WOOD PRESERVATIVES
Fate, Human Health, and Nontarget Organism (Ecological) Data Requirements Perspective
40 CFR PART 158 W

United States Environmental Protection Agency

Office of Pesticides

Antimicrobial Division

Outline

1. Overview of Wood Preservatives Industry
   - Wood preservative life cycle
   - Wood preservative treatment processes
   - Types of pressure treatments
   - Retention level
2. Environmental Fate data requirements
   - Emission Scenarios for Estimating Wood Preservative (WP)Concentrations in the Environment
   - Example of sample input, output, and model calculations for house built with pressure treated wood.
3. Human health data requirements
4. Ecological data requirements

Wood preservative life cycle

Stage 1: Product application

- Industrial preventive wood preservative treatments (including storage of treated wood prior to shipment)
- Preventive or curative treatments performed in situ

Stage 2: Treated wood in service

- Preventive wood preservatives are usually applied to the wood before the wood is placed in service
- Curative wood preservatives are applied to the wood product in service *in situ*

Wood Preservative Treatment Processes

Pressure Treatment

- Process by which the preservative is forced into the wood. A combination of pressure and/or vacuum are used to force preservatives into wood and remove the excess preservative at the end of the treatment.

Non-Pressure Treatment

- The wood is treated with a wood preservative fluid. The fluid can be sprayed, wiped or submerged
  - Anti-sapstain
  - Remedial (e.g., *in situ* treatments of wood in service)

Wood Preservative Treatment Processes

Use Site Index category 10 for wood preservatives includes pressure and non pressure treatments.

A. Pressure treated products include, but are not limited to:

- Rail road ties and cross-arms
- Utility poles
- Plywood
- Dimensional lumber

B. Non pressure treatments include, but are not limited to:

- anti-sapstain uses such as mill work and de-barked trees
- remedial treatment of utility poles with pole wraps and injections

Types of Wood preservatives

Water-borne

- Used in residential, commercial and industrial building structures.

  Examples: Chromated Copper Arsenates (CCA),
  Alkaline Copper Quat (ACQ-C, ACQ-D)

Creosote

- Used for treating railroad ties, guardrail posts, and marine structures

Oil-borne

- Used for treatment of utility poles and cross arms

  Examples: Pentachlorophenol (PCP), Copper Naphthenate

Retention Level in wood

- The amount of wood preservative which remains after treatment.
- Measured on a weight basis - expressed as “pound per cubic foot” (pcf) of wood.
- The retention level varies based on:
  1. The chemical used for treatment
  2. End use of the wood product
  3. Environment to which the wood is exposed

Sapstain

Anti-sapstain treatment

Remedial Pole Treatment

Images of Wood Treatment Process

Fate Data Requirements

Fate data Requirements for Wood Preservatives

Guideline Number	Data Requirement	Wood Preservatives Antimicrobial Use Pattern	Test Substance to Support MP or EP
Degradation Studies-Laboratory			
835.2120	Hydrolysis	R	TGAI or PAIRA
835.2240	Photo degradation in water	R	TGAI or PAIRA
835.2410	Photo degradation in soil	R	TGAI or PAIRA
Toxicity and fate in Wastewater Systems			
850.3300	Activated Sludge, Respiration Inhibition Test (ASRI)	R	TGAI
835.1110	Activated Sludge Sorption Isotherm	CR	TGAI
835.3110	Ready Biodegradability	CR	TGAI
835.3220	Porous Pot Study	CR	TGAI
835.3280	Simulation Tests to Assess the Biodegradability of Chemicals Discharged in Wastewater	CR	TGAI
835.3240	Simulation Test—Aerobic Sewage Treatment: A. Activated Sludge Units	CR	TGAI

Fate data Requirements for Wood Preservatives (Continued)

