple

Parameter	Data
Exposure route:	oral
Physical form:	liquid, solid
Dermal exposure data:	Oral Exposure Model: $E_{ii} = L_d \times SA \times TE$ (pdf pg. 2) TE were experimentally determined for liquid, solid, fine powder, rough powder, soluble powder, and insoluble powder (Table IV on pdf pg. 9).

Domain	Metric	EVALUATION Rating	Comments
Domain 1: Reliability	Metric 1: Methodology	Medium	The model is based on scientifically sound approaches, however, the model does not take into account evaporation or absorption. The experimentally determined TE's may be useful and the model may be adapted to account for those factors.
Domain 2: Representativeness	Metric 2: Geographic Scope	Medium	The data are from the U.K., an OECD country.
	Metric 3: Applicability	High	Model can be applied to occupational scenarios where inadvertent oral exposure is likely.
	Metric 4: Temporal Representativeness	High	Data was published in 2014, so generally no more than 10 years old.
Domain 3: Accessibility/ Clarity	Metric 5: Metadata Completeness	High	Model approach, equations, and choice of parameter values are transparent and clear and can be evaluated. Rationale for selection of approach, equations, and parameter values is provided.
Domain 4: Variability and Uncertainty	Metric 6: Metadata Completeness	High	The model characterizes variability (e.g., study tests several different factors in varying transfer efficiencies) and uncertainty in the results (contains a limitation section).

<b>Overall Quality Determination</b>	<b>High</b>
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<b>Study Citation:</b>	OECD, (2011). Emission scenario document on the chemicals used in water-based washing operations at industrial and institutional laundries.
<b>HERO ID:</b>	6387321
<b>Conditions of Use:</b>	Commercial Use – Laundry and Dishwashing Products - Laundry Detergent (Liquid); Laundry Detergent (Unit Dose/Granule); Fabric Enhancers; Stain Removers; Dry Cleaning and Associated Products; Dishwashing Detergent (Liquid/ Gel); Dishwashing Detergent (Unit Dose/ Granule); Dishwashing Detergent Liquid (Hand-Wash)

EXTRACTION	
Parameter	Data
Worker activity description:	unloading, container cleaning, handling damp laundry/cleaning operations
Exposure route:	dermal and inhalation
Exposure frequency:	20-250 days/yr
Number of workers:	2-9 workers/sites
Personal protective equipment:	gloves, faceshield

		EVALUATION	
Domain	Metric	Rating	Comments
Domain 1: Reliability	Metric 1: Methodology	High	Assessment uses high quality data/techniques/methods from frequently-used sources.
Domain 2: Representativeness	Metric 2: Geographic Scope	High	This ESD was developed by EPA based on U.S. data
	Metric 3: Applicability	Medium	Data is for an in-scope occupational scenario; however, data is general and not specific to a chemical.
	Metric 4: Temporal Representativeness	Low	Assessment is based on data greater than 20 years old.
Domain 3: Accessibility/ Clarity	Metric 5: Metadata Completeness	Medium	Sample distribution characterized by limited statistics (min,max, mean, median, and 90th percentile) but discrete samples not provided and distribution not fully characterized.
Domain 4: Variability and Uncertainty	Metric 6: Metadata Completeness	High	All data sources, methods, results, and assumptions are clearly documented.

<b>Overall Quality Determination</b>	<b>Medium</b>
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<b>Study Citation:</b>	Pelletier, M., Bonvallot, N., Ramalho, O., Blanchard, O., Mercier, F., Mandin, C., Bot, Le, B., Glorennec, P. (2017). Dermal absorption of semivolatile organic compounds from the gas phase: Sensitivity of exposure assessment by steady state modeling to key parameters. Environment International 102:106-113.			
<b>HERO ID:</b>	3602893			
<b>Conditions of Use:</b>	Manufacturing			
EXTRACTION				
<b>Parameter</b>	<b>Data</b>			
Exposure route:	Dermal			
Physical form:	Vapor			
Dermal exposure data:	Dermal exposure modeling data from vapor phase exposure. Parameters used for the model are contained in Table 1 in the source.			
EVALUATION				
Domain		Metric	Rating	Comments
Domain 1: Reliability	Metric 1:	Methodology	High	The model is free of mathematical errors and is based on scientifically sound approaches or methods. Equations and choice of parameter values are appropriate for the model’s application .
Domain 2: Representativeness	Metric 2:	Geographic Scope	Medium	The data are from an OECD country other than the U.S. (France), and locality-specific factors (e.g., potential differences in regulatory occupational exposure or emission limits, industry/ process technologies) may impact exposures or releases relative to the U.S.
	Metric 3:	Applicability	High	The model can be appropriately applied to an occupational scenario within the scope of the risk evaluation, such as manufacturing.
	Metric 4:	Temporal Representativeness	High	The model is based on data that are generally no more than 10 years old (2017).
Domain 3: Accessibility/ Clarity	Metric 5:	Metadata Completeness	High	Model approach, equations, and choice of parameter values are transparent and clear and can be evaluated. Rationale for selection of approach, equations, and parameter values is provided.
Domain 4: Variability and Uncertainty	Metric 6:	Metadata Completeness	High	The model characterizes variability and uncertainty in the results. Includes discussion of uncertainty of each parameter.
Overall Quality Determination			High	

<b>Study Citation:</b>	Bello, A. (2008). Assessment of exposures to cleaning product ingredients used in common cleaning tasks.			
<b>HERO ID:</b>	9551179			
<b>Conditions of Use:</b>	Use in liquid, spray, and aerosol cleaning products			
<b>EXTRACTION</b>				
<b>Parameter</b>	<b>Data</b>			
Worker activity description:	p. 50-52 describes worker cleaning activities and specifies duration of each cleaning task. p.72-73 shows the typical combination of cleaning activities through a flow chart and identifies activities with higher potential for inhalation exposure			
Area sampling data:	p. 58-60 and identifies additional details of cleaning process that may increase inhalation exposure. P. 92 describes product application methods that increase potential for inhalation exposure. Area samples collected during simulations of the tasks in a test bathroom. Washroom cleaning product used contained fragrance (p. 117) Area samples quantified levels of total VOCs (TVOCs)			
Dermal exposure data:	P. 60 describes potential for dermal exposure during cleaning activities, p. 74-75: modeled dermal exposure and affected body parts			
Exposure duration:	duration of various tasks is listed p. 50-52. More information on duration provided on p. 59			
Exposure frequency:	frequency of various tasks is listed p. 50-52			
<b>EVALUATION</b>				
Domain	Metric	Rating	Comments	
Domain 1: Reliability	Metric 1: Methodology	High	Assessment uses high quality methods from frequently-used sources.	
Domain 2: Representativeness	Metric 2: Geographic Scope	High	Data are from the U.S.	
	Metric 3: Applicability	High	Data are for use in liquid, spray, and aerosol cleaners, an in-scope occupational scenario.	
	Metric 4: Temporal Representativeness	Medium	Assessment is based on data greater than 10 years old but no more than 20 years old and industry conditions that are expected to be representative of current industry conditions (2008)	
	Metric 5: Sample Size	Medium	Sample distribution characterized by a range with uncertain statistics.	
Domain 3: Accessibility/ Clarity	Metric 6: Metadata Completeness	Medium	All data sources, methods, results, and assumptions are clearly documented.	
Domain 4: Variability and Uncertainty	Metric 7: Metadata Completeness	High	Variability addressed by observing multiple hospital workers but uncertainty is addressed in limitations section.	
<b>Overall Quality Determination</b>		<b>High</b>		



<b>Study Citation:</b>	Bello, A., Quinn, M. M., Perry, M. J., Milton, D. K. (2009). Characterization of occupational exposures to cleaning products used for common cleaning tasks—a pilot study of hospital cleaners. Environmental Health 8:11.
<b>HERO ID:</b>	992639
<b>Conditions of Use:</b>	Use of cleaning products

EXTRACTION	
Parameter	Data
Worker activity description:	General cleaning activities: preparation of cleaning solutions, floor cleaning, window cleaning, mirror cleaning, toilet bowl cleaning, sink cleaning, and floor finishing tasks (buffing, waxing and stripping). Low exposure category- floor cleaning; medium exposure category- window and mirror cleaning, sink cleaning, counter cleaning, and toilet bowl cleaning; high exposure category- bathroom cleaning, floor finishing
Exposure route:	inhalation and dermal
Dermal exposure data:	calculates potential total body skin exposure per task - sum of potential skin exposure for 9 body parts that consider exposure from emission, deposition, and transfer; Overall, floor cleaning tasks were associated with the lowest potential for dermal exposures. Hands were identified as having the highest potential for dermal exposure for most of the tasks. Forearms were at the next highest risk of exposure during sink, toilet bowl & mirror cleaning while for floor cleaning, feet and lower legs were most prone to exposure.
Exposure duration:	floor cleaning: patient room floor cleaning required about 5–10 minutes and hallway floor cleaning required several hours. bathroom cleaning: cleaning time varied from 10–15 minutes per cleaning
Exposure frequency:	floor cleaning: performed daily; window cleaning: as needed; mirror cleaning: daily; bathroom cleaning: bathrooms were cleaned two times per day; floor finishing tasks (buffing, waxing and stripping): Floor stripping was performed twice a year, buffing was needed more frequently

EVALUATION				
Domain	Metric		Rating	Comments
Domain 1: Reliability	Metric 1:	Methodology	Medium	The assessment or report uses high quality data and sound methods that are not from a frequently used source, and associated information does not indicate flaws or quality issues.
Domain 2: Representativeness	Metric 2:	Geographic Scope	High	The data are from the United States and are representative of the industry being evaluated.
	Metric 3:	Applicability	Medium	Data are for use of cleaning products, but do not specifically identify HHCB as a part of the cleaning product mixture
	Metric 4:	Temporal Representativeness	Medium	Monitoring data are greater than 10 years old but no more than 20 years old (2008)
	Metric 5:	Sample Size	Medium	Exposure duration and frequency are given with limited statistics (range and mean). Dermal exposure data is mostly qualitative.
Domain 3: Accessibility/ Clarity	Metric 6:	Metadata Completeness	Medium	Assessment or report clearly documents results, methods, and assumptions. Data sources are generally described but not fully transparent.
Domain 4: Variability and Uncertainty	Metric 7:	Metadata Completeness	Medium	Variability addressed by samples collected at multiple sites and on multiple visits to the same site. Only limited discussion of the uncertainty in the results.

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<b>Study Citation:</b>	Bello, A., Quinn, M. M., Perry, M. J., Milton, D. K. (2009). Characterization of occupational exposures to cleaning products used for common cleaning tasks—a pilot study of hospital cleaners. Environmental Health 8:11.		
<b>HERO ID:</b>	992639		
<b>Conditions of Use:</b>	Use of cleaning products		
Domain		Metric	<b>EVALUATION</b>
		Rating	Comments
<b>Overall Quality Determination</b>		<b>Medium</b>	

<b>Study Citation:</b>	ECB, (2008). European Union risk assessment report: 1,3,4,6,7,8-hexahydro-4,6,6,7,8,8-hexamethylcyclopenta-γ-2-benzopyran (HHCB).
<b>HERO ID:</b>	5155574
<b>Conditions of Use:</b>	Manufacture

EXTRACTION	
Parameter	Data
Worker activity description:	Manual sampling of small volumes (100 mL); Loading of tanker trucks at 75C(4 tanker trucks per week); washing of equipment
Exposure route:	inhalation, dermal
Physical form:	vapor, liquid
Personal sampling data:	manufacture: drumming or filling of tanks trucks of dibutyl-phtalate (DBP):0.003ppm(N=114), toluene diisocyanate (TDI): 0.007 ppm(N=95), trichlorotoluol: 0.005ppm(N=33)
Dermal exposure data:	0 – 0.1 mg/cm2/day (EASE 2.0 model)
Exposure duration:	3 times(less than a minute) per 12 hours during sampling
Personal protective equipment:	Operators wear heavy-duty gloves and overalls in accordance to their heavy mechanical duties. Operators do not handle any products except during sampling operations. Proper use of gloves to prevent exposure is assumed, because of the high temperature of the product when handled.
Engineering control:	Due to the use of formaldehyde in the process, adequate Local Exhaust Ventilation (LEV) is provided at a specific sampling place
Comments:	Also used models to estimate exposure. inhalation model used the SRC MpBp Win V 1.30 with estimated saturated air concentration of 447 mg/m3. Dermal model used the EASE 2.0 model which estimated exposure to be 0 – 0.1 mg/cm2/day.

		EVALUATION	
Domain	Metric	Rating	Comments
Domain 1: Reliability	Metric 1: Methodology	High	Assessment uses high quality data from frequently-used sources.
Domain 2: Representativeness	Metric 2: Geographic Scope	Medium	Data are from The Netherlands, an OECD country.
	Metric 3: Applicability	High	Data are for Manufacturing HHCB, an in-scope occupational scenario.
	Metric 4: Temporal Representativeness	Medium	Assessment is based on data greater than 10 years old but no more than 20 years old and industry conditions that are expected to be representative of current industry conditions.
	Metric 5: Sample Size	High	Statistical distribution of samples is fully characterized (discrete sampling data provided).
Domain 3: Accessibility/ Clarity	Metric 6: Metadata Completeness	High	All data sources, methods, results, and assumptions are clearly documented.
Domain 4: Variability and Uncertainty	Metric 7: Metadata Completeness	Medium	Variability addressed by multiple samples at the same facility and referencing multiple exposure sources but uncertainty is not addressed.

<b>Overall Quality Determination</b>	<b>High</b>
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# Occupational Exposure

<b>Study Citation:</b>	ECB, (2008). European Union risk assessment report: 1,3,4,6,7,8-hexahydro-4,6,6,7,8,8-hexamethylcyclopenta- $\gamma$ -2-benzopyran (HHCB).
<b>HERO ID:</b>	5155574
<b>Conditions of Use:</b>	Manufacture; Incorporation into Formulation of Mixture; Use of Cleaning Products

EXTRACTION	
Parameter	Data
Worker activity description:	Manufacture: Process operation (3 operators in each shift), Dilution (1 person in each shift), Analytical measurements (1 person in each shift), Odour Quality control (2 persons, daily basis), Wastewater treatment (1 person, daily basis); Processing: Delivery, Filling of stock tanks, Compounding of fragrance oils, Analytical determinations, Odour control;
Number of workers:	Manufacture: Process operation (3 operators in each shift), Dilution (1 person in each shift), Analytical measurements (1 person in each shift), Odour Quality control (2 persons, daily basis), Wastewater treatment (1 person, daily basis); Processing: In a typical compounding facility, about 15 to 60 compounders work often in shifts, with a rotation of tasks
Personal protective equipment:	Manufacture: Operators wear heavy-duty gloves and overalls in accordance to their heavy mechanical duties. Operators do not handle any products except during sampling operations. Proper use of gloves to prevent exposure is assumed, because of the high temperature of the product when handled.

		EVALUATION	
Domain	Metric	Rating	Comments
Domain 1: Reliability	Metric 1: Methodology	High	Assessment uses high quality data from frequently-used sources.
Domain 2: Representativeness	Metric 2: Geographic Scope	Medium	Data are from The Netherlands, an OECD country.
	Metric 3: Applicability	High	Data are for Manufacture, processing, formulation, and use as a cleaning product, an in-scope occupational scenario.
	Metric 4: Temporal Representativeness	Medium	Assessment is based on data greater than 10 years old but no more than 20 years old and industry conditions that are expected to be representative of current industry conditions.
	Metric 5: Sample Size	High	Statistical distribution of samples is fully characterized (discrete sampling data provided).
Domain 3: Accessibility/ Clarity	Metric 6: Metadata Completeness	High	All data sources, methods, results, and assumptions are clearly documented.
Domain 4: Variability and Uncertainty	Metric 7: Metadata Completeness	High	Uncertainty is addressed. Variability addressed by sampling/observing multiple facilities.

<b>Overall Quality Determination</b>	<b>High</b>
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<b>Study Citation:</b>	ECB, (2008). European Union risk assessment report: 1,3,4,6,7,8-hexahydro-4,6,6,7,8,8-hexamethylcyclopenta- $\gamma$ -2-benzopyran (HHCB).
<b>HERO ID:</b>	5155574
<b>Conditions of Use:</b>	Formulation of products that contain fragrance oils

EXTRACTION	
Parameter	Data
Worker activity description:	handling of the drums and during cleaning and maintenance of the equipment. Empty vessels of fragrance oil are rinsed with water that is added to the product. The rinsed vessels are filled with hot water and put aside for some time. Before cleaning the water is drained to the sewer.
Comments:	Products handled will contain not more than 1% of a 4 % solution. No monitoring data, but uses a model for inhalation and dermal exposure. Inhalation exposure used the EASE model, which estimated exposure of 0-0.1 ppm. The EASE model estimates for the direct handling of liquids assuming non-dispersive use and for incidental contact a dermal exposure of 0 – 0.1 mg/cm <sup>2</sup> /day. With the palms of both hands (together 420 cm <sup>2</sup> ) and a maximum concentration of 4 % for the undiluted fragrance oil this results in 1.7 mg HHCB/day.

EVALUATION				
Domain	Metric		Rating	Comments
Domain 1: Reliability	Metric 1:	Methodology	High	Assessment uses high quality methods from frequently-used sources.
Domain 2: Representativeness	Metric 2:	Geographic Scope	Medium	Data are from The Netherlands, an OECD country.
	Metric 3:	Applicability	High	Data are for formulation, an in-scope occupational scenario.
	Metric 4:	Temporal Representativeness	Medium	Assessment is based on data greater than 10 years old but no more than 20 years old and industry conditions that are expected to be representative of current industry conditions.
	Metric 5:	Sample Size	High	Statistical distribution of samples is fully characterized (discrete model results provided).
Domain 3: Accessibility/ Clarity	Metric 6:	Metadata Completeness	Medium	Methods, results, and assumptions are clearly documented, but underlying data sources are not fully transparent.
Domain 4: Variability and Uncertainty	Metric 7:	Metadata Completeness	Low	Variability and uncertainty are not addressed.

<b>Overall Quality Determination</b>	<b>Medium</b>
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<b>Study Citation:</b>	ECB, (2008). European Union risk assessment report: 1,3,4,6,7,8-hexahydro-4,6,6,7,8,8-hexamethylcyclopenta- $\gamma$ -2-benzopyran (HHCB).			
<b>HERO ID:</b>	5155574			
<b>Conditions of Use:</b>	Use of Cleaning Products			
<b>EXTRACTION</b>				
<b>Parameter</b>	<b>Data</b>			
Exposure duration:	refreshed on the skin every 15 minutes, and accumulated over the day			
Engineering control:	workers will wear rubber gloves			
Comments:	No monitoring data, but uses a model for inhalation and dermal exposure. Inhalation exposure used the EASE model, which estimated exposure of 0-0.1 ppm. Due to the very low vapour pressure of the diluted substance however, the exposure is assumed to be negligible. For dermal exposure assuming extensive contact and wide dispersive use the exposure according to EASE ranges from 5 – 15 mg/cm2/day on both hands (840 cm2) so 4200 –12,600 mg water with cleaning agent diluted 1 to 50. Total estimated dermal daily dose of 0.32 mg/d.			
<b>EVALUATION</b>				
Domain	Metric		Rating	Comments
Domain 1: Reliability	Metric 1:	Methodology	High	Assessment uses high quality methods from frequently-used sources.
Domain 2: Representativeness	Metric 2:	Geographic Scope	Medium	Data are from The Netherlands, an OECD country.
	Metric 3:	Applicability	High	Data are for use as a cleaning product, an in-scope occupational scenario.
	Metric 4:	Temporal Representativeness	Medium	Assessment is based on data greater than 10 years old but no more than 20 years old and industry conditions that are expected to be representative of current industry conditions.
	Metric 5:	Sample Size	High	Statistical distribution of samples is fully characterized (discrete sampling data provided).
Domain 3: Accessibility/ Clarity	Metric 6:	Metadata Completeness	Medium	Results and assumptions are clearly documented, but underlying details of methods are not fully transparent.
Domain 4: Variability and Uncertainty	Metric 7:	Metadata Completeness	Low	Variability and uncertainty are not addressed.
<b>Overall Quality Determination</b>			<b>Medium</b>	

<b>Study Citation:</b>	ECB, (2008). European Union risk assessment report: 1,3,4,6,7,8-hexahydro-4,6,6,7,8,8-hexamethylcyclopenta-γ-2-benzopyran (HHCB).
<b>HERO ID:</b>	5155574
<b>Conditions of Use:</b>	Compounding of Fragrance Oil

EXTRACTION	
Parameter	Data
Worker activity description:	"Nine of the workers were engaged in compounding offragrances, which included weighing, dispensing and mixing of fragrance ingredients. The remaining 2 workers were material handlers with job duties such as transporting fragrance ingredients in metal drums and periodically collecting aliquots of samples from large drums for QC purposes.
Dermal exposure data:	Cumulative extracted amounts: 0.32-39 mg (average 9 mg).Modeled estimates using EASE 2.0: Incidental handling of liquid drums (non dispersive use) is assumed to result in an exposure of 0 – 0.1 mg/cm2/day, or based on the surface of hands and forearms (1300 cm2): 130 mg/day. pg. 146
Comments:	EU report cites Cohen and Wolff (1998) study of a compounding facility measuring isobornyl acetate with a vapor pressure of 13.3 pa(~0.1 torr) as measured data for dermal.

EVALUATION				
Domain	Metric		Rating	Comments
Domain 1: Reliability	Metric 1:	Methodology	Medium	Sampling methodology is generally described but as this is not the primary source, there may be sampling details not included.
Domain 2: Representativeness	Metric 2:	Geographic Scope	High	The underlying data are from the US.
	Metric 3:	Applicability	Medium	The data are for an occupational scenario for a different chemical, but it may be useful the information is for another chemical.
	Metric 4:	Temporal Representativeness	Low	Data is from 1998 over 20 years old.
	Metric 5:	Sample Size	Medium	Distribution of samples is characterized by a range with uncertain statistics.
Domain 3: Accessibility/ Clarity	Metric 6:	Metadata Completeness	Medium	EU report clearly summarizes the results, methods, and assumptions. Some of the methodology may not be fully transparent.
Domain 4: Variability and Uncertainty	Metric 7:	Metadata Completeness	Medium	The assessment does not address variability but does provide a limited discussion on uncertainty based on the range of values reported and the consideration of other factors on the loading.

<b>Overall Quality Determination</b>	<b>Medium</b>
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<b>Study Citation:</b>	ECB, (2008). European Union risk assessment report: 1,3,4,6,7,8-hexahydro-4,6,6,7,8,8-hexamethylcyclopenta- $\gamma$ -2-benzopyran (HHCB).			
<b>HERO ID:</b>	5155574			
<b>Conditions of Use:</b>	Compounding of Fragrance Oil			
<b>EXTRACTION</b>				
<b>Parameter</b>	<b>Data</b>			
Personal sampling data:	Plant 2- Both area and personal monitoring was carried out, below the detection limit of 30 ug/m3. pg. 143			
Area sampling data:	Plant 4 Static Measurements- Majority of the samples below a detection limit of 8 ug/m3, 6 samples between 11 and 13 ug/m3 and one sample 58 ug/m3. Median is <8 ug/m3. The 58 ug/m3 was a moment after filling of the stock flasks in the small robot filling station. pg.144			
<b>EVALUATION</b>				
Domain	Metric		Rating	Comments
Domain 1: Reliability	Metric 1:	Methodology	Low	Sampling or analytical methodology is not specified.
Domain 2: Representativeness	Metric 2:	Geographic Scope	Medium	The data are from the EU (e.g., potential differences in regulatory occupational exposure limits, industry/ processtechnologies) may impact exposures relative to the U.S.
	Metric 3:	Applicability	High	The data are for an occupational scenario within the scope of the risk evaluation.
	Metric 4:	Temporal Representativeness	Low	Data is from 1988 and 1999, over 20 years old.
	Metric 5:	Sample Size	Medium	Distribution of samples is with some statistics but the full sample data is not provided.
Domain 3: Accessibility/ Clarity	Metric 6:	Metadata Completeness	Medium	Monitoring data include most critical metadata, such as sample type, exposure durations, worker activities and exposure type, but the metadata on sample durations and exposure frequency was unclear.
Domain 4: Variability and Uncertainty	Metric 7:	Metadata Completeness	Medium	The monitoring study provides only limited discussion of the variability in the determinants of exposure for the sampled sites. The monitoring study provides only limited discussion of the uncertainty in the exposure estimates.
<b>Overall Quality Determination</b>			<b>Medium</b>	



<b>Study Citation:</b>	ECB, (2008). 1,3,4,6,7,8-Hexahydro-4,6,6,7,8,8-hexamethylcyclopenta- $\gamma$ -2-benzopyran, (1,3,4,6,7,8-hexahydro-4,6,6,7,8,8-hexamethylinden[5,6-c]pyran - HHCB) summary risk assessment report.
<b>HERO ID:</b>	8404084
<b>Conditions of Use:</b>	Manufacture; Formulation into fragrance oils; formulation into liquid and powder products; Use of cleaning products

EXTRACTION	
Parameter	Data
Exposure route:	inhalation and dermal
Personal sampling data:	exposure is estimated by modeled data; During formulation of products it is assumed that the production is highly automated with little or no exposure. Exposure may be possible during handling of the drums and during cleaning and maintenance of the equipment and is modeled with the EASE model. Because of the very low vapor pressure of the substance after dilution, inhalation exposure is estimated as negligible. During the use of cleaning products, Professional cleaners may be exposed to HHCB. Due to the very low vapor pressure of the diluted substance however, the exposure is assumed to be negligible.
Dermal exposure data:	the dermal exposure estimated during manufacture, formulation, and the use of cleaning agents by professional cleaners using the EASE model.
Exposure duration:	provides exposure duration for multiple scenarios
Exposure frequency:	Provides # working days for various scenarios
Engineering control:	LEV during fragrance formulation

EVALUATION				
Domain	Metric		Rating	Comments
Domain 1: Reliability	Metric 1:	Methodology	High	Assessment uses high quality methods that are from frequently-used sources (EU RAR) and there are no known quality issues.
Domain 2: Representativeness	Metric 2:	Geographic Scope	Medium	Data are from The Netherlands, an OECD country.
	Metric 3:	Applicability	High	Data are for Manufacture, Formulation into fragrance oils, formulation into liquid and powder products, and Use of cleaning products, which are in-scope occupational scenarios.
	Metric 4:	Temporal Representativeness	Low	Assessment is based on data greater than 20 years old and industry conditions that are expected to be outdated (2000)
	Metric 5:	Sample Size	Low	Model results characterized by no statistics.
Domain 3: Accessibility/ Clarity	Metric 6:	Metadata Completeness	Low	Assessment results are provided but underlying methods, assumptions, and data sources are not fully transparent.
Domain 4: Variability and Uncertainty	Metric 7:	Metadata Completeness	Low	Variability and uncertainty are not addressed.

## Overall Quality Determination

Low

<b>Study Citation:</b>	NICNAS, (2019). Cyclopenta[g]-2-benzopyran, 1,3,4,6,7,8-hexahydro-4,6,6,7,8,8-hexamethyl-: Human health tier II assessment.			
<b>HERO ID:</b>	5349389			
<b>Conditions of Use:</b>	Formulation Into Products			
<b>EXTRACTION</b>				
<b>Parameter</b>	<b>Data</b>			
Worker activity description:	transfer and blending activities, quality control analysis, and cleaning and maintaining equipment			
Exposure route:	dermal, oral and ocular exposure			
<b>EVALUATION</b>				
Domain	Metric	Rating	Comments	
Domain 1: Reliability	Metric 1: Methodology	High	Assessment uses high quality methods from a frequently-used source (NICNAS).	
Domain 2: Representativeness	Metric 2: Geographic Scope	Medium	Data are from Australia, an OECD country.	
	Metric 3: Applicability	High	Data are for Formulation Into Products, an in-scope occupational scenario.	
	Metric 4: Temporal Representativeness	High	Assessment is based on current industry conditions and data no more than 10 years old (2019).	
	Metric 5: Sample Size	N/A	N/A - data not dependent on samples	
Domain 3: Accessibility/ Clarity	Metric 6: Metadata Completeness	Low	Assessment results are provided but underlying methods, assumptions, and data sources are not fully transparent.	
Domain 4: Variability and Uncertainty	Metric 7: Metadata Completeness	Low	Variability and uncertainty are not addressed.	
<b>Overall Quality Determination</b>		<b>Medium</b>		

<b>Study Citation:</b>	OECD, (2010). Emission scenario document on the blending of fragrance oils into commercial and consumer products.
<b>HERO ID:</b>	6387319
<b>Conditions of Use:</b>	Processing into formulation

EXTRACTION	
Parameter	Data
Worker activity description:	Unloading from transport containers and charging the aroma chemical; Container cleaning; Sampling; Equipment cleaning; and packaging of commercial and consumer products
Exposure route:	inhalation, dermal
Physical form:	liquids, vapor, solids
Area sampling data:	"Two NIOSH HHEs for Purex Corporation and The Clorox Company were used to estimate inhalation exposures to solids in the 1994 generic scenario for this industry. Based on the monitoring data from these facilities, the scenario presents a concentration range of respirable particles of 0.14 to 2.82 mg/m3 and of total dust particulate of 0.19 to 18.9 mg/m3. "(Page 52)
Exposure frequency:	default: 250 days but also noted tha can be adjusted based on
Number of workers:	Total numbers of workers-113,041; Average Number of Workers per Site- 48; Average Number of Production Workers per site- 29; Percentage of Production Workers-60%. More number of workers are included per 6-digit NAICS code.
Personal protective equipment:	"Typical Material Safety Data Sheets (MSDS) for fragrance oil suggest wearing gloves, goggles, and impervious clothing when handling the fragrance oil. A respirator with an organic vapor cartridge is also frequently recommended (for instance, in poorly ventilated spaces). " (Page 43)
Comments:	"The ventilation rate of a perfume and air freshener formulation facility evaluated in a NIOSH Health Hazard Evaluation (HHE) was found to be 3,500-4,000 ft3/min (NIOSH, 1992). "(Page 44)

EVALUATION				
Domain		Metric	Rating	Comments
Domain 1: Reliability	Metric 1:	Methodology	High	The report uses high quality data and/or techniques that are from a frequently used source (e.g., EPA/OPPT models, NIOSH HHEs, Kirk-Othmer) and associated information does not indicate flaws or quality issues.
Domain 2: Representativeness	Metric 2:	Geographic Scope	High	The data are from the United States and are representative of the industry being evaluated.
	Metric 3:	Applicability	Medium	The assessment is for an occupational scenario (processing into formulation) within the scope of the risk evaluation; however, data is general and not specific to a chemical.
	Metric 4:	Temporal Representativeness	Medium	The source is generally more than 10 years but no more than 20 years old.
	Metric 5:	Sample Size	Medium	Distribution of samples is characterized by a range with uncertain statistics. It is unclear if analysis is representative.
Domain 3: Accessibility/ Clarity	Metric 6:	Metadata Completeness	High	Report clearly documents its data sources, assessment methods, results, and assumptions
Domain 4: Variability and Uncertainty	Metric 7:	Metadata Completeness	High	The assessment addresses variability (e.g., different products) and uncertainty (e.g., data gaps/uncertainties section included) in the results. Uncertainty is well characterized.

