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Environmental Protection Agency

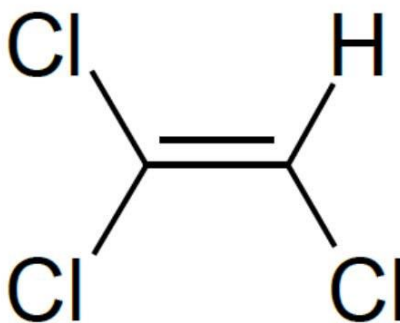
Office of Chemical Safety and
Pollution Prevention

Draft Risk Evaluation for Trichloroethylene

Systematic Review Supplemental File:

**Data Extraction Tables for
Environmental Fate and Transport Studies**

CASRN: 79-01-6



February 2020

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Table 1. Biodegradation Study Summary for Trichloroethylene

Study Type (year)	Initial Concentration	Inoculum Source	(An)aerobic Status	Duration	Result	Comments	Affiliated Reference	Data Quality Evaluation results of Full Study Report
Water								
Other; Anaerobic serum bottle test	83 µg/L	Digested sludge	Anaerobic	60 days	<u>Biodegradation parameter: percent removal: 100%/60d</u>	The reviewer agreed with this study's overall quality level.	(Long et al., 1993)	High
Other; Batch transformation experiment under methanogenic conditions	ca. 200 µg/L	Activated sludge (adaptation not specified)	Anaerobic	57 days	<u>Biodegradation parameter: percent removal: 40%/8 weeks</u>	The reviewer agreed with this study's overall quality level.	(Bouwer and Mccarty, 1983)	High
Other; Sequential-Aerobic serum bottle test	35 µg	Digested sludge	Aerobic	22 days	<u>Biodegradation parameter: percent removal: methane culture and phenol culture, respectively: 100%/22d and 100%/22d</u>	The reviewer agreed with this study's overall quality level.	(Long et al., 1993)	High
Other; Aerobic batch fed reactor	160 µg/L	Digested sludge	Aerobic	More than a year	<u>Biodegradation parameter: test reactor influent/effluent comparison: Average reactor influent of TCE = 160 µg/L, average reactor effluent = ND µg/L</u>	The reviewer agreed with this study's overall quality level.	(Long et al., 1993)	High
Other; Aerobic serum bottle test	38 µg	Digested sludge	Aerobic	20 days	<u>Biodegradation parameter: percent removal: methane culture and phenol culture, respectively: 100%/20d and 100%/20d</u>	The reviewer agreed with this study's overall quality level.	(Long et al., 1993)	High

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Study Type (year)	Initial Concentration	Inoculum Source	(An)aerobic Status	Duration	Result	Comments	Affiliated Reference	Data Quality Evaluation results of Full Study Report
Other; Anaerobic batch fed reactor	120 µg/L	Digested sludge	Anaerobic	More than a year	<u>Biodegradation parameter: test reactor influent/effluent comparison:</u> Average reactor influent of TCE = 120 µg/L, average reactor effluent = 2 µg/L	The reviewer agreed with this study's overall quality level.	(Long et al., 1993)	High
Other; non-guideline	19 µm	Other: Hanford soil microcosms	Aerobic	30h	<u>Biodegradation parameter: test substance transformation rate</u> 0.01 µmol/mg total suspended solids/h	The reviewer agreed with this study's overall quality level.	(Kim et al., 2000)	High
Other; non-guideline study; reductive dechlorination in a semi-continuous reactor with an anaerobic enrichment culture	550 to 700 nmol/100 mL	Digested sludge	Anaerobic	300 days 1st generation inoculum; 120 days sixth generation inoculum	<u>Biodegradation parameter: removal:</u> 2.83 µmol/17d	The reviewer agreed with this study's overall quality level.	(Freedman and Gossett, 1989)	High
Other; non-guideline anaerobic biodegradation experiment	≥18 to ≤187 µg/L	Other: Methanogenic mixed culture grown in a laboratory-scale	Anaerobic	16 weeks	<u>Biodegradation parameter: removal:</u> limited degradation	The reviewer agreed with this study's overall quality level.	(Bouwer et al., 1981)	High
Other; non-guideline	20 mg/L	Other	Anaerobic	10 days	<u>Biodegradation parameter: removal:</u> 95%/5d	The reviewer agreed with this	(Phelps et al., 1991)	High

Study Type (year)	Initial Concentration	Inoculum Source	(An)aerobic Status	Duration	Result	Comments	Affiliated Reference	Data Quality Evaluation results of Full Study Report
experimental bioreactor						study's overall quality level.		
OECD Guideline 302 B (Inherent biodegradability: Zahn-Wellens/EMPA Test); A "fast biodegradability test" was done initially, according to Polo et al. 2011. Compounds, including TCE, that were not determined to be biodegradable in adapted sludge according to that test underwent the OECD 302 B test.	100 mg/L	Activated sludge, domestic, adapted	Aerobic	28 days	<u>Biodegradation parameter: TOC:</u> 38.9%/28d	The reviewer agreed with this study's overall quality level.	(Tobajas et al., 2016)	High
Other; static-culture flask-screening test	5 to 10 mg/L	Sewage, domestic, non-adapted	Aerobic	28 days (includes 7-day static incubation and 3 weekly subcultures)	<u>Biodegradation parameter: percent removal at 5 mg/L test substance and 10 mg/L test substance, respectively:</u> 64%/7d and 87%/28d; and 87%/7d and 84%/28d	The reviewer agreed with this study's overall quality level.	(Tabak et al., 1981)	High