Guideline Number	Data Requirement	Wood Preservatives Antimicrobial Use Pattern	Test Substance to Support MP or EP
Mobility Studies			
835.1230	Leaching and adsorption/de-sorption	R	TGAI or PAIRA
Metabolism Studies - Laboratory			
835.4200	Anaerobic soil metabolism	R	TGAI or PAIRA
835.4300	Aerobic aquatic metabolism	R	TGAI or PAIRA
835.4400	Anaerobic aquatic metabolism	R	TGAI or PAIRA
Dissipation Studies—Field			
835.4200	Aquatic (sediment)	CR	TEP
Ground and Surface Water Monitoring			
None	Monitoring of representative U.S. waters	CR	ROC
Special Studies			
None	Special leaching	R	TGAI

How We Use The Fate Data

Emission Scenarios for Estimating Wood Preservative (WP) Concentrations in the Environment

The following scenarios will be used based on major use of the WP:

-> House

-> Fence

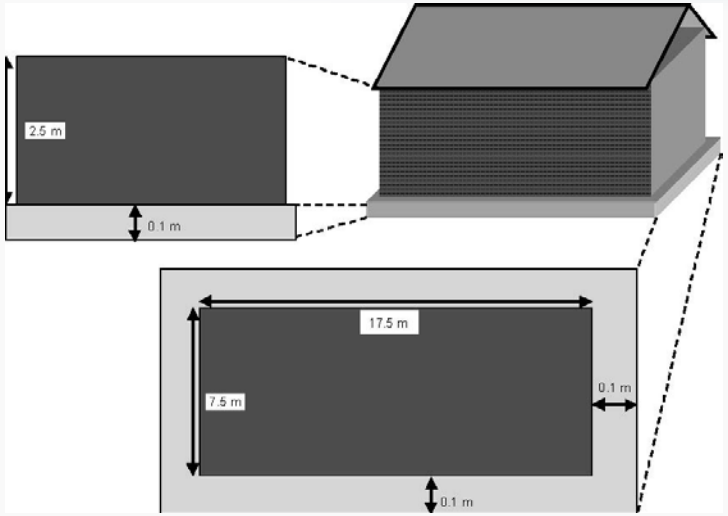
-> Pilings

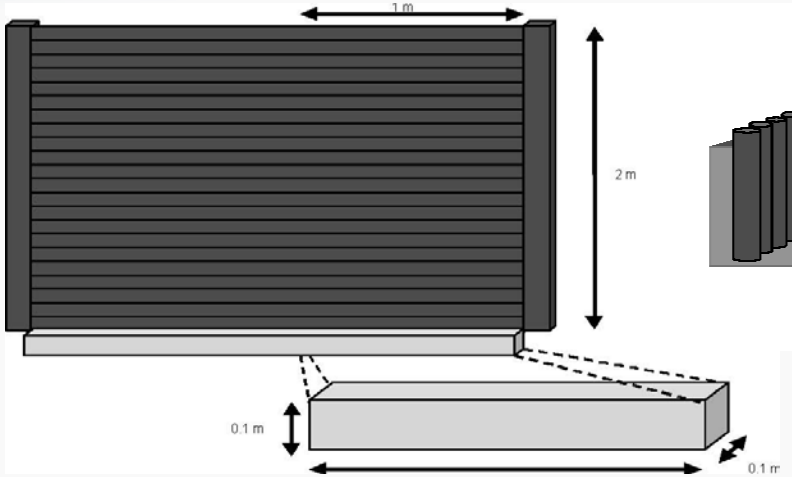
-> Fence post

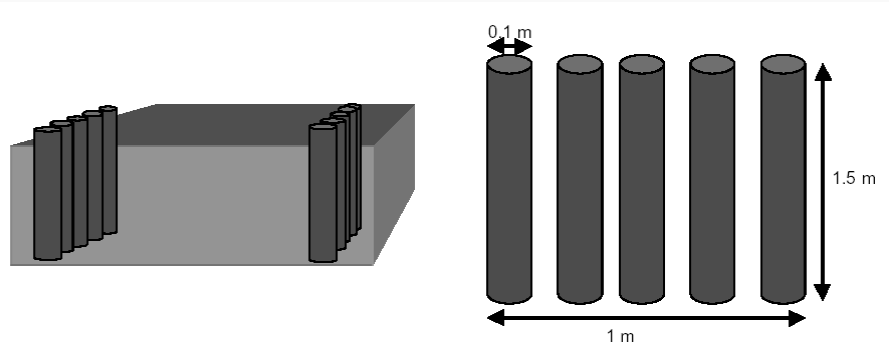
-> Utility Pole

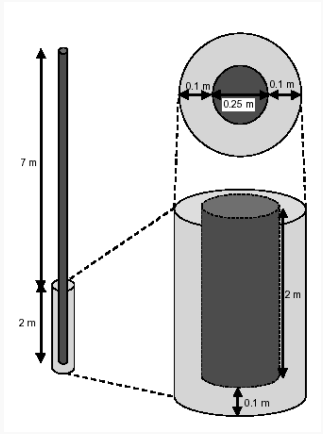
-> Dock

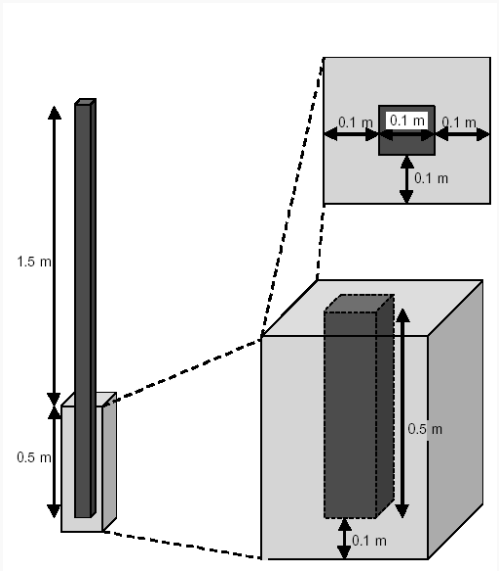
A few of these scenarios are similar to the OECD, but differences arise from the dimensions of structures and environmental conditions.