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<b>Study Citation:</b> OECD, (2010). Emission scenario document on the blending of fragrance oils into commercial and consumer products.			
<b>HERO ID:</b> 6387319			
<b>Conditions of Use:</b> Processing into formulation			
Domain	Metric	<b>EVALUATION</b> Rating	Comments
<b>Overall Quality Determination</b>		<b>High</b>	

<b>Study Citation:</b>	U.S. EPA, (2023). Use of laboratory chemicals - Generic scenario for estimating occupational exposures and environmental releases (Revised draft generic scenario).
<b>HERO ID:</b>	10480466
<b>Conditions of Use:</b>	Use - Laboratory Chemicals

EXTRACTION	
Parameter	Data
Worker activity description:	container unloading (liquids and solids), container cleaning, equipment cleaning, laboratory analyses, disposal of laboratory chemicals
Exposure route:	Dermal, Inhalation
Physical form:	Liquid or solid
Exposure duration:	8-12 hr/day
Exposure frequency:	250 days/yr
Number of workers:	3 workers/facility and 3 ONUs/facility
Personal protective equipment:	Basic PPE includes wearing long sleeves (lab coats), long pants, closed-toe shoes, safety glasses or goggles, and gloves during the use of laboratory chemicals. Additional PPE may be worn depending on the level of hazard or specifics of the process.
Engineering control:	fume hood

EVALUATION				
Domain	Metric		Rating	Comments
Domain 1: Reliability	Metric 1:	Methodology	High	Assessment uses high quality information/data from frequently-used sources.
Domain 2: Representativeness	Metric 2:	Geographic Scope	High	This GS is based on U.S. data
	Metric 3:	Applicability	Medium	Data is for an in-scope occupational scenario; however, data is general and not specific to a chemical.
	Metric 4:	Temporal Representativeness	High	Assessment is based on current industry conditions and data no more than 10 years old.
	Metric 5:	Sample Size	Medium	Sample distribution characterized by a range with uncertain statistics.
Domain 3: Accessibility/ Clarity	Metric 6:	Metadata Completeness	High	All data sources, methods, results, and assumptions are clearly documented.
Domain 4: Variability and Uncertainty	Metric 7:	Metadata Completeness	Low	Variability and uncertainty are not addressed.

<b>Overall Quality Determination</b>	<b>High</b>
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<b>Study Citation:</b>	U.S. EPA, (2022). Chemical repackaging - Generic scenario for estimating occupational exposures and environmental releases (revised draft).			
<b>HERO ID:</b>	11182966			
<b>Conditions of Use:</b>	Repackaging			
<b>EXTRACTION</b>				
<b>Parameter</b>	<b>Data</b>			
Worker activity description:	Unloading transport containers, container cleaning, equipment cleaning, loading of transport containers.			
Exposure route:	Dermal, Inhalation			
Physical form:	Liquid or solid			
Area sampling data:	Inhalation: Provides methods for modeling exposures to non-volatile and volatile liquids and solids.			
Dermal exposure data:	Dermal: Provides methods for modeling exposures to non-volatile and volatile liquids and solids.			
Exposure duration:	8-12 hr/day			
Exposure frequency:	The number of operating days is given in a range of 174-260 days/yr with an EPA default of 260 days/yr.			
Number of workers:	3 workers/facility and 1 ONUs/facility (total number of employees and facilities given in Table 5-3).			
Personal protective equipment:	Commonly used PPE includes safety glasses, face shields, aprons, and gloves.			
Engineering control:	Local exhaust ventilation.			
<b>EVALUATION</b>				
Domain	Metric	Rating	Comments	
Domain 1: Reliability	Metric 1:	Methodology	High	Assessment uses high quality information/data from frequently-used sources.
Domain 2: Representativeness	Metric 2:	Geographic Scope	High	This GS is based on U.S. data.
	Metric 3:	Applicability	Medium	Data are for an in-scope occupational scenario; however, data is general and not specific to a chemical.
	Metric 4:	Temporal Representativeness	Medium	Assessment is based on data greater than 10 years old but no more than 20 years old and industry conditions that are expected to be representative of current industry conditions.
	Metric 5:	Sample Size	High	Statistical distribution of samples is fully characterized (discrete use amounts provided).
Domain 3: Accessibility/ Clarity	Metric 6:	Metadata Completeness	High	All data sources, methods, results, and assumptions are clearly documented.
Domain 4: Variability and Uncertainty	Metric 7:	Metadata Completeness	Medium	Uncertainty not addressed. Variability addressed by considering multiple worker activities.
<b>Overall Quality Determination</b>		<b>High</b>		

<b>Study Citation:</b>	U.S. EPA, (2014). Generic scenario draft on the use of additives in plastic compounding.			
<b>HERO ID:</b>	3827195			
<b>Conditions of Use:</b>	Plastics Compounding			
<b>EXTRACTION</b>				
<b>Parameter</b>	<b>Data</b>			
Worker activity description:	Unloading and charging additives to process, container cleaning, equipment cleaning, and compounding processes			
Exposure route:	dermal and inhalation			
Personal sampling data:	Provides methods for modeling exposures to both solids and volatile liquids			
Dermal exposure data:	Provides methods for modeling exposures to both solids and non-volatile liquids			
Exposure frequency:	148-264 days/yr			
Number of workers:	24 workers/site			
Engineering control:	Forced ventilation			
<b>EVALUATION</b>				
Domain	Metric	Rating	Comments	
Domain 1: Reliability	Metric 1: Methodology	High	Assessment uses high quality data/techniques/methods from frequently-used sources.	
Domain 2: Representativeness	Metric 2: Geographic Scope	High	This GS is based on U.S. data	
	Metric 3: Applicability	Medium	Data is for an in-scope occupational scenario; however, data is general and not specific to a chemical.	
	Metric 4: Temporal Representativeness	Medium	Assessment is generally based on data greater than 10 years old but no more than 20 years old and industry conditions that are expected to be representative of current industry conditions.	
	Metric 5: Sample Size	Low	Model results characterized by no statistics.	
Domain 3: Accessibility/ Clarity	Metric 6: Metadata Completeness	High	All data sources, methods, results, and assumptions are clearly documented.	
Domain 4: Variability and Uncertainty	Metric 7: Metadata Completeness	Medium	Uncertainty not addressed. Variability addressed by considering multiple plastic types, additive types, and worker activities.	
<b>Overall Quality Determination</b>		<b>Medium</b>		

<b>Study Citation:</b>	U.S. EPA, (2004). Additives in plastics processing (compounding) – generic scenario for estimating occupational exposures and environmental release – Draft.
<b>HERO ID:</b>	6311218
<b>Conditions of Use:</b>	incorporation into articles as a Odor agent in plastics material and resin manufacturing

EXTRACTION	
Parameter	Data
Worker activity description:	Unloading and charging additives to process, container cleaning, equipment cleaning, and compounding processes
Exposure route:	dermal and inhalation
Personal sampling data:	Inhalation: Provides methods for modeling exposures to both solids and volatile liquids
Dermal exposure data:	dermal: Provides methods for modeling exposures to both solids and non-volatile liquids
Exposure duration:	8 hr/day
Exposure frequency:	250 days/yr
Number of workers:	24 workers/site

EVALUATION				
Domain	Metric		Rating	Comments
Domain 1: Reliability	Metric 1:	Methodology	High	Assessment uses high quality data/techniques/methods from frequently-used sources.
Domain 2: Representativeness	Metric 2:	Geographic Scope	High	This GS is based on U.S. data
	Metric 3:	Applicability	Medium	Data is for an in-scope occupational scenario; however, data is general and not specific to a chemical.
	Metric 4:	Temporal Representativeness	Medium	Assessment is generally based on data greater than 10 years old but no more than 20 years old and industry conditions that are expected to be representative of current industry conditions.
	Metric 5:	Sample Size	Low	Model results characterized by no statistics.
Domain 3: Accessibility/ Clarity	Metric 6:	Metadata Completeness	High	All data sources, methods, results, and assumptions are clearly documented.
Domain 4: Variability and Uncertainty	Metric 7:	Metadata Completeness	Medium	Uncertainty not addressed. Variability addressed by considering multiple plastic types, additive types, and worker activities.

<b>Overall Quality Determination</b>	<b>Medium</b>
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# Occupational Exposure

<b>Study Citation:</b>	U.S. EPA, (1991). Granular detergents manufacture - generic scenario for estimating occupational exposures environmental releases: Draft.			
<b>HERO ID:</b>	6385740			
<b>Conditions of Use:</b>	Formulation of powder products			
<b>EXTRACTION</b>				
<b>Parameter</b>	<b>Data</b>			
Worker activity description:	handling bags, connecting feed hose, sampling mixtures, equipment leaks, handling fines from dust collectors/cyclone, cleaning spray dryer, dumping fines back into system, packing, maintenance work			
Exposure route:	dermal and inhalation			
Personal sampling data:	Inhalation: Provides methods for modeling exposures to volatile liquids and solids			
Dermal exposure data:	dermal: Provides methods for modeling exposures to non-volatile liquids and solids			
Exposure frequency:	250 days/yr			
Number of workers:	3 material handlers/site3 wet-end operators/site3 dry-end operators/site6-9 packers/site3-6 maintenance workers/site			
<b>EVALUATION</b>				
Domain	Metric	Rating	Comments	
Domain 1: Reliability	Metric 1: Methodology	High	Assessment uses high quality data/techniques/methods from frequently-used sources.	
Domain 2: Representativeness	Metric 2: Geographic Scope	High	This GS is based on U.S. data	
	Metric 3: Applicability	Medium	Data are for manufacture of granulated detergents, which is similar to the in-scope occupational scenario for the formulation of powders.	
	Metric 4: Temporal Representativeness	Low	Assessment is based on data greater than 20 years old.	
	Metric 5: Sample Size	Low	Model results characterized by no statistics.	
Domain 3: Accessibility/ Clarity	Metric 6: Metadata Completeness	High	All data sources, methods, results, and assumptions are clearly documented.	
Domain 4: Variability and Uncertainty	Metric 7: Metadata Completeness	Medium	Uncertainty not addressed. Variability addressed by considering multiple job types	
<b>Overall Quality Determination</b>		<b>Medium</b>		

<b>Study Citation:</b>	U.S. EPA, (2014). Use of additive in plastic compounding - generic scenario for estimating occupational exposures and environmental releases: Draft.			
<b>HERO ID:</b>	6385748			
<b>Conditions of Use:</b>	Processing; Plastics Compounding			
EXTRACTION				
Parameter	Data			
Worker activity description:	Unloading and charging additives to process, container cleaning, equipment cleaning, and compounding processes			
Exposure route:	dermal and inhalation			
Exposure frequency:	264			
Number of workers:	24 workers/site			
Engineering control:	'Forced ventilation			
EVALUATION				
Domain	Metric	Rating	Comments	
Domain 1: Reliability	Metric 1: Methodology	High	Assessment uses high quality data/techniques/methods from frequently-used sources.	
Domain 2: Representativeness	Metric 2: Geographic Scope	High	This GS is based on U.S. data	
	Metric 3: Applicability	Medium	Data is for an in-scope occupational scenario; however, data is general and not specific to a chemical.	
	Metric 4: Temporal Representativeness	Medium	Assessment is generally based on data greater than 10 years old but no more than 20 years old and industry conditions that are expected to be representative of current industry conditions.	
	Metric 5: Sample Size	Low	Model results characterized by no statistics.	
Domain 3: Accessibility/ Clarity	Metric 6: Metadata Completeness	High	All data sources, methods, results, and assumptions are clearly documented.	
Domain 4: Variability and Uncertainty	Metric 7: Metadata Completeness	Medium	Uncertainty not addressed. Variability addressed by considering multiple plastic types, additive types, and worker activities.	
Overall Quality Determination		Medium		

<b>Study Citation:</b>	Ashkin, S., Ellis, R. (2006). Cleaning materials and methods. :169-188.
<b>HERO ID:</b>	9551178
<b>Conditions of Use:</b>	Use of Liquid Cleaners; Use of Powder Cleaners

EXTRACTION	
Parameter	Data
Worker activity description:	Source provides the typical area cleaned per 8-hr shift for each level of cleanliness. 18,000-20,000 sq. ft. at a level 2 standard of cleanliness in an 8-hr shift. 28,000-31,000 sq. ft. at a level 3 standard of cleanliness in an 8-hr shift. 45,000-50,000 sq. ft. at a level 4 standard of cleanliness in an 8-hr shift. Classrooms are cleaned every other day, carpets vacuumed every third day, and dusting occurs once a month. Source describes typical areas of cleaning that may include chemicals: cleaning throughout the school, floors, food service areas, vertical surfaces, dusting, trash removal, and exterior of buildings.
Engineering control:	Small adjustments in ventilation systems and cleaning materials can reduce the indoor concentration of contaminants. (9/20) Microfiber instead of mop may reduce chemical use. (11/20) Reliable dispensing equipment systems are increasingly available for concentrated cleaners. (16/20)

EVALUATION			
Domain	Metric	Rating	Comments
Domain 1: Reliability	Metric 1: Methodology	Medium	Report uses high quality data that are not from a frequently used source and associated information does not indicate flaws or quality issues.
Domain 2: Representativeness	Metric 2: Geographic Scope	High	Data are from the U.S.
	Metric 3: Applicability	High	Data are for use of liquid and powder cleaners, in-scope occupational scenarios.
	Metric 4: Temporal Representativeness	Medium	Report is based on data greater than 10 years old (2006) but no more than 20 years old and industry conditions that are expected to be representative of current industry conditions.
	Metric 5: Sample Size	Medium	Sample distribution characterized by a range with uncertain statistics.
Domain 3: Accessibility/ Clarity	Metric 6: Metadata Completeness	High	All data sources, methods, results, and assumptions are clearly documented.
Domain 4: Variability and Uncertainty	Metric 7: Metadata Completeness	High	Uncertainty and Variability addressed.

<b>Overall Quality Determination</b>	<b>High</b>
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<b>Study Citation:</b>	Espinoza, T., Geiger, C., Everson, I. (2010). The real costs of institutional "green" cleaning.			
<b>HERO ID:</b>	9551187			
<b>Conditions of Use:</b>	Use of Cleaning Products			
<b>EXTRACTION</b>				
<b>Parameter</b>	<b>Data</b>			
Number of workers:	The cleaning industry employs approximately 2.8 million potentially exposed workers, according to the US EPA			
<b>EVALUATION</b>				
Domain	Metric	Rating	Comments	
Domain 1: Reliability	Metric 1: Methodology	High	The assessment or report uses data that are from frequently used sources (data from a study done by the EPA).	
Domain 2: Representativeness	Metric 2: Geographic Scope	High	The data are from the United States and are representative of the industry being evaluated.	
	Metric 3: Applicability	Medium	The report is for an occupational scenario, cleaning products, within the scope of the risk evaluation; however, data is general and not specific to a chemical.	
	Metric 4: Temporal Representativeness	Medium	The report captures operations, equipment, and worker activities that are expected to be reasonably representative of current conditions. The report is generally more than 10 years but no more than 20 years old (2010).	
	Metric 5: Sample Size	Low	Distribution of samples is qualitative or characterized by no statistics.	
Domain 3: Accessibility/ Clarity	Metric 6: Metadata Completeness	Medium	Assessment or report clearly documents results, and assumptions. Data sources are generally described but not fully transparent.	
Domain 4: Variability and Uncertainty	Metric 7: Metadata Completeness	Low	The report does not address variability or uncertainty.	
<b>Overall Quality Determination</b>		<b>Medium</b>		

<b>Study Citation:</b>	Hsieh, Y. C., Apostolopoulos, Y., Hatzudis, K., Sönmez, S. (2014). Occupational exposures and health outcomes among Latina hotel cleaners. Hispanic Health Care International 12(1):6-15.
<b>HERO ID:</b>	9551208
<b>Conditions of Use:</b>	Use of Liquid Cleaning Products; Use of Aerosol, Spray, or Foam Cleaning Products; Use of Powder Cleaners and Deodorizers

**EXTRACTION**

Parameter	Data
Worker activity description:	On average, a Latina hotel cleaner is assigned to clean 12 to 16 rooms per shift
Exposure duration:	8 hours per day
Exposure frequency:	5 days per week

**EVALUATION**

Domain	Metric	Rating	Comments
Domain 1: Reliability	Metric 1: Methodology	High	Report uses high quality data from frequently-used sources.
Domain 2: Representativeness	Metric 2: Geographic Scope	High	Data are from the U.S.
	Metric 3: Applicability	High	Data are for use of cleaners, an in-scope occupational scenario.
	Metric 4: Temporal Representativeness	Medium	Report is based on data greater than 10 years old but no more than 20 years old (2004) and industry conditions that are expected to be representative of current industry conditions.
	Metric 5: Sample Size	Medium	Reasonable Values are provided but uncertain sample distribution and statistics behind the values.
Domain 3: Accessibility/ Clarity	Metric 6: Metadata Completeness	Medium	Assessment or report clearly documents results, methods, and assumptions. Datasources are generally described but not fully transparent.
Domain 4: Variability and Uncertainty	Metric 7: Metadata Completeness	Medium	Variability addressed by providing a range of data but uncertainty is not addressed.

**Overall Quality Determination**

**High**

<b>Study Citation:</b>	Lee, S. J., Nam, B., Harrison, R., Hong, O. (2014). Acute symptoms associated with chemical exposures and safe work practices among hospital and campus cleaning workers: a pilot study. American Journal of Industrial Medicine 57(11):1216-1226.		
<b>HERO ID:</b>	5443926		
<b>Conditions of Use:</b>	Use of Cleaners		
EXTRACTION			
<b>Parameter</b>	<b>Data</b>		
Number of workers:	As of December 2010, the HospitalityService Department had 280 employees, which consisted of122 (44%) patient support assistants (PSAs) who assistpatient transport and perform cleaning of patient rooms andclinical areas (e.g., operating room), and 133 (48%)custodians who perform cleaning of other nonclinical orpublic areas (e.g., hallway, restroom, or waiting room)128 custodians were employed on the campus		
Personal protective equipment:	Use of PPE while handling chemicals (% compliance)Gloves 98.4%Surgical Mask 37.2%Safety goggle or glass 28.4%Long sleeve clothing 26.2%Face shield 15.9%Rubber apron 3.3%		
EVALUATION			
Domain	Metric	Rating	Comments
Domain 1: Reliability	Metric 1: Methodology	Medium	The assessment or report uses high quality data and/or techniques or sound methods that are not from a frequently used source and associated information does not indicate flaws or quality issues
Domain 2: Representativeness	Metric 2: Geographic Scope	High	The data are from the United States and are representative of the industry being evaluated.
	Metric 3: Applicability	Medium	The report is for an occupational scenario that is similar to an occupational scenario within the scope of the risk evaluation, in terms of the type of industry, operations, and work activities; however HHCB is not specifically mentioned
	Metric 4: Temporal Representativeness	High	The report captures operations, equipment, and worker activities expected to be representative of current conditions (report from 2014)
	Metric 5: Sample Size	Medium	Distribution of samples is characterized by a range with uncertain statistics. It is unclear if analysis is representative.
Domain 3: Accessibility/ Clarity	Metric 6: Metadata Completeness	Medium	Assessment or report clearly documents results, methods, and assumptions. Data sources are generally described but not fully transparent.
Domain 4: Variability and Uncertainty	Metric 7: Metadata Completeness	Medium	The report provides only limited discussion of the variability and uncertainty in the results.
Overall Quality Determination		Medium	

<b>Study Citation:</b>	Nazaroff, W. W., Coleman, B. K., Destailats, H., Hodgson, A. T., Liu, D.,-L, Lunden, M. M., Singer, B. C., Weschler, C. J. (2006). Indoor air chemistry: Cleaning agents, ozone and toxic air contaminants.
<b>HERO ID:</b>	4682850
<b>Conditions of Use:</b>	Use of liquid cleaning products

EXTRACTION	
Parameter	Data
Worker activity description:	domestic cleaner
Exposure route:	inhalation
Physical form:	vapor, mist, particulate
Exposure duration:	p. 179between 0.5 - 4.5 depending on the task
Exposure frequency:	p. 179250 days/yr
Number of workers:	three million people are employed as “janitors and cleaners,” or as “maids and housekeeping cleaners” (US Department of Labor, 2001). p. 28

EVALUATION				
Domain	Metric		Rating	Comments
Domain 1: Reliability	Metric 1:	Methodology	High	The assessment or report uses high quality data and/or techniques or sound methods that are from frequently used sources (e.g., European Union or OECD reports, NIOSH HHEs, journalarticles, Kirk-Othmer) and are generally accepted by the scientific community, and associated information does not indicate flaws or quality issues.
Domain 2: Representativeness	Metric 2:	Geographic Scope	High	The data are from the United States and are representative of the industry being evaluated.
	Metric 3:	Applicability	Medium	The report is for an occupational scenario within the scope of the risk evaluation, however information is not specific to chemical
	Metric 4:	Temporal Representativeness	Medium	The report captures operations, equipment, and worker activities that are expected to be reasonably representative of current conditions. The report is generally more than 10 years but no more than 20 years old (published in 2006).
	Metric 5:	Sample Size	Low	Distribution of samples is qualitative or characterized by no statistics.
Domain 3: Accessibility/ Clarity	Metric 6:	Metadata Completeness	High	Assessment or report clearly documents its data sources, assessment methods, results, and assumptions.
Domain 4: Variability and Uncertainty	Metric 7:	Metadata Completeness	Low	The report does not address variability or uncertainty.

<b>Overall Quality Determination</b>	<b>Medium</b>
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<b>Study Citation:</b>	Nazaroff, W. W., Weschler, C. J. (2004). Cleaning products and air fresheners: exposure to primary and secondary air pollutants. Atmospheric Environment 38(18):2841-2865.
<b>HERO ID:</b>	57058
<b>Conditions of Use:</b>	Use of air care products; use of cleaning and furnishing care products

EXTRACTION	
Parameter	Data
Exposure duration:	Household study: all-purpose cleaners had an average contact frequency of 0.35 per subject per day, mean duration of 20 minutes per contact, and average product usage of 27g per contact
Number of workers:	3 million people are employed as Janitors and cleaners or as maids and housekeeping cleaners (US Department of Labor, 2001)

		EVALUATION	
Domain	Metric	Rating	Comments
Domain 1: Reliability	Metric 1:	Methodology	Medium
			Report uses high quality data that are not from frequently-used sources and there are no known quality issues.
Domain 2: Representativeness	Metric 2:	Geographic Scope	Medium
	Metric 3:	Applicability	Medium
	Metric 4:	Temporal Representativeness	Low
	Metric 5:	Sample Size	Medium
Domain 3: Accessibility/ Clarity	Metric 6:	Metadata Completeness	Low
			Assessment results are provided but underlying methods, assumptions, and data sources are not fully transparent.
Domain 4: Variability and Uncertainty	Metric 7:	Metadata Completeness	Medium
			Variability addressed by testing multiple households but uncertainty is not addressed.

<b>Overall Quality Determination</b>	<b>Low</b>
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<b>Study Citation:</b>	Nazaroff, W. W., Weschler, C. J. (2004). Cleaning products and air fresheners: exposure to primary and secondary air pollutants. Atmospheric Environment 38(18):2841-2865.			
<b>HERO ID:</b>	57058			
<b>Conditions of Use:</b>	Use of air care products; use of cleaning and furnishing care products			
<b>EXTRACTION</b>				
<b>Parameter</b>	<b>Data</b>			
Number of workers:	3 million people are employed as Janitors and cleaners or as maids and housekeeping cleaners (US Department of Labor, 2001)			
<b>EVALUATION</b>				
Domain	Metric	Rating	Comments	
Domain 1: Reliability	Metric 1: Methodology	Medium	Report uses high quality data that are not from frequently-used sources, cites its data sources, and there are no known quality issues.	
Domain 2: Representativeness	Metric 2: Geographic Scope	Medium	Data are from The Netherlands, an OECD country.	
	Metric 3: Applicability	Medium	Data are for use of cleaning products, but do not specifically identify HHCB as a part of the cleaning product mixture.	
	Metric 4: Temporal Representativeness	Low	Report is based on data greater than 20 years old and industry conditions that are expected to be outdated (2001, 1997)	
	Metric 5: Sample Size	Medium	Sample distribution characterized by limited statistics (e.g., mean) but discrete samples not provided and distribution not fully characterized.	
Domain 3: Accessibility/ Clarity	Metric 6: Metadata Completeness	Low	Assessment results are provided but underlying methods, assumptions, and data sources are not fully transparent.	
Domain 4: Variability and Uncertainty	Metric 7: Metadata Completeness	Low	The report does not address variability or uncertainty.	
<b>Overall Quality Determination</b>		<b>Low</b>		

<b>Study Citation:</b>	P&G, (2023). Comments of The Procter & Gamble Company on 1,4-Dioxane: Draft Supplement to the TSCA Risk Evaluation Science Advisory Committee on Chemicals (SACC) Meeting.
<b>HERO ID:</b>	11333406
<b>Conditions of Use:</b>	Commercial Use – Laundry and Dishwashing Products - Laundry Detergent (Liquid); Laundry Detergent (Unit Dose/Granule); Fabric Enhancers; Stain Removers; Dry Cleaning and Associated Products; Dishwashing Detergent (Liquid/ Gel); Dishwashing Detergent (Unit Dose/ Granule); Dishwashing Detergent Liquid (Hand-Wash)

**EXTRACTION**

Parameter	Data
Worker activity description:	Food service workers rarely if ever only wash dishes for 8 hours as their full-time job. They also help with many other jobs in the back of the house such as restocking items, taking out trash,sweeping floors, personal breaks, etc.Hand dish washer personnel may have their hands in the sink water at an (excessively high) estimate of once per minute for an 8-hour shift (60 x 8 = 480 times per shift).
Exposure route:	inhalation and dermal
Exposure duration:	We estimate 5 seconds exposure each time to pull an item from the sink. Contact exposure to diluted hand dish wash water is calculated to be 40 minutes / shift.
Engineering control:	P&G Professional supplies several ways for employees to dose the hand dish soap into sinks to minimize end-users' exposure to the finished product, both for safety and ease of use.1. Auto dose in which the product is proportioned at the proper dose into the sink via a product tube in a proportioning system (Figure 1).2. A pump affixed to the top of the detergent bottle that is pumped directly into the sink (Figure 2).3. A flip-top squirt cap that is squirted directly into the sink (Figure 2)4. Some end-users will free-pour from a gallon bottle directly into the sink or pour from an open gallon into a measuring cup or similar.The 1 oz pumps are most frequently used, followed by the proportioned auto dose system (Figure 3).
Comments:	Source also supplies assessment methodologies and recommendations for inhalation and dermal exposure.

**EVALUATION**

Domain	Metric	Rating	Comments
Domain 1: Reliability	Metric 1: Methodology	High	Report uses high quality data from frequently-used sources.
Domain 2: Representativeness	Metric 2: Geographic Scope	High	Data are from the U.S.
	Metric 3: Applicability	High	Data are for use of dishwasher detergent, an in-scope condition of use.
	Metric 4: Temporal Representativeness	Medium	Report is based on some data greater than 20 years old, but industry conditions are not expected to be outdated.
	Metric 5: Sample Size	Low	Sample distribution is described qualitatively.
Domain 3: Accessibility/ Clarity	Metric 6: Metadata Completeness	High	All data sources, methods, results, and assumptions are clearly documented.
Domain 4: Variability and Uncertainty	Metric 7: Metadata Completeness	Low	Variability and uncertainty are not addressed.