Study Type (year)	Initial Concentration	Inoculum Source	(An)aerobic Status	Duration	Result	Comments	Affiliated Reference	Data Quality Evaluation results of Full Study Report
Other: granular sludge from USAB reactor treating sugar beet refinery wastewater. Methanol used as growth substrate.	≥1000 to ≤1500 other	Activated sludge, industrial, non-adapted	Anaerobic	65 days	<u>Biodegradation parameter: concentration:</u> approx. 900 nmol after 65d (initial concentration: 1375 nmol)	The reviewer agreed with this study's overall quality level.	(van Eekert et al., 2001)	High
other: aquifer water from 15, 25, 35, 45 and 55 m away from landfill	ca.120 to ca.150 µg/L	Water (not specified): sediment and ground water collected 15, 25, 35, 45 and 55 m away from landfill	Anaerobic	537 days	<u>Biodegradation parameter: percent removal (anaerobic):</u> Complete reduction was seen closest to the landfill (15, 25 and 35m). No degradation was observed at further distances	The reviewer agreed with this study's overall quality level.	(Bjerg et al., 1999)	High
Other: cylinder open at bottom, screened at top. Installed in the aquifer through a borehole approx. 5 m below ground surface.	ca.150 µg/L	Natural water: freshwater	Aerobic	3 months	<u>Biodegradation parameter: percent removal (aerobic):</u> 0%/3 months	The reviewer agreed with this study's overall quality level.	(Nielsen et al., 1996)	High
other: ISMs - Stainless steel cylinder open at bottom, screened at top. Installed at 15, 25, 35, 45 and 55m from landfill	ca.120 to ca.150 µg/L	Water (not specified)	Anaerobic	220 days	<u>Biodegradation parameter: percent removal (anaerobic):</u> Complete reduction was seen closest to the landfill (15, 25 and 35 m). No degradation was	The reviewer agreed with this study's overall quality level.	(Bjerg et al., 1999)	High

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Study Type (year)	Initial Concentration	Inoculum Source	(An)aerobic Status	Duration	Result	Comments	Affiliated Reference	Data Quality Evaluation results of Full Study Report
					observed at further distances			
Other: bottles on shaker table		Other; Anaerobic mixed culture known to be capable dechlorinating PCE to ethene seeded with aquifer material from a PCE-contaminated site in Victoria, TX	Anaerobic	1h	<u>Biodegradation parameter:</u> <u>Dechlorination rate:</u> 59 $\mu\text{M}/\text{day}$; <u>Biodegradation parameter: Half-Velocity Coefficients (Ks):</u> 1.4+/-0.09 μM ; kapp = 1.6+/-0.3 μmol (mg of volatile suspended solids) ⁻¹ d ⁻¹)	The reviewer agreed with this study's overall quality level.	(Haston and Mccarty, 1999)	High
Other: groundwater collected from drive point piezometers.	ca.150 $\mu\text{g}/\text{L}$	Natural water: freshwater		3 months	<u>Biodegradation parameter: percent removal:</u> No degradation observed under aerobic conditions	The reviewer agreed with this study's overall quality level.	(Nielsen et al., 1996)	High
Other; groundwater microcosm studies using water obtained from a metal-working industry polluted with chlorinated solvents	$\leq 11.8 \text{ mg}/\text{L}$	Other; groundwater	Anaerobic	100 days for anaerobic reductive dechlorination studies	<u>Biodegradation parameter: percent removal via reductive dechlorination:</u> 100%/40d using groundwater microcosms amended with hydrogen/acetate	The reviewer agreed with this study's overall quality level.	(Schmidt and Tiehm, 2008)	High
Other; influents and effluents of		Activated sludge,	Not specified	3 months	<u>Biodegradation parameter: percent</u>	The reviewer agreed with this	(Lee et al., 2015)	High

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Study Type (year)	Initial Concentration	Inoculum Source	(An)aerobic Status	Duration	Result	Comments	Affiliated Reference	Data Quality Evaluation results of Full Study Report
27 Korean WWTPs screened for 22 chemicals		industrial (adaptation not specified)			<u>removal (estimated from graph):</u> 95%/3 mo. (degradation, volatilization, sorption to solids, all included in "removal")	study's overall quality level.		
Other; non-guideline	5 to 30 mg/L	Other; from stream at U of Washington Seattle campus, enriched by phenol feeding and non-enriched	Aerobic	1 day	<u>Biodegradation parameter: degradation rate:</u> 0.10-0.25 (avg = 0.18) g/g volatile suspended solids/d	The reviewer agreed with this study's overall quality level.	(Bielefeldt et al., 1995)	High
Other; non-guideline	30 to 60 µg/L	Natural water	Anaerobic	62 hours	<u>Biodegradation parameter: pseudo-first-order rate coefficient k', without and with methane, respectively:</u> 2.3+/- 0.05 L mg/day and 0.004 to 0.046 L mg/day	The reviewer agreed with this study's overall quality level.	(Henry and Grbić-Galić, 1991)	High
Anaerobic continuous flow study (large column)	ca. 300 µg/L	Organic waste streams	Anaerobic	Not applicable	<u>Biodegradation parameter: concentration (initial concentration: ca. 300 µg/L):</u> <5 µg/L; PCE and TCE were loaded to column	The reviewer agreed with this study's overall quality level.	(Vogel and Mccarty, 1985)	High

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Study Type (year)	Initial Concentration	Inoculum Source	(An)aerobic Status	Duration	Result	Comments	Affiliated Reference	Data Quality Evaluation results of Full Study Report
					together, transformation product was vinyl chloride			
Other; microcosm study (cometabolism)	2.5 mg/L	Natural water	Anaerobic	34 days	<u>Biodegradation parameter: percent removal in the presence of methanol and chlorobenzene respectively: 100%/23d and 100%/34d</u>	The reviewer agreed with this study's overall quality level.	(Kao and Prosser, 1999)	Medium
Other; microcosm study (cometabolism)	2.5 mg/L	Natural water	Aerobic	34 days	<u>Biodegradation parameter: percent removal in the presence of phenol and chlorobenzene respectively: 100%/15d and 100%/23d</u>	The reviewer agreed with this study's overall quality level.	(Kao and Prosser, 1999)	Medium
Other; controlled microcosm studies conducted to simulate seasonal (spring, summer and winter) field conditions	≥3.2 to ≤3.6 µg/L	Natural water: marine	Aerobic	6 days	<u>Biodegradation parameter: half-lives poisoned with HgCl₂ and not poisoned, respectively: 10.7 d and 8.6 d; Biodegradation parameter: rate constants poisoned with HgCl₂ and not poisoned, respectively: -0.064 day⁻¹ and -0.081 day⁻¹</u>	The reviewer agreed with this study's overall quality level.	(Wakeham et al., 1983)	Medium