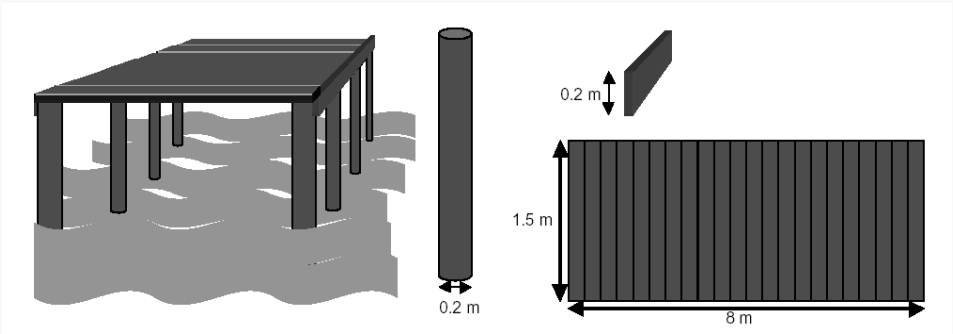






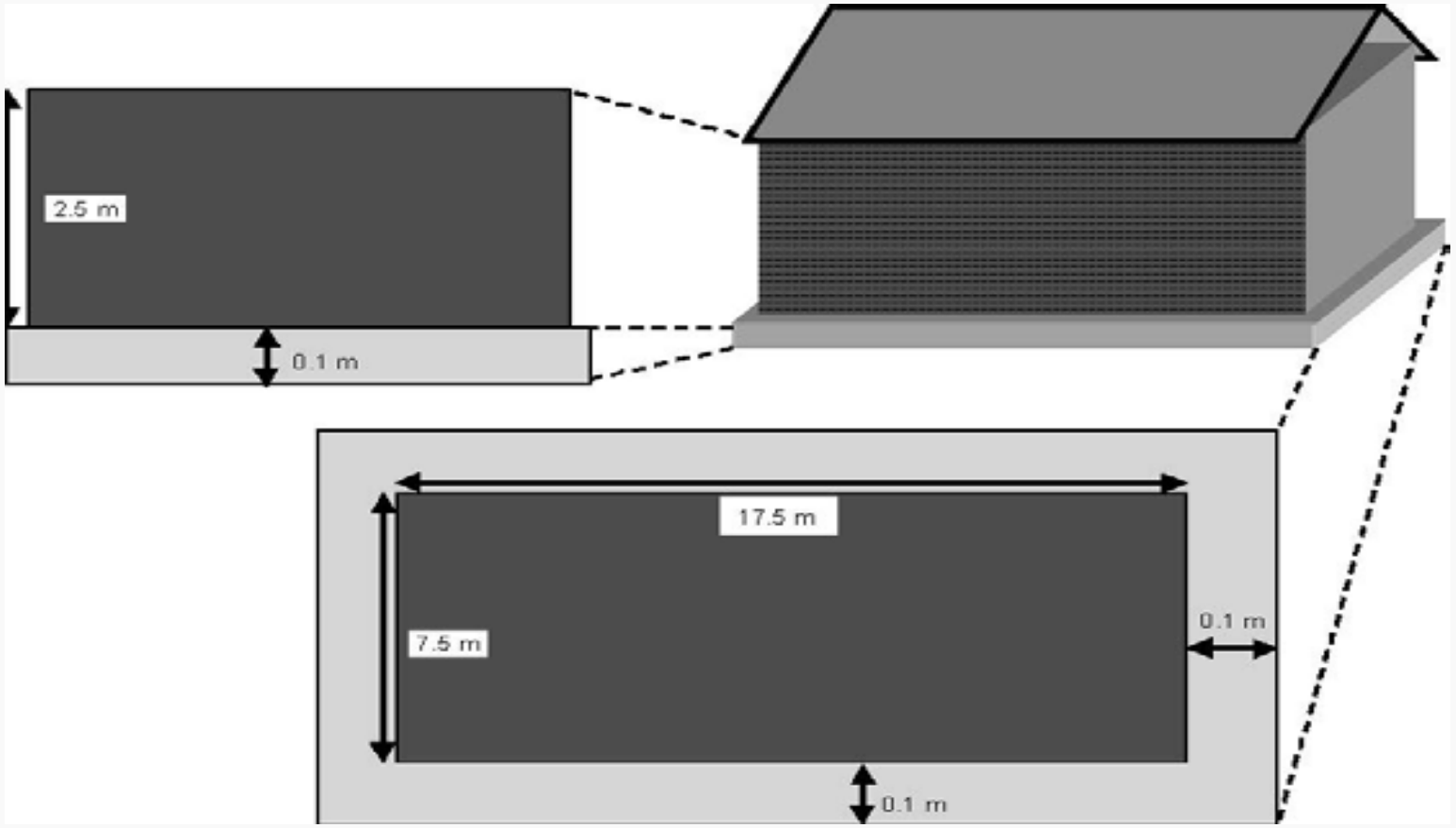






Wood preservative use scenarios

Schematic drawing of the timber cladded house



Emission scenario for House – Treated wood in service

Parameter/variable	Symbol	Value	Unit
Leachable wood area	$AREA_{house}$	125	[m²]
Duration of the initial assessment period	*TIME1*	30	[d]
Duration of the long-term assessment period	*TIME2*		[d]
Cumulative quantity of substance leached out of 1 m2 of treated wood over the initial assessment period	$Q^*_{leach,time1}$		[kg.m-2]
Cumulative quantity of substance leached out of 1 m² of treated wood over a longer assessment period	$Q^*_{leach,time2}$		[kg.m-2]
Soil volume (wet)	V_{soil}	0.5	[m³]
Bulk density of wet soil	RHO_{soil}	1700	[kgwwt.m-3]
OUTPUT			
Cumulative quantity of substance, leached over the initial assessment period	$Q_{leach,time1}$		[kg]
Cumulative quantity of substance, leached over a longer assessment period	$Q_{leach,time2}$		[kg]
Concentration in local soil at the end of the initial assessment period	$Clocal_{soil,leach,time1}$		[kg.kgwwt-1]
Concentration in local soil at the end of a longer assessment period	$Clocal_{soil,leach,time2}$		[kg.kgwwt-1]

MODEL CALCULATIONS

$$Q_{leach,time1} = AREAhouse \bullet Q^*_{leach,time1}$$

$$Q_{leach,time2} = AREAhouse \bullet Q^*_{leach,time2}$$

$$Clocal_{soil\ leach\ time1} - \frac{Q_{leach\ time1}}{V_{soil} \bullet RHO_{soil}}$$

$$Clocal_{soil\ leach\ time2} - \frac{Q_{leach\ time2}}{V_{soil} \bullet RHO_{soil}}$$

Human Health Data Requirements

When are human health data required for 158W?

Data are required if these two 158W criteria are both met:

1. Evidence of toxicity (adverse effects)
2. Potential for exposure to occur

What types of exposure data are typically required?

Applicator Exposure Data

1. Dermal (875.1100 and .1200)
2. Inhalation (875.1300 and .1400)
3. Product use information (875.1700)

What types of exposure data are typically required?

Post-Application exposure data

- Pressure treatment of dimensional lumber
  - Surface residue (875.2300)
  - Product Use & Description of Human Activity (875.2700 & .2800)
- Note that for certain other types of treatments (e.g. mill work, remedial pole wraps & injections) EPA assumes minimal post-application contact and may not require quantitative assessment