**Overall Quality Determination****Medium**

<b>Study Citation:</b>	U.S. BLS, (2023). U.S. Census Bureau of Labor Statistics Data from 2021.			
<b>HERO ID:</b>	11138808			
<b>Conditions of Use:</b>	All			
<b>EXTRACTION</b>				
<b>Parameter</b>	<b>Data</b>			
Number of workers:	Used to develop a method to estimate number of sites and workers.			
<b>EVALUATION</b>				
Domain	Metric		Rating	Comments
Domain 1: Reliability	Metric 1:	Methodology	High	BLS is expected to use reliable survey methods.
Domain 2: Representativeness	Metric 2:	Geographic Scope	High	U.S. based economic data.
	Metric 3:	Applicability	High	These economic data cover all industry and occupation types in scope for all chemicals.
	Metric 4:	Temporal Representativeness	High	The BLS OES data are from 2021.
	Metric 5:	Sample Size	High	The BLS OES program provides detailed statistics and estimated relative standard error for each state, industry, and occupation survey conducted ( <a href="https://www.bls.gov/oes/current/oes_research_estimates.htm">https://www.bls.gov/oes/current/oes_research_estimates.htm</a> ).
Domain 3: Accessibility/ Clarity	Metric 6:	Metadata Completeness	Medium	BLS documents results and methods, but underlying survey results not accessible.
Domain 4: Variability and Uncertainty	Metric 7:	Metadata Completeness	Medium	Limited discussion of variability and uncertainty in results.
<b>Overall Quality Determination</b>			<b>High</b>	

<b>Study Citation:</b>	U.S. Census Bureau, (2021). 2021 SUSB Annual Datasets by Establishment Industry.			
<b>HERO ID:</b>	13027718			
<b>Conditions of Use:</b>	All			
<b>EXTRACTION</b>				
<b>Parameter</b>	<b>Data</b>			
Number of workers:	Source provides total number of employees per NAICS code and state.			
<b>EVALUATION</b>				
Domain	Metric	Rating	Comments	
Domain 1: Reliability	Metric 1: Methodology	High	U.S. Census Bureau is expected to use reliable survey and census methods.	
Domain 2: Representativeness	Metric 2: Geographic Scope	High	U.S. based economic data	
	Metric 3: Applicability	Medium	These economic data cover all industry and occupation types in scope for all chemicals but information is not specific to the chemical.	
	Metric 4: Temporal Representativeness	High	The Census Bureau SUSB data are from 2021	
	Metric 5: Sample Size	High	The SUSB is a compilation of data extracted from the Business Register, U.S. Census Bureau’s ”most complete, current, and consistent data for U.S. business establishments.” Incorporates data from economic censuses and current business surveys, quarterly and annual Federal tax records, and other departmental and federal statistics. Expected to be sufficiently representative. ( <a href="https://www.census.gov/programs-surveys/susb/about.html">https://www.census.gov/programs-surveys/susb/about.html</a> )	
Domain 3: Accessibility/ Clarity	Metric 6: Metadata Completeness	Medium	U.S. Census Bureau documents results and methods, but underlying survey results not accessible.	
Domain 4: Variability and Uncertainty	Metric 7: Metadata Completeness	Medium	Limited discussion of variability and uncertainty in results.	
<b>Overall Quality Determination</b>		<b>High</b>		

<b>Study Citation:</b>	U.S. EPA, (2020). 2020 CDR: Commercial and consumer use.			
<b>HERO ID:</b>	10366189			
<b>Conditions of Use:</b>	Manufacture and Import			
<b>EXTRACTION</b>				
<b>Parameter</b>	<b>Data</b>			
Physical form:	Provides physical form.			
Number of workers:	Provides number of workers.			
<b>EVALUATION</b>				
Domain	Metric	Rating	Comments	
Domain 1: Reliability	Metric 1: Methodology	High	EPA is a trusted source.	
Domain 2: Representativeness	Metric 2: Geographic Scope	High	CDR is U.S. based data.	
	Metric 3: Applicability	High	CDR covers chemical manufacturers and importers for HHCB, which are in scope for all chemicals.	
	Metric 4: Temporal Representativeness	High	EPA used data from the 2020 CDR.	
	Metric 5: Sample Size	Medium	Due to reporting threshold, statistical representativeness is unclear.	
Domain 3: Accessibility/ Clarity	Metric 6: Metadata Completeness	Medium	Submissions do not include method of how production volumes were determined. CDR industry sector codes, industrial processing and use codes, industrial function codes, and commercial product codes provide good metadata; but lack of clarifying information and narratives and occasional misreportings limit clarity of data.	
Domain 4: Variability and Uncertainty	Metric 7: Metadata Completeness	Low	CDR data do not address variability or uncertainty in submitter provided data.	
<b>Overall Quality Determination</b>		<b>High</b>		

<b>Study Citation:</b>	U.S. EPA, (2013). Updating CEB’s method for screening-level estimates of dermal exposure.			
<b>HERO ID:</b>	11224653			
<b>Conditions of Use:</b>	All			
<b>EXTRACTION</b>				
<b>Parameter</b>	<b>Data</b>			
Dermal exposure data:	This document provides updates to the parameters used for dermal exposure estimates. Updated parameters are listed below: Routine, direct handling of solids with 2 hands Resulting dermal contact: up to 3,100 mg Routine contact with surfaces, 2 hands, solids Resulting dermal contact: up to 1,100 mg Routine immersion, 2 hands, liquids Surface area: 1,070 cm^2 Amount retained on skin: 1.3-10.3 mg/cm^2 Resulting dermal contact: up to 11,000 mg Routine contact, 2 hands, liquids Surface area: 1,070 cm^2 Amount retained on skin: 0.7-2.1 mg/cm^2 Resulting dermal contact: up to 2,200 mg Incidental contact, 2 hands, liquids Surface area: 1,070 cm^2 Amount retained on skin: 0.7-2.1 mg/cm^2 Resulting dermal contact: up to 2,200 mg Incidental contact, 1 hand, liquids Surface area: 535 cm^2 Amount retained on skin: 0.7-2.1 mg/cm^2 Resulting dermal contact: up to 1,100 mg			
<b>EVALUATION</b>				
Domain	Metric	Rating	Comments	
Domain 1: Reliability	Metric 1:	Methodology	High	Document published by EPA CEB.
Domain 2: Representativeness	Metric 2:	Geographic Scope	High	Data are from the U.S.
	Metric 3:	Applicability	High	Data are applicable to all COUs involving dermal contact.
	Metric 4:	Temporal Representativeness	Medium	Report is based on data greater than 10 years old but no more than 20 years old and industry conditions that are expected to be representative of current industry conditions.
	Metric 5:	Sample Size	N/A	N/A - Document describes general dermal exposure parameters. Sample size is not applicable.
Domain 3: Accessibility/ Clarity	Metric 6:	Metadata Completeness	High	All data sources, methods, results, and assumptions are clearly documented.
Domain 4: Variability and Uncertainty	Metric 7:	Metadata Completeness	Medium	Variability addressed by describing dermal exposure parameters for different exposure scenarios but uncertainty is not addressed.
<b>Overall Quality Determination</b>			<b>High</b>	

# Occupational Exposure

<b>Study Citation:</b>	U.S. EPA, (2003). Transportation equipment cleaning - Generic scenario for estimating occupational exposures and environmental releases (draft).			
<b>HERO ID:</b>	6385708			
<b>Conditions of Use:</b>	Manufacturing, import and repackaging, formulation into fragrance oils, and formulation into products			
<b>EXTRACTION</b>				
<b>Parameter</b>	<b>Data</b>			
Worker activity description:	Heel removal - The greatest potential for worker exposure to materials last transported occurs during heel removal; Some tanks require manual cleaning with scouring pads, shovels, or razor blades to remove residual materials.; Tank washing is typically performed using one of two methods: (1) low-or-high-pressure spinner nozzles, or (2) hand-held wands and nozzles. After cleaning, tanks may be dried by applying ambient or heated air using a blower. Cleaning personnel may enter and inspect tank interiors and perform manual cleaning as required. Valves and fittings may be removed and cleaned by hand.			
Exposure duration:	Operating cycles range from rinse bursts of a few seconds to detergent or caustic washes of 20 minutes or longer for caked or crystallized residues.; 1.5 hours total duration for cleaning, visual inspection and any manual cleaning of tank trucks; On average, tank trucks, IBCs, or intermodal tank containers requires two hours for cleaning.			
Personal protective equipment:	during heel removal, facility personnel typically wear coveralls, safety shoes, protective glasses, and protective gloves during tank cleaning operations.			
<b>EVALUATION</b>				
Domain	Metric	Rating	Comments	
Domain 1: Reliability	Metric 1: Methodology	High	Report uses high quality data reported by EPA from industrial surveys.	
Domain 2: Representativeness	Metric 2: Geographic Scope	High	Data are from the U.S.	
	Metric 3: Applicability	Medium	Data are for transport container cleaning, which is a worker activity/release point included in the in-scope occupational scenario of Manufacturing, import and repackaging, formulation into fragrance oils, and formulation into products.	
	Metric 4: Temporal Representativeness	Low	Report is based on data greater than 20 years old and industry conditions that are expected to be outdated (1994).	
	Metric 5: Sample Size	Low	Sample distribution is described qualitatively.	
Domain 3: Accessibility/ Clarity	Metric 6: Metadata Completeness	Medium	Methods, results, and assumptions are clearly documented, but underlying data sources are not fully transparent.	
Domain 4: Variability and Uncertainty	Metric 7: Metadata Completeness	High	Uncertainty is addressed by statements throughout the source. Variability addressed by using multiple sources and describing multiple processes.	
<b>Overall Quality Determination</b>		<b>Medium</b>		

<b>Study Citation:</b>	Wei, W., Boumier, J., Wyart, G., Ramalho, O., Mandin, C. (2016). Cleaning practices and cleaning products in nurseries and schools: to what extent can they impact indoor air quality?. Indoor Air 26(4):517-525.
<b>HERO ID:</b>	3401413
<b>Conditions of Use:</b>	Use of spray Cleaning Products

EXTRACTION	
Parameter	Data
Worker activity description:	The report provides HHCB-specific data on cleaning product used to clean floors at nurseries. In general, provides data comprised of cleaning frequencies, e.g. times per day, week or month; cleaning periods, e.g. morning, evening, or between classes; cleaning techniques, e.g. dry or wet mopping; ventilation through opening of windows, i.e. during cleaning, after, or no ventilation.
Physical form:	sprays,
Exposure frequency:	Every day for HHCB identified product but in general cleaning frequencies varied among objects and locations. The furniture and floors were cleaned every day in more than 63% of locations, whereas beds or mattresses were typically cleaned once per week. Windows and toys were cleaned in a wide variety of frequencies, such as every day, once per week, or once per year (Table 1). In nurseries, cleaning was performed more intensively, i.e. two or three times per day for the floor (3% of the nurseries) and windows (1%), four times per day for toys (2%), and six times per day for furniture (1%).

EVALUATION				
Domain	Metric		Rating	Comments
Domain 1: Reliability	Metric 1:	Methodology	High	Report uses high quality data from frequently-used sources.
Domain 2: Representativeness	Metric 2:	Geographic Scope	Medium	Data are from France, an OECD country.
	Metric 3:	Applicability	High	Data are for use of cleaning products, an in-scope occupational scenario.
	Metric 4:	Temporal Representativeness	Medium	Report is based on data greater than 10 years old but no more than 20 years old and industry conditions that are expected to be representative of current industry conditions.
	Metric 5:	Sample Size	High	Statistical distribution of samples is fully characterized (discrete sampling data provided).
Domain 3: Accessibility/ Clarity	Metric 6:	Metadata Completeness	Medium	Assessment or report clearly documents results, methods, and assumptions. Data sources are generally described but not fully transparent.
Domain 4: Variability and Uncertainty	Metric 7:	Metadata Completeness	Medium	The report provides only limited discussion of the variability and uncertainty in the results.

<b>Overall Quality Determination</b>	<b>High</b>
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<b>Study Citation:</b>	AS., COWI (2018). Screening programme 2017: Suspected PBT compounds.			
<b>HERO ID:</b>	7303021			
<b>Conditions of Use:</b>	Disposal			
<b>EXTRACTION</b>				
<b>Parameter</b>	<b>Data</b>			
Description of release source:	WWTPs, landfills, sludge			
Release quantity:	WWTP: 1 000 ng/L - 40 000 ng/L; Landfill: 1600 ng/L - 35000 ng/L; sludge: 6800-14000 ng/g			
Waste treatment methods and pollution control:	Wastewater is treated mechanically, chemically and biologically (nitrogen removal) before being discharged; landfill pre-treats the run-off water in two ABR-reactors before it discharges to the municipal sewer system			
<b>EVALUATION</b>				
Domain	Metric	Rating	Comments	
Domain 1: Reliability	Metric 1:	Methodology	High	Report uses high quality methods from frequently-used sources (International Environmental Agencies).
Domain 2: Representativeness	Metric 2:	Geographic Scope	Medium	Data are from Norway, an OECD country.
	Metric 3:	Applicability	High	Data are for Disposal, an in-scope occupational scenario.
	Metric 4:	Temporal Representativeness	High	Report is based on current industry conditions and data no more than 10 years old. 2017
	Metric 5:	Sample Size	High	Statistical distribution of samples is fully characterized (discrete sampling data provided).
Domain 3: Accessibility/ Clarity	Metric 6:	Metadata Completeness	High	All data sources, methods, results, and assumptions are clearly documented.
Domain 4: Variability and Uncertainty	Metric 7:	Metadata Completeness	High	Uncertainty is addressed by explanation throughout. Variability addressed by multiple locations and multiple sampling times.
<b>Overall Quality Determination</b>			<b>High</b>	

<b>Study Citation:</b>	Balk, F., Ford, R. A. (1999). Environmental risk assessment for the polycyclic musks AHTN and HHCB in the EU. I. Fate and exposure assessment. Toxicology Letters 111(1-2):57-79.
<b>HERO ID:</b>	5349126
<b>Conditions of Use:</b>	Disposal; use in laundry products

**EXTRACTION**

Parameter	Data
Description of release source:	for use in cleaning/washing agents and cosmetics it may be conservatively assumed that the entire use volume is disposed of down the drain
Release quantity:	Influent to STPs [ug/l]: 7 sites in Germany, Ruhr - mean 1.5; 9 sites in The Netherlands - median 6.4, max. 14.5; USA - 13.6 Effluent from STPs [ug/l]: 21 sites in Germany, Ruhr - median 1.9, 90-perc.2.3; 8 sites in The Netherlands - median 1.9, max. 1.6; 3 sites in The Netherlands - mean 0.23, max. 0.29; 17 sites in Switzerland - median 2.3, 90-perc. 4.7; USA - 1.2

**EVALUATION**

Domain	Metric	Rating	Comments
Domain 1: Reliability			
	Metric 1: Methodology	Low	Methodology is not specified.
Domain 2: Representativeness			
	Metric 2: Geographic Scope	Medium	Data are from Germany and The Netherlands, which are both OECD countries.
	Metric 3: Applicability	Medium	The release data are for an occupational scenario (disposal) within the scope but the type of release data (influent/effluent of WWTP) may be covered under fate and transport data/information. The data may be useful for occupational purposes.
	Metric 4: Temporal Representativeness	Low	Data are greater than 20 years old (1994; 1995; 1998; 1999)
	Metric 5: Sample Size	Medium	Sample distribution characterized by limited statistics (median, max, mean) but discrete samples not provided and distribution not fully characterized.
Domain 3: Accessibility/ Clarity			
	Metric 6: Metadata Completeness	Low	Release media provided but no other metadata.
Domain 4: Variability and Uncertainty			
	Metric 7: Metadata Completeness	Medium	Variability is addressed by different effluent concentrations from different countries, and limited discussion of uncertainty.

**Overall Quality Determination****Low**

<b>Study Citation:</b>	Berding, V., Koormann, F., Schwartz, S., Wagner, J. O., Matthies, M. (2001). Spatial refinement of regional exposure assessment. NATO Science Series IV Earth and Environmental Sciences 2:205-222.			
<b>HERO ID:</b>	5428645			
<b>Conditions of Use:</b>	Wastewater treatment			
EXTRACTION				
<b>Parameter</b>	<b>Data</b>			
Waste treatment methods and pollution control:	94% elimination by WWTP; 1.93x10-3 l/h removal rate			
EVALUATION				
Domain	Metric	Rating	Comments	
Domain 1: Reliability	Metric 1:	Methodology	High	Methodology is known and expected to be accurate and cover all release sources at the site.
Domain 2: Representativeness	Metric 2:	Geographic Scope	Medium	Data are from Germany, an OECD country.
	Metric 3:	Applicability	Uninformative	Data are for wastewater treatment plants which is covered by fate and therefore not in-scope or similar to an in-scope occupational scenario.
	Metric 4:	Temporal Representativeness	Low	Data are greater than 20 years old.
	Metric 5:	Sample Size	Medium	Sample distribution characterized by limited statistics (e.g., mean]) but discrete samples not provided and distribution not fully characterized.
Domain 3: Accessibility/ Clarity	Metric 6:	Metadata Completeness	Medium	Release data include most critical metadata, including release media and release frequency, but lacks additional metadata, such as process, unit operation, and/or activity that is the source ofthe release.
Domain 4: Variability and Uncertainty	Metric 7:	Metadata Completeness	Low	Variability and uncertainty are not addressed.
Overall Quality Determination		Uninformative		

<b>Study Citation:</b>	Consulting,, Integral (2021). Analysis of monitoring data for HHCB in surface waters of the United States from 2015 to 2021.
<b>HERO ID:</b>	8729831
<b>Conditions of Use:</b>	Disposal

**EXTRACTION**

Parameter	Data
Description of release source:	wastewater treatment plant effluent
Release quantity:	Concentrations in the Virginia WWTP effluent range from 0.9 to 1.78 $\mu\text{g/L}$ . samples collected contemporaneously over seven periods during 2015 and 2016 upstream and downstream of the outfall find HHCB is not detected ( $<0.04 \mu\text{g/L}$ ); Samples collected contemporaneously over nine periods from 2015 through 2019 adjacent to the Moab, UT WWTP outfall find HHCB is not detected ( $<0.04 \mu\text{g/L}$ ) or detected at very low levels (0.01–0.09 $\mu\text{g/L}$ ) but concentrations in the WWTP effluent (at the outfall) range from 0.33 to 1.98 $\mu\text{g/L}$ .
Waste treatment methods and pollution control:	EPA observed that HHCB removal by wastewater treatment is usually $>80\%$ .

**EVALUATION**

Domain	Metric	Rating	Comments
Domain 1: Reliability	Metric 1: Methodology	Medium	Methodology is known and expected to be accurate but may not cover all release sources at the site.
Domain 2: Representativeness	Metric 2: Geographic Scope	High	Data are from the U.S.
	Metric 3: Applicability	High	Data are for Disposal through a WWTP, an in-scope occupational scenario.
	Metric 4: Temporal Representativeness	High	Data are no more than 10 years old (2015-2019)
	Metric 5: Sample Size	Medium	Sample distribution characterized by limited statistics (e.g., min, max) but discrete samples not provided and distribution not fully characterized.
Domain 3: Accessibility/ Clarity	Metric 6: Metadata Completeness	Low	Release media provided but no other metadata.
Domain 4: Variability and Uncertainty	Metric 7: Metadata Completeness	Medium	Variability addressed by samples collected at multiple sites and on multiple visits to the same site, but uncertainty is not addressed.

**Overall Quality Determination****Medium**

<b>Study Citation:</b>	FCA, (2021). Site emission survey of fragrance formulation compounders and product manufacturers using HHCB: Information to support the TSCA risk evaluation; with comment, dated 08/05/2021.
<b>HERO ID:</b>	8802195
<b>Conditions of Use:</b>	Compounding of Fragrance Oils, Formulation of Liquid/Powder Products

**EXTRACTION**

Parameter	Data
Release or emission factors:	p. 21 Container cleaning: The FMA study also measured residuals of fragrance ingredients and found the 95th percentile values for pumping and pouring scenarios, respectively, to be roughly comparable: 0.572 and 0.530 percent. Residuals ranged from 0.32 to 0.091 percent for one company (average: 0.1 percent) and from 0.08 to 0.07 percent for the other (average: 0.07 percent). The latter company also measured residuals in containers, at 0.08 percent, for a combined total of 0.15 percent. p. 22 Cleaning process vessels: The values measured by respondents to this survey discussed in this report (between 0.00 and 0.53 percent) are consistent with the RIFM findings.
Release frequency:	Number of working days: 240–365 (p. 19)
Waste treatment methods and pollution control:	p. 2013/16 responders indicated wastewater is treated on-site. 9 responders stated chemical treatment was used; 1 said physical-chemical; 1 said secondary; 1 said tertiary. additional information: • pH adjustment + defoamer addition (1 response) • Flocculant with two stage filtration (1 response) • Aerobic biological, filtration, nutrient removal (1 response) • Remove residual chlorine, ph adjust., defoamer (5 responses) • Sequencing batch reactor (1 response) • NR (8 responses) Q: Is wastewater discharged to an off-response wastewater treatment facility? A: Yes - 12; No - 3; NR - 2 Q: What level of treatment is employed? A: Chemical - 1; Physical-chemical - 5; Secondary/tertiary - 2; N/A or NR - 7

**EVALUATION**

Domain	Metric	Rating	Comments
Domain 1: Reliability	Metric 1: Methodology	Low	The release data is provided by company but methodology for estimation is not specified for all of the data. Some sites used the worst case estimate based on annual consumption.
Domain 2: Representativeness	Metric 2: Geographic Scope	High	The data are from the United States and are representative of the industry being evaluated.
	Metric 3: Applicability	High	The release data are for an occupational scenario within the scope of the risk evaluation.
	Metric 4: Temporal Representativeness	High	The operations, equipment, and worker activities associated with the data indicate that the data should be representative of current operations, equipment, and activities. The data are generally no more than 10 years old.
	Metric 5: Sample Size	Low	Statistical distribution of samples is fully characterized. Sample size is not sufficiently representative for all questions.
Domain 3: Accessibility/ Clarity	Metric 6: Metadata Completeness	Medium	Release data include most critical metadata, including release media and activity of release, but lacks additional metadata, such as release frequency.
Domain 4: Variability and Uncertainty	Metric 7: Metadata Completeness	Medium	The release data study provides only limited discussion of the variability in the determinants of release. The release data study provides only limited discussion of the uncertainty in the release results.

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HHCB

Environmental Releases

HERO ID: 8802195 Table: 1 of 1

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Study Citation:	FCA, (2021). Site emission survey of fragrance formulation compounders and product manufacturers using HHCB: Information to support the TSCA risk evaluation; with comment, dated 08/05/2021.
HERO ID:	8802195
Conditions of Use:	Compounding of Fragrance Oils, Formulation of Liquid/Powder Products

		EVALUATION	
Domain	Metric	Rating	Comments

Overall Quality Determination	Medium
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<b>Study Citation:</b>	Milbrandt, A., Coney, K., Badgett, A., Beckham, G. T. (2022). Quantification and evaluation of plastic waste in the United States. Resources, Conservation and Recycling 183:106363.			
<b>HERO ID:</b>	11360398			
<b>Conditions of Use:</b>	Disposal			
EXTRACTION				
Parameter		Data		
Release quantity:		PDF PG. 4 "We estimate approximately 44 million tons (Mt) of plastic waste was managed through landfilling, combustion, and recycling in 2019."		
Waste treatment methods and pollution control:		PDF Pg. 1"Of the estimated 44 Mt of plastic waste managed in 2019 domestically, approximately 86% was landfilled, 9% was combusted, and 5% was recycled."		
EVALUATION				
Domain	Metric	Rating	Comments	
Domain 1: Reliability	Metric 1:	Methodology	Medium	Methodology is known and expected to be accurate but may not cover all release sources at the site.
Domain 2: Representativeness	Metric 2:	Geographic Scope	High	Data are from the U.S.
	Metric 3:	Applicability	Medium	Data are for disposal, an in-scope occupational scenario; however, the data are not chemical specific.
	Metric 4:	Temporal Representativeness	High	Data are no more than 10 years old.
	Metric 5:	Sample Size	Medium	Distribution of samples is characterized by a range with uncertain statistics. It is unclear if analysis is representative.
Domain 3: Accessibility/ Clarity	Metric 6:	Metadata Completeness	Low	Release media provided but no other metadata.
Domain 4: Variability and Uncertainty	Metric 7:	Metadata Completeness	Medium	Variability addressed by discussing multiple plastic waste types, but uncertainty is not addressed.
Overall Quality Determination		Medium		

<b>Study Citation:</b>	Nazaroff, W. W., Coleman, B. K., Destailats, H., Hodgson, A. T., Liu, D.,-L, Lunden, M. M., Singer, B. C., Weschler, C. J. (2006). Indoor air chemistry: Cleaning agents, ozone and toxic air contaminants.			
<b>HERO ID:</b>	4682850			
<b>Conditions of Use:</b>	Use of Liquid Cleaning Product			
EXTRACTION				
<b>Parameter</b>	<b>Data</b>			
Release quantity:	p. 43 Table 2.1General purpose cleaners: 7.4 tonnes/day of VOC emissionsAir fresheners: 7.5 tonnes/day			
EVALUATION				
Domain	Metric		Rating	Comments
Domain 1: Reliability	Metric 1:	Methodology	High	The release data methodology is known or expected to be accurate and is known to cover all release sources at the site, CARB data.
Domain 2: Representativeness	Metric 2:	Geographic Scope	High	The data are from the United States and are representative of the industry being evaluated.
	Metric 3:	Applicability	Low	The release data combines releases from household and commercial cleaning products, and is not specific to HHCB
	Metric 4:	Temporal Representativeness	Medium	The release data are more than 10 years but no more than 20 years old. However, operations, equipment, and worker activities are expected to be reasonably representative of current conditions.
	Metric 5:	Sample Size	Low	Distribution of samples is qualitative or characterized by no statistics (whole industry).
Domain 3: Accessibility/ Clarity	Metric 6:	Metadata Completeness	Low	Release data include release media but no other metadata.
Domain 4: Variability and Uncertainty	Metric 7:	Metadata Completeness	Low	The release data study does not address variability or uncertainty.
Overall Quality Determination			Low	



<b>Study Citation:</b>	RIVM, (1997). Environmental risk assessment of the polycyclic musks AHTN and HHCB according to the EU-TGD.			
<b>HERO ID:</b>	5349388			
<b>Conditions of Use:</b>	Fragrance Oils			
<b>EXTRACTION</b>				
<b>Parameter</b>	<b>Data</b>			
Release quantity:	PDF Pg. 25 Daily Per Capita Release to Water11.1 mg/day - 33.3 mg/day			
<b>EVALUATION</b>				
Domain	Metric		Rating	Comments
Domain 1: Reliability	Metric 1:	Methodology	Low	Methodology is general and assumes a 100% release scenario.
Domain 2: Representativeness	Metric 2:	Geographic Scope	Medium	Data are from the Netherlands, an OECD country.
	Metric 3:	Applicability	High	Data are for fragrance oils, an in-scope occupational scenario.
	Metric 4:	Temporal Representativeness	Low	Data are greater than 20 years old.
	Metric 5:	Sample Size	Medium	Sample distribution characterized by limited statistics (min, max) but discrete samples not provided and distribution not fully characterized.
Domain 3: Accessibility/ Clarity	Metric 6:	Metadata Completeness	Medium	Release media and release frequency provided but missing emission factors.
Domain 4: Variability and Uncertainty	Metric 7:	Metadata Completeness	Medium	Variability addressed by giving a range of releases/day, but uncertainty is not addressed.
<b>Overall Quality Determination</b>			<b>Medium</b>	

<b>Study Citation:</b>	U.S. EPA, (2024). Toxics Release Inventory (TRI) data: 1,3,4,6,7,8-Hexahydro-4,6,6,7,8,8-hexamethylcyclopenta-g-2- benzopyran (HHCB), reporting year 2023.			
<b>HERO ID:</b>	13027717			
<b>Conditions of Use:</b>	All			
<b>EXTRACTION</b>				
<b>Parameter</b>	<b>Data</b>			
Release quantity:	Provides the media of release.			
Release or emission factors:	Provides release data.			
Waste treatment methods and pollution control:	Provides the waste treatment done on-site or transferred off-site.			
<b>EVALUATION</b>				
Domain	Metric	Rating	Comments	
Domain 1: Reliability	Metric 1:	Methodology	Medium	Submitters report a methodology from a drop down list but the available methods are not fully clear. Source should cover all release sources and release media.
Domain 2: Representativeness	Metric 2:	Geographic Scope	High	TRI is U.S. based data
	Metric 3:	Applicability	High	TRI includes industries included in the scopes of this chemical
	Metric 4:	Temporal Representativeness	High	TRI data are from 2023
	Metric 5:	Sample Size	Medium	Varies, submitters can specify ranges or actual values. The data used to generate the annual release amounts is not required.
Domain 3: Accessibility/ Clarity	Metric 6:	Metadata Completeness	Low	TRI includes release media but lacks release frequency, and additional metadata, such as process, unit operation, and/or activity that is the source of the release.
Domain 4: Variability and Uncertainty	Metric 7:	Metadata Completeness	Low	TRI does not address variability or uncertainty in submitter provided data.
<b>Overall Quality Determination</b>		<b>Medium</b>		

<b>Study Citation:</b>	U.S. EPA, (1995). AP-42: Compilation of air pollutant emission factors. Volume I: Stationary point and area sources, fifth edition.
<b>HERO ID:</b>	46492
<b>Conditions of Use:</b>	Disposal; Plastic Converting; Plastic Compounding; Rubber Additives; Laundry Detergents and Related Laundry Products; Manufacturing; Import and Repackaging; Formulation of Fragrance Oils, Liquid Products, and Powder Products

**EXTRACTION**

Parameter	Data
Description of release source:	Disposal: solid-waste combustion and sewage sludge incineration releases from the furnace stack, landfill gas is released over the area of the waste treatment area, and VOCs are released at the liquid surface from any of the collection, storage or treatment tanks. Plastics: describes process units and identifies tanks or streams with emissions; Laundry Detergents and Related Laundry Products: releases primarily from exhaust air from detergent spray drying towers; Rubber Additives: Releases listed from the tail gases of multiple process units;
Release or emission factors:	Disposal: emission factors provided for release of particulate matter, metals, acid gases, CO, NOx and toxics for solid waste combustion in both kg/mg refuse combusted and lb/ton refuse combusted on pages 222-229; emission factors provided for release of particulate matter, metals, CO, NOx, Sox, and unburned hydrocarbons during incineration of sewage sludge in both kg/mg dry sludge burned and lb/ton dry sludge burned on pages 256-289; Provides equations to calculate uncontrolled release of methane and NMOCs and emission factors for uncontrolled landfill gas concentrations; Provides emission equations of VOCs from waste water treatment based on the design of the POTW; Plastics: Provides emission of VOC and particulate emissions from identified streams in all described plastic manufacturing processes as well as a sitewide estimate.; Laundry Detergents and Related Laundry Products: emission factors for dust particulates from spray drying detergents are provided in both kg/Mg product and lb/ton of product on page 749; Rubber Additives: Emission factors for release of VOCs during synthetic rubber production processes are listed in g/kg product (page 779); chapter 7 (page 831) provides emission estimation equations from organic liquid storage tanks; chapter 4.8 (page 591) provides emission factors for particulates, NOx, VOCs, and multiple specific chemicals during rail tank car cleaning, tank truck cleaning, and drum burning
Waste treatment methods and pollution control:	Disposal: Multiple control technologies are described to limit emission from solid-waste combustion, sewage sludge incineration, waste water collection, storage, and treatment.; Plastics: Multiple control technologies are described to limit emission from manufacture of plastics; Laundry Detergents and Related Laundry Products: Emission control technologies are discussed to reduce particulate release from the spray drying process of laundry detergent manufacturing; Rubber Additives: Emission control technologies are discussed to reduce release of VOCs;

**EVALUATION**

Domain	Metric	Rating	Comments
Domain 1: Reliability	Metric 1:	Methodology	Medium
			Methodology is known and expected to be accurate but may not cover all release sources at the site.
Domain 2: Representativeness	Metric 2:	Geographic Scope	High
	Metric 3:	Applicability	Medium
	Metric 4:	Temporal Representativeness	Low
	Metric 5:	Sample Size	Low
Domain 3: Accessibility/ Clarity	Metric 6:	Metadata Completeness	High
			All metadata provided.
Domain 4: Variability and Uncertainty	Metric 7:	Metadata Completeness	High
			Uncertainty is addressed and variability addressed by consideration of multiple sites

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<b>Study Citation:</b>	U.S. EPA, (1995). AP-42: Compilation of air pollutant emission factors. Volume I: Stationary point and area sources, fifth edition.
<b>HERO ID:</b>	46492
<b>Conditions of Use:</b>	Disposal; Plastic Converting; Plastic Compounding; Rubber Additives; Laundry Detergents and Related Laundry Products; Manufacturing; Import and Repackaging; Formulation of Fragrance Oils, Liquid Products, and Powder Products

		EVALUATION	
Domain	Metric	Rating	Comments

<b>Overall Quality Determination</b>	<b>Medium</b>
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**Study Citation:** U.S. EPA, (2003). Transportation equipment cleaning - Generic scenario for estimating occupational exposures and environmental releases (draft).  
**HERO ID:** 6385708  
**Conditions of Use:** Manufacturing, import and repackaging, formulation into fragrance oils, and formulation into products

**EXTRACTION**

Parameter	Data
Description of release source:	tank heels, tank interior cleaning and rinsing
Release quantity:	Between 35 and 1,124 gallons of wastewater per tank were reportedly generated during tank truck cleaning, between 76 and 2,399 gallons of wastewater per tank during rail tank car cleaning, and between 3,000 and 30,000 gallons of wastewater per tank during tank barge cleaning. Wastewater is sent off-site for disposal or wastewater treatment.
Waste treatment methods and pollution control:	percentages listed for both Rail Car Cleaning Facilities and Tank Truck Cleaning Facilities using the following treatment technologies: No Treatment, Pretreatment, Primary Treatment, Secondary Treatment, and Advanced Treatment; Facilities that are primarily TEC facilities have wastewater treatment systems that typically include equalization, pH adjustment, physical settling, and oil/water separation. Most facilities discharge treated wastewater to a Publicly Owned Treatment Works (POTW). Facilities with very efficient treatment systems may discharge treated wastewater directly to surface waters.pg. 8 contains table of % of facilities using different Heel disposal methods.

**EVALUATION**

Domain	Metric	Rating	Comments
Domain 1: Reliability	Metric 1: Methodology	Medium	Methodology is known and expected to be accurate but may not cover all release sources at the site.
Domain 2: Representativeness	Metric 2: Geographic Scope	High	Data are from the U.S.
	Metric 3: Applicability	Medium	Data are for facilities that clean transport container cleaning, which is a worker activity/release point included in the in-scope occupational scenario of Manufacturing, import and repackaging, formulation into fragrance oils, and formulation into products.
	Metric 4: Temporal Representativeness	Low	Data are greater than 20 years old (1994).
	Metric 5: Sample Size	Medium	Sample distribution characterized by a range with uncertain statistics. Wastewater volume listed and disposal methods listed, but unsure how many facilities were considered in the data
Domain 3: Accessibility/ Clarity	Metric 6: Metadata Completeness	Medium	Release data include most critical metadata, including release media and release source, but lacks additional metadata, such as release frequency and duration.
Domain 4: Variability and Uncertainty	Metric 7: Metadata Completeness	High	Uncertainty is addressed by statements throughout the source. Variability addressed by listing information for multiple facilities.