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Study Type (year)	Initial Concentration	Inoculum Source	(An)aerobic Status	Duration	Result	Comments	Affiliated Reference	Data Quality Evaluation results of Full Study Report
Other; controlled microcosm studies conducted to simulate seasonal (spring, summer and winter) field conditions	≥ 2.4 to ≤ 3.8 $\mu\text{g/L}$	Natural water: marine	Aerobic	64 d (spring), 20 d (summer), 61 d (winter)	<u>Biodegradation parameter: half-lives:</u> 28 d (spring), 13 d (summer), 15 d (winter); <u>Biodegradation parameter: rate constants:</u> -0.025 days ⁻¹ (spring), -0.052 days ⁻¹ (summer), -0.045 days ⁻¹ (winter); Volatilization dominated the loss of test material	The reviewer agreed with this study's overall quality level.	(Wakeham et al., 1983)	Medium
Other; non-guideline	~ 3.33 $\mu\text{g/ml}$	Other: muck from the Everglades	Anaerobic	30 days	<u>Biodegradation parameter: half-life:</u> 43 d	The reviewer downgraded this study's overall quality rating. They noted: Trichloroethylene is a transformation product in this study.	(Wood et al., 1981)	Medium
Other; non-guideline microcosm	30 to 70 $\mu\text{g/L}$	Other; 0.7 g of fresh, washed, dried plant roots	Aerobic	approx. 90d total	<u>Biodegradation parameter: pseudo first-order rate constant:</u> 0.22 (± 0.12) d ⁻¹	The reviewer agreed with this study's overall quality level.	(Qin et al., 2014)	Medium
Other; biotransformation in static microcosms	3.7 mg/L	Natural water / sediment: freshwater	Aerobic	16 weeks	<u>Biodegradation parameter: Concentration ($\mu\text{g/L}$) of degradation products (95%</u>	The reviewer downgraded this study's overall quality rating. They noted: Loss	(Parsons et al., 1985)	Low

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Study Type (year)	Initial Concentration	Inoculum Source	(An)aerobic Status	Duration	Result	Comments	Affiliated Reference	Data Quality Evaluation results of Full Study Report
					<u>confidence interval in parentheses</u>): Cis: wk 0 - ND, wk 2: 38(13), wk 8: 30(4), wk 12: trace; wk 16: 1200(637); Trans: wk 0 - ND, wk 2: 85(906), wk 8: trace, wk 12: ND; wk 16: ND;; wk 0 - ND, wk 2: ND, wk 8: 57(340), wk 12: ND; wk 16: ND	due to abiotic processes and/or adsorption were not controlled. Concentrations of TCE over time, degradation rate or half-life were not reported, limiting evaluation of the study.		
Other; inhibition of gas production to anaerobic sludge from an operating municipal sludge digester	0 to 1000 mg/L	Sewage, domestic (adaptation not specified)	Anaerobic	48 hours	<u>Parameter: inhibition of gas production</u> : 21% inhibition at 10 mg/L and 56% at 100 mg/L after 48h	The reviewer downgraded this study's overall quality rating. They noted: Study describes inhibition of gas production not biodegradation rates or transformation pathways.	(Dow Chem Co, 1977)	Low
Other; anaerobic continuous-flow column studies	≥4.4 µg/L to ≤20.5 mg/L	Anaerobic bacteria	Anaerobic	22 days; Liquid detention in large column = 6 days; small column = 2-4 days	<u>Biodegradation parameter: concentration: (large column)</u> : PCE and TCE influents ~300 µg/L were reduced to <5 µg/L	The reviewer downgraded this study's overall quality rating. They noted: Based on lack of control group details and the test substance, Trichloroethylen	(Vogel and Mccarty, 1985)	Low

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Study Type (year)	Initial Concentration	Inoculum Source	(An)aerobic Status	Duration	Result	Comments	Affiliated Reference	Data Quality Evaluation results of Full Study Report
						e, was a degradation product of the test substance mixture.		
Other; thermodynamic parameters such as enthalpy of formation and entropies of formation were calculated for aqueous chloroethylenes by extrapolating partial molar enthalpies for gas phased species.		Not specified	Anaerobic		<u>Biodegradation parameter:</u> <u>Thermodynamic parameters:</u> Calculated standard partial molal thermodynamic properties for the aqueous chloroethylenes at elevated temperatures and pressures may be used to predict the equilibrium stabilities of these species under a wide range of environmental and geologic conditions.	The reviewer downgraded this study's overall quality rating. They noted: Study reports calculated estimates with limited details for endpoints related to fate (thermodynamic property).	(Haas and Shock, 1999)	Low
Other; non-guideline aerobic biodegradation experiment	11+/-17% to 81+/-18% µg/L	Other: primary sewage effluent Palo Alto, CA, Water Pollution Control Facility	Aerobic	25 weeks	<u>Biodegradation parameter: percent removal in test system:</u> No detectable or significant degradation observed under the tested conditions	The reviewer downgraded this study's overall quality rating. They noted: Greater than 100% of test substance was remaining relative to the	(Bouwer et al., 1981)	Low

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Study Type (year)	Initial Concentration	Inoculum Source	(An)aerobic Status	Duration	Result	Comments	Affiliated Reference	Data Quality Evaluation results of Full Study Report
						controls after 25 weeks.		
Other; trichloroethylene transformation by a Mixed Methanotrophic Culture	≥0.6 to ≤15 mg/L	anaerobic microorganisms	anaerobic		<u>Biodegradation parameter: transformation rates from freshly harvested cells:</u> 0.58 to 1.1 mg/mg cells/day; <u>Biodegradation parameter: transformation rates for initial TCE concentrations of 0.6, 3, and 6 mg/L, respectively:</u> 0.068, 0.048, and 0.026 mg/mg cells/day; the rate of transformation declined over time and was found to increase if an electron donor (formate) was added; it was also noted that toxicity as a result of TCE and/or transformation products may be a factor	The reviewer downgraded this study's overall quality rating. They noted: Variation in transformation rates indicated that loss was affected by factors other than strictly biotic processes.	(Alvarez-Cohen and McCarty, 1991)	Low
Other; anaerobic biodegradation	1.00 mg/L	anaerobic sludge	anaerobic	100 days	<u>Biodegradation parameter: percent removal:</u> 39%/100d	Extraction efficiency, percent	(Gossett, 1985)	Unacceptable

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Study Type (year)	Initial Concentration	Inoculum Source	(An)aerobic Status	Duration	Result	Comments	Affiliated Reference	Data Quality Evaluation results of Full Study Report
					from seeded samples; <u>Biodegradation parameter: concentration of degradation intermediates and products:</u> 1,1-DCE (11 nmol); cis-1,2-DCE (27 nmol); VC (12 nmol)	recovery, and mass balance were not reported; analytical methods were not reported, and loss of test material not accounted for limits evaluation of the study.		
Other	14.6 mg/L	activated sludge (adaptation not specified)	aerobic/anaerobic	14 days	<u>Biodegradation parameter: percent removal: anaerobic:</u> 0%/14d ; <u>Biodegradation parameter: removal: aerobic changed to anaerobic conditions:</u> some transformation/14d	The test method was not suitable for the test substance since TCE was also a degradation product of another compound being tested it is difficult to confirm or determine TCE removal.	(Kästner, 1991)	Unacceptable
Other; solid, liquid, and gas emissions from a municipal solid waste and sludge composting reactor were analyzed for DCM and other VOC.		activated sludge, domestic, adapted	aerobic	5 days	<u>Biodegradation parameter: percent removal:</u> >0%/5d	Based on insufficient data reported for TCE. Removal efficiency for volatilization, biodegradation and residuals for TCE of >0%	(Kim et al., 1995)	Unacceptable

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Study Type (year)	Initial Concentration	Inoculum Source	(An)aerobic Status	Duration	Result	Comments	Affiliated Reference	Data Quality Evaluation results of Full Study Report
Based on degradation rates from Howard 1991 and other system parameters, VOC concentrations were estimated in starting MSW.						were not sufficient to evaluate study results.		
Other; degradation in open and closed systems	≥0.1 to ≤1 ppm	natural water: marine	not specified	14 days	<u>Biodegradation parameter: percent removal in open-light, closed-light, and closed-dark systems, respectively: 80%, 35%, 30%</u>	Serious uncertainties or limitations were identified in sampling methods of the outcome of interest. In addition, loss from leaks in valves and open test systems were likely to have a substantial impact on the results. These serious flaws make the study unusable.	(Jensen and Rosenberg, 1975)	Unacceptable
14C-labelled	Not reported	activated sludge, adapted	aerobic	Not reported	<u>Biodegradation parameter: percent removal of radiolabel: 3.4%</u>	No information was provided about the test substance other than a statement saying some test	(Freitag et al., 1985)	Unacceptable

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Study Type (year)	Initial Concentration	Inoculum Source	(An)aerobic Status	Duration	Result	Comments	Affiliated Reference	Data Quality Evaluation results of Full Study Report
						substances were bought, some were synthesized in the lab.		
Other; non-guideline	Not reported for TCE study (cites Powell et al. 2011)	Not reported for TCE study (cites Powell et al. 2011)	aerobic	Not reported for TCE study (cites Powell et al. 2011)	<u>Biodegradation parameter: degradation rate constant: 0.15 d⁻¹</u> (mean; biomass normalized)	Study details for TCE reported in separate study (not available in HERO: Powell, C.L., Agrawal, A., 2011. Co-metabolic degradation of trichloroethene by methane oxidizers naturally associated with wetland plant roots: investigation with Carex comosa and Scirpus atrovirens. Wetlands 31 (1), 45–52.)	(Powell et al., 2014)	Unacceptable
Sediment								
Other; anaerobic biodegradation with methane-utilizing mixed culture	110 ng/mL	natural sediment	anaerobic	54 hours	<u>Biodegradation parameter: percent removal of radiolabel via primary degradation:</u> 100%/2d (not all of	The reviewer agreed with this study's overall quality level.	(Fogel et al., 1986)	High

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Study Type (year)	Initial Concentration	Inoculum Source	(An)aerobic Status	Duration	Result	Comments	Affiliated Reference	Data Quality Evaluation results of Full Study Report
					this is completely biodegrading to carbon dioxide during this time period)			
Other; static microcosm with muck and surface water in sealed septum bottles studying tetrachloroethene	100 µg	natural sediment: freshwater	anaerobic	21 days	<u>Biodegradation parameter: percent removal: 72.2%/21d</u>	The reviewer agreed with this study's overall quality level.	(Parsons et al. 1984)	Medium
Non-guideline	50 µmol/L	Dehalococcoides sp. was characterized as the microbe responsible for the dechlorination of TCE	anaerobic		<u>Biodegradation parameter: highest dechlorination rate observed: 68.8 µmol/L day; Biodegradation parameter: dechlorination products: trans-DCE:cis-DCE ratio = 1.43:1; Complete reductive dechlorination of TCE to ethene was accomplished in sediments from 1 location.</u>	The reviewer downgraded this study's overall quality rating. They noted: This study focused on dechlorination by a specific species and due to limited information being reported in the study, evaluation of the reasonableness of the study results was not possible.	(Cheng et al. 2010)	Low