**Overall Quality Determination**

**Medium**

<b>Study Citation:</b>	U.S. EPA, (2014). Use of additive in plastic compounding - generic scenario for estimating occupational exposures and environmental releases: Draft.			
<b>HERO ID:</b>	6385748			
<b>Conditions of Use:</b>	Processing; Plastics Compounding			
<b>EXTRACTION</b>				
<b>Parameter</b>	<b>Data</b>			
Description of release source:	Unloading containers, spillage, Container cleaning, dusts and fugitive emissions from compounding, equipment cleaning			
Release quantity:	Provides models for estimating various fugitive air releases			
Release or emission factors:	0.005 for loading/unloading of solid powders, 0.0001 for spillage, 0.03 for container residue, 0.0005 compounding, 0.02 equipment cleaning			
Release frequency:	148-264			
<b>EVALUATION</b>				
Domain	Metric		Rating	Comments
Domain 1: Reliability	Metric 1:	Methodology	High	Assessment uses high quality data/techniques/methods from frequently-used sources.
Domain 2: Representativeness	Metric 2:	Geographic Scope	High	This GS is based on U.S. data
	Metric 3:	Applicability	Medium	Data is for an in-scope occupational scenario; however, data is general and not specific to a chemical
	Metric 4:	Temporal Representativeness	Medium	Assessment is generally based on data greater than 10 years old but no more than 20 years old and industry conditions that are expected to be representative of current industry conditions.
	Metric 5:	Sample Size	Medium	Data characterized by a range with uncertain statistics.
Domain 3: Accessibility/ Clarity	Metric 6:	Metadata Completeness	High	All data sources, methods, results, and assumptions are clearly documented.
Domain 4: Variability and Uncertainty	Metric 7:	Metadata Completeness	Medium	Uncertainty not addressed. Variability addressed by considering multiple plastic types, and additive types
<b>Overall Quality Determination</b>			<b>High</b>	

<b>Study Citation:</b>	U.S. EPA, (1995). Chapter 6: Organic chemical process industry. Compilation of air pollutant emission factors. Volume I: Stationary point and area sources, fifth edition, AP-42.			
<b>HERO ID:</b>	7310513			
<b>Conditions of Use:</b>	Formulation into Laundry Detergents and Related Laundry Products			
EXTRACTION				
Parameter	Data			
Description of release source:	The exhaust air from detergent spray drying towers contains 2 types of air contaminants: (1) fine detergent particles and (2) organics vaporized in the higher temperature zones of the tower. Dust emissions are generated at scale hoppers, mixers, and crutchers during the batching and mixing offme dry ingredients to form slurry. Conveying, mixing, and packaging of detergent granules can also cause dust emissions. Pneumatic conveying of fine materials causes dust emissions when conveying air is separated from bulk solids. For this process, fabric filters are generally used, not only to reduce or to eliminate dust emissions, but also to recover raw materials. T			
Release or emission factors:	Particulate (kg/Mg): Uncontrolled, 45, cyclone, 7, cyclone with spray chamber, 3.5, cyclone with packed scrubber, 2.5, cyclone with venturi scrubber, 1.5, cyclone with wet scrubber, 0.544, cyclone with wet scrubber (ESP), 0.023, cyclone with packed scrubber (ESP), 0.47, fabric filter, 0.54			
Waste treatment methods and pollution control:	Efficiencies of pollution controls given			
EVALUATION				
Domain	Metric	Rating	Comments	
Domain 1: Reliability	Metric 1:	Methodology	Medium	The release data methodology is known or expected to be accurate but may not cover all release sources at the site.
Domain 2: Representativeness	Metric 2:	Geographic Scope	High	Data are from the U.S.
	Metric 3:	Applicability	Medium	Data are for the Manufacturing of Laundry Detergents and Related Laundry Products, which are in-scope occupational scenarios but releases are for total particulates release and not HHCB-specific
	Metric 4:	Temporal Representativeness	Low	Data are greater than 20 years old (1995)
	Metric 5:	Sample Size	Medium	Sample distribution characterized by limited statistics (e.g., min, max, mean) but discrete samples not provided and distribution not fully characterized.
Domain 3: Accessibility/ Clarity	Metric 6:	Metadata Completeness	Medium	Release media and emission factors provided but missing release frequency and duration.
Domain 4: Variability and Uncertainty	Metric 7:	Metadata Completeness	Low	Variability in different pollution controls is discussed but uncertainty are not addressed.
Overall Quality Determination		Medium		

<b>Study Citation:</b>	U.S. EPA, (1995). Chapter 6: Organic chemical process industry. Compilation of air pollutant emission factors. Volume I: Stationary point and area sources, fifth edition, AP-42.
<b>HERO ID:</b>	7310513
<b>Conditions of Use:</b>	Plastic Converting; Plastic Compounding;

**EXTRACTION**

Parameter	Data
Description of release source:	Plastics: describes process units and identifies tanks or streams with emissions;
Release or emission factors:	Plastics: Provides emission of VOC and particulate emissions from identified streams in all described plastic manufacturing processes as well as a sitewide estimate.;
Waste treatment methods and pollution control:	Plastics: Multiple control technologies are described to limit emission from manufacture of plastics;

**EVALUATION**

Domain	Metric	Rating	Comments
Domain 1: Reliability	Metric 1: Methodology	High	Methodology is known and expected to be accurate and cover all release sources at the site.
Domain 2: Representativeness	Metric 2: Geographic Scope	High	Data are from the U.S.
	Metric 3: Applicability	Medium	Data are for Plastic Converting, Plastic Compounding, which are in-scope occupational scenarios; however, data is general and not specific to a chemical
	Metric 4: Temporal Representativeness	Low	Data are greater than 20 years old (1995).
	Metric 5: Sample Size	Medium	Sample distribution characterized by limited statistics (e.g., min, max, mean) but discrete samples not provided and distribution not fully characterized.
Domain 3: Accessibility/ Clarity	Metric 6: Metadata Completeness	Medium	Release media and emission factors provided but missing release frequency and duration.
Domain 4: Variability and Uncertainty	Metric 7: Metadata Completeness	Low	Variability and uncertainty are not addressed.

**Overall Quality Determination****Medium**



<b>Study Citation:</b>	U.S. EPA, (1995). Chapter 6: Organic chemical process industry. Compilation of air pollutant emission factors. Volume I: Stationary point and area sources, fifth edition, AP-42.			
<b>HERO ID:</b>	7310513			
<b>Conditions of Use:</b>	Rubber Additives;			
<b>EXTRACTION</b>				
<b>Parameter</b>	<b>Data</b>			
Description of release source:	Rubber Additives: Releases listed from the tail gases of multiple process units;			
Release or emission factors:	Rubber Additives: Emission factors for release of VOCs during synthetic rubber production processes are listed in g/kg product (page 779)			
Waste treatment methods and pollution control:	Rubber Additives: Emission control technologies are discussed to reduce release of VOCs			
<b>EVALUATION</b>				
Domain	Metric	Rating		Comments
Domain 1: Reliability	Metric 1:	Methodology	High	Methodology is known and expected to be accurate and cover all release sources at the site.
Domain 2: Representativeness	Metric 2:	Geographic Scope	High	Data are from the U.S.
	Metric 3:	Applicability	Medium	Data are for Rubber Additives, which are in-scope occupational scenarios; however, data is general and not specific to a chemical
	Metric 4:	Temporal Representativeness	Low	Data are greater than 20 years old (1995).
	Metric 5:	Sample Size	Medium	Sample distribution characterized by limited statistics (e.g., min, max, mean) but discrete samples not provided and distribution not fully characterized.
Domain 3: Accessibility/ Clarity	Metric 6:	Metadata Completeness	Medium	Release media and emission factors provided but missing release frequency and duration.
Domain 4: Variability and Uncertainty	Metric 7:	Metadata Completeness	Low	Variability and uncertainty are not addressed.
<b>Overall Quality Determination</b>		<b>Medium</b>		

<b>Study Citation:</b>	Upadhyay, N., Sun, Q., Allen, J. O., Westerhoff, P., Herckes, P. (2011). Synthetic musk emissions from wastewater aeration basins. Water Research 45(3):1071-1078.
<b>HERO ID:</b>	1970730
<b>Conditions of Use:</b>	Disposal

#### EXTRACTION

Parameter	Data
Description of release source:	POTW - aeration basin; In aeration basins, air is bubbled through wastewater using submerged diffusers to deliver oxygen to aerobic bacteria that degrade organics and oxidize nitrogen species. Volatile organics, many of which cause foul odors, are stripped from the water during aeration
Release quantity:	[ng/m3] Plant A: aeration chamber gas - 74585, 112455, 344306; Odor control unit gas - 79047, 95656, 91044; Plant B: aeration chamber gas- 14610, 17223, 6704; Off-site gas: 282, 429, 674;
Waste treatment methods and pollution control:	odor control unit used a plant A did not appeared to be efficient at HHCb removal

#### EVALUATION

Domain	Metric	Rating	Comments
Domain 1: Reliability	Metric 1: Methodology	Medium	The sample methodology is described but the identities of the plant were not disclosed
Domain 2: Representativeness	Metric 2: Geographic Scope	High	Data from U.S.
	Metric 3: Applicability	High	The release data are for an occupational scenario within the scope of the risk evaluation.
	Metric 4: Temporal Representativeness	Medium	Release data more than 10 years old.
	Metric 5: Sample Size	High	sample data fully characterized
Domain 3: Accessibility/ Clarity	Metric 6: Metadata Completeness	High	Release data include all associated metadata, including release media; process, unit operation, or activity that is the source of the release
Domain 4: Variability and Uncertainty	Metric 7: Metadata Completeness	High	Discusses uncertainty of samples and variability (multiple dates and plants)

### Overall Quality Determination

High

<b>Study Citation:</b>	ERG, (1998). Air emissions inventories, volume 2: Point sources: Chapter 11: Preferred and alternative methods for estimating air emissions from plastic products manufacturing.			
<b>HERO ID:</b>	7349020			
<b>Conditions of Use:</b>	Plastics compounding; plastics converting			
EXTRACTION				
<b>Parameter</b>	<b>Data</b>			
Description of release source:	The primary sources of emissions at plastic products manufacturing facilities are the pieces of equipment (e.g., extruder hopper, die head, sander) used to handle raw materials and produce the final product. Emission sources from secondary processes include storage tanks, equipment leaks, wastewater treatment, combustion sources, and cleaning and surface coating operations.			
Release or emission factors:	Provides models for estimating various fugitive air releases			
Waste treatment methods and pollution control:	Emissions from plastic products manufacturing may be reduced either through process modifications or by using add-on control devices. incineration, adsorption, absorption, or condensation; PM emissions generated from finishing operations, including cutting and grinding, are typically controlled by cyclones or fabric filters.			
EVALUATION				
Domain	Metric	Rating	Comments	
Domain 1: Reliability	Metric 1:	Methodology	High	Assessment uses high quality data/techniques/methods developed by EPA.
Domain 2: Representativeness	Metric 2:	Geographic Scope	High	Data are from the U.S.
	Metric 3:	Applicability	Medium	Data are for plastic converting and compounding, which are in-scope occupational scenarios; however, data is general and not specific to a chemical.
	Metric 4:	Temporal Representativeness	Low	Assessment is based on data greater than 20 years old and industry conditions that are expected to be outdated (1998 or older)
Domain 3: Accessibility/ Clarity	Metric 5:	Metadata Completeness	Low	The model documentation describes the approach and parameters, but the selection of parameter values are not provided.
Domain 4: Variability and Uncertainty	Metric 6:	Metadata Completeness	Low	Uncertainty not addressed. Variability is not addressed as parameter values are not selected.
Overall Quality Determination		Medium		

<b>Study Citation:</b>	OECD, (2011). Emission scenario document on the chemicals used in water-based washing operations at industrial and institutional laundries.
<b>HERO ID:</b>	6387321
<b>Conditions of Use:</b>	Commercial Use – Laundry and Dishwashing Products - Laundry Detergent (Liquid); Laundry Detergent (Unit Dose/Granule); Fabric Enhancers; Stain Removers; Dry Cleaning and Associated Products; Dishwashing Detergent (Liquid/ Gel); Dishwashing Detergent (Unit Dose/ Granule); Dishwashing Detergent Liquid (Hand-Wash)

**EXTRACTION**

Parameter	Data
Description of release source:	container cleaning, unloading, cleaning operations
Release or emission factors:	Container cleaning: 0.2% (bulk liquids); 0.6% (small containers for liquids); 3% (drums for liquids); 1% (solids)unloading: 0.5% (solids)
Release frequency:	20-365 days/yr
Waste treatment methods and pollution control:	incineration; collection or settling basins, screens, pH equalization/neutralization, air flotation, clarification, media filtration, sludge dewatering, oil/water separation

**EVALUATION**

Domain	Metric	Rating	Comments
Domain 1: Reliability	Metric 1: Methodology	High	Assessment uses high quality data/techniques/methods from frequently-used sources.
Domain 2: Representativeness	Metric 2: Geographic Scope	High	This ESD was developed by EPA based on U.S. data
	Metric 3: Applicability	Medium	Data is for an in-scope occupational scenario; however, data is general and not specific to a chemical.
	Metric 4: Temporal Representativeness	Low	Assessment is based on data greater than 20 years old.
Domain 3: Accessibility/ Clarity	Metric 5: Metadata Completeness	Medium	Sample distribution characterized by limited statistics (min,max, mean, median, and 90th percentile) but discrete samples not provided and distribution not fully characterized.
Domain 4: Variability and Uncertainty	Metric 6: Metadata Completeness	High	All data sources, methods, results, and assumptions are clearly documented.

**Overall Quality Determination****Medium**

<b>Study Citation:</b>	Schwartz, S., Berding, V., Matthies, M. (2000). Aquatic fate assessment of the polycyclic musk fragrance HHCB - Scenario and variability analysis in accordance with the EU risk assessment guidelines. Chemosphere 41(5):671-679.			
<b>HERO ID:</b>	5428093			
<b>Conditions of Use:</b>	Disposal			
EXTRACTION				
<b>Parameter</b>	<b>Data</b>			
Release quantity:	model estimations of sewage treatment plant effluent			
EVALUATION				
Domain	Metric	Rating	Comments	
Domain 1: Reliability	Metric 1:	Methodology	Medium	Model is free of mathematical errors but [assumption and/or parameter value] cause significant uncertainty in results.
Domain 2: Representativeness	Metric 2:	Geographic Scope	Medium	Data are from Germany, an OECD country.
	Metric 3:	Applicability	High	Model can be applied to disposal, an in-scope occupational scenario.
	Metric 4:	Temporal Representativeness	Low	Model is based on data greater than 20 years old and industry conditions that are expected to be outdated.
Domain 3: Accessibility/ Clarity	Metric 5:	Metadata Completeness	Low	Model approach and parameters described but the underlying equations and parameter values are not provided. Rationales for choice of approach and parameters are not provided.
Domain 4: Variability and Uncertainty	Metric 6:	Metadata Completeness	High	Uncertainty is addressed by uncertainties in parameter values or assumptions in model equations. Variability addressed by Monte Carlo simulation using distributions for input parameters.
Overall Quality Determination			Medium	

<b>Study Citation:</b>	ECB, (2008). European Union risk assessment report: 1,3,4,6,7,8-hexahydro-4,6,6,7,8,8-hexamethylcyclopenta- $\gamma$ -2-benzopyran (HHCB).
<b>HERO ID:</b>	5155574
<b>Conditions of Use:</b>	Manufacture

**EXTRACTION**

Parameter	Data
Description of release source:	1. Concentrated process water that is treated off-site; 2. Organic by-product streams are used as fuel in a combustion process on the site or sold to a third party; 3. Secondary washes during the production process, washing water from occasional cleaning of vessels or tanks and run-off water from the contained site is treated in the site's wastewater treatment plant (WWTP).
Release quantity:	The effluent flow of the WWTP is around 400 – 450 m3 per day; the average content of HHCB (total concentration) is 0.1 mg/l (maximum 0.2 mg/l). This implies that 40 – 45 g per day is lost. The effluent stream is treated in a local STP, designed for 28,135 i.e. and with a dry weather flow of 4,500 m3. The influent to the local STP is 45 g / 4500 m3 = 0.010 mg/l (max. 0.020 mg/l). The dilution factor of the effluent into the river is 3.7 (based on the 10-perc. low water flow).
Waste treatment methods and pollution control:	1. Concentrated process water that is treated off-site; 2. Organic by-product streams are used as fuel in a combustion process on the site or sold to a third party. The sludge produced on site in connection with the treatment of waste water is collected and incinerated.; 3. Secondary washes during the production process, washing water from occasional cleaning of vessels or tanks and run-off water from the contained site is treated in the site's wastewater treatment plant (WWTP).

**EVALUATION**

Domain	Metric	Rating	Comments	
Domain 1: Reliability	Metric 1:	Methodology	High	Assessment uses high quality data from frequently-used sources.
Domain 2: Representativeness	Metric 2:	Geographic Scope	Medium	Data are from The Netherlands, an OECD country.
	Metric 3:	Applicability	High	Data are for Manufacture, an in-scope occupational scenario.
	Metric 4:	Temporal Representativeness	Medium	Assessment is based on data greater than 10 years old but no more than 20 years old and industry conditions that are expected to be representative of current industry conditions.
	Metric 5:	Sample Size	Medium	Sample distribution characterized by limited statistics (e.g., calculates release based on range of PV) but discrete samples not provided and distribution not fully characterized. sludge volume not provided
Domain 3: Accessibility/ Clarity	Metric 6:	Metadata Completeness	Medium	Methods, results, and assumptions are clearly documented, but underlying data sources are not fully transparent.
Domain 4: Variability and Uncertainty	Metric 7:	Metadata Completeness	Low	Variability and uncertainty are not addressed.

**Overall Quality Determination****Medium**

<b>Study Citation:</b>	ECB, (2008). European Union risk assessment report: 1,3,4,6,7,8-hexahydro-4,6,6,7,8,8-hexamethylcyclopenta- $\gamma$ -2-benzopyran (HHCB).			
<b>HERO ID:</b>	5155574			
<b>Conditions of Use:</b>	Formulation of end products			
<b>EXTRACTION</b>				
<b>Parameter</b>	<b>Data</b>			
Release quantity:	The daily emission to water from a large formulator is 1427 ton . 0.035 / 345 d . 0.00017 = 0.0246 kg/d. This is released to the municipal STP; for a small formulator, the loss to the STP is 6135 kg . 0.002 / 250 d = 49 g/day.			
Release or emission factors:	the emission factor “washing liquid”6 for waste water is 0.0009 and air is 0.00002			
Comments:	Emission factors are from TGD			
<b>EVALUATION</b>				
Domain	Metric		Rating	Comments
Domain 1: Reliability	Metric 1:	Methodology	High	Assessment uses high quality [data/techniques/methods] from frequently-used sources.
Domain 2: Representativeness	Metric 2:	Geographic Scope	Medium	Data are from The Netherlands, an OECD country.
	Metric 3:	Applicability	High	Data are for formulation, an in-scope occupational scenario.
	Metric 4:	Temporal Representativeness	Medium	Assessment is based on data greater than 10 years old but no more than 20 years old and industry conditions that are expected to be representative of current industry conditions.
	Metric 5:	Sample Size	Medium	Sample distribution characterized by limited statistics (e.g., calculated release estimation based on use volume) but discrete samples not provided and distribution not fully characterized.
Domain 3: Accessibility/ Clarity	Metric 6:	Metadata Completeness	High	All data sources, methods, results, and assumptions are clearly documented.
Domain 4: Variability and Uncertainty	Metric 7:	Metadata Completeness	Low	Variability and uncertainty are not addressed.
<b>Overall Quality Determination</b>			<b>Medium</b>	

<b>Study Citation:</b>	ECB, (2008). 1,3,4,6,7,8-Hexahydro-4,6,6,7,8,8-hexamethylcyclopenta- $\gamma$ -2-benzopyran, (1,3,4,6,7,8-hexahydro-4,6,6,7,8,8-hexamethylin-deno[5,6-c]pyran - HHCB) summary risk assessment report.		
<b>HERO ID:</b>	8404084		
<b>Conditions of Use:</b>	Manufacture; Formulation into fragrance oils; formulation into liquid and powder products		
EXTRACTION			
<b>Parameter</b>	<b>Data</b>		
Description of release source:	source provides sitewide releases to water		
Release or emission factors:	source provides emission factors to water provided from facilities and generic scenarios		
Release frequency:	source provides number of working days per year for multiple facilities		
EVALUATION			
Domain	Metric	Rating	Comments
Domain 1: Reliability	Metric 1: Methodology	High	Assessment uses high quality methods that are from frequently-used sources (eu rar) and there are no known quality issues.
Domain 2: Representativeness	Metric 2: Geographic Scope	Medium	Data are from The Netherlands, an OECD country.
	Metric 3: Applicability	High	Data are for Manufacture, Formulation into fragrance oils, and formulation into liquid and powder products, which are in-scope scenarios
	Metric 4: Temporal Representativeness	Low	Assessment is based on data greater than 20 years old and industry conditions that are expected to be outdated.
	Metric 5: Sample Size	Medium	Sample distribution characterized by limited statistics but discrete samples not provided and distribution not fully characterized.
Domain 3: Accessibility/ Clarity	Metric 6: Metadata Completeness	Low	Assessment results are provided but underlying methods, assumptions, and data sources are not fully transparent.
Domain 4: Variability and Uncertainty	Metric 7: Metadata Completeness	Medium	Variability addressed by release data from multiple sites, but uncertainty is not addressed.
Overall Quality Determination		Medium	



<b>Study Citation:</b>	OECD, (2009). Emission scenario document on plastic additives.			
<b>HERO ID:</b>	5079084			
<b>Conditions of Use:</b>	Processing – Incorporation into Articles – Odor Agent in Plastics Material and Resin Manufacturing			
<b>EXTRACTION</b>				
<b>Parameter</b>	<b>Data</b>			
Release or emission factors:	Provides emission factors based on the type of additive and the type of process used for compounding and converting			
<b>EVALUATION</b>				
Domain	Metric		Rating	Comments
Domain 1: Reliability	Metric 1:	Methodology	High	Assessment uses high quality data/techniques/methods from frequently-used sources.
Domain 2: Representativeness	Metric 2:	Geographic Scope	Medium	This ESD was not developed by EPA, but another OECD-member country.
	Metric 3:	Applicability	Medium	Data are for multiple in-scope occupational scenarios; however, data is general and not specific to a chemical.
	Metric 4:	Temporal Representativeness	Low	Assessment from 2009 but is based on data greater than 20 years old.
	Metric 5:	Sample Size	Medium	Sample distribution characterized by a range with uncertain statistics.
Domain 3: Accessibility/ Clarity	Metric 6:	Metadata Completeness	High	All data sources, methods, results, and assumptions are clearly documented.
Domain 4: Variability and Uncertainty	Metric 7:	Metadata Completeness	Medium	Uncertainty not addressed. Variability addressed by considering prevalence of various processing methods, additive functions, and plastics.
<b>Overall Quality Determination</b>			<b>Medium</b>	

<b>Study Citation:</b>	OECD, (2009). Emission scenario document on plastic additives.			
<b>HERO ID:</b>	5079084			
<b>Conditions of Use:</b>	Consumer Use – Plastic and Rubber Articles			
<b>EXTRACTION</b>				
<b>Parameter</b>	<b>Data</b>			
Release or emission factors:	Emission factors provided for various additives based on measured and estimated values			
<b>EVALUATION</b>				
Domain	Metric		Rating	Comments
Domain 1: Reliability	Metric 1:	Methodology	High	Assessment uses high quality data/techniques/methods from frequently-used sources.
Domain 2: Representativeness	Metric 2:	Geographic Scope	Medium	This ESD was not developed by EPA, but another OECD-member country.
	Metric 3:	Applicability	Medium	Data are for multiple in-scope occupational scenarios; however, data is general and not specific to a chemical.
	Metric 4:	Temporal Representativeness	Low	Assessment from 2009 but is based on data greater than 20 years old.
	Metric 5:	Sample Size	Medium	Sample distribution characterized by a range with uncertain statistics.
Domain 3: Accessibility/ Clarity	Metric 6:	Metadata Completeness	High	All data sources, methods, results, and assumptions are clearly documented.
Domain 4: Variability and Uncertainty	Metric 7:	Metadata Completeness	Medium	Uncertainty not addressed. Variability addressed by considering prevalence of various processing methods, additive functions, and plastics.
<b>Overall Quality Determination</b>			<b>Medium</b>	

**Study Citation:** OECD, (2010). Emission scenario document on the blending of fragrance oils into commercial and consumer products.  
**HERO ID:** 6387319  
**Conditions of Use:** Processing into formulation

#### EXTRACTION

Parameter	Data
Description of release source:	Releases from: container residue, container cleaning, unloading the chemical, fugitive losses to air during operations, sampling residue, fugitive losses to air during sampling, equipment cleaning, fugitive losses to air during equipment cleaning, transfer operation losses from loading final product, and dust waste generated from conveying, mixing, and packaging powdered detergents. Release media: Water, Incineration, Fugitive Air, Stack Air, land
Release or emission factors:	Cites EPA/OPPT models; Includes appendix referencing a RIFM industry survey that includes 0.5% Container residue and information on container cleaning and info on equipment cleaning
Release frequency:	Includes appendix referencing a RIFM document which provided operating days of 345 days(large formulators) and 250(small formulators who formulate polycyclic musk into cleaning products), and 250-312 days for 8 formulators
Waste treatment methods and pollution control:	Includes appendix referencing a RIFM document which provided that some type of on-site treatment is generally utilized prior to discharge of wastewater. The WWTP removal ranges from 70-96%. However, there is insufficient details on the type of wastewater treatment for all product types

#### EVALUATION

Domain	Metric	Rating	Comments
Domain 1: Reliability	Metric 1: Methodology	High	The report uses high quality data and/or techniques that are from a frequently used source (e.g., EPA/OPPT models, NIOSH HHEs, Kirk-Othmer) and associated information does not indicate flaws or quality issues.
Domain 2: Representativeness	Metric 2: Geographic Scope	High	The data are from the United States and are representative of the industry being evaluated.
	Metric 3: Applicability	Medium	The assessment is for an occupational scenario(Processing into a formulation) within the scope of the risk evaluation; however, data is general and not specific to a chemical.
	Metric 4: Temporal Representativeness	Medium	The source is generally more than 10 years but no more than 20 years old.
	Metric 5: Sample Size	N/A	Models are used for release estimation
Domain 3: Accessibility/ Clarity	Metric 6: Metadata Completeness	High	Report clearly documents its data sources, assessment methods, results, and assumptions
Domain 4: Variability and Uncertainty	Metric 7: Metadata Completeness	High	The assessment addresses variability (e.g., different products) and uncertainty(e.g., data gaps/uncertainties section included) in the results. Uncertainty is well characterized.

### Overall Quality Determination

High

<b>Study Citation:</b>	OECD, (2009). Emission scenario document on transport and storage of chemicals.			
<b>HERO ID:</b>	6393282			
<b>Conditions of Use:</b>	Transportation and Storage			
<b>EXTRACTION</b>				
<b>Parameter</b>	<b>Data</b>			
Description of release source:	filling and emptying of containers, storage, pipelines, washing and cleaning, recycling and disposal of packaging			
Release or emission factors:	Filling/emptying: 0.05-70 kg/tonne 0.21-0.61% (solids) Storage (breathing losses): 0.01-13.1 kg/m3 storage capacity-yr Fugitive emissions from leaking seals, connectors and flanges: 0.01-1.67 g/h Storage of solids in open systems: 0.12-20 kg/tonne Container residuals: <1% (road tankers); 0.19-0.63% (rail tankers); 1% (drums); 0.3% (IBCs) Fugitive emissions during container cleaning: 1.07-311 g/container (road tanker); 0.3-2,350 g/ container (rail and ship tanker) Disposal: 0.01% (drums); 0.3% (IBCs); 0.0025-0.25 kg/bag (solids)			
<b>EVALUATION</b>				
Domain	Metric	Rating	Comments	
Domain 1: Reliability	Metric 1:	Methodology	High	Assessment uses high quality data/techniques/methods from frequently-used sources.
Domain 2: Representativeness	Metric 2:	Geographic Scope	Medium	This ESD was not developed by EPA, but another OECD-member country.
	Metric 3:	Applicability	Medium	Data is for an in-scope occupational scenario; however, data is general and not specific to a chemical.
	Metric 4:	Temporal Representativeness	Low	Assessment is based on data greater than 20 years old.
	Metric 5:	Sample Size	Medium	Sample distribution characterized by a range with uncertain statistics.
Domain 3: Accessibility/ Clarity	Metric 6:	Metadata Completeness	High	All data sources, methods, results, and assumptions are clearly documented.
Domain 4: Variability and Uncertainty	Metric 7:	Metadata Completeness	Medium	Uncertainty not addressed. Variability addressed by considering multiple chemical forms, containers and storage system types.
<b>Overall Quality Determination</b>		<b>Medium</b>		

<b>Study Citation:</b>	OECD, (2015). Emission scenario document (ESD) on industrial use of industrial cleaners.
<b>HERO ID:</b>	6414932
<b>Conditions of Use:</b>	Use; Cleaning and Degreasing Solvents

**EXTRACTION**

Parameter	Data
Description of release source:	draggout, evaporation from openings of the washing tank, waste cleaning solution, drying
Release quantity:	Provides methodology to estimate releases based on various parameters including: opening area of cleaning equipment, physical-chemical properties of cleaner, air velocity, etc.
Waste treatment methods and pollution control:	Natural sedimentation device: 0-50% Coagulation-sedimentation equipment: 0-95% Microorganism decomposition device (aerobic): 0-95% Membrane filtration device: 0-100% Activated carbon adsorption device: 0-90%

**EVALUATION**

Domain	Metric	Rating	Comments
Domain 1: Reliability	Metric 1: Methodology	High	Assessment uses high quality data/techniques/methods from frequently-used sources.
Domain 2: Representativeness	Metric 2: Geographic Scope	Medium	This ESD was not developed by EPA, but another OECD-member country.
	Metric 3: Applicability	Low	Data is for cleaning products/de greasers used to clean metal, which is similar to HHCB use in fragrance containing cleaning products,an in-scope occupational scenario.
	Metric 4: Temporal Representativeness	Medium	Assessment is generally based on data greater than 10 years old but no more than 20 years old and industry conditions that are expected to be representative of current industry conditions.
	Metric 5: Sample Size	Low	Methodology results characterized by no statistics.
Domain 3: Accessibility/ Clarity	Metric 6: Metadata Completeness	High	All data sources, methods, results, and assumptions are clearly documented.
Domain 4: Variability and Uncertainty	Metric 7: Metadata Completeness	Medium	Uncertainty not addressed. Variability addressed by considering multiple cleaner types

**Overall Quality Determination****Medium**

<b>Study Citation:</b>	U.S. EPA, (2023). Use of laboratory chemicals - Generic scenario for estimating occupational exposures and environmental releases (Revised draft generic scenario).			
<b>HERO ID:</b>	10480466			
<b>Conditions of Use:</b>	Use - Laboratory Chemicals			
<b>EXTRACTION</b>				
<b>Parameter</b>	<b>Data</b>			
Engineering control:	local ventilation, accurate labeling of wastes, using secondary containment for hazardous wastes, and contacting specialty disposal companies			
Description of release source:	container unloading, container cleaning, labware equipment cleaning, during laboratory analyses, waste disposalMedia: Water, air, landfill			
Release or emission factors:	Transfer operation losses of solids: 0.5%Container Cleaning (liquids in small containers): 0.6%Container Cleaning (solids): 1%Labware equipment cleaning (liquids): 2%Labware equipment cleaning (solids): 1%laboratory waste disposal: 100%			
Release frequency:	260 day/yr			
Waste treatment methods and pollution control:	Labware rinsed with water. Non-hazardous chemicals to landfill. laboratory chemicals or solvents used to clean labware may be considered hazardous. hazardous waste must be disposed of by incineration or to designated hazardous waste landfills			
<b>EVALUATION</b>				
Domain	Metric	Rating	Comments	
Domain 1: Reliability	Metric 1:	Methodology	High	Assessment uses high quality information/data from frequently-used sources.
Domain 2: Representativeness	Metric 2:	Geographic Scope	High	This GS is based on U.S. data
	Metric 3:	Applicability	Medium	Data is for an in-scope occupational scenario; however, data is general and not specific to a chemical.
	Metric 4:	Temporal Representativeness	High	Assessment is based on current industry conditions and data no more than 10 years old.
	Metric 5:	Sample Size	Medium	Sample distribution characterized by a range with uncertain statistics.
Domain 3: Accessibility/ Clarity	Metric 6:	Metadata Completeness	High	All data sources, methods, results, and assumptions are clearly documented.
Domain 4: Variability and Uncertainty	Metric 7:	Metadata Completeness	Low	Variability and uncertainty are not addressed.
<b>Overall Quality Determination</b>		<b>High</b>		

<b>Study Citation:</b>	U.S. EPA, (2022). Chemical repackaging - Generic scenario for estimating occupational exposures and environmental releases (revised draft).			
<b>HERO ID:</b>	11182966			
<b>Conditions of Use:</b>	Repackaging			
<b>EXTRACTION</b>				
<b>Parameter</b>	<b>Data</b>			
Description of release source:	Transfer losses, container cleaning, equipment cleaning, transfer losses during loading.			
Release quantity:	Provides methodology to estimate releases based on various parameters including: opening area of cleaning equipment, physical-chemical properties, air velocity, etc.			
Release or emission factors:	Transfer losses of solid chemicals: 0.5%Container cleaning (liquids): 0.2%Equipment Cleaning (liquids): 2% Equipment Cleaning (solids): 1%			
Release frequency:	The number of operating days is given in a range of 174-260 days/yr with an EPA default of 260 days/yr.			
Waste treatment methods and pollution control:	Filters used for fugitive dust emissions are disposed of in landfills or by incineration. Wastewater is treated on-site or sent off to a POTW. Automated pumps and containment systems are used to control emissions. Containment methods include bunds, kerbs, drip trays or any other systems that will prevent a spilled product escaping are recommended.			
<b>EVALUATION</b>				
Domain	Metric	Rating	Comments	
Domain 1: Reliability	Metric 1:	Methodology	High	Assessment uses high quality data/techniques/methods from frequently-used sources.
Domain 2: Representativeness	Metric 2:	Geographic Scope	High	This GS is based on U.S. data.
	Metric 3:	Applicability	Medium	Data is for an in-scope occupational scenario; however, data is general and not specific to a chemical.
	Metric 4:	Temporal Representativeness	Medium	Assessment is generally based on data greater than 10 years old but no more than 20 years old and industry conditions that are expected to be representative of current industry conditions.
	Metric 5:	Sample Size	Medium	Sample distribution characterized by a range with uncertain statistics.
Domain 3: Accessibility/ Clarity	Metric 6:	Metadata Completeness	High	All data sources, methods, results, and assumptions are clearly documented.
Domain 4: Variability and Uncertainty	Metric 7:	Metadata Completeness	Medium	Uncertainty not addressed. Variability addressed by considering emissions from multiple activities.
<b>Overall Quality Determination</b>		<b>High</b>		

<b>Study Citation:</b>	U.S. EPA, (2014). Generic scenario draft on the use of additives in plastic compounding.
<b>HERO ID:</b>	3827195
<b>Conditions of Use:</b>	Plastics Compounding

**EXTRACTION**

Parameter	Data
Description of release source:	Unloading containers, spillage, Container cleaning, dusts and fugitive emissions from compounding, equipment cleaning
Release quantity:	Provides models for estimating various fugitive air releases
Release or emission factors:	'Unloading solids: 0.1-0.5%Spillage: 0.01%Container cleaning: 1% (solids), 0.2% (bulk liquids) 0.6% (small containers for liquids) 3% (drums for liquids)Compounding dusts: 0.01-0.05%Compounding Volatiles: 0.002-0.05%Equipment Cleaning: 2%
Release frequency:	148-264
Waste treatment methods and pollution control:	Incineration; WWT: settling or clarification, neutralization, sludge treatment and/or dewatering, biological treatment, chemical precipitation, phase separation, adsorption.Air: Mechanical separation, settling or clarification, scrubbers, incineration/thermal destruction, condenser, adsorptionSolid waste streams: Settling or clarification, stabilization or chemical fixation prior to disposalNon-aqueous liquid waste streams: stabilization or chemical fixation prior to disposal, incineration/thermal destructionEfficiency: 0-100% depending on treatment method

**EVALUATION**

Domain	Metric	Rating	Comments
Domain 1: Reliability	Metric 1: Methodology	High	Assessment uses high quality data/techniques/methods from frequently-used sources.
Domain 2: Representativeness	Metric 2: Geographic Scope	High	This GS is based on U.S. data
	Metric 3: Applicability	Medium	Data is for an in-scope occupational scenario; however, data is general and not specific to a chemical.
	Metric 4: Temporal Representativeness	Medium	Assessment is generally based on data greater than 10 years old but no more than 20 years old and industry conditions that are expected to be representative of current industry conditions.
	Metric 5: Sample Size	Medium	Data characterized by a range with uncertain statistics.
Domain 3: Accessibility/ Clarity	Metric 6: Metadata Completeness	High	All data sources, methods, results, and assumptions are clearly documented.
Domain 4: Variability and Uncertainty	Metric 7: Metadata Completeness	Medium	Uncertainty not addressed. Variability addressed by considering multiple plastic types, and additive types.

**Overall Quality Determination****High**



<b>Study Citation:</b>	U.S. EPA, (2004). Additives in plastics processing (compounding) – generic scenario for estimating occupational exposures and environmental release – Draft.			
<b>HERO ID:</b>	6311218			
<b>Conditions of Use:</b>	incorporation into articles as a Odor agent in plastics material and resin manufacturing			
EXTRACTION				
<b>Parameter</b>	<b>Data</b>			
Description of release source:	Unloading containers, spillage, Container cleaning, dusts and fugitive emissions from compounding, equipment cleaning			
Release quantity:	Provides models for estimating various fugitive air releases			
Release or emission factors:	'Unloading solids: 0.1-0.5%Container cleaning: 1% (solids), 0.2% (bulk liquids) 0.6% (small containers for liquids) 3% (drums for liquids)Compounding dusts: 0.21-0.65%Compounding Volatiles: 0.002-0.05%Equipment Cleaning: 2%			
Release frequency:	250 days/yr			
Waste treatment methods and pollution control:	incineration			
EVALUATION				
Domain	Metric	Rating	Comments	
Domain 1: Reliability	Metric 1:	Methodology	High	Assessment uses high quality data/techniques/methods from frequently-used sources.
Domain 2: Representativeness	Metric 2:	Geographic Scope	High	This GS is based on U.S. data
	Metric 3:	Applicability	Medium	Data is for an in-scope occupational scenario; however, data is general and not specific to a chemical.
	Metric 4:	Temporal Representativeness	Medium	Assessment is generally based on data greater than 10 years old but no more than 20 years old and industry conditions that are expected to be representative of current industry conditions.
	Metric 5:	Sample Size	Medium	Data characterized by a range with uncertain statistics.
Domain 3: Accessibility/ Clarity	Metric 6:	Metadata Completeness	High	All data sources, methods, results, and assumptions are clearly documented.
Domain 4: Variability and Uncertainty	Metric 7:	Metadata Completeness	Medium	Uncertainty not addressed. Variability addressed by considering multiple plastic types, and additive types.
Overall Quality Determination		High		

<b>Study Citation:</b>	U.S. EPA, (1991). Granular detergents manufacture - generic scenario for estimating occupational exposures environmental releases: Draft.			
<b>HERO ID:</b>	6385740			
<b>Conditions of Use:</b>	Formulation of powder products			
<b>EXTRACTION</b>				
<b>Parameter</b>	<b>Data</b>			
Description of release source:	equipment cleaning, spillage			
Release or emission factors:	Equipment Cleaning: 1% (aqueous), 1% (solid wastes)Spillage: 0.5% (aqueous), 1% (solid wastes)			
Waste treatment methods and pollution control:	Collector, scrubber, precipitators			
<b>EVALUATION</b>				
Domain	Metric	Rating	Comments	
Domain 1: Reliability	Metric 1:	Methodology	High	Assessment uses high quality data/techniques/methods from frequently-used sources (EPA)
Domain 2: Representativeness	Metric 2:	Geographic Scope	High	This GS is based on U.S. data
	Metric 3:	Applicability	Medium	Data are for manufacture of granulated detergents, which is similar to the in-scope occupational scenario for the formulation of powders.
	Metric 4:	Temporal Representativeness	Low	Assessment is based on data greater than 20 years old.
	Metric 5:	Sample Size	Low	characterized by no statistics
Domain 3: Accessibility/ Clarity	Metric 6:	Metadata Completeness	High	All data sources, methods, results, and assumptions are clearly documented.
Domain 4: Variability and Uncertainty	Metric 7:	Metadata Completeness	Medium	Uncertainty not addressed. Variability addressed by considering multiple chemical physical forms
<b>Overall Quality Determination</b>		<b>Medium</b>		

<b>Study Citation:</b>	Nazaroff, W. W., Weschler, C. J. (2004). Cleaning products and air fresheners: exposure to primary and secondary air pollutants. Atmospheric Environment 38(18):2841-2865.
<b>HERO ID:</b>	57058
<b>Conditions of Use:</b>	Use of air care products; use of cleaning and furnishing care products

**EXTRACTION**

Parameter	Data
Release quantity:	provides estimated atmospheric emissions of VOCs from use of household commercial cleaning products in mg/day/person for carpet and upholstery care, spot removers, fabric protectants, floor care, general purpose cleaners, general purpose degreasers, glass cleaners, oven cleaners, bathroom cleaners, furniture waxes, and air fresheners

**EVALUATION**

Domain	Metric	Rating	Comments
Domain 1: Reliability	Metric 1: Methodology	High	Report uses high quality data/techniques/methods from frequently-used sources (CARB, 2003, 1997).
Domain 2: Representativeness	Metric 2: Geographic Scope	High	Data are from the U.S.
	Metric 3: Applicability	Low	Data are integrated for both household and commercial use of cleaning and air care products, the data due to the in-scope occupational scenario of the commercial use of cleaning and air care products can not be determined. In addition, data is for VOCs in general
	Metric 4: Temporal Representativeness	Low	Report is based on data greater than 20 years old and industry conditions that are expected to be outdated (2003, 1997)
	Metric 5: Sample Size	Medium	Sample distribution characterized by limited statistics but discrete samples not provided and distribution not fully characterized.
Domain 3: Accessibility/ Clarity	Metric 6: Metadata Completeness	High	All data sources, methods, results, and assumptions are clearly documented.
Domain 4: Variability and Uncertainty	Metric 7: Metadata Completeness	Low	Variability and uncertainty are not addressed.

**Overall Quality Determination**

**Medium**

<b>Study Citation:</b>	OECD, (2011). Emission scenario document on the chemicals used in water-based washing operations at industrial and institutional laundries.			
<b>HERO ID:</b>	6387321			
<b>Conditions of Use:</b>	Commercial Use – Laundry and Dishwashing Products - Laundry Detergent (Liquid); Laundry Detergent (Unit Dose/Granule); Fabric Enhancers; Stain Removers; Dry Cleaning and Associated Products; Dishwashing Detergent (Liquid/ Gel); Dishwashing Detergent (Unit Dose/ Granule); Dishwashing Detergent Liquid (Hand-Wash)			
EXTRACTION				
Parameter	Data			
Production, import, or use volume:	110,000-15,000,000 kg dry, clean laundry/site-yr450-95,000 kg cleaning product/site-yr			
Life cycle description:	Use of Liquid Cleaning Products			
Process description:	laundry received/sorted/weighed, cleaning product received, automatic or manual loading of chemicals into washing machine, washing, handling damp laundry, drying and steaming, hanging and folding			
Throughput:	Provides methodology for estimating throughput based on the amount of adhesived used, and the concentration of the chemical in the formulation			
Number of sites:	1,018-54,000 total sites			
Chemical concentration:	Provides conc. estimates based on the cleaning product type and chemical function, not chemical specific			
EVALUATION				
Domain	Metric	Rating	Comments	
Domain 1: Reliability	Metric 1: Methodology	High	Assessment uses high quality data/techniques/methods from frequently-used sources.	
Domain 2: Representativeness	Metric 2: Geographic Scope	High	This ESD was developed by EPA based on U.S. data	
	Metric 3: Applicability	Medium	Data is for an in-scope occupational scenario; however, data is general and not specific to a chemical.	
	Metric 4: Temporal Representativeness	Low	Assessment is based on data greater than 20 years old.	
Domain 3: Accessibility/ Clarity	Metric 5: Metadata Completeness	Medium	Sample distribution characterized by limited statistics (min,max, mean, median, and 90th percentile) but discrete samples not provided and distribution not fully characterized.	
Domain 4: Variability and Uncertainty	Metric 6: Metadata Completeness	High	All data sources, methods, results, and assumptions are clearly documented.	
Overall Quality Determination		Medium		

<b>Study Citation:</b>	Bello, A. (2008). Assessment of exposures to cleaning product ingredients used in common cleaning tasks.
<b>HERO ID:</b>	9551179
<b>Conditions of Use:</b>	Use in liquid, spray, and aerosol cleaning products

EXTRACTION	
Parameter	Data
Process description:	Process descriptions provided for cleaning process at hospitals. Generally categorized as floor cleaning, window cleaning, mirror cleaning, toilet bowl cleaning, sink cleaning, floor waxing and stripping, counter cleaning and preparation of cleaning solutions. P. 50-52. Additional process information described for cleaning process on p. 58-59 and identifies additional details that may increase inhalation exposure. pp. 72-73 process flow diagrams
Throughput:	p. 50 about 1, 250 ml /day bottle of deodorant vs. 250 ml /week of glass cleaner used in 8 bathrooms
Chemical concentration:	p. 77-83 lists % fragrance of pure cleaning product. P. 50 lists some dilution rates of products

EVALUATION		Comments
Domain	Metric	
Domain 1: Reliability		
	Metric 1: Methodology	High Assessment uses high quality methods from frequently-used sources.
Domain 2: Representativeness		
	Metric 2: Geographic Scope	High Data are from the U.S.
	Metric 3: Applicability	High Data are for use of liquid, spray, and aerosol cleaning products, an in-scope occupational scenario.
	Metric 4: Temporal Representativeness	Medium Assessment is based on data greater than 10 years old but no more than 20 years old and industry conditions that are expected to be representative of current industry conditions (2008)
	Metric 5: Sample Size	Medium Sample distribution characterized by a range with uncertain statistics.
Domain 3: Accessibility/ Clarity		
	Metric 6: Metadata Completeness	High All data sources, methods, results, and assumptions are clearly documented.
Domain 4: Variability and Uncertainty		
	Metric 7: Metadata Completeness	Medium Variability addressed by sampling from multiple hospitals but uncertainty is not addressed.

<b>Overall Quality Determination</b>	<b>High</b>
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<b>Study Citation:</b>	ECB, (2008). European Union risk assessment report: 1,3,4,6,7,8-hexahydro-4,6,6,7,8,8-hexamethylcyclopenta-γ-2-benzopyran (HHCB).
<b>HERO ID:</b>	5155574
<b>Conditions of Use:</b>	Manufacture; Incorporation into Formulation of Mixture; Use of Cleaning Products

EXTRACTION	
Parameter	Data
Production, import, or use volume:	2000 PV for Europe: 1000-5000 ton/year; Compounding volume ranges 43,914 kg to 319,000 kg per site
Life cycle description:	risk assessment describes manufacture process of HHCB, processing (compounding), formulations, and use of cleaning products. The distribution of end products is 25% detergents, 14% fabric softeners, 9% soaps, 10% bath & shower, 8% ind. and household cleaners, 10% hair care, 13% personal care products, 5% fine fragrances, 6% other.
Process description:	Manufacture: The nominal batch size is circa 7 tonnes. Each batch takes 10 – 15 hours. Production is continuous during 24 hours a day, 7 days a week for 48 weeks in a year (approximately 330 days)., Process operation (3 operators in each shift), Dilution (1 person in each shift), Analytical measurements (1 person in each shift), Odour Quality control (2 persons, daily basis), Wastewater treatment (1 person, daily basis); Processing: Delivery (transported in diluted form in tanker trucks or containers of 200 L or more)), Filling of stock tanks, Compounding of fragrance oils (batch process between 1-20,000 kg)), Analytical determinations, Odour control; Formulation: The drummed liquid fragrance oil is used in the cosmetic industry for production of toiletries, shampoos, soap, and the household cleaning products industry for production of detergents and cleaning agents etc. It is assumed that the production is highly automated with little or no exposure to polycyclic musks. Exposure may be possible during handling of the drums and during cleaning and maintenance of the equipment.
Throughput:	use volumes for 6 processing facilities of HHCB; Processing and formulating batch sizes are also provided.
Number of sites:	1 manufacturer in Europe; 39 processing facilities in Europe that dilute HHCB
Chemical concentration:	nearly all of the HHCB produced is diluted in organic solvent to a 65% by weight; The average final weight in HHCB containing products is about 3 – 4 %. Stock solutions of HHCB are between 10 and 65 %. Many fragrance oils contain HHCB at an average concentration of 4%

		EVALUATION	
Domain	Metric	Rating	Comments
Domain 1: Reliability	Metric 1: Methodology	High	Assessment uses high quality data from frequently-used sources.
Domain 2: Representativeness	Metric 2: Geographic Scope	Medium	Data are from The Netherlands, an OECD country.
	Metric 3: Applicability	High	Data are for Manufacture, processing, formulation, and use as a cleaning product, an in-scope occupational scenario.
	Metric 4: Temporal Representativeness	Medium	Assessment is based on data greater than 10 years old but no more than 20 years old and industry conditions that are expected to be representative of current industry conditions.
	Metric 5: Sample Size	High	Statistical distribution of samples is fully characterized (discrete sampling data provided).
Domain 3: Accessibility/ Clarity	Metric 6: Metadata Completeness	High	All data sources, methods, results, and assumptions are clearly documented.
Domain 4: Variability and Uncertainty	Metric 7: Metadata Completeness	High	Uncertainty is addressed. Variability addressed by sampling/observing multiple facilities.

Continued on next page ...

HHCB

General Engineering Assessment

HERO ID: 5155574 Table: 1 of 2

...continued from previous page			
Study Citation:	ECB, (2008). European Union risk assessment report: 1,3,4,6,7,8-hexahydro-4,6,6,7,8,8-hexamethylcyclopenta- $\gamma$ -2-benzopyran (HHCB).		
HERO ID:	5155574		
Conditions of Use:	Manufacture; Incorporation into Formulation of Mixture; Use of Cleaning Products		
Domain	Metric	EVALUATION Rating	Comments
Overall Quality Determination		High	

<b>Study Citation:</b>	ECB, (2008). European Union risk assessment report: 1,3,4,6,7,8-hexahydro-4,6,6,7,8,8-hexamethylcyclopenta- $\gamma$ -2-benzopyran (HHCB).		
<b>HERO ID:</b>	5155574		
<b>Conditions of Use:</b>	Use of Cleaning Products		
<b>EXTRACTION</b>			
<b>Parameter</b>	<b>Data</b>		
Chemical concentration:	The final professional cleaning products contain 0.1 % fragrance oil, which in turn contains on average 4 % HHCB.		
Comments:	No monitoring data, but uses a model for inhalation and dermal exposure. Inhalation exposure used the EASE model, which estimated exposure of 0-0.1 ppm. Due to the very low vapour pressure of the diluted substance however, the exposure is assumed to be negligible. For dermal exposure assuming extensive contact and wide dispersive use the exposure according to EASE ranges from 5 – 15 mg/cm2/day on both hands (840 cm2) so 4200 –12,600 mg water with cleaning agent diluted 1 to 50. Total estimated dermal daily dose of 0.32 mg/d.		
<b>EVALUATION</b>			
Domain	Metric	Rating	Comments
Domain 1: Reliability	Metric 1: Methodology	High	Assessment uses high quality methods from frequently-used sources.
Domain 2: Representativeness	Metric 2: Geographic Scope	Medium	Data are from The Netherlands, an OECD country.
	Metric 3: Applicability	High	Data are for use as a cleaning product, an in-scope occupational scenario.
	Metric 4: Temporal Representativeness	Medium	Assessment is based on data greater than 10 years old but no more than 20 years old and industry conditions that are expected to be representative of current industry conditions.
	Metric 5: Sample Size	High	Statistical distribution of samples is fully characterized (discrete sampling data provided).
Domain 3: Accessibility/ Clarity	Metric 6: Metadata Completeness	Medium	Results and assumptions are clearly documented, but underlying details of methods are not fully transparent.
Domain 4: Variability and Uncertainty	Metric 7: Metadata Completeness	Low	Variability and uncertainty are not addressed.
<b>Overall Quality Determination</b>		<b>Medium</b>	



<b>Study Citation:</b>	ECB, (2008). 1,3,4,6,7,8-Hexahydro-4,6,6,7,8,8-hexamethylcyclopenta- $\gamma$ -2-benzopyran, (1,3,4,6,7,8-hexahydro-4,6,6,7,8,8-hexamethylinden[5,6-c]pyran - HHCB) summary risk assessment report.
<b>HERO ID:</b>	8404084
<b>Conditions of Use:</b>	Manufacture; Formulation into fragrance oils; formulation into liquid and powder products

EXTRACTION	
Parameter	Data
Production, import, or use volume:	Manufacture: 1 plant in Europe with production of 1,000-5,000 ton/year (year 2000). 63% exported. Nearly all HHCB produced is diluted in organic solvent to 65% to be pourable, but is still highly viscous. Dilution is carried out at a separate facility from the manufacturer. Formulation: In Europe there are approximately 39 compounding sites of circa 29 larger and medium sized companies that receive HHCB. The fraction directly used in formulation is estimated at 14%. The total volume of HHCB in end product formulation in Europe for 2000 is assumed to be 1427 tonnes. Calculates estimated use rates based on the PV and estimated number of sites
Life cycle description:	An ingredient in fragrance oils; Applications of the fragrance oils are in consumer products such as perfumes, cosmetics, soaps, shampoos, detergents, fabric conditioners, household cleaning products and air fresheners.
Number of sites:	1 manufacturing site and at least 39 formulation sites
Chemical concentration:	Circa 63% of the production volume (HHCB undiluted) is exported outside the EU (that is the EU-15, and including also Norway and Switzerland), of which 25% (HHCB undiluted) in form as undiluted and 37.5% (HHCB undiluted) after dilution. To simplify handling nearly all of the HHCB produced is diluted in organic solvent to a 65% by weight pourable but still highly viscous liquid. This dilution is carried out at another plant in Europe.

EVALUATION				
Domain	Metric		Rating	Comments
Domain 1: Reliability	Metric 1:	Methodology	High	Assessment uses high quality methods that are from frequently-used sources (EU risk assessments) and there are no known quality issues.
Domain 2: Representativeness	Metric 2:	Geographic Scope	Medium	Data are from the Netherlands, an OECD country.
	Metric 3:	Applicability	High	Data are for Manufacture which is in-scope occupational scenarios.
	Metric 4:	Temporal Representativeness	Low	Assessment is based on data greater than 20 years old and industry conditions that are expected to be outdated (2000)
	Metric 5:	Sample Size	Medium	Sample distribution characterized by a range with uncertain statistics.
Domain 3: Accessibility/ Clarity	Metric 6:	Metadata Completeness	Medium	Methods, results, and assumptions are clearly documented, but underlying data sources are not fully transparent.
Domain 4: Variability and Uncertainty	Metric 7:	Metadata Completeness	N/A	Variability and uncertainty are not addressed but not expected. Production volume information directly gathered from specific sites.

**Overall Quality Determination**

**Medium**

<b>Study Citation:</b>	ECB, (2008). 1,3,4,6,7,8-Hexahydro-4,6,6,7,8,8-hexamethylcyclopenta- $\gamma$ -2-benzopyran, (1,3,4,6,7,8-hexahydro-4,6,6,7,8,8-hexamethylin-deno[5,6-c]pyran - HHCB) summary risk assessment report.
<b>HERO ID:</b>	8404084
<b>Conditions of Use:</b>	Formulation into fragrance oils; formulation into liquid and powder products

EXTRACTION	
Parameter	Data
Production, import, or use volume:	Formulation: In Europe there are approximately 39 compounding sites of circa 29 larger and medium sized companies that receive HHCB. The fraction directly used in formulation is estimated at 14%. The total volume of HHCB in end product formulation in Europe for 2000 is assumed to be 1427 tonnes. Calculates estimated use rates based on the PV and estimated number of sites
Life cycle description:	An ingredient in fragrance oils; Applications of the fragrance oils are in consumer products such as perfumes, cosmetics, soaps, shampoos, detergents, fabric conditioners, household cleaning products and air fresheners.
Throughput:	Calculates estimated use rates based on the PV and estimated number of sites (table 3-1)
Number of sites:	at least 39 formulation sites

		EVALUATION	
Domain	Metric	Rating	Comments
Domain 1: Reliability	Metric 1: Methodology	High	Assessment uses high quality methods that are from frequently-used sources (EU risk assessments) and there are no known quality issues.
Domain 2: Representativeness	Metric 2: Geographic Scope	Medium	Data are from the Netherlands, an OECD country.
	Metric 3: Applicability	High	Data are for formulation which is in-scope occupational scenarios.
	Metric 4: Temporal Representativeness	Low	Assessment is based on data greater than 20 years old and industry conditions that are expected to be outdated (2000)
	Metric 5: Sample Size	Medium	Sample distribution characterized by a range with uncertain statistics.
Domain 3: Accessibility/ Clarity	Metric 6: Metadata Completeness	Medium	Methods, results, and assumptions are clearly documented, but underlying data sources are not fully transparent.
Domain 4: Variability and Uncertainty	Metric 7: Metadata Completeness	N/A	Variability and uncertainty are not addressed but not expected. Production volume information directly gathered from specific sites.

<b>Overall Quality Determination</b>	<b>Medium</b>
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<b>Study Citation:</b>	ERG, (1998). Air emissions inventories, volume 2: Point sources: Chapter 11: Preferred and alternative methods for estimating air emissions from plastic products manufacturing.			
<b>HERO ID:</b>	7349020			
<b>Conditions of Use:</b>	Plastics compounding; plastics converting			
EXTRACTION				
<b>Parameter</b>	<b>Data</b>			
Production, import, or use volume:	1995 Production volumes given for different types of plastics			
Process description:	molding, forming, shaping, or otherwise altering plasticresins or plastic materials to produce an intermediate or final product; extrusion, injection molding, blow molding, compression molding, transfer molding, lamination, coating, foam processing[more details in report]			
EVALUATION				
Domain	Metric		Rating	Comments
Domain 1: Reliability	Metric 1:	Methodology	High	Assessment uses high quality data/techniques/methods from frequently-used sources.
Domain 2: Representativeness	Metric 2:	Geographic Scope	High	Data is based on U.S. data
	Metric 3:	Applicability	Medium	Data are for plastics compounding and converting, in-scope occupational scenarios; however, data is general and not specific to a chemical.
	Metric 4:	Temporal Representativeness	Low	Assessment is based on data greater than 20 years old and industry conditions that are expected to be outdated (1998 or older).
	Metric 5:	Sample Size	Medium	Sample distribution characterized by a range with uncertain statistics.
Domain 3: Accessibility/ Clarity	Metric 6:	Metadata Completeness	High	All data sources, methods, results, and assumptions are clearly documented.
Domain 4: Variability and Uncertainty	Metric 7:	Metadata Completeness	Medium	Uncertainty not addressed. Variability addressed by considering multiple plastic and additive types.
Overall Quality Determination			Medium	

<b>Study Citation:</b>	OECD, (2009). Emission scenario document on plastic additives.			
<b>HERO ID:</b>	5079084			
<b>Conditions of Use:</b>	Processing – Incorporation into Articles – Odor Agent in Plastics Material and Resin Manufacturing			
<b>EXTRACTION</b>				
<b>Parameter</b>	<b>Data</b>			
Production, import, or use volume:	Provides % of polymers used for various end-use applications			
Life cycle description:	Plastics Compounding and Converting			
Process description:	Provides descriptions for a variety of closed, partially open, and open compound and converting processing. Including the following compounding processes: tumbling, ball blending, gravity mixers, paddle mixers, intensive vortex mixers, banbury mixers, two roll mills, and extruder mixing. And the following converting processes: extrusion, injection molding, compression molding, extrusion blow molding, injection blow molding, film extrusion, extrusion coating, thermoforming, calendaring, hand lay up, spray techniques, and filament winding.ESD also provides a break down of the % and volume of polymers used in each process in the UK.			
Throughput:	Provides methodology for estimating throughput of polymers and additives			
Number of sites:	4000 sites in UK			
Chemical concentration:	Provides conc. estimates based on additive function in various plastics, not chemical specific.			
<b>EVALUATION</b>				
Domain	Metric	Rating	Comments	
Domain 1: Reliability	Metric 1:	Methodology	High	Assessment uses high quality data/techniques/methods from frequently-used sources.
Domain 2: Representativeness	Metric 2:	Geographic Scope	Medium	This ESD was not developed by EPA, but another OECD-member country.
	Metric 3:	Applicability	Medium	Data are for multiple in-scope occupational scenarios; however, data is general and not specific to a chemical.
	Metric 4:	Temporal Representativeness	Low	Assessment from 2009 but is based on data greater than 20 years old.
	Metric 5:	Sample Size	Medium	Sample distribution characterized by a range with uncertain statistics.
Domain 3: Accessibility/ Clarity	Metric 6:	Metadata Completeness	High	All data sources, methods, results, and assumptions are clearly documented.
Domain 4: Variability and Uncertainty	Metric 7:	Metadata Completeness	Medium	Uncertainty not addressed. Variability addressed by considering prevalence of various processing methods, additive functions, and plastics.
<b>Overall Quality Determination</b>		<b>Medium</b>		

## General Engineering Assessment

<b>Study Citation:</b>	OECD, (2010). Emission scenario document on the blending of fragrance oils into commercial and consumer products.
<b>HERO ID:</b>	6387319
<b>Conditions of Use:</b>	Processing into formulation

## EXTRACTION

Parameter	Data
Production, import, or use volume:	Average Annual Use Rate (kg/site-yr)-28,500(NAICS 325611- Soap and Other Detergent Manufacturing); 10,600(NAICS 325612 Polish and Other Sanitation Goods Manufacturing)...Quantity manufactured by present- 88% 100<x<1,000kg/yr; 8.3% 1,000<x<10,000kg/yr; <4% >10,000kg/yr. Median of Production Volume from EPA PMN program is 900kg(2005).
Life cycle description:	Lifecycle of Aroma Chemical is Manufacture/Import of Aroma Chemical, Formulation of fragrance oil, formulation of commercial and consumer products, and commercial/consumer use. Aroma chemicals are either extracted from natural sources or synthetically manufactured;
Process description:	General Process: Unloading; Mixing (Closed Vessel), and Packaging. More specific process descriptions are reported based on the product (e.g., powdered detergents, liquid detergents or cleaning products, solid bar soaps, gel air fresheners, and aerosol air fresheners and cleaners.
Number of sites:	2,356 sites for NAICS code 3256; more number of sites are included per 6-digit NAICS code.
Chemical concentration:	Concentration of fragrances in consumer products: scented candle (3-7%), scented gel air freshener, plug-in(60-100%), scented gel air freshener, non-plug-in(1-3%), carpet & room deodorizer (0.5-5%), toilet bowl cleaner/deodorizer (<10%), laundry detergent (0.5%), Pet care products (<1-6%), liquid auto products (0-10%), paste auto products (<1%), aerosol auto product (<1-5%)
Comments:	Concentrations for non-tsca(e.g., FDA regulated) products are also included in source.