Table 2. Bioconcentration Study Summary for Trichloroethylene

Study Type (year)	Initial Concentration	Species	Duration	Result	Comments	Affiliated Reference	Data Quality Evaluation results of Full Study Report
Bioconcentration in Bluegill sunfish: Aquarium with well-water and modified continuous-flow proportional dilution apparatus for chemical introduction	8.23±0.42 µg/L	Bluegill sunfish (Lepomis macrochirus) 100 per aquarium	Tetrachloroethylene 14 days; Test: 28 days or until equilibrium; water and fish samples collected periodically until apparent equilibrium was reached or the max exposure of 28 days was reached	<u>Bioconcentration parameter: BCF:</u> 17 (bluegill); <u>Bioconcentration parameter: half-life:</u> >1 day;	The reviewer agreed with this study's overall quality level.	(Barrows et al. 1980)	High
OECD Guideline 305 B (Bioaccumulation: Semi-static Fish Test)	2500 µg/L	Zebra fish (Brachydanio rerio)	2 weeks	<u>Bioconcentration parameter: BCF:</u> 19 (zebra fish, average), 12 (zebra fish, based on initial concentration), 65 (zebra fish, based on concentration 48 hours into test)	The reviewer downgraded this study's overall quality rating. They noted: Evaluation of the reasonableness of the study results was not possible due to limited data reporting regarding sampling and controls.	(Umweltbundesamt 1984)	Low

Table 3. Photolysis Study Summary for Trichloroethylene

Study Type (year)	Wavelength Range	Duration	Result	Comments	Affiliated Reference	Data Quality Evaluation results of Full Study Report
Air						
Photooxidation through the action of NO ₂ and sunlight.	3160-3660 Angstrom	140 minutes	<u>Photodegradation parameter: indirect photolysis (NO₂) percent removal: 66%/140 min;</u> <u>Photodegradation parameter: indirect rate constant K (NO₂): 0.6 min⁻¹</u>	The reviewer agreed with this study's overall quality level.	(Gay et al. 1976)	High
Water						
Photodegradation in water (indirect photolysis)	185 to 254 nm	60 min	<u>Photodegradation parameter: indirect photolysis rate constants:</u> 0.0135k deg min ⁻¹ (oxygenated) 0.0498 k deg min ⁻¹ (oxygen free) <u>Photodegradation parameter: indirect photolysis half-lives:</u> 3.75 min (oxygenated); 3.39 min (oxygen free)	The reviewer agreed with this study's overall quality level.	(Shirayama et al. 2001)	High
Outdoor solar treatment system using solar radiation and TiO ₂	365 nm	6 hours; 10 am to 4 pm	<u>Photodegradation parameter: First-order rate constants: Clear sky, Partly cloudy sky, and Thick cloudy sky, respectively: 0.074/min, 0.018/min, and 0.004/min;</u> <u>Photodegradation parameter: percent removal: Clear sky, Partly cloudy sky, and Thick cloudy sky, respectively: 88%, 81.2%, and 55.1%;</u>	The reviewer agreed with this study's overall quality level.	(Park et al. 2003)	High

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Study Type (year)	Wavelength Range	Duration	Result	Comments	Affiliated Reference	Data Quality Evaluation results of Full Study Report
			TCE rapidly degraded in the presence of TiO ₂ and solar light, complete degradation was observed after 120 min under a clear sky and 270 min under a cloudy sky, 80% loss was observed under a thickly cloudy sky; results were negative in the presence of TiO ₂ alone and solar light alone.			
Seasonal variation and byproducts of TCE using an outdoor solar treatment system with solar radiation and TiO ₂	365 nm	6 hours; 10 am to 4 pm (Summer: July-August; Winter: December-January)	<p><u>Photodegradation parameter:</u> <u>First-order rate constants:</u> <u>Winter at 50, 100, 150, and 200 mg/L, respectively:</u> 0.073/min, 0.047/min, 0.028, and 0.018/min,</p> <p><u>Photodegradation parameter:</u> <u>First-order rate constants:</u> <u>Summer at 50, 100, 150, and 200 mg/L, respectively:</u> 0.095/min, 0.065/min, 0.038/min, 0.024min; Summer resulted in 1.3X faster degradation rates compared to winter</p>	The reviewer agreed with this study's overall quality level.	(Park et al., 2003)	High
EPA OTS 796.3700 (Direct Photolysis Rate in Water by Sunlight)	sunlight	1 year	<p><u>Photodegradation parameter:</u> <u>DT50:</u> 6.6 months</p>	The reviewer agreed with this study's overall quality level. Related HERO ID 3970783, ECHA. Phototransformation in water:	(Dilling et al., 1975)	High

Study Type (year)	Wavelength Range	Duration	Result	Comments	Affiliated Reference	Data Quality Evaluation results of Full Study Report
				Tetrachloroethylene. 2017.		
Non-guideline batch reactor	253.7 nm	60 min	<u>Photodegradation parameter: indirect photolysis (OH radicals generated from peroxide): concentration:</u> studies at pH 3, 5, 7, 11 and varying conc. of H ₂ O ₂ all had significant decreases in C(final)/C ₀ over 60 min of experiment (<0.3)	The reviewer agreed with this study's overall quality level.	(Dobaradaran et al., 2012)	Medium
Other			<u>Photodegradation parameter: degradation:</u> 36%	A single data point (36% degradation) was provided. More info may be available in the report; however, the document is illegible.	(Freitag et al., 1985)	Unacceptable