## EVALUATION

Domain	Metric	Rating	Comments
Domain 1: Reliability	Metric 1: Methodology	High	The assessment or report uses high quality data and/or techniques or sound methods that are from a frequently used source (e.g., EPA/OPPT models, NIOSH HHES, Kirk-Othmer) and are generally accepted by the scientific community, and associated information does not indicate flaws or quality issues.
Domain 2: Representativeness	Metric 2: Geographic Scope	High	The data are from the United States and are representative of the industry being evaluated.
	Metric 3: Applicability	Medium	The assessment is for an occupational scenario within the scope of the risk evaluation; however, data is general and not specific to a chemical.
	Metric 4: Temporal Representativeness	Medium	The report is generally, more than 10 years but no more than 20 years old.
	Metric 5: Sample Size	N/A	N/A - data not dependent on samples
Domain 3: Accessibility/ Clarity	Metric 6: Metadata Completeness	High	Report clearly documents its data sources, assessment methods, results, and assumptions.
Domain 4: Variability and Uncertainty	Metric 7: Metadata Completeness	High	The assessment addresses variability (e.g., different products) and uncertainty(e.g., data gaps/uncertainties section included) in the results. Uncertainty is well characterized.

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<b>Study Citation:</b>		OECD, (2010). Emission scenario document on the blending of fragrance oils into commercial and consumer products.		
<b>HERO ID:</b>		6387319		
<b>Conditions of Use:</b>		Processing into formulation		
Domain	Metric	<b>EVALUATION</b>		Comments
		Rating		
<b>Overall Quality Determination</b>		<b>High</b>		

<b>Study Citation:</b>	OECD, (2009). Emission scenario document on transport and storage of chemicals.		
<b>HERO ID:</b>	6393282		
<b>Conditions of Use:</b>	Transportation and storage		
<b>EXTRACTION</b>			
<b>Parameter</b>	<b>Data</b>		
Production, import, or use volume:	11 million tonnes shipped via rail tankers 30 million tonnes shipped via pipelines		
Process description:	On-site storage of chemicals, filling of containers, transport to distributors/downstream users/consumers, containers with residual chemical transported to recycling/cleaning or disposal site, empty/cleaned containers returned to distributor or production site		
Throughput:	Road tankers: 18-25 tonnes Rail tankers: 130,000 L IBCs: 400-2,000 L or 225-2,270 kg Steel Drums: 49-416 L Steel Pails: </= 45 L Plastic drums: 9.5-208 L Fibre drums: 4-450 L or up to 400 kg Bags/sacks: 25-1000 kg Carboys: 10-50 L Glass bottles </=2.5 L		
Number of sites:	Container cleaning sites in UK: 40 for road tankers; 8 for steel drums; 8 for plastics drums; 6 for fibre drums; 13 for IBCs; 7 for hazardous waste containers		
<b>EVALUATION</b>			
Domain	Metric	Rating	Comments
Domain 1: Reliability	Metric 1: Methodology	High	Assessment uses high quality data/techniques/methods from frequently-used sources.
Domain 2: Representativeness	Metric 2: Geographic Scope	Medium	This ESD was not developed by EPA, but another OECD-member country.
	Metric 3: Applicability	Medium	Data is for an in-scope occupational scenario; however, data is general and not specific to a chemical.
	Metric 4: Temporal Representativeness	Low	Assessment is based on data greater than 20 years old
	Metric 5: Sample Size	Medium	Sample distribution characterized by a range with uncertain statistics.
Domain 3: Accessibility/ Clarity	Metric 6: Metadata Completeness	High	All data sources, methods, results, and assumptions are clearly documented.
Domain 4: Variability and Uncertainty	Metric 7: Metadata Completeness	Medium	Uncertainty not addressed. Variability addressed by considering multiple chemical forms, containers and storage system types.
<b>Overall Quality Determination</b>		<b>Medium</b>	

<b>Study Citation:</b>	OECD, (2015). Emission scenario document (ESD) on industrial use of industrial cleaners.			
<b>HERO ID:</b>	6414932			
<b>Conditions of Use:</b>	Use of Cleaning Products			
<b>EXTRACTION</b>				
<b>Parameter</b>	<b>Data</b>			
Production, import, or use volume:	1-12,961 tonne/yr (Japan)			
Process description:	Provides descriptions for a variety of cleaning methods including ultrasonic, jet washing, oscillate (rotate) washing, mechanical vibration stirring, bubble washing, reduced pressure (vacuum) washing, jet (spray, shower) washing, steam washing			
Chemical concentration:	Provides conc. estimates based on type of cleaner, not chemical specific.			
<b>EVALUATION</b>				
Domain	Metric	Rating	Comments	
Domain 1: Reliability	Metric 1: Methodology	High	Assessment uses high quality data/techniques/methods from frequently-used sources.	
Domain 2: Representativeness	Metric 2: Geographic Scope	Medium	This ESD was not developed by EPA, but another OECD-member country.	
	Metric 3: Applicability	Low	Data is for cleaning products/de greasers used to clean metal, which is similar to HHCB use in fragrance containing cleaning products,an in-scope occupational scenario.	
	Metric 4: Temporal Representativeness	Medium	Assessment is generally based on data greater than 10 years old but no more than 20 years old and industry conditions that are expected to be representative of current industry conditions.	
	Metric 5: Sample Size	Medium	Sample distribution characterized by a range with uncertain statistics.	
Domain 3: Accessibility/ Clarity	Metric 6: Metadata Completeness	High	All data sources, methods, results, and assumptions are clearly documented.	
Domain 4: Variability and Uncertainty	Metric 7: Metadata Completeness	Medium	Uncertainty not addressed. Variability addressed by considering multiple cleaner types	
<b>Overall Quality Determination</b>		<b>Medium</b>		



<b>Study Citation:</b>	U.S. EPA, (2023). Use of laboratory chemicals - Generic scenario for estimating occupational exposures and environmental releases (Revised draft generic scenario).
<b>HERO ID:</b>	10480466
<b>Conditions of Use:</b>	Use - Laboratory Chemicals

EXTRACTION	
Parameter	Data
Production, import, or use volume:	Provides methodology to estimate annual use rate. Provides some use rate quantities for the first 10 chemicals in table 1-2
Process description:	Receive chemicals, weigh or measure chemical, add chemical to labware, dilute/add other laboratory chemicals, add sample, run analytical testing, dispose of sample and laboratory chemical waste
Throughput:	260 days/yr 255 grams reagent/site-day (average); 2,000 mL reagent/site-day (average); Table 3-2 gives daily throughput for laboratory stock solutions
Number of sites:	Provides methodology to estimate number of sites based on chemical production volume, annual throughput - 40,639 total establishments
Chemical concentration:	Provides conc. estimates based on the chemical function, not chemical specific.
Physical form:	liquid or solid

		EVALUATION	
Domain	Metric	Rating	Comments
Domain 1: Reliability	Metric 1: Methodology	High	Assessment uses high quality information/data from frequently-used sources.
Domain 2: Representativeness	Metric 2: Geographic Scope	High	This GS is based on U.S. data
	Metric 3: Applicability	Medium	Data is for an in-scope occupational scenario; however, data is general and not specific to a chemical.
	Metric 4: Temporal Representativeness	High	Assessment is based on current industry conditions and data no more than 10 years old.
	Metric 5: Sample Size	Medium	Sample distribution characterized by a range with uncertain statistics.
Domain 3: Accessibility/ Clarity	Metric 6: Metadata Completeness	High	All data sources, methods, results, and assumptions are clearly documented.
Domain 4: Variability and Uncertainty	Metric 7: Metadata Completeness	Medium	Uncertainty not addressed. Variability addressed by considering different chemical functions

<b>Overall Quality Determination</b>	<b>High</b>
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<b>Study Citation:</b>	U.S. EPA, (2022). Chemical repackaging - Generic scenario for estimating occupational exposures and environmental releases (revised draft).			
<b>HERO ID:</b>	11182966			
<b>Conditions of Use:</b>	Repackaging			
<b>EXTRACTION</b>				
<b>Parameter</b>	<b>Data</b>			
Production, import, or use volume:	Table B-1 presents PMN data on repackaging rate in kg chemical/site-yr.			
Process description:	<p>Pre-manufacture notices (PMN) submitted from 2010 to 2020 under EPA’s New Chemicals Program indicated imported and repackaged chemicals can be solids or liquids and may be neat or in solutions/mixtures and contained in various packaging types. After they arrive at the repackaging site, repackaging operations occur where the chemical is transferred from the transport container it was imported in to a new one of a different size in order to meet the customer’s needs (JACO, 2021). Chemicals may also be transferred from original containers to intermediate storage containers before packaging into smaller containers (Cooke, 2013; NIOSH, 2009). Chemicals are expected to be received at repackaging sites in drums or larger bulk containers (supersacks, totes, tank trucks, etc.) (Cooke, 2013; NIOSH, 2009). The chemical of interest may be received in its final formulation and transferred directly from these large containers into smaller containers, charged to a temporary storage tank, or it may be charged to a mixing tank and diluted or mixed with other chemicals before it is repackaged. Once the chemical has been formulated to desired specifications, it can be repackaged. Workers may be potentially exposed during the unloading of chemicals from the original transport containers into temporary storage or new transport containers. Releases of chemicals may also occur during this stage, from open container surfaces (e.g., if the chemical is volatile), transfer operations (e.g., if the chemical is volatile or a powder), and original transport container disposal. Repackaging operations for liquid chemicals typically involve pouring or pumping the product from the original containers or mixing /storage tanks into the new containers. A study conducted by the Health and Safety Laboratory in the U.K. investigated two chemical repackaging sites (Cooke, 2013). At both of these sites the chemical was delivered to the site by road tanker and pumped into dedicated storage tanks. One of the sites, a hydrazine supplier, pumped the hydrazine into a mixing vessel where it was diluted with water and packaged into smaller containers for sale to customers. At the other site, trichloroethylene was pumped from storage tanks into a closed loop system where workers using a hydraulic lance connected to a semi-automated filling system transferred the chemical into new containers (Cooke, 2013). The usual process for repackaging solid chemicals differs from the processes for liquids. A NIOSH Health Hazard Evaluation Report (HHE) from 2009 investigated a repackaging facility that was transferring bulk shipments of silane-coated glass beads ranging between 0.2 – 1.2mm in diameter. At this facility, 2,200 lb supersacks of the product are lifted with a forklift over a metal bin, then cutting the bottom of the container with a knife to empty the beads into the bin. The metal bin is then lifted by a forklift, and the glass beads are poured into hoppers. From the hoppers the beads are gravity fed into smaller cardboard boxes or paper sacks that are shipped to customers (NIOSH, 2009). Workers may be potentially exposed during the transfer of chemicals from temporary storage into new transport containers. Releases of chemicals may also occur during this stage from open container surfaces (e.g., if the chemical is volatile), transfer operations (e.g., if the chemical is volatile or a powder), and cleaning any equipment that was used in during the process.</p>			
Number of sites:	Table 1-2 presents the number of repackaging sites based on 2019 U.S. Census data.			
Chemical concentration:	A fraction of completed IRERs from 2010-2020 were reviewed, 21 submissions contained information on chemical repackaging. In these submissions, chemicals were repackaged at concentrations ranging from 1% to 100%, with a 50th percentile of 93%, a 95th percentile of 100%, and a mode of 100%.			
<b>EVALUATION</b>				
Domain	Metric		Rating	Comments
Domain 1: Reliability	Metric 1:	Methodology	High	Assessment uses high quality information/data from frequently-used sources.
Domain 2: Representativeness	Metric 2:	Geographic Scope	High	This GS is based on U.S. data.
	Metric 3:	Applicability	Medium	Data are for an in-scope occupational scenario; however, data is general and not specific to a chemical.
	Metric 4:	Temporal Representativeness	Medium	Assessment is based on data greater than 10 years old but no more than 20 years old and industry conditions that are expected to be representative of current industry conditions.
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General Engineering Assessment

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<b>Study Citation:</b>	U.S. EPA, (2022). Chemical repackaging - Generic scenario for estimating occupational exposures and environmental releases (revised draft).			
<b>HERO ID:</b>	11182966			
<b>Conditions of Use:</b>	Repackaging			
Domain		Metric	EVALUATION	
			Rating	Comments
	Metric 5:	Sample Size	High	Statistical distribution of samples is fully characterized (discrete use amounts provided).
Domain 3: Accessibility/ Clarity				
	Metric 6:	Metadata Completeness	High	All data sources, methods, results, and assumptions are clearly documented.
Domain 4: Variability and Uncertainty				
	Metric 7:	Metadata Completeness	Medium	Uncertainty not addressed. Variability addressed by considering multiple repackaging facilities.
<b>Overall Quality Determination</b>			<b>High</b>	

<b>Study Citation:</b>	U.S. EPA, (2014). Generic scenario draft on the use of additives in plastic compounding.			
<b>HERO ID:</b>	3827195			
<b>Conditions of Use:</b>	Plastics Compounding			
<b>EXTRACTION</b>				
<b>Parameter</b>	<b>Data</b>			
Process description:	Polymer pellets/resins received, blending/compounding into masterbatch, extrusion/shaping, packaging			
Throughput:	'Provides methodology for estimating throughput based on the amount of plastic produced, and the concentration of the chemical additive in the plastic			
Number of sites:	'Provides methodology for estimating number of sites based on chemical PV, the amount of plastic produced, and the concentration of the chemical additive in the plastic			
Chemical concentration:	'Provides conc. estimates based on additive function in various plastics, not chemical specific.			
<b>EVALUATION</b>				
Domain	Metric	Rating	Comments	
Domain 1: Reliability	Metric 1: Methodology	High	Assessment uses high quality data/techniques/methods from frequently-used sources.	
Domain 2: Representativeness	Metric 2: Geographic Scope	High	This GS is based on U.S. data	
	Metric 3: Applicability	Medium	Data is for an in-scope occupational scenario; however, data is general and not specific to a chemical.	
	Metric 4: Temporal Representativeness	Medium	Assessment is generally based on data greater than 10 years old but no more than 20 years old and industry conditions that are expected to be representative of current industry conditions.	
	Metric 5: Sample Size	Medium	Sample distribution characterized by a range with uncertain statistics.	
Domain 3: Accessibility/ Clarity	Metric 6: Metadata Completeness	High	All data sources, methods, results, and assumptions are clearly documented.	
Domain 4: Variability and Uncertainty	Metric 7: Metadata Completeness	Medium	Uncertainty not addressed. Variability addressed by considering multiple plastic and additive types.	
<b>Overall Quality Determination</b>		<b>High</b>		

<b>Study Citation:</b>	U.S. EPA, (2004). Additives in plastics processing (compounding) – generic scenario for estimating occupational exposures and environmental release – Draft.
<b>HERO ID:</b>	6311218
<b>Conditions of Use:</b>	incorporation into articles as a Odor agent in plastics material and resin manufacturing

#### EXTRACTION

Parameter	Data
Production, import, or use volume:	provides the North American Production (lb/yr) of the types of Thermoplastics from 2003 -p. 3
Process description:	Polymer pellets/resins received, blending/compounding into masterbatch, extrusion/shaping, packaging
Throughput:	'Provides methodology for estimating throughput based on the amount of plastic produced, and the concentration of the chemical additive in the plastic
Number of sites:	'Provides methodology for estimating number of sites based on chemical PV, the amount of plastic produced, and the concentration of the chemical additive in the plastic
Chemical concentration:	'Provides conc. estimates based on additive function in various plastics, not chemical specific.

#### EVALUATION

Domain	Metric	Rating	Comments
Domain 1: Reliability	Metric 1: Methodology	High	Assessment uses high quality data/techniques/methods from frequently-used sources.
Domain 2: Representativeness	Metric 2: Geographic Scope	High	This GS is based on U.S. data
	Metric 3: Applicability	Medium	Data is for an in-scope occupational scenario; however, data is general and not specific to a chemical.
	Metric 4: Temporal Representativeness	Medium	Assessment is generally based on data greater than 10 years old but no more than 20 years old and industry conditions that are expected to be representative of current industry conditions.
	Metric 5: Sample Size	Medium	Sample distribution characterized by a range with uncertain statistics.
Domain 3: Accessibility/ Clarity	Metric 6: Metadata Completeness	High	All data sources, methods, results, and assumptions are clearly documented.
Domain 4: Variability and Uncertainty	Metric 7: Metadata Completeness	Medium	Uncertainty not addressed. Variability addressed by considering multiple plastic and additive types.

### Overall Quality Determination

**High**

<b>Study Citation:</b>	U.S. EPA, (1991). Granular detergents manufacture - generic scenario for estimating occupational exposures environmental releases: Draft.			
<b>HERO ID:</b>	6385740			
<b>Conditions of Use:</b>	Formulation of powder products			
EXTRACTION				
Parameter	Data			
Life cycle description:	Granular Detergent Manufacture			
Process description:	Raw material receipt and storage, paste making (surfactant), adding additives, mixing and pumping, spray drying, cooling/screening/mixing, packaging			
Throughput:	300,000-500,000 kg detergent/site-day			
Number of sites:	Provides estimate for estimating number of sites			
Chemical concentration:	Provides conc. estimates based on function of chemical in product: <0.5% for perfumes or fragrances			
EVALUATION				
Domain	Metric	Rating	Comments	
Domain 1: Reliability	Metric 1: Methodology	High	Assessment uses high quality data/techniques/methods from frequently-used sources (EPA).	
Domain 2: Representativeness	Metric 2: Geographic Scope	High	This GS is based on U.S. data	
	Metric 3: Applicability	Medium	Data are for manufacture of granulated detergents, which is similar to the in-scope occupational scenario for the formulation of powders.	
	Metric 4: Temporal Representativeness	Low	Assessment is based on data greater than 20 years old.	
	Metric 5: Sample Size	Medium	Sample distribution characterized by a range with uncertain statistics.	
Domain 3: Accessibility/ Clarity	Metric 6: Metadata Completeness	High	All data sources, methods, results, and assumptions are clearly documented.	
Domain 4: Variability and Uncertainty	Metric 7: Metadata Completeness	Medium	Uncertainty not addressed. Variability addressed by considering multiple chemical functions	
Overall Quality Determination		Medium		

<b>Study Citation:</b>	U.S. EPA, (2014). Use of additive in plastic compounding - generic scenario for estimating occupational exposures and environmental releases: Draft.			
<b>HERO ID:</b>	6385748			
<b>Conditions of Use:</b>	Processing; Plastics Compounding			
<b>EXTRACTION</b>				
<b>Parameter</b>	<b>Data</b>			
Process description:	Polymer pellets/resins received, blending/compounding into masterbatch, extrusion/shaping, packaging			
Throughput:	Provides methodology for estimating throughput based on the amount of plastic produced, and the concentration of the chemical additive in the plastic			
Number of sites:	'Provides methodology for estimating number of sites based on chemical PV, the amount of plastic produced, and the concentration of the chemical additive in the plastic			
Chemical concentration:	'Provides conc. estimates based on additive function in various plastics, not chemical specific.			
<b>EVALUATION</b>				
Domain	Metric	Rating	Comments	
Domain 1: Reliability	Metric 1: Methodology	High	Assessment uses high quality data/techniques/methods from frequently-used sources.	
Domain 2: Representativeness	Metric 2: Geographic Scope	High	This GS is based on U.S. data	
	Metric 3: Applicability	Medium	Data is for an in-scope occupational scenario; however, data is general and not specific to a chemical.	
	Metric 4: Temporal Representativeness	Medium	Assessment is generally based on data greater than 10 years old but no more than 20 years old and industry conditions that are expected to be representative of current industry conditions.	
	Metric 5: Sample Size	Medium	Sample distribution characterized by a range with uncertain statistics.	
Domain 3: Accessibility/ Clarity	Metric 6: Metadata Completeness	High	All data sources, methods, results, and assumptions are clearly documented.	
Domain 4: Variability and Uncertainty	Metric 7: Metadata Completeness	Medium	Uncertainty not addressed. Variability addressed by considering multiple plastic and additive types.	
<b>Overall Quality Determination</b>		<b>High</b>		

<b>Study Citation:</b>	ACA, (2019). Comment submitted by Raleigh Davis, Assistant Director and Riaz Zaman, Counsel, Government Affairs, American Coatings Association (ACA) regarding the proposed 20 high priority candidates for chemical risk evaluation.			
<b>HERO ID:</b>	10369850			
<b>Conditions of Use:</b>	Use of Paint and Coatings			
EXTRACTION				
Parameter		Data		
Chemical concentration:		an impurity in amounts less then 0.1%.		
EVALUATION				
Domain		Metric	Rating	Comments
Domain 1: Reliability	Metric 1:	Methodology	Medium	The assessment or report uses high quality data and/or techniques or sound methods that are not from a frequently used source and associated information does not indicate flaws or quality issues.
Domain 2: Representativeness	Metric 2:	Geographic Scope	High	U.S. data
	Metric 3:	Applicability	Low	The report is for an occupational scenario (paints, coatings, sealants and adhesives) not within the scope of the risk evaluation, however, it may be similar to occupational scenarios within the scope of the risk evaluation.
	Metric 4:	Temporal Representativeness	High	The report is generally no more than 10 years old.
	Metric 5:	Sample Size	Low	characterized by no statistics.
Domain 3: Accessibility/ Clarity	Metric 6:	Metadata Completeness	Low	Assessment or report provides results, but the underlying methods, data sources, and assumptions are not fully transparent.
Domain 4: Variability and Uncertainty	Metric 7:	Metadata Completeness	Low	The report does not address variability or uncertainty.
Overall Quality Determination			Low	



<b>Study Citation:</b>	APR, (2020). U.S. post-consumer plastic recycling data.			
<b>HERO ID:</b>	11360400			
<b>Conditions of Use:</b>	Recycling			
EXTRACTION				
Parameter	Data			
Production, import, or use volume:	”In 2020, a minimum of 4,803.8 million pounds of post-consumer plastic material sources in the U.S. was recovered for recycling in the categories of Bottles (by resin), Non-bottle Rigid, Film, and Other Plastics (excluding foam).”			
Life cycle description:	% of total recovered for recycling: All bottles: 57.1%PET Bottles: 36.8%HDPE Bottles: 19.6% PP & Other Bottles: 0.7%Non-bottle Rigid: 22.0%Film: 20.5%Other Plastics: 0.3%			
EVALUATION				
Domain	Metric	Rating	Comments	
Domain 1: Reliability	Metric 1: Methodology	High	Report uses high quality data from frequently-used sources.	
Domain 2: Representativeness	Metric 2: Geographic Scope	High	Data are from the U.S.	
	Metric 3: Applicability	High	Data are for recycling, an in-scope occupational scenario.	
	Metric 4: Temporal Representativeness	High	Report is based on current industry conditions and data no more than 10 years old.	
	Metric 5: Sample Size	Low	Sample distribution is characterized by no statistics.	
Domain 3: Accessibility/ Clarity	Metric 6: Metadata Completeness	Medium	Assessment or report clearly documents results, methods, and assumptions. Data sources are generally described but not fully transparent.	
Domain 4: Variability and Uncertainty	Metric 7: Metadata Completeness	Medium	Variability addressed by describing amounts of recycled products for several categories but uncertainty is not addressed.	
Overall Quality Determination		High		

<b>Study Citation:</b>	AS., COWI (2018). Screening programme 2017: Suspected PBT compounds.
<b>HERO ID:</b>	7303021
<b>Conditions of Use:</b>	Disposal

EXTRACTION	
Parameter	Data
Process description:	annual water treatment and discharge from VEAS is 100-110 million m <sup>3</sup> .; total landfill area at ROAF waste disposal is approx. 2 100 000 m <sup>3</sup> . Residual volume is approximately 800 000 m <sup>3</sup> .; The sludge from VEAS has undergone anaerobic stabilization (including the addition of lime), hygienization and drying to over 45% dry matter.; The sludge from HIAS is treated by thermal hydrolysis (Cambiprocess at 160°C) prior to anaerobic digestion at 38°C. The total landfill area is approx. 2100 000 m <sup>3</sup> , residual volume is approximately 800000 m <sup>3</sup> . ROAF pre-treats run-off water in two ABR-reactors before it discharges to the municipal sewer system.
Number of sites:	2 WWTPs; 1 landfill; 1 office building, 1 hospital, 1 school

EVALUATION			
Domain	Metric	Rating	Comments
Domain 1: Reliability	Metric 1: Methodology	High	Report uses high quality methods from frequently-used sources(e.g., International Environmental Agencies).
Domain 2: Representativeness	Metric 2: Geographic Scope	Medium	Data are from Norway, an OECD country.
	Metric 3: Applicability	High	Data are for Disposal, an in-scope occupational scenario.
	Metric 4: Temporal Representativeness	High	Report is based on current industry conditions and data no more than 10 years old. 2017
	Metric 5: Sample Size	N/A	Not applicable for extracted data.
Domain 3: Accessibility/ Clarity	Metric 6: Metadata Completeness	High	All data sources, methods, results, and assumptions are clearly documented.
Domain 4: Variability and Uncertainty	Metric 7: Metadata Completeness	High	The report addresses uncertainty by discussion of potential uncertainty throughout testing and variability addressed by information at multiple waste management locations at multiple times throughout the year.

<b>Overall Quality Determination</b>	<b>High</b>
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<b>Study Citation:</b>	Aschmann, S. M., Arey, J., Atkinson, R., Simonich, S. L. (2001). Atmospheric lifetimes and fates of selected fragrance materials and volatile model compounds. Environmental Science & Technology 35(18):3595-3600.			
<b>HERO ID:</b>	19035			
<b>Conditions of Use:</b>	Manufacture			
EXTRACTION				
<b>Parameter</b>	<b>Data</b>			
Production, import, or use volume:	in 1995, 1482 metric tonnes of HHCB produced in Europe			
EVALUATION				
Domain	Metric		Rating	Comments
Domain 1: Reliability	Metric 1:	Methodology	Medium	Report uses data that are not from frequently-used sources but the sources are cited and there is no indication of flaws or quality issues.
Domain 2: Representativeness	Metric 2:	Geographic Scope	Medium	Data are from the EU, OECD countries
	Metric 3:	Applicability	High	Data are for manufacturing, an in-scope occupational scenario.
	Metric 4:	Temporal Representativeness	Low	Report is based on data greater than 20 years old and industry conditions that are expected to be outdated.
	Metric 5:	Sample Size	Low	Distribution of samples is characterized by no statistics
Domain 3: Accessibility/ Clarity	Metric 6:	Metadata Completeness	Low	Assessment results are provided but underlying methods, assumptions, and data sources are not fully transparent.
Domain 4: Variability and Uncertainty	Metric 7:	Metadata Completeness	Low	Variability and uncertainty are not addressed.
Overall Quality Determination			Low	

<b>Study Citation:</b>	Ashkin, S., Ellis, R. (2006). Cleaning materials and methods. :169-188.			
<b>HERO ID:</b>	9551178			
<b>Conditions of Use:</b>	Use of Liquid Cleaners; Use of Powder Cleaners			
<b>EXTRACTION</b>				
<b>Parameter</b>	<b>Data</b>			
Process description:	Cleaning process are divided into 3 broad categories: mechanical cleaning, chemical cleaning, and surface-abrasion cleaning			
Throughput:	The average janitor uses 23 gallons of chemicals per year; At level 2 cleaning, a custodian can clean approximately 18,000–20,000 square vs. 28,000–31,000 square feet for level 3 and 45,000–50,000 square feet in 8 hours for level 4 (2/20); In K–12schools, an average custodian is responsible forcleaning more than 23,000 square feet (5/20)			
<b>EVALUATION</b>				
Domain	Metric	Rating	Comments	
Domain 1: Reliability	Metric 1:	Methodology	Medium	Report uses high quality data that are not from a frequently used source and associated information does notindicate flaws or quality issues.
Domain 2: Representativeness	Metric 2:	Geographic Scope	High	Data are from the U.S.
	Metric 3:	Applicability	High	Data are for use in liquid and powder cleaners, in-scope occupational scenarios.
	Metric 4:	Temporal Representativeness	Medium	Report is based on data greater than 10 years old but no more than 20 years old and industry conditions that are expected to be representative of current industry conditions
	Metric 5:	Sample Size	Medium	Distribution of samples is characterized by a range with uncertain statistics.
Domain 3: Accessibility/ Clarity	Metric 6:	Metadata Completeness	High	All data sources, methods, results, and assumptions are clearly documented.
Domain 4: Variability and Uncertainty	Metric 7:	Metadata Completeness	Medium	Variability addressed but uncertainty is not addressed.
<b>Overall Quality Determination</b>		<b>High</b>		

<b>Study Citation:</b>	Balk, F., Ford, R. A. (1999). Environmental risk assessment for the polycyclic musks AHTN and HHCB in the EU. I. Fate and exposure assessment. Toxicology Letters 111(1-2):57-79.			
<b>HERO ID:</b>	5349126			
<b>Conditions of Use:</b>	Manufacture & Import			
EXTRACTION				
Parameter		Data		
Production, import, or use volume:		Throughout the EU, in 1995, the estimated use volume of HHCB was 1482 tonnes.		
EVALUATION				
Domain		Metric	Rating	Comments
Domain 1: Reliability	Metric 1:	Methodology	Medium	The assessment or report uses high quality data and/or techniques or sound methods that are not from a frequently used source and associated information does not indicate flaws or quality issues
Domain 2: Representativeness	Metric 2:	Geographic Scope	Medium	The data are from an OECD country other than the U.S., EU
	Metric 3:	Applicability	High	The report is for an occupational scenario within the scope of the risk evaluation.
	Metric 4:	Temporal Representativeness	Low	The report is more than 20 years old (1999).
	Metric 5:	Sample Size	Low	Distribution of samples is qualitative or characterized by no statistics.
Domain 3: Accessibility/ Clarity	Metric 6:	Metadata Completeness	Medium	Assessment or report clearly documents results, methods, and assumptions. Datasources are generally described but not fully transparent.
Domain 4: Variability and Uncertainty	Metric 7:	Metadata Completeness	Low	The report does not address variability or uncertainty.
Overall Quality Determination			Low	

<b>Study Citation:</b>	Bello, A., Quinn, M. M., Perry, M. J., Milton, D. K. (2009). Characterization of occupational exposures to cleaning products used for common cleaning tasks—a pilot study of hospital cleaners. Environmental Health 8:11.
<b>HERO ID:</b>	992639
<b>Conditions of Use:</b>	Use of Cleaning Products

**EXTRACTION**

Parameter	Data
Process description:	<p>preparation of cleaning solutions: Cleaning solutions were prepared in the preparation room and were later transported to each floor using a cart. In most of the cases, solutions were prepared using an automated dispensing system. Concentrated cleaning products were diluted to the ready to use (RTU) form at a certain dilution rate. The dilution rate differed from oneproduct to another; for example the dilution rate was higher for floor cleaners (rate = 3 gallon/min) than for glass cleaners (rate = 1 gallon/min). Only floor finishing products such as floor strippers were prepared by manual mixing.floor cleaning: Two methods of floor cleaning were observed: a) wet mopcleaning and b) microfiber mop cleaning. The traditional method involved dipping the mop into a bucket filled with cleaning solution. The second involved the use of the microfiber cloths that were soaked by hand in cleaning solution, used attached to a handle, and send to laundry after one room was cleaned. Floor cleaning was performed daily and its duration varied by the size of the room. For example, patient room cleaning required about 5–10 minutes and hallway floor cleaning required several hours.window/mirror cleaning: During these tasks the product was sprayed and then wiped with paper towels. The frequency of window cleaning was lower compared to other tasks. Windows were cleaned as needed and mostly in the main areas or hallways with glass doors. Bathroom mirrors were leaneddaily using glass cleaners.toilet bowl/sink cleaning: Bathroom cleaning involved several cleaning tasks such as: sink cleaning, mirror cleaning, toilet bowl cleaning, and floor cleaning and required application of many products, specific for each task. For mirror and sink cleaning the product was sprayed and wiped with paper towels. During toilet bowl cleaning the product was sprayed into the toilet bowl, followed by brushing with a toilet cleaning brush. In general, bathrooms were cleaned two times per day. The average cleaning time varied from 10–15 minutes.floor finishing tasks (buffing, waxing and stripping): During stripping the floor stripper was applied and left to reside on the floor for about 10 minutes. Then the old floor finish and the residue of the stripper were removed by using a stripping and a wet vacuum machine. Floor waxing was performed after stripping by mopping the protective coat on the floor. After waxing the floor was left for about 20–40 minutes to dry, depending on the indoor air temperature and humidity. Fans were usually used to speed up this drying process. Floor stripping was performed twice a year and in cases when floors were worn or scratched. Floor buffing was needed more frequently, and was performed by spraying the solution and finishing the localized area with a buffing machinepatient room cleaning: Patient room cleaning involved combination of several cleaning tasks, such as floor, counters and bathroom cleaning tasks. An example of a patient room cleaning flow chart is given in Figure 1. The workers were responsible for cleaning a certain number of patient rooms (in one case, 22 rooms) during the work shift.</p>
Chemical concentration:	<p>% of fragrance in products: Neutral cleaner concentrate (floor cleaner)- &lt;2; disinfectant cleaner concentrate (general purpose cleaner)- 0.5-1.5; bath mate acid free disinfectant washroom concentrate (bathroom cleaner)- 3-5; bathroom cleaner concentrate- 1-5;non acid bathroom cleaner- 1-5; non acid bathroom cleaner RTU- &lt;1; Glass Cleaner Concentrate- 1-5</p>

**EVALUATION**

Domain	Metric	Rating	Comments
Domain 1: Reliability	Metric 1: Methodology	Medium	The report uses site surveys and MSDSs which are sound methods that is not from a frequently used source and associated information does not indicate flaws or quality issues.
Domain 2: Representativeness	Metric 2: Geographic Scope	High	The data are from the United States
	Metric 3: Applicability	Medium	Data are for use of cleaning products, but do not specifically identify HHCB as a part of the cleaning product mixture
	Metric 4: Temporal Representativeness	Medium	More than 10 years but less than 20 years old.
	Metric 5: Sample Size	Medium	Distribution of samples is characterized by a range with uncertain statistics.

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# General Engineering Assessment

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<b>Study Citation:</b>	Bello, A., Quinn, M. M., Perry, M. J., Milton, D. K. (2009). Characterization of occupational exposures to cleaning products used for common cleaning tasks—a pilot study of hospital cleaners. Environmental Health 8:11.
<b>HERO ID:</b>	992639
<b>Conditions of Use:</b>	Use of Cleaning Products

Domain	Metric	EVALUATION		Comments
		Rating		
Domain 3: Accessibility/ Clarity				
	Metric 6: Metadata Completeness	High		Report clearly document its sources for the process description and concentration data.
Domain 4: Variability and Uncertainty				
	Metric 7: Metadata Completeness	High		The report addresses uncertainty by using industrial hygiene worksite observation, interviews with workers, and videotaping of cleaning. The report addresses variability by investigating 6 hospitals, but the hospitals are all from Eastern Michigan.

**Overall Quality Determination**

**High**

<b>Study Citation:</b>	Berding, V., Koormann, F., Schwartz, S., Wagner, J. O., Matthies, M. (2001). Spatial refinement of regional exposure assessment. NATO Science Series IV Earth and Environmental Sciences 2:205-222.
<b>HERO ID:</b>	5428645
<b>Conditions of Use:</b>	Manufacture

EXTRACTION	
Parameter	Data
Production, import, or use volume:	1,000 ton world-wide in 1990; 1992 consumption of 2400 ton in Europe; 1994 consumption of 1,482 ton

EVALUATION				
Domain	Metric		Rating	Comments
Domain 1: Reliability	Metric 1:	Methodology	High	Report uses high quality data from frequently-used sources.
Domain 2: Representativeness	Metric 2:	Geographic Scope	Medium	Data are from Germany, an OECD country.
	Metric 3:	Applicability	High	Data are for manufacture, an in-scope occupational scenario.
	Metric 4:	Temporal Representativeness	Low	Report is based on data greater than 20 years old and industry conditions that are expected to be outdated.
	Metric 5:	Sample Size	Low	Sample distribution is characterized by no statistics.
Domain 3: Accessibility/ Clarity	Metric 6:	Metadata Completeness	High	All data sources, methods, results, and assumptions are clearly documented.
Domain 4: Variability and Uncertainty	Metric 7:	Metadata Completeness	Low	Variability and uncertainty are not addressed.

<b>Overall Quality Determination</b>	<b>Medium</b>
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<b>Study Citation:</b>	Consulting,, Integral (2021). Analysis of monitoring data for HHCB in surface waters of the United States from 2015 to 2021.			
<b>HERO ID:</b>	8729831			
<b>Conditions of Use:</b>	Manufacture/Import			
EXTRACTION				
Parameter	Data			
Production, import, or use volume:	"According to the Fragrance Creators Association (FCA 2021), the HHCB use concentration in 2015 ranged between 1,000,000 to 2,000,000 lb in North America (including Canada)."...the population of the United States is approximately 90% of that for all of North America, we can assume a U.S. use volume between 900,000 to 1,800,000 lb (408,237 to 816,475 kg).			
EVALUATION				
Domain	Metric	Rating	Comments	
Domain 1: Reliability	Metric 1: Methodology	Low	The report uses data that are not from a frequently used source and not information to determine method of estimation.	
Domain 2: Representativeness	Metric 2: Geographic Scope	High	The data are from the United States	
	Metric 3: Applicability	High	The report is for an occupational scenario within the scope of the risk evaluation.	
	Metric 4: Temporal Representativeness	High	The report is generally no more than 10 years old.	
	Metric 5: Sample Size	Medium	Distribution of samples is characterized by a range with uncertain statistics.	
Domain 3: Accessibility/ Clarity	Metric 6: Metadata Completeness	High	Assessment clearly documents its data sources and assumptions.	
Domain 4: Variability and Uncertainty	Metric 7: Metadata Completeness	Low	Does not address variability or uncertainty	
Overall Quality Determination		Medium		

<b>Study Citation:</b>	Correia, P., Cruz, A., Santos, L., Alves, A. (2013). Human dermal exposure to galaxolide from personal care products. International Journal of Cosmetic Science 35(3):299-309.			
<b>HERO ID:</b>	1863036			
<b>Conditions of Use:</b>	Personal care products			
EXTRACTION				
<b>Parameter</b>	<b>Data</b>			
Chemical concentration:	various conc. in fda regluated products			
EVALUATION				
Domain	Metric	Rating	Comments	
Domain 1: Reliability	Metric 1:	Methodology	Medium	The assessment or report uses high quality data and/or techniques or sound methods that are not from a frequently used source and associated information does not indicate flaws or quality issues.
Domain 2: Representativeness	Metric 2:	Geographic Scope	Medium	The data are from Portugal (OECD country)
	Metric 3:	Applicability	Uninformative	Non-tsca products
	Metric 4:	Temporal Representativeness	High	The report captures operations, equipment, and worker activities expected to be representative of current conditions. The report is generally no more than 10 years old.
	Metric 5:	Sample Size	Low	Distribution of samples is qualitative or characterized by no statistics.
Domain 3: Accessibility/ Clarity	Metric 6:	Metadata Completeness	High	Assessment or report clearly documents its data sources, assessment methods, results, and assumptions.
Domain 4: Variability and Uncertainty	Metric 7:	Metadata Completeness	Medium	The report provides only limited discussion of the variability and uncertainty in the results.
Overall Quality Determination		Uninformative		

<b>Study Citation:</b>	ENF, (2024). Plastic recycling plants in the United States.			
<b>HERO ID:</b>	11360395			
<b>Conditions of Use:</b>	Recycling			
<b>EXTRACTION</b>				
<b>Parameter</b>	<b>Data</b>			
Number of sites:	59 plants in the U.S. recycle plastics into various forms, including granules/pellets and flakes. The document lists all plants along with hyperlinks to their address and other metadata.			
<b>EVALUATION</b>				
Domain	Metric	Rating	Comments	
Domain 1: Reliability	Metric 1: Methodology	High	Report uses high quality data from frequently-used sources.	
Domain 2: Representativeness	Metric 2: Geographic Scope	High	Data are from the U.S.	
	Metric 3: Applicability	High	Data are for recycling, an in-scope occupational scenario.	
	Metric 4: Temporal Representativeness	High	Report is based on current industry conditions and data no more than 10 years old.	
	Metric 5: Sample Size	N/A	N/A - number of sites.	
Domain 3: Accessibility/ Clarity	Metric 6: Metadata Completeness	High	All data sources, methods, results, and assumptions are clearly documented.	
Domain 4: Variability and Uncertainty	Metric 7: Metadata Completeness	N/A	N/A - number of sites.	
<b>Overall Quality Determination</b>		<b>High</b>		

<b>Study Citation:</b>	Espinoza, T., Geiger, C., Everson, I. (2010). The real costs of institutional ”green” cleaning.			
<b>HERO ID:</b>	9551187			
<b>Conditions of Use:</b>	Use of Cleaning Products			
EXTRACTION				
Parameter	Data			
Throughput:	Table 1: Chemical use/day is 0.5 oz/day (Microfiber mop to clean 22 rooms)10.5 oz/day using a conventional wet loop mop to clean 20 rooms.p.10 ”Unit as sold quantities range from 1-12 containers per order and container sizes range from 1 quart to 55 gallons”			
EVALUATION				
Domain	Metric	Rating	Comments	
Domain 1: Reliability	Metric 1: Methodology	High	The assessment or report uses data that are from frequently used sources (data from a study done by the EPA).	
Domain 2: Representativeness	Metric 2: Geographic Scope	High	The data are from the United States and are representative of the industry being evalu-ated.	
	Metric 3: Applicability	Medium	The report is for an occupational scenario, cleaning products, within the scope of the risk evaluation; however, data is general and not specific to a chemical.	
	Metric 4: Temporal Representativeness	Medium	The report captures operations, equipment, and worker activities that are expected to be reasonably representative of current conditions. The report is generally more than 10 years but no more than 20 years old (2010).	
	Metric 5: Sample Size	Medium	Distribution of samples is characterized by a range with uncertain statistics.	
Domain 3: Accessibility/ Clarity	Metric 6: Metadata Completeness	Medium	Assessment or report clearly documents results, and assumptions. Data sources are generally described but not fully transparent.	
Domain 4: Variability and Uncertainty	Metric 7: Metadata Completeness	Low	The report does not address variability or uncertainty.	
Overall Quality Determination		Medium		

<b>Study Citation:</b>	FCA, (2021). Site emission survey of fragrance formulation compounders and product manufacturers using HHCB: Information to support the TSCA risk evaluation; with comment, dated 08/05/2021.
<b>HERO ID:</b>	8802195
<b>Conditions of Use:</b>	Compounding of Fragrance Oils, Formulation of Liquid/Powder Products

EXTRACTION	
Parameter	Data
Process description:	Raw materials from vendor added to process vessel or sent to storage (pumped or poured manually) -> Formulated -> Packaged (p.14)
Throughput:	Most batches were approximately 1,000 kg or smaller, and the most common means of transfer of finished product for filling was pumping. (p. 21)Batch Weight (kg) - 19 to 8,000 (4 resp.); 95 to 1,140 (13 resp.); 1,900 to 44,035 (5 resp.); 10,000 to 22,000 (p. 22)Usage of HHCB at many product formulation sites is very small (<100 kg per year) (p. 29)"10.75 kg is max annual usage for any HHCB" ;"70.2 kg is the max annual usage for any 1222- 05-5 (substance) in a years time" (p.23)
Number of sites:	Fragrance oil formulators: Fragrance formulation compounders: 1 (5 resp.), 57 (1 resp.) Finished product manufacturer sites: 5-6 (2 resp.)Finished product formulators: 1– 500(p. 19)

		EVALUATION	
Domain	Metric	Rating	Comments
Domain 1: Reliability			
	Metric 1: Methodology	Medium	The assessment or report uses sound methods from an industry survey, however, name of site is withheld. It does not appear to indicate flaws or quality issues with how the survey was conducted.
Domain 2: Representativeness			
	Metric 2: Geographic Scope	High	The data are from the United States and are representative of the industry being evaluated.
	Metric 3: Applicability	High	The report is for an occupational scenario within the scope of the risk evaluation.
	Metric 4: Temporal Representativeness	High	The report captures operations, equipment, and worker activities expected to be representative of current conditions. The report is generally no more than 10 years old.
	Metric 5: Sample Size	High	Statistical distribution of samples is fully characterized. Specific survey results are provided in appendix. Sample size is sufficiently representative.
Domain 3: Accessibility/ Clarity			
	Metric 6: Metadata Completeness	Medium	Assessment or report clearly documents results, methods, and assumptions. Datasources are generally described but not fully transparent..
Domain 4: Variability and Uncertainty			
	Metric 7: Metadata Completeness	Medium	The report provides only limited discussion of the variability and uncertainty in the results.

<b>Overall Quality Determination</b>	<b>High</b>
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<b>Study Citation:</b>	Gerster, Melchior, F., Hopf, Brenna, N., Wild, Pierre, P., Vernez, D. (2014). Airborne exposures to monoethanolamine, glycol ethers, and benzyl alcohol during professional cleaning: a pilot study. Annals of Occupational Hygiene 58(7):846-859.
<b>HERO ID:</b>	2452666
<b>Conditions of Use:</b>	Use of Cleaning Products

EXTRACTION	
Parameter	Data
Process description:	Intensive floor cleaning- emptied rooms and corridors, the top floor layer was removed and replaced by new one, only one cleaning product used; Apartment cleaning- apartments, bathroom, kitchen, floor, window, and general surface cleaning, large number of cleaning products uses, no other persons present during cleaning;Industrial Cleaning- construction sites and workshop halls, floor and general surface cleaning, other chemical substances than cleaning products likely present, other persons present during cleaning;Public Space Cleaning- any kind of public corridors, rooms, and bathrooms, bathroom, floor, window, and general surface cleaning, other chemical substances than cleaning products likely present, other persons present during cleaning.Patient room cleaning- hospitals, bathroom, kitchen, floor, window, and general surface cleaning, other chemical substances than cleaning products likely present, other persons present during cleaning

EVALUATION				
Domain	Metric		Rating	Comments
Domain 1: Reliability	Metric 1:	Methodology	Medium	Report uses sound methods, not from frequently used sources, and associated information does not indicate flaws.
Domain 2: Representativeness	Metric 2:	Geographic Scope	Medium	The data are from an OECD country other than the U.S.
	Metric 3:	Applicability	High	Data are for use of cleaning products, but do not specifically identify HHCB as a part of the cleaning product mixture.
	Metric 4:	Temporal Representativeness	High	The report (2014) is generally no more than 10 years old.
	Metric 5:	Sample Size	N/A	No quantitative information.
Domain 3: Accessibility/ Clarity	Metric 6:	Metadata Completeness	Medium	Report clearly documents results and assumption but sources are not fully transparent.
Domain 4: Variability and Uncertainty	Metric 7:	Metadata Completeness	Medium	The report provides only limited discussion of the variability and uncertainty in the information.

<b>Overall Quality Determination</b>	<b>Medium</b>
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<b>Study Citation:</b>	International Code Council, (2020). 2021 International Plumbing Code (IPC), Chapter 4: Fixtures, faucets, and fixture fittings.			
<b>HERO ID:</b>	13027721			
<b>Conditions of Use:</b>	Commercial Use – Cleaning and Furnishing Care Products - All-Purpose Foam Spray Cleaner; All-Purpose Liquid Cleaner/Polish; All-Purpose Liquid Spray Cleaner; All-Purpose Waxes and Polishes; Appliance Cleaners; Drain and Toilet Cleaners (Liquid); Powder Cleaners (Floors); Powder Cleaners (Porcelain)			
EXTRACTION				
Parameter	Data			
Throughput:	Page 2 "1 per 25 of the first 50 and 1 per 50 for the remainder exceeding 50". This is referring to minimum number of toilets required for each gender in business buildings. This information is used in the assessment of throughput for the use of cleaning products condition of use.			
EVALUATION				
Domain	Metric		Rating	Comments
Domain 1: Reliability	Metric 1:	Methodology	High	Data is from the International Plumbing Code (IPC) which establishes installation mini- mums for buildings.
Domain 2: Representativeness	Metric 2:	Geographic Scope	High	IPC is based in the United States.
	Metric 3:	Applicability	High	The information in this source pertains to the use of cleaning products, an in-scope condition of use.
	Metric 4:	Temporal Representativeness	High	Report is based on current industry conditions and data no more than 10 years old. Data comes from 2021 IPC.
	Metric 5:	Sample Size	N/A	Information is not clearly based on statistical sampling.
Domain 3: Accessibility/ Clarity	Metric 6:	Metadata Completeness	N/A	Information is not clearly based on statistical sampling.
Domain 4: Variability and Uncertainty	Metric 7:	Metadata Completeness	N/A	Information is not clearly based on statistical sampling.
Overall Quality Determination			High	

Study Citation:	Milbrandt, A., Coney, K., Badgett, A., Beckham, G. T. (2022). Quantification and evaluation of plastic waste in the United States. Resources, Conservation and Recycling 183:106363.			
HERO ID:	11360398			
Conditions of Use:	Disposal			
EXTRACTION				
Parameter	Data			
Production, import, or use volume:	Total Plastic Waste Managed in U.S. in 2019:PET: 5,986 ktHDPE: 7,910 ktPP: 8,189 ktLDPE/LLDPE: 15,139 ktPVC: 699 ktPS/EPS: 3,094 ktOther: 3,115 kt			
Life cycle description:	Percentage of total plastic waste managed by category:PET: 14%HDPE: 18%PP: 19%LDPE/LLDPE: 34%PVC: 2%PS/EPS: 7%Other: 7%			
EVALUATION				
Domain	Metric		Rating	Comments
Domain 1: Reliability	Metric 1:	Methodology	High	Report uses high quality data from frequently-used sources.
Domain 2: Representativeness	Metric 2:	Geographic Scope	High	Data are from the U.S.
	Metric 3:	Applicability	Medium	Data are for disposal, an in-scope occupational scenario; however, the data are not chemical specific.
	Metric 4:	Temporal Representativeness	High	Report is based on current industry conditions and data no more than 10 years old.
	Metric 5:	Sample Size	Medium	Distribution of samples is characterized by a range with uncertain statistics.
Domain 3: Accessibility/ Clarity	Metric 6:	Metadata Completeness	High	All data sources, methods, results, and assumptions are clearly documented.
Domain 4: Variability and Uncertainty	Metric 7:	Metadata Completeness	Medium	Variability addressed by discussing multiple types of plastic products but uncertainty is not addressed.
Overall Quality Determination			High	



<b>Study Citation:</b>	Nazaroff, W. W., Coleman, B. K., Destailats, H., Hodgson, A. T., Liu, D.,-L, Lunden, M. M., Singer, B. C., Weschler, C. J. (2006). Indoor air chemistry: Cleaning agents, ozone and toxic air contaminants.
<b>HERO ID:</b>	4682850
<b>Conditions of Use:</b>	Use of Liquid Cleaning Products

EXTRACTION	
Parameter	Data
Throughput:	Spray cleaner use rate (p. 80): "The calculated geometric means (GM) and geometric standard deviations (GSD) of the distributions were 6.0 g/m-2 and 1.9 g/m-2 for the trigger spray cleaner (GPC-3)[Appendix C.10] and 6.7 g/m-2 and 2.5 g/m-2 for one of the liquid cleaner and disinfectants (GPC-1). To obtain high but realistic product use rates, we chose levels corresponding to the measured GM $\times$ GSD, yielding application rates of approximately 11 and 17 g /m-2 (~ 1 and 1.6 g /ft-2) for the trigger spray and liquid cleaner/disinfectant, respectively"
Comments:	Table C.12. Measured masses (g) of solutions and cleaning equipment during mopping experiments; Table C.13. Measured masses (grams) of cleaning products and equipment for full strength, counter-cleaning experiments.

EVALUATION			
Domain	Metric	Rating	Comments
Domain 1: Reliability	Metric 1: Methodology	High	The report uses high quality data and sound methods and are generally accepted by the scientific community, and associated information does not indicate flaws or quality issues.
Domain 2: Representativeness	Metric 2: Geographic Scope	High	The data are from the United States and are representative of the industry being evaluated.
	Metric 3: Applicability	Medium	The report is for an occupational scenario within the scope of the risk evaluation, however not specific to the chemical
	Metric 4: Temporal Representativeness	Medium	The report captures operations, equipment, and worker activities that are expected to be reasonably representative of current conditions. The report is generally more than 10 years but no more than 20 years old (2006).
	Metric 5: Sample Size	High	Distribution of samples is provided in the appendix. Sample size is sufficiently representative.
Domain 3: Accessibility/ Clarity	Metric 6: Metadata Completeness	High	Assessment or report clearly documents its data sources, assessment methods, results, and assumptions.
Domain 4: Variability and Uncertainty	Metric 7: Metadata Completeness	Low	The report does not address variability or uncertainty.

<b>Overall Quality Determination</b>	<b>High</b>
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## General Engineering Assessment

<b>Study Citation:</b>	P&G, (2023). Comments of The Procter & Gamble Company on 1,4-Dioxane: Draft Supplement to the TSCA Risk Evaluation Science Advisory Committee on Chemicals (SACC) Meeting.
<b>HERO ID:</b>	11333406
<b>Conditions of Use:</b>	Commercial Use – Laundry and Dishwashing Products - Laundry Detergent (Liquid); Laundry Detergent (Unit Dose/Granule); Fabric Enhancers; Stain Removers; Dry Cleaning and Associated Products; Dishwashing Detergent (Liquid/ Gel); Dishwashing Detergent (Unit Dose/ Granule); Dishwashing Detergent Liquid (Hand-Wash)

## EXTRACTION

Parameter	Data
Process description:	The required and standard method for washing dishes is the 3-compartment sink of Wash-Rinse-Sanitize. The first sink is filled with hand dish detergent solution, the 2nd compartment is potable water for rinsing, and the 3rd sink is filled with a sanitizing solution. As the temperature of the dish sink water is 110°F, it is necessary to convert the vapor pressure at room temperature to the temperature of the dish sink water. Auto dishwashing machines run in discrete cycles, each one lasting a couple minutes in length (loading rack, washing racks, emptying racks). An employee working 8 hours would run approximately 160 cycles over the shift where they would be exposed to anything in the vapor at the end of the wash when the door is opened.
Throughput:	Chronic Assessments Onlya. Frequency of Use (events/year): 250b. Duration of Use (min/use): 40c. Mass of Product Used (g/use): 14817. Acute Assessments Onlya. Frequency of Use (events/day): 3b. Duration of use (min/use): 13.3c. Mass of Product Used (g/use): 148
Comments:	Source also supplies assessment methodologies and recommendations for inhalation and dermal exposure.

## EVALUATION

Domain	Metric	Rating	Comments
Domain 1: Reliability	Metric 1: Methodology	High	Report uses high quality data from frequently-used sources.
Domain 2: Representativeness	Metric 2: Geographic Scope	High	Data are from the U.S.
	Metric 3: Applicability	High	Data are for use of dishwasher detergent, an in-scope condition of use.
	Metric 4: Temporal Representativeness	Medium	Report is based on some data greater than 20 years old, but industry conditions are not expected to be outdated.
	Metric 5: Sample Size	Low	Sample distribution is described qualitatively.
Domain 3: Accessibility/ Clarity	Metric 6: Metadata Completeness	High	All data sources, methods, results, and assumptions are clearly documented.
Domain 4: Variability and Uncertainty	Metric 7: Metadata Completeness	Low	Variability and uncertainty are not addressed.

## Overall Quality Determination

Medium

<b>Study Citation:</b>	RIVM, (2018). Cleaning Products Fact Sheet: Default parameters for estimating consumer exposure (updated version 2018).
<b>HERO ID:</b>	13027719
<b>Conditions of Use:</b>	Commercial Use – Cleaning and Furnishing Care Products - All-Purpose Foam Spray Cleaner; All-Purpose Liquid Cleaner/Polish; All-Purpose Liquid Spray Cleaner; All-Purpose Waxes and Polishes; Appliance Cleaners; Drain and Toilet Cleaners (Liquid); Powder Cleaners (Floors); Powder Cleaners (Porcelain)

EXTRACTION	
Parameter	Data
Throughput:	Page 46. "a wet surface holds 40 mL water per m <sup>2</sup> " which is used to estimate amount of floor cleaning liquid used per square meter of floor;Page 125. "The product amount depends on the type of toilet cleaner: acid- or bleach-based. According to Weegels (1997), the average amount bleach agents used is 55 g and the 75th percentile is 80 g (St. Dev=37 g, n=9). For acid agents Weegels found an average amount of 40 g and a 75th percentile of 55 g (St. Dev=22g, n=12). AISE only gives 30 g as a typical amount for liquid toilet cleaners, whereas for gel toilet cleaners the typical amount is set as 25 g with a range from 20 to 35 g (AISE, 2014). Therefore, the default product amounts for inhalation are still based on Weegels' 75th percentiles: 80 g for bleach and 55 g for acids" For powder carpet cleaner: 50-100 g per m2 based on a Vanish powder product in Europe with an assumption of a 22m2 area. Exposure duration of 30 min.
Comments:	Source contains recommended amounts used, application times and other exposure parameters for consumers for use of consumer products

EVALUATION				
Domain	Metric		Rating	Comments
Domain 1: Reliability	Metric 1:	Methodology	Low	Report does not specify the data methodology used.
Domain 2: Representativeness	Metric 2:	Geographic Scope	Medium	Data are from the Netherlands, an OECD country.
	Metric 3:	Applicability	High	Data are for the Use of Cleaning Products, an in-scope condition of use.
	Metric 4:	Temporal Representativeness	Medium	Report is based on data greater than 10 years old but no more than 20 years old and industry conditions that are expected to be representative of current industry conditions.
	Metric 5:	Sample Size	Medium	Sample distribution characterized by limited statistics (medians, modes, and percentiles) but discrete samples not provided and distribution not fully characterized.
Domain 3: Accessibility/ Clarity	Metric 6:	Metadata Completeness	Medium	Assessment or report clearly documents results, data sources and assumptions. Data methods are generally described but not fully transparent.
Domain 4: Variability and Uncertainty	Metric 7:	Metadata Completeness	Low	Variability and uncertainty are not addressed.

<b>Overall Quality Determination</b>	<b>Medium</b>
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<b>Study Citation:</b>	RIVM, (1997). Environmental risk assessment of the polycyclic musks AHTN and HHCB according to the EU-TGD.			
<b>HERO ID:</b>	5349388			
<b>Conditions of Use:</b>	Fragrance Oils			
<b>EXTRACTION</b>				
<b>Parameter</b>	<b>Data</b>			
Production, import, or use volume:	Use volume of HHCB in Europe (in tonnes):1992: 2,4001995: 1,482			
Life cycle description:	PDF Pg. 20"According to RIFM the volumes for 1995 account for approximately 88% with a range of 81-95% of the total use volume".PDF Pg. 24 Use of fragrance oils per product category in the EU (1995):Detergents: 24.3%Fabric Softeners: 14.2%Soaps: 9.1%Personal Care: 13.2%Fine Fragrances: 5.1%Hair Care: 10.2%Bath and Shower: 10.2%Industrial and household cleaners: 7.6%Other (air freshener, candles, potpurri, masking, paper): 6.1%			
Chemical concentration:	PDF Pg. 20 "due to the high viscosity of pure HHCB commercial HHCB is a c. 65% solution in a neutral solvent"			
<b>EVALUATION</b>				
Domain	Metric	Rating	Comments	
Domain 1: Reliability	Metric 1:	Methodology	High	Report uses high quality data/techniques/methods from frequently-used sources.
Domain 2: Representativeness	Metric 2:	Geographic Scope	Medium	Data are from the Netherlands, an OECD country.
	Metric 3:	Applicability	High	Data are for fragrance oils, an in-scope occupational scenario.
	Metric 4:	Temporal Representativeness	Low	Report is based on data greater than 20 years old and industry conditions that are expected to be outdated.
	Metric 5:	Sample Size	Medium	Sample distribution characterized by a range with uncertain statistics.
Domain 3: Accessibility/ Clarity	Metric 6:	Metadata Completeness	High	All data sources, methods, results, and assumptions are clearly documented.
Domain 4: Variability and Uncertainty	Metric 7:	Metadata Completeness	Medium	Variability addressed by multiple years of use volume but uncertainty is not addressed.
<b>Overall Quality Determination</b>		<b>Medium</b>		

<b>Study Citation:</b>	Saito, R., Virji, M. A., Henneberger, P. K., Humann, M. J., Lebouf, R. F., Stanton, M. L., Liang, X., Stefaniak, A. B. (2015). Characterization of Cleaning and Disinfecting Tasks and Product Use Among Hospital Occupations. American Journal of Industrial Medicine 58(1):101-111.
<b>HERO ID:</b>	3259071
<b>Conditions of Use:</b>	Use of Liquid/Solid Cleaning Products

EXTRACTION	
Parameter	Data
Number of sites:	5 hospital facilities were studied. Three government general hospitals and two university teaching hospitals. Four of the facilities were located in the South East and one in the North East of the United States.
Comments:	The report discusses multiple occupations, but Supplemental Table SII shows that only housekeeper and floor strippers/waxers used products that contain fragrances. HHCB is expected to be a component of the fragrance therefore extracted data is for housekeepers and floor strippers/waxers specific to fragrance exposure.