Table 4. Hydrolysis Study Summary for Trichloroethylene

Study Type (year)	pH	Temperature	Duration	Results	Comments	Affiliated Reference	Data Quality Evaluation Results of Full Study Report
Nonguideline lab study in Pyrex tubes with light-proof container, shaken every 2-weeks, water purged with air for 15 min prior to addition of chlorinated compounds	Not reported	approx. 25 °C	1 year	<u>Hydrolysis parameter: Half-life:</u> 10.7 months (avg.), 1 ppm/0 months, 0.68 ppm/6 months, 0.44 ppm/12 months; Decomposition rate in aerated water in the dark; part of the reaction may have occurred in the vapor phase.	The reviewer agreed with this study's overall quality level.	(Dilling et al., 1975)	High
Alkaline homogenous hydrolysis experiments; a range of pH and temperature evaluated. Arrhenius temperature dependence assumed.	2-14	70-160	30 min to several days (for all test materials; specific duration for tetrachloroethylene not specified)	<u>Hydrolysis parameter: half-life (pH 7, 25 °C):</u> 1.3E6 years.	The reviewer agreed with this study's overall quality level.	(Jeffers et al., 1989)	Medium

Table 5. Other Fate Endpoints Summary for Trichloroethylene

System	Study Type (year)	Results	Comments	Affiliated Reference	Data Quality Evaluation results of Full Study Report
For the wind speed experiments, bottles were cut so that the height of the bottle was <0.5 cm from the water surface. For water motion experiments, the bottles were cut to make that distance 4.5cm so that and wind speed was not a factor.	TCE evaporation from DI water was measured at various wind speeds and water agitation speeds.	<p><u>Parameter: volatilization half-life with no wind/water motion:</u> 50%/3h</p> <p><u>Parameter: volatilization half-life with water motion at 50, 100, and 150 rpm, respectively</u> 50%/2.07h, 0.59h and 0.16h</p> <p><u>Parameter: volatilization half-life with wind speeds 0.54 m/s and 1.58 m/s:</u> 50%/2.43h and 0.31h</p>	The reviewer agreed with this study's overall quality level.	(Pant et al. 2007)	High
Model	Two-dimensional numerical model and analysis of vapor sorption on the subsurface transport of volatile organic compounds	<p><u>Parameter: volatilization percent removal after 100 days:</u> From soil w/ moist surface and dry lower levels, 73.2% w/ strong vapor sorption and 84.6% w/o vapor sorption; From dry soil, similar to previous; From soil w/ dry surface and moist lower levels, 81.2-90.3% w/ strong vapor sorption and 72.3% w/o vapor sorption.</p>	The reviewer agreed with this study's overall quality level.	(Culver et al. 1991)	High
>90% of the wastewater is composed of residential and commercial domestic sewage with <5% from industrial sources; most plants also receive runoff (18-40%) from the	Analysis of NYC municipal wastewaters from 1989-1993	<p><u>Parameter: WWTP influent/effluent comparison:</u> Trichloroethene was detected in 27% of influent samples and 7% of effluent samples; the concentration range detected in influent was 1-46 µg/L and effluent was 2-3 µg/L.</p>	The reviewer agreed with this study's overall quality level.	(Stubin et al. 1996)	High

System	Study Type (year)	Results	Comments	Affiliated Reference	Data Quality Evaluation results of Full Study Report
surrounding urban watershed					
Processes governing solute transport and volatilization were quantified using measured field data and the OTIS (one-dimensional transport with inflow and storage)	Volatilization rates and half-lives for VOCs in constructed wastewater treatment wetlands	<u>Parameter: wastewater treatment wetlands to air mass flux:</u> 0.06 g/d/hectare	The reviewer agreed with this study's overall quality level.	(Keefe et al., 2004)	High
Modified EPA method 624	Stripping of volatile organics from wastewater	<u>Parameter: WWTP influent/effluent comparison:</u> 213 and 745 µg/m ³ max off gas samples; avg influent and effluent: 0.6 and 0.1 µg/L in water and 50 and 19 µg/m ³ in off gas at skyway, respectively. influent and effluent: 20.9 and 2.9 µg/L in water and 289 and 252 µg/m ³ in off gas at highland creek, respectively.	The reviewer agreed with this study's overall quality level.	(Bell et al., 1993)	High
Beaker with mixer and dissolved oxygen analyzer in line	Volatilization rate study for high-volatility compounds	<u>Parameter: volatilization rate constant ratios kvC/kvo:</u> 0.57 ±0.09; range of kvo = 1.6-10.7 h ⁻¹	The reviewer agreed with this study's overall quality level.	(Smith et al., 1980)	High
Monitoring; trichloroethene concentrations in KWRP wastewater ~0.4 µg/L, Post-MF ~0.6 µg/L, Post-RO < 0.003 µg/L; in BPP wastewater <0.04 µg/L, Post-MF <0.03 µg/L, Post-RO <0.003 µg/L	Monitoring of water samples and correlation to treatment efficiency	<u>Parameter: WWTP removal efficiency:</u> 91.2% for tetrachloroethene; STE samples (n=29): 48.3% detections; post-MF samples (n=9): 55.6% detections; post-RO samples (n=27): 7.4% detections	The reviewer agreed with this study's overall quality level.	(Rodriguez et al., 2012)	High