EVALUATION				
Domain	Metric		Rating	Comments
Domain 1: Reliability	Metric 1:	Methodology	Medium	The assessment or report uses high quality data and/or techniques or sound methods that are not from a frequently used source and associated information does not indicate flaws or quality issues.
Domain 2: Representativeness	Metric 2:	Geographic Scope	High	The data are from the United States and are representative of the industry being evaluated.
	Metric 3:	Applicability	Medium	The report is for an occupational scenario within the scope of the risk evaluation (use of cleaning products). The extracted information is specific to fragrance use but not necessarily HHCB use.
	Metric 4:	Temporal Representativeness	Medium	The report captures operations, equipment, and worker activities expected to be reasonably representative of current conditions. The report is less than 10 years old but the survey data was collected from 2009 to 2011 more than 10 yearsbut less more than 20 years ago.
	Metric 5:	Sample Size	Medium	Distribution of samples is characterized by a range with uncertain statistics. It is unclear if analysis is representative.
Domain 3: Accessibility/ Clarity	Metric 6:	Metadata Completeness	High	Assessment or report clearly documents its data sources, assessment methods, results, and assumptions.
Domain 4: Variability and Uncertainty	Metric 7:	Metadata Completeness	Medium	The report provides only limited discussion of the variability and uncertainty in the results

**Overall Quality Determination**

**Medium**

<b>Study Citation:</b>	Schwartz, S., Berding, V., Matthies, M. (2000). Aquatic fate assessment of the polycyclic musk fragrance HHCB - Scenario and variability analysis in accordance with the EU risk assessment guidelines. Chemosphere 41(5):671-679.			
<b>HERO ID:</b>	5428093			
<b>Conditions of Use:</b>	Manufacture			
EXTRACTION				
<b>Parameter</b>	<b>Data</b>			
Production, import, or use volume:	worldwide PV, 1990: 1000 ton; 1992: 2400 ton; 1995:1482 ton			
EVALUATION				
Domain	Metric	Rating	Comments	
Domain 1: Reliability	Metric 1: Methodology	Low	Report does not specify the data used.	
Domain 2: Representativeness	Metric 2: Geographic Scope	Medium	Data are from Germany, an OECD country.	
	Metric 3: Applicability	High	Data are for manufacturing, an in-scope occupational scenario.	
	Metric 4: Temporal Representativeness	Low	Report is based on data greater than 20 years old and industry conditions that are expected to be outdated.	
	Metric 5: Sample Size	High	Statistical distribution of samples is fully characterized (discrete sampling data provided).	
Domain 3: Accessibility/ Clarity	Metric 6: Metadata Completeness	Low	Assessment results are provided but underlying methods, assumptions, and data sources are not fully transparent.	
Domain 4: Variability and Uncertainty	Metric 7: Metadata Completeness	Low	Variability and uncertainty are not addressed.	
Overall Quality Determination		Low		

<b>Study Citation:</b>	U.S. Census Bureau, (2021). 2021 SUSB Annual Datasets by Establishment Industry.			
<b>HERO ID:</b>	13027718			
<b>Conditions of Use:</b>	All			
<b>EXTRACTION</b>				
<b>Parameter</b>	<b>Data</b>			
Number of sites:	Provides the number of firms and establishments per NAICS codes and state. Not specific to chemical, covers these sites in the U.S.			
<b>EVALUATION</b>				
Domain	Metric	Rating	Comments	
Domain 1: Reliability	Metric 1: Methodology	High	U.S. Census Bureau is expected to use reliable survey and census methods.	
Domain 2: Representativeness	Metric 2: Geographic Scope	High	U.S. based economic data	
	Metric 3: Applicability	Medium	These economic data cover all industry and occupation types in scope for all chemicals, however, information is not chemical-specific.	
	Metric 4: Temporal Representativeness	High	The Census Bureau SUSB data are from 2021	
	Metric 5: Sample Size	High	The SUSB is a compilation of data extracted from the Business Register, U.S. Census Bureau’s ”most complete, current, and consistent data for U.S. business establishments.” Incorporates data from economic censuses and current business surveys, quarterly and annual Federal tax records, and other departmental and federal statistics. Expected to be sufficiently representative. ( <a href="https://www.census.gov/programs-surveys/susb/about.html">https://www.census.gov/programs-surveys/susb/about.html</a> )	
Domain 3: Accessibility/ Clarity	Metric 6: Metadata Completeness	Medium	U.S. Census Bureau documents results and methods, but underlying survey results not accessible.	
Domain 4: Variability and Uncertainty	Metric 7: Metadata Completeness	Medium	Limited discussion of variability and uncertainty in results.	
<b>Overall Quality Determination</b>		<b>High</b>		

<b>Study Citation:</b>		U.S. Census Bureau, (2024). U.S. Census Bureau QuickFacts: United States.		
<b>HERO ID:</b>		13027720		
<b>Conditions of Use:</b>		All		
<b>EXTRACTION</b>				
<b>Parameter</b>		<b>Data</b>		
Number of sites:		Used to determine the number of homes in the U.S., contextual information for professional carpet cleaners who conduct work at residential homes.		
<b>EVALUATION</b>				
Domain		Metric	Rating	Comments
Domain 1: Reliability	Metric 1:	Methodology	High	U.S. Census Bureau is expected to use reliable survey and census methods.
Domain 2: Representativeness	Metric 2:	Geographic Scope	High	U.S. based economic data
	Metric 3:	Applicability	High	These economic data cover all industry types in scope for all chemicals.
	Metric 4:	Temporal Representativeness	High	The SUSB is a compilation of data extracted from the Business Register, U.S. Census Bureau’s ”most complete, current, and consistent data for U.S. business establishments.” Incorporates data from economic censuses and current business surveys, quarterly and annual Federal tax records, and other departmental and federal statistics. Expected to be sufficiently representative. ( <a href="https://www.census.gov/programs-surveys/susb/about.html">https://www.census.gov/programs-surveys/susb/about.html</a> )
	Metric 5:	Sample Size	High	U.S. Census Bureau documents results and methods, but underlying survey results not accessible.
Domain 3: Accessibility/ Clarity	Metric 6:	Metadata Completeness	Medium	Limited discussion of variability and uncertainty in results.
Domain 4: Variability and Uncertainty	Metric 7:	Metadata Completeness	Medium	Limited discussion of variability and uncertainty in results.
<b>Overall Quality Determination</b>			<b>High</b>	



<b>Study Citation:</b>	U.S. EPA, (2020). 2020 CDR: Commercial and consumer use.			
<b>HERO ID:</b>	10366189			
<b>Conditions of Use:</b>	Manufacture and Import			
<b>EXTRACTION</b>				
<b>Parameter</b>	<b>Data</b>			
Production, import, or use volume:	Provides U.S. domestic manufactured and imported PV and %PV to downstream uses. HHCB has a non-CBI aggregate PV of 1 to 10 million lbs.			
Number of sites:	Provides number of manufacturing and import sites.			
Chemical concentration:	Provides concentration ranges.			
<b>EVALUATION</b>				
Domain	Metric	Rating	Comments	
Domain 1: Reliability	Metric 1: Methodology	High	EPA is a trusted source.	
Domain 2: Representativeness	Metric 2: Geographic Scope	High	CDR is U.S. based data.	
	Metric 3: Applicability	High	CDR covers chemical manufacturers and importers, which are in scope for all chemicals.	
	Metric 4: Temporal Representativeness	High	EPA used data from the 2020 CDR.	
	Metric 5: Sample Size	Medium	Due to reporting threshold, statistical representativeness is unclear.	
Domain 3: Accessibility/ Clarity	Metric 6: Metadata Completeness	Medium	Submissions do not include method of how production volumes were determined. CDR industry sector codes, industrial processing and use codes, industrial function codes, and commercial product codes provide good metadata; but lack of clarifying information and narratives and occasional misreportings limit clarity of data.	
Domain 4: Variability and Uncertainty	Metric 7: Metadata Completeness	Low	CDR data do not address variability or uncertainty in submitter provided data.	
<b>Overall Quality Determination</b>		<b>High</b>		

<b>Study Citation:</b>	U.S. EPA, (2023). Summarized data of the Building Assessment Survey and Evaluation (BASE) Study.			
<b>HERO ID:</b>	11328021			
<b>Conditions of Use:</b>	Commercial Use – Cleaning and Furnishing Care Products - All-Purpose Foam Spray Cleaner; All-Purpose Liquid Cleaner/Polish; All-Purpose Liquid Spray Cleaner; All-Purpose Waxes and Polishes; Appliance Cleaners; Drain and Toilet Cleaners (Liquid); Powder Cleaners (Floors); Powder Cleaners (Porcelain)			
EXTRACTION				
Parameter	Data			
Throughput:	The source contains summary statistics for occupied floor area, gross floor area, and number of occupants on page 2 of the pdf. This information is used in the assessment of throughput for the use of cleaning products condition of use.			
EVALUATION				
Domain	Metric	Rating	Comments	
Domain 1: Reliability	Metric 1: Methodology	High	Report uses high quality data from frequently-used sources.	
Domain 2: Representativeness	Metric 2: Geographic Scope	High	Data are from the U.S.	
	Metric 3: Applicability	High	Data are for use of cleaning products, an in-scope condition of use.	
	Metric 4: Temporal Representativeness	Low	Although the access date is 2023, the data is over a five-year period from 1994-1998, which is more than 20 years old.	
	Metric 5: Sample Size	High	Statistical distribution of samples is fully characterized.	
Domain 3: Accessibility/ Clarity	Metric 6: Metadata Completeness	High	All data sources, methods, results, and assumptions are clearly documented.	
Domain 4: Variability and Uncertainty	Metric 7: Metadata Completeness	High	Uncertainty is addressed by discussions on the methodology. Variability addressed by presenting the summary statistics of the distribution.	
Overall Quality Determination		High		

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<b>Study Citation:</b>	U.S. EPA, (2024). Toxics Release Inventory (TRI) data: 1,3,4,6,7,8-Hexahydro-4,6,6,7,8,8-hexamethylcyclopenta-g-2- benzopyran (HHCB), reporting year 2023.			
<b>HERO ID:</b>	13027717			
<b>Conditions of Use:</b>	All			
EXTRACTION				
<b>Parameter</b>	<b>Data</b>			
Number of sites:	Provides the number of sites which reports the chemical under TRI.			
EVALUATION				
Domain	Metric	Rating	Comments	
Domain 1: Reliability	Metric 1: Methodology	High	The database has mandatory reporting requirements, and is generally accepted by the scientific community, and associated information does not indicate flaws or quality issues.	
Domain 2: Representativeness	Metric 2: Geographic Scope	High	TRI is U.S. based data.	
	Metric 3: Applicability	High	The report is for multiple occupational scenarios within the scope of the risk evaluation.	
	Metric 4: Temporal Representativeness	High	The data used is from 2023, which is considered recent data (<10 years)	
	Metric 5: Sample Size	Medium	Number of sites data is provided per site, although some sites may not be required to report.	
Domain 3: Accessibility/ Clarity	Metric 6: Metadata Completeness	Medium	Assessment or report clearly documents results, methods, and assumptions. Data sources are generally described but not fully transparent.	
Domain 4: Variability and Uncertainty	Metric 7: Metadata Completeness	Medium	The report provides only limited discussion of the variability but no discussion of uncertainty in the results.	
Overall Quality Determination		High		

<b>Study Citation:</b>	U.S. EPA, (1995). AP-42: Compilation of air pollutant emission factors. Volume I: Stationary point and area sources, fifth edition.
<b>HERO ID:</b>	46492
<b>Conditions of Use:</b>	Disposal; Plastic Converting; Plastic Compounding; Rubber Additives; Laundry Detergents and Related Laundry Products; Manufacturing; Import and Repackaging; Formulation of Fragrance Oils, Liquid Products, and Powder Products

**EXTRACTION**

Parameter	Data
Process description:	Disposal: “Approximately 67 percent of solid waste is landfilled, 16 percent is incinerated, and 17 percent is recycled or composted.” Chapter 2.1 (beginning page 201) describes multiple types of solid-waste combustor technology; Chapter 2.2 (beginning page 247) describes multiple types of sewage sludge incineration process; Chapter 2.4 (beginning page 331) describes the major designs for landfills; Chapter 4.3 (beginning page 523) describes typical treatment system at a POTW waste water facility including discussion on the collection system and treatment strategies (primary settling, biotreatment, secondary settling, and disinfection)Plastic Converting; Plastic Compounding: Chapter 6.6 (pages 709-742) describes the creation of polyvinyl chloride, poly(ethylene terephthalate) (PET), polystyrene, and polypropylene.;Laundry Detergents and Related Laundry Products: Chapter 6.8 (beginning page 745) describes bar soap and Heavy-duty powders and liquids for home and commercial laundry detergent; Heavy-duty powders and liquids for home and commercial laundry detergent comprise 60-65% of the U. S. soap and detergent market and were estimated at 2.6 megagrams (Mg) (2.86 million tons) in 1990;Rubber Additives: Chapter 6.10 (beginning page 775) describes the manufacture of styrene-butadiene copolymers and latex productsChapter 7 (page 831) provides detailed descriptions of typical tank varieties including horizontal, vertical, and underground fixed roof tanks, and internal and external floating roof tanksChapter 4.8 describes the cleaning process of rail tank cars, tank trucks, and drumsNo specific mention the addition of HHCB or any fragrances.;
Number of sites:	Disposal: In 1992, 160 municipal waste combustor plants in US; 170 sewage sludge incineration plants in US; estimated 5,345 active MSW landfills in the United States in 1992

**EVALUATION**

Domain	Metric	Rating	Comments
Domain 1: Reliability	Metric 1: Methodology	Medium	Methodology is known and expected to be accurate but may not cover all release sources at the site.
Domain 2: Representativeness	Metric 2: Geographic Scope	High	Data are from the U.S.
	Metric 3: Applicability	Medium	Data are for multiple in-scope occupational scenarios but is not information specific to HHCB.
	Metric 4: Temporal Representativeness	Low	Data are greater than 20 years old (1995)
	Metric 5: Sample Size	Low	Sample distribution is described qualitatively.
Domain 3: Accessibility/ Clarity	Metric 6: Metadata Completeness	High	All metadata provided.
Domain 4: Variability and Uncertainty	Metric 7: Metadata Completeness	High	Uncertainty is addressed and variability addressed by consideration of multiple sites

**Overall Quality Determination****Medium**

# General Engineering Assessment

<b>Study Citation:</b>	U.S. EPA, (2003). Transportation equipment cleaning - Generic scenario for estimating occupational exposures and environmental releases (draft).
<b>HERO ID:</b>	6385708
<b>Conditions of Use:</b>	Manufacturing, import and repackaging, formulation into fragrance oils, and formulation into products

## EXTRACTION

Parameter	Data
Process description:	A typical cleaning sequence is as follows: Review shipping manifest forms to determine the commodity last transported in the tank; Drain the tank heel (product remaining in the container; does not include residue) and if necessary, segregate the heel for off-site disposal; Rinse the tank; Wash the tank using one or more cleaning methods and solutions; Rinse the tank; and Dry the tank. The cleaning facility determines the commodity last transported in the tank to: (1) assess the facility's ability to clean the tank effectively; (2) determine the appropriate cleaning sequence and cleaning solutions; (3) evaluate whether the residue cleaned from the tank will be compatible with the facility's wastewater treatment system; and (4) establish an appropriate level of health and safety protection for the employees who will clean the tank. Tank washing is typically performed using one of two methods: (1) low-or-high-pressure spinner nozzles, or (2) hand-held wands and nozzles. Spinner nozzles are inserted through the main tank hatch and operate at pressures between 100 pounds per square inch (psi) and 600 psi to deliver hot or cold water rinses and a variety of cleaning solutions. They are designed to rotate around both their vertical and horizontal axes to create an overlapping spray pattern that cleans the entire interior of the tank. Operating cycles range from rinse bursts of a few seconds to detergent or caustic washes of 20 minutes or longer for caked or crystallized residues. The use of hand-held wands and nozzles is similar to washing with high pressure spinner nozzles, but require facility personnel to manually direct the wash solution across the interior surface of the tank.
Throughput:	EPA estimates 500,000 IBCs are cleaned annually in the United States. Of this amount, EPA believes 225,000 IBCs are cleaned by TEC facilities. The remaining 275,000 IBCs are cleaned by drum reconditioning facilities.
Number of sites:	lists at least 627 cleaning facilities based on response from the 1994 Detailed Questionnaire for the Transportation Equipment Cleaning Industry

## EVALUATION

Domain	Metric	Rating	Comments
Domain 1: Reliability	Metric 1: Methodology	High	Report uses high quality data reported by EPA from industry surveys.
Domain 2: Representativeness	Metric 2: Geographic Scope	High	Data are from the U.S.
	Metric 3: Applicability	Medium	Data are for container cleaning, which is similar to the in-scope occupational scenario of Manufacturing, import and repackaging, formulation into fragrance oils, and formulation into products.
	Metric 4: Temporal Representativeness	Low	Report is based on data greater than 20 years old and industry conditions that are expected to be outdated (1994).
	Metric 5: Sample Size	Low	Sample distribution is described qualitatively.
Domain 3: Accessibility/ Clarity	Metric 6: Metadata Completeness	Medium	Methods, results, and assumptions are clearly documented, but underlying data sources are not fully transparent.
Domain 4: Variability and Uncertainty	Metric 7: Metadata Completeness	High	Uncertainty is addressed by statements throughout the source. Variability addressed by using multiple sources and describing multiple processes.

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<b>Study Citation:</b>	U.S. EPA, (2003). Transportation equipment cleaning - Generic scenario for estimating occupational exposures and environmental releases (draft).		
<b>HERO ID:</b>	6385708		
<b>Conditions of Use:</b>	Manufacturing, import and repackaging, formulation into fragrance oils, and formulation into products		
		<b>EVALUATION</b>	
Domain	Metric	Rating	Comments
<b>Overall Quality Determination</b>		<b>Medium</b>	

<b>Study Citation:</b>	U.S. EPA, (1995). Chapter 6: Organic chemical process industry. Compilation of air pollutant emission factors. Volume I: Stationary point and area sources, fifth edition, AP-42.				
<b>HERO ID:</b>	7310513				
<b>Conditions of Use:</b>	Plastic Converting; Plastic Compounding;				
<b>EXTRACTION</b>					
<b>Parameter</b>	<b>Data</b>				
Process description:		Plastic Converting; Plastic Compounding: Chapter 6.6 (pages 709-742) describes the creation of polyvinyl chloride, poly(ethylene terephthalate) (PET), polystyrene, and polypropylene but does not mention the addition of HHCB or any fragrances.;			
<b>EVALUATION</b>					
Domain		Metric	Rating		Comments
Domain 1: Reliability	Metric 1:	Methodology	High	The report is from EPA, and associated information does not indicate flaws or quality issues.	
Domain 2: Representativeness	Metric 2:	Geographic Scope	High	The data are from the United States	
	Metric 3:	Applicability	High	Data are for Plastic Converting, Plastic Compounding, which are in-scope occupational scenarios.	
	Metric 4:	Temporal Representativeness	Low	The report is more than 20 years old.	
	Metric 5:	Sample Size	N/A	N/A - data not dependent on samples	
Domain 3: Accessibility/ Clarity	Metric 6:	Metadata Completeness	High	Assessment or report clearly documents its data sources, assessment methods, results, and assumptions.	
Domain 4: Variability and Uncertainty	Metric 7:	Metadata Completeness	Medium	The report provides only limited discussion of the variability and uncertainty in the results.	
<b>Overall Quality Determination</b>			<b>High</b>		

# General Engineering Assessment

<b>Study Citation:</b>	U.S. EPA, (1995). Chapter 6: Organic chemical process industry. Compilation of air pollutant emission factors. Volume I: Stationary point and area sources, fifth edition, AP-42.				
<b>HERO ID:</b>	7310513				
<b>Conditions of Use:</b>	Rubber Additives				
<b>EXTRACTION</b>					
<b>Parameter</b>	<b>Data</b>				
Process description:		Rubber Additives: Chapter 6.10 (beginning page 775) describes the manufacture of styrene-butadiene copolymers and latex products			
<b>EVALUATION</b>					
Domain		Metric	Rating	Comments	
Domain 1: Reliability	Metric 1:	Methodology	High	The report is from EPA, and associated information does not indicate flaws or quality issues.	
Domain 2: Representativeness	Metric 2:	Geographic Scope	High	The data are from the United States	
	Metric 3:	Applicability	High	Data are for Rubber Additives, which are in-scope occupational scenarios.	
	Metric 4:	Temporal Representativeness	Low	The report is more than 20 years old.	
	Metric 5:	Sample Size	N/A	N/A - data not dependent on samples	
Domain 3: Accessibility/ Clarity	Metric 6:	Metadata Completeness	High	Assessment or report clearly documents its data sources, assessment methods, results, and assumptions.	
Domain 4: Variability and Uncertainty	Metric 7:	Metadata Completeness	Medium	The report provides only limited discussion of the variability and uncertainty in the results.	
<b>Overall Quality Determination</b>			<b>High</b>		



<b>Study Citation:</b>	U.S. EPA, (1995). Chapter 6: Organic chemical process industry. Compilation of air pollutant emission factors. Volume I: Stationary point and area sources, fifth edition, AP-42.
<b>HERO ID:</b>	7310513
<b>Conditions of Use:</b>	Formulation into Laundry Detergents and Related Laundry Products

EXTRACTION	
Parameter	Data
Production, import, or use volume:	Heavy-duty powders and liquids for home and commercial laundry detergent comprise 60-65% of the U. S. soap and detergent market and were estimated at 2.6 megagrams (Mg) (2.86 million tons) in 1990
Process description:	Laundry Detergents and Related Laundry Products: Chapter 6.8 (beginning page 745) : The manufacture of spray-dried detergent has 3 main processing steps: (1) slurry preparation,(2) spray drying, and (3) granule handling.

EVALUATION				
Domain	Metric		Rating	Comments
Domain 1: Reliability	Metric 1:	Methodology	High	The report is from EPA, and associated information does not indicate flaws or quality issues.
Domain 2: Representativeness	Metric 2:	Geographic Scope	High	The data are from the United States
	Metric 3:	Applicability	Medium	The report is for an occupational scenario within the scope of the risk evaluation; however, data is general and not specific to a chemical
	Metric 4:	Temporal Representativeness	Low	The report is more than 20 years old.
	Metric 5:	Sample Size	N/A	N/A - data not dependent on samples
Domain 3: Accessibility/ Clarity	Metric 6:	Metadata Completeness	High	Assessment or report clearly documents its data sources, assessment methods, results, and assumptions.
Domain 4: Variability and Uncertainty	Metric 7:	Metadata Completeness	Medium	The report provides only limited discussion of the variability and uncertainty in the results.
<b>Overall Quality Determination</b>			<b>Medium</b>	

<b>Study Citation:</b>	U.S. EPA, (1995). Ap-42: Chapter 4.12 - Manufacture of rubber products.
<b>HERO ID:</b>	7315841
<b>Conditions of Use:</b>	Rubber Additives

EXTRACTION	
Parameter	Data
Process description:	<p>The manufacturing of rubber products involves six principal processing steps (mixing, milling, extrusion, calendering, curing, and grinding), with ancillary steps in between. Initially, the raw rubber(natural or synthetic) is mixed with several additives which are chosen based upon the desired properties of the final product. The mixed rubber is often milled and transferred to an extruder where it can be combined with other rubbers. Many rubber products contain synthetic fabric or fibers for strengthening purposes. These fibers are typically coated with mixed rubber using a calender. The extruded rubber and rubber coated materials are then assembled into a final shape and cured. Among the steps in the tire assembly process, described in more detail below, are bead building; cementing and marking; cutting and cooling; tire building; and green tire spraying. It is during the curing process that the rubber vulcanizes (crosslinks), producing the characteristic properties of finished rubber. Once the final product is cured, it is often ground to remove rough surfaces and/or to achieve symmetry. Mixing consists of taking the raw rubber and mixing it with several chemical additives. These additives consist of accelerators (to initiate the vulcanization process), zinc oxides (to assist in accelerating vulcanization), retarders (to prevent premature vulcanization), antioxidants (to prevents aging), softeners (to facilitate processing of the rubber), carbon black or other fillers (to serve as reinforcing / strengthening agents), and inorganic or organic sulfur compounds (to serve as vulcanizing agents).Mixing typically is performed in an internal batch mixer. The internal mixer contains two rotors which shear the rubber mix against the wall of the vessel. Internal mixing is performed at elevated temperatures up to approximately 330oF.Once mixed, the rubber is discharged from the mixer and processed into slab rubber or pellets. Rubber mixing typically occurs in two or more stages wherein the rubber is returned to the mixer and remixed with additional chemicals. The initial stage results in non-productive compounds, and the final stage results in productive compounds. It should also be noted that various rubber compounds produced at a particular facility can be exported to other facilities for use there.Non-productive compounds consist of the raw rubber, process oils, reinforcing materials such as carbon black and / or silica and the antioxidant / antiozonant protection system. These materials are mixed at temperatures around 330oF. The final, “productive,” stage involves mixing the rubber from the last non-productive stage with the activators, accelerators and sulfur curing agents. This stage is mixed at a lower temperature (around 230oF) because the rubber compound will now scorch and cure at elevated temperatures.[More Process Description contained in source]</p>
Comments:	HHCB not identified in emission factors contained in supplemental excel file.

		EVALUATION	
Domain	Metric	Rating	Comments
Domain 1: Reliability	Metric 1: Methodology	High	The report uses high quality data, techniques, and methods from EPA.
Domain 2: Representativeness	Metric 2: Geographic Scope	High	Data are from the U.S.
	Metric 3: Applicability	Medium	Data are for rubber additives, an in-scope occupational scenario; however, data is general and not specific to a chemical.
	Metric 4: Temporal Representativeness	Medium	Report is based on data greater than 10 years old but no more than 20 years old and industry conditions that are expected to be representative of current industry conditions; 2008
	Metric 5: Sample Size	N/A	N/A - data not dependent on samples
Domain 3: Accessibility/ Clarity	Metric 6: Metadata Completeness	High	All data sources, methods, results, and assumptions are clearly documented. Process description information is fully characterized.

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General Engineering Assessment

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Study Citation:	U.S. EPA, (1995). Ap-42: Chapter 4.12 - Manufacture of rubber products.		
HERO ID:	7315841		
Conditions of Use:	Rubber Additives		
Domain	Metric	EVALUATION Rating	Comments
Domain 4: Variability and Uncertainty			
	Metric 7: Metadata Completeness	Medium	The report provides only limited discussion of the variability and uncertainty in the results.
Overall Quality Determination		High	

## General Engineering Assessment

<b>Study Citation:</b>	Upadhyay, N., Sun, Q., Allen, J. O., Westerhoff, P., Herckes, P. (2011). Synthetic musk emissions from wastewater aeration basins. Water Research 45(3):1071-1078.		
<b>HERO ID:</b>	1970730		
<b>Conditions of Use:</b>	Disposal		
EXTRACTION			
<b>Parameter</b>	<b>Data</b>		
Process description:	Plant A: Plant A has a design treatment capacity of 68 million liters per day (MLD) of wastewater and includes the following covered processes: headworks, primary sedimentation, aerated activated sludge treatment, secondary sedimentation, tertiary filtration, and disinfection. Off-gas is passed through an odor control unit (OCU) that consists of packed beds of activated carbon.Plant B: Plant B has a design capacity of 680 MLD of wastewater, is an uncovered facility (i.e., no odor control), and employs primary sedimentation, aerated activated sludge treatment, secondary treatment, and disinfection.		
Number of sites:	2		
Chemical concentration:	Liquid samples from aeration basins in plant A: 13,600, 25000; plant B: 12200, 7800 [ng/L]; New York: 1780-12700; Europe: 16600		
EVALUATION			
Domain	Metric	Rating	Comments
Domain 1: Reliability	Metric 1: Methodology	Medium	The assessment or report uses high quality data that are not from a frequently used source and associated information does not indicate flaws or quality issues.
Domain 2: Representativeness	Metric 2: Geographic Scope	High	Data are from the United States.
	Metric 3: Applicability	High	Data is for disposal, an occupational scenario within the scope of the risk evaluation
	Metric 4: Temporal Representativeness	Medium	Report is more than 10 years but no more than 20 years old
	Metric 5: Sample Size	Low	Distribution of samples is qualitative or characterized by no statistics.
Domain 3: Accessibility/ Clarity	Metric 6: Metadata Completeness	High	Assessment or report clearly documents its data sources, assessment methods, results, and assumptions.
Domain 4: Variability and Uncertainty	Metric 7: Metadata Completeness	High	Report addresses that concentration may vary day to day; estimates this factor
Overall Quality Determination		High	

<b>Study Citation:</b>	Wei, W., Boumier, J., Wyart, G., Ramalho, O., Mandin, C. (2016). Cleaning practices and cleaning products in nurseries and schools: to what extent can they impact indoor air quality?. Indoor Air 26(4):517-525.			
<b>HERO ID:</b>	3401413			
<b>Conditions of Use:</b>	Use of spray Cleaning Products			
<b>EXTRACTION</b>				
<b>Parameter</b>	<b>Data</b>			
Number of sites:	1			
Chemical concentration:	2.5%			
<b>EVALUATION</b>				
Domain	Metric		Rating	Comments
Domain 1: Reliability	Metric 1:	Methodology	High	Report uses high quality data from frequently-used sources.
Domain 2: Representativeness	Metric 2:	Geographic Scope	Medium	Data are from France, an OECD country.
	Metric 3:	Applicability	High	Data are for use of cleaning products, an in-scope occupational scenario.
	Metric 4:	Temporal Representativeness	Medium	Report is based on data greater than 10 years old but no more than 20 years old and industry conditions that are expected to be representative of current industry conditions.
	Metric 5:	Sample Size	High	Statistical distribution of samples is fully characterized (discrete sampling data provided).
Domain 3: Accessibility/ Clarity	Metric 6:	Metadata Completeness	Medium	Assessment or report clearly documents results, methods, and assumptions. Data sources are generally described but not fully transparent.
Domain 4: Variability and Uncertainty	Metric 7:	Metadata Completeness	Medium	The report provides only limited discussion of the variability and uncertainty in the results.
<b>Overall Quality Determination</b>			<b>High</b>	

<b>Study Citation:</b>	Zhang, X., Yu, Y., Gu, Y., Li, X., Zhang, X., Yu, Y. (2017). In vitro determination of transdermal permeation of synthetic musks and estimated dermal uptake through usage of personal care products. Chemosphere 173:417-424.			
<b>HERO ID:</b>	3603871			
<b>Conditions of Use:</b>	Incorporation into Formulation of Mixture as an Odor Agent/Fragrance			
EXTRACTION				
<b>Parameter</b>	<b>Data</b>			
Chemical concentration:	(ug/g)lotion:10.8;shower gel: 6.4; shampoo: 42; perfume: 3.98			
EVALUATION				
Domain	Metric		Rating	Comments
Domain 1: Reliability	Metric 1:	Methodology	High	Report uses high quality data from frequently-used sources.
Domain 2: Representativeness	Metric 2:	Geographic Scope	Low	Data are from China, a non-OECD country.
	Metric 3:	Applicability	Uninformative	Data are for personal care products regulated under FDA, which is not an occupational scenario in scope.
	Metric 4:	Temporal Representativeness	High	Report is based on current industry conditions and data no more than 10 years old.
	Metric 5:	Sample Size	Medium	Sample distribution characterized by a range with uncertain statistics.
Domain 3: Accessibility/ Clarity	Metric 6:	Metadata Completeness	Low	Assessment results are provided but underlying methods, assumptions, and data sources are not fully transparent.
Domain 4: Variability and Uncertainty	Metric 7:	Metadata Completeness	High	Uncertainty is addressed by listed standard deviation. Variability addressed by testing of multiple products.
Overall Quality Determination			Uninformative	