System	Study Type (year)	Results	Comments	Affiliated Reference	Data Quality Evaluation results of Full Study Report
Gravimetric measurements by a Mettler H54 balance	Evaporation rates of solutes from water	<u>Parameter: volatilization rates at 23.9 °C:</u> 5.07E5 g/cm ² -s	The reviewer agreed with this study's overall quality level.	(Chiou et al. 1980)	High
12h Batch reactions run in lab-scale bioreactor continuously simulating pre-sedimentation without aeration (1st to 2nd hr.), followed by forepart (3rd to 6th hr.) and rear part aerobic biological treatment (7th to 10th hr.), post-sedimentation (final 2 hrs.)	Lab-scale batch experiments using a bioreactor to simulate the fate of VOCs in wastewater treatment plants (WWTP) and fugacity model predictions of VOCs in WWTP	<u>Parameter: partitioning:</u> The concentrations of the VOCs in the air, water, and sludge phases of the bioreactor were analyzed regularly. Mass distributions indicated that TCE was mainly present in the water phase throughout the four treatment stages; less than 1% of the total mass was subject to biological sorption and/or degradation by the sludge; water aeration resulted in increased partitioning to the air phase with a negative impact on biological removal; TCE mass distribution throughout the 4 stages: ~99% water, ~0.1% air, less than 0.1% sludge	The reviewer agreed with this study's overall quality level.	(Chen et al. 2014)	High
	Concentration in seawater and air	<u>Parameter: seawater to air flux:</u> 0.03-309.7 (mean 70.0) nmol m ⁻² d ⁻¹	The reviewer agreed with this study's overall quality level.	(He et al., 2013)	High
200 rpm stirring of the solution with a shallow-pitch		<u>Parameter: volatilization half-life:</u> 23.5 min	The reviewer agreed with this study's overall quality level.	(Dilling, 1977)	High
Wastewater flow: 41.5, 21, 852, 2390, 499, 110 and 30.5 L/min. Volatile organic loading rate: 14.6, 4.6, 292, 286, 19, 5.29, 0.395 kg/L. Feed ratio: 9.6, 10.5, 28.8, NA, 14.7, 7.1, 1.4 kg/kg for plants A-G respectively	7 steam stripper operations are reported	<u>Parameter: percent removal from steam stripper operations:</u> >99.7 to >99.9% removal from plants A, C and D.	The reviewer agreed with this study's overall quality level.	(Blaney, 1989)	Medium

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System	Study Type (year)	Results	Comments	Affiliated Reference	Data Quality Evaluation results of Full Study Report
VOCs injected into water line of shower and glass syringes were used to collect air and water samples.		<p><u>Parameter: percent volatilization at 25 °C, 33 °C, and 42 °C, respectively:</u> ~56% +/- 7%, ~60% +/- 10% and ~62% +/- 8%</p> <p><u>Parameter: percent volatilization at 42 °C by flow rates:</u> ~67% +/- 7% at 9.7 L/min, ~65% +/- 7% at 13.5 L/min</p>	The reviewer downgraded this study's overall quality rating. They noted: Study investigated volatilization from shower water. Study results may not be relevant to a specific/designated Fate endpoint.	(Tancrede et al., 1992)	Low
Reactors were fed by actual wastewater from unnamed facilities that were spiked with various VOCs.	Field study	<p><u>Parameter: WWTP influent/effluent comparison: influent:</u> 22-190 (mean 110) mg/L (SD 50.1); <u>effluent:</u> nd-6 mg/L (mean 2.86) (SD 1.73)</p>	The reviewer downgraded this study's overall quality rating. They noted: Modeling study that did not report the related experimental details well.	(Soltanali and Hagani, 2008)	Low
WWTP sampling		<p><u>Parameter: 8h TWA in air</u> 200 ppb</p> <p><u>Parameter: air concentration:</u> 0.04-35 ppm v/v;</p> <p><u>Parameter: WW concentration:</u> 0.11-7.5 µg/L</p>	The reviewer downgraded this study's overall quality rating. They noted: The volatility is reported for 3 sites in open systems.	(Dunovant et al., 1986)	Low
continuous release of chemicals and steady hydrological parameters assumed to develop a steady-state model for estimating concentration in river	Hydrological data and monitoring samples are used to calculate volatilization	<p><u>Parameter: half-life in river:</u> 4-6d;</p> <p>TCE release from the river is variable with an average value of 0.16%. Mainly removed by volatilization.</p>	This is a site specific modeling study reporting estimated data.	(Brüggemann and Trapp, 1988)	Unacceptable

System	Study Type (year)	Results	Comments	Affiliated Reference	Data Quality Evaluation results of Full Study Report
Full scale Wet Air Oxidation (WAO) of solvent still bottoms and general organic waste details	Wet air oxidation performance data	<u>Parameter: percent removal from test system:</u> >67.74%; Effluent concentration solvent still bottoms of trichloroethylene = <50 mg/L	Due to limited information, evaluation of the reasonableness of the study results was not possible.	(Matienzo, 1989)	Unacceptable
Highland Creek WWTP in Toronto, Ontario (pilot plant study also reported in the study)	Partitioning in activated sludge plant	<u>Parameter: percent removal from WWTP:</u> >90% by full scale aeration basin; TCE not detected in liquid-phase	Study evaluates removal based on air stripping. The extent of air stripping is a function of the compound physical-chemical properties and a function of WWTP design and operation.	(Parker et al., 1993)	Unacceptable
Performance data was collected on full scale batch fractional distillation systems as referenced in the source document	Distillation performance data	<u>Parameter: performance of test system:</u> Mean solvent concentration of distillation residues: trichloroethylene 14 reported values, mean concentration = 4; feasible treatment level = 2.0 mg/kg	Due to limited information, evaluation of the reasonableness of the study results was not possible.	(Matienzo, 1989)	Unacceptable

EPI Suite™ Model Outputs

CAS Number: 000079-01-6

SMILES : C(=CCL)(CL)CL

CHEM : TRICHLOROETHENE

MOL FOR: C2 H1 CL3

MOL WT : 131.39

----- EPI SUMMARY (v4.11) -----

Physical Property Inputs:

Log Kow (octanol-water): 2.42

Boiling Point (deg C) : 87.20

Melting Point (deg C) : -84.70

Vapor Pressure (mm Hg) : 69

Water Solubility (mg/L): 1280

Henry LC (atm-m3/mole) : 0.00985

Log Octanol-Water Partition Coef (SRC):

Log Kow (KOWWIN v1.68 estimate) = 2.47

Log Kow (Exper. database match) = 2.42

Exper. Ref: HANSCH,C ET AL. (1995)

Boiling Pt, Melting Pt, Vapor Pressure Estimations (MPBPVP v1.43):

Boiling Pt (deg C): 84.79 (Adapted Stein & Brown method)

Melting Pt (deg C): -77.15 (Mean or Weighted MP)

VP(mm Hg,25 deg C): 72.5 (Mean VP of Antoine & Grain methods)

VP (Pa, 25 deg C) : 9.66E+003 (Mean VP of Antoine & Grain methods)

MP (exp database): -84.7 deg C

BP (exp database): 87.2 deg C

VP (exp database): 6.90E+01 mm Hg (9.20E+003 Pa) at 25 deg C

Water Solubility Estimate from Log Kow (WSKOW v1.42):

Water Solubility at 25 deg C (mg/L): 1191

log Kow used: 2.42 (user entered)

melt pt used: -84.70 deg C

Water Sol (Exper. database match) = 1280 mg/L (25 deg C)

Exper. Ref: HORVATH,AL ET AL. (1999)

Water Sol Estimate from Fragments:

Wat Sol (v1.01 est) = 755.94 mg/L

ECOSAR Class Program (ECOSAR v1.11):

Class(es) found:

Vinyl/Allyl Halides

Henrys Law Constant (25 deg C) [HENRYWIN v3.20]:

Bond Method : 2.30E-002 atm-m3/mole (2.33E+003 Pa-m3/mole)

Group Method: 1.86E-002 atm-m3/mole (1.88E+003 Pa-m3/mole)

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Exper Database: 9.85E-03 atm-m³/mole (9.98E+002 Pa-m³/mole)
For Henry LC Comparison Purposes:
User-Entered Henry LC: 9.850E-003 atm-m³/mole (9.981E+002 Pa-m³/mole)
Henrys LC [via VP/WSol estimate using User-Entered or Estimated values]:
HLC: 9.319E-003 atm-m³/mole (9.443E+002 Pa-m³/mole)
VP: 69 mm Hg (source: User-Entered)
WS: 1.28E+003 mg/L (source: User-Entered)

Log Octanol-Air Partition Coefficient (25 deg C) [KOAWIN v1.10]:
Log Kow used: 2.42 (user entered)
Log Kaw used: -0.395 (user entered)
Log Koa (KOAWIN v1.10 estimate): 2.815
Log Koa (experimental database): 2.990

Probability of Rapid Biodegradation (BIOWIN v4.10):
Biowin1 (Linear Model) : 0.3508
Biowin2 (Non-Linear Model) : 0.0119
Expert Survey Biodegradation Results:
Biowin3 (Ultimate Survey Model): 2.3893 (weeks-months)
Biowin4 (Primary Survey Model) : 3.3563 (days-weeks)
MITI Biodegradation Probability:
Biowin5 (MITI Linear Model) : 0.3307
Biowin6 (MITI Non-Linear Model): 0.0408
Anaerobic Biodegradation Probability:
Biowin7 (Anaerobic Linear Model): 0.7186
Ready Biodegradability Prediction: NO

Hydrocarbon Biodegradation (BioHCwin v1.01):
Structure incompatible with current estimation method!

Sorption to aerosols (25 Dec C)[AEROWIN v1.00]:
Vapor pressure (liquid/subcooled): 9.2E+003 Pa (69 mm Hg)
Log Koa (Exp database): 2.990
Kp (particle/gas partition coef. (m³/μg)):
Mackay model : 3.26E-010
Octanol/air (Koa) model: 2.4E-010
Fraction sorbed to airborne particulates (phi):
Junge-Pankow model : 1.18E-008
Mackay model : 2.61E-008
Octanol/air (Koa) model: 1.92E-008

Atmospheric Oxidation (25 deg C) [AopWin v1.92]:
Hydroxyl Radicals Reaction:
OVERALL OH Rate Constant = 0.8048 E-12 cm³/molecule-sec
Half-Life = 13.291 Days (12-hr day; 1.5E6 OH/cm³)
Ozone Reaction:
OVERALL Ozone Rate Constant = 0.000512 E-17 cm³/molecule-sec
Half-Life = 2239.432 Days (at 7E11 mol/cm³)

Fraction sorbed to airborne particulates (ϕ):

1.89E-008 (Junge-Pankow, Mackay avg)

1.92E-008 (Koa method)

Note: the sorbed fraction may be resistant to atmospheric oxidation

Soil Adsorption Coefficient (KOCWIN v2.00):

Koc : 60.7 L/kg (MCI method)

Log Koc: 1.783 (MCI method)

Koc : 125.9 L/kg (Kow method)

Log Koc: 2.100 (Kow method)

Experimental Log Koc: 2 (database)

Aqueous Base/Acid-Catalyzed Hydrolysis (25 deg C) [HYDROWIN v2.00]:

Rate constants can NOT be estimated for this structure!

Bioaccumulation Estimates (BCFBAF v3.01):

Log BCF from regression-based method = 1.264 (BCF = 18.35 L/kg wet-wt)

Log Biotransformation Half-life (HL) = 0.0509 days (HL = 1.124 days)

Log BCF Arnot-Gobas method (upper trophic) = 1.375 (BCF = 23.7)

Log BAF Arnot-Gobas method (upper trophic) = 1.375 (BAF = 23.7)

log Kow used: 2.42 (user entered)

Volatilization from Water:

Henry LC: 0.00985 atm-m³/mole (entered by user)

Half-Life from Model River: 1.238 hours

Half-Life from Model Lake : 109.6 hours (4.567 days)

Removal in Wastewater Treatment:

Total removal: 79.58 percent

Total biodegradation: 0.04 percent

Total sludge adsorption: 1.26 percent

Total to Air: 78.28 percent

(using 10000 hr Bio P,A,S)

Level III Fugacity Model:

	Mass Amount (percent)	Half-Life (hr)	Emissions (kg/hr)
Air	35.4	109	1000
Water	54.2	900	1000
Soil	10.1	1.8e+003	1000
Sediment	0.261	8.1e+003	0

Persistence Time: 147 hr

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