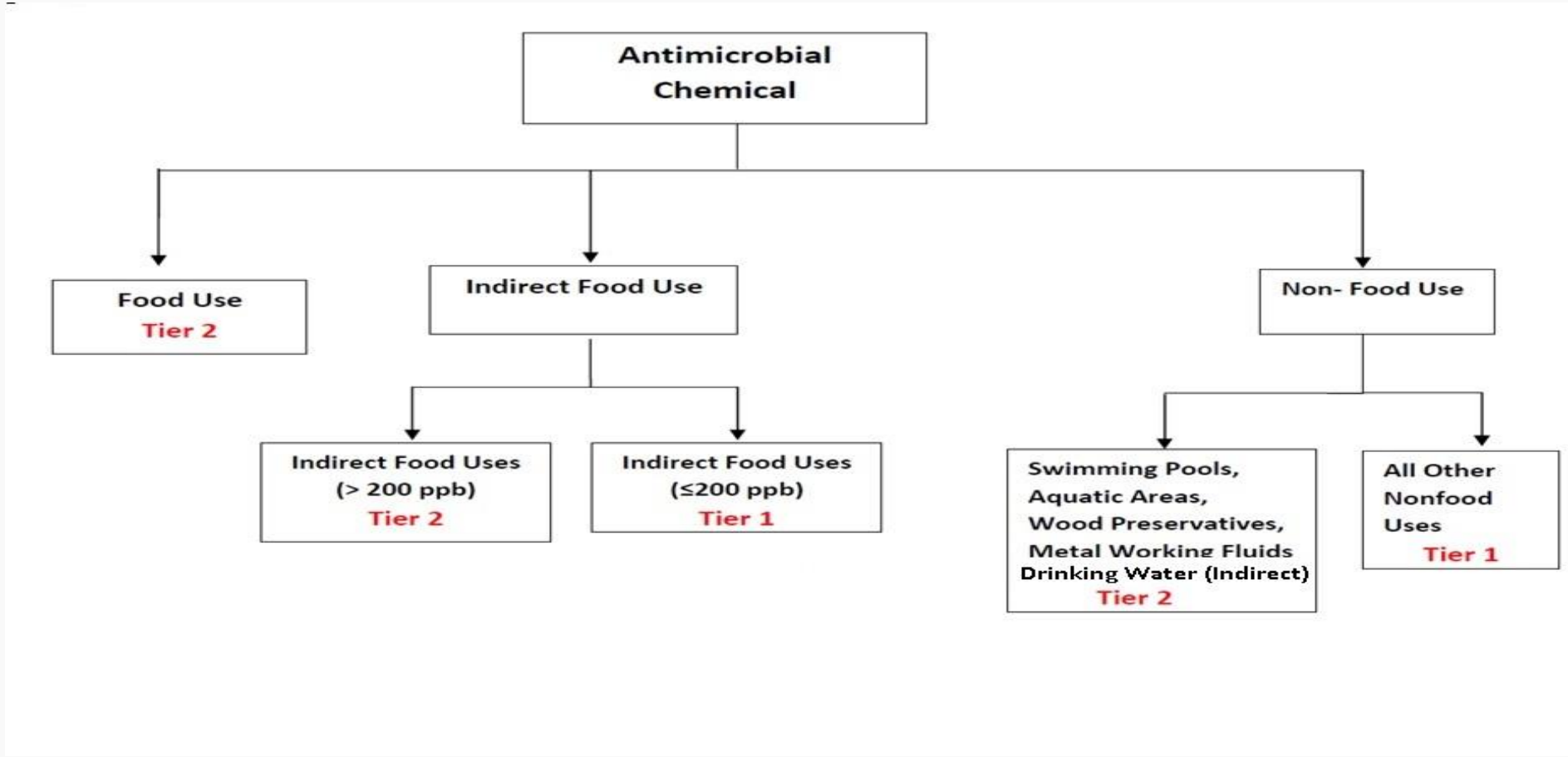
Are indirect dietary data required?

- At this time, EPA is not requiring data nor assessing dietary exposures from treated wood.
- It is assumed that there is minimal intermittent contact from wood potentially used in the construction of picnic tables, flat beds of farm trucks, raised garden beds.

What Toxicity Data are Required in 158W for Wood Preservatives?

- Wood treatments are considered a long-term exposure duration (<6 months)
- Toxicity data required include:
  - Basic Tier 1 toxicity studies; plus
  - Tier 2 (neurotoxicity, 90-day oral, chronic, and cancer studies)

158W Toxicology Decision Tree



Toxicology Data Requirements, 158W

Guideline Number	Data Requirement	Food Uses			Nonfood Uses		Test Substance to Support		Test Note No.
		Direct Food Uses	Indirect Food Uses (> 200 ppb)	Indirect Food Uses (≤ 200 ppb)	Swimming Pools, Aquatic Areas, Wood Preservatives, Metal Working Fluids	All Other Nonfood Uses	MP	EP	
Acute Testing									
870.1100	Acute oral toxicity – rat	R	R	R	R	R	MP and TGAI	EP and TGAI	1, 2
870.1200	Acute dermal toxicity	R	R	R	R	R	MP and TGAI	EP and TGAI	1, 2, 3
870.1300	Acute inhalation toxicity - rat	R	R	R	R	R	MP and TGAI	EP and TGAI	2, 4
870.2400	Primary eye irritation - rabbit	R	R	R	R	R	MP and TGAI	EP and TGAI	1, 2, 3
870.2500	Primary dermal irritation	R	R	R	R	R	MP and TGAI	EP and TGAI	1, 2, 3
870.2600	Dermal sensitization	R	R	R	R	R	MP and TGAI	EP and TGAI	1, 2, 3, 5
870.6200	Acute neurotoxicity - rat	R	R	CR	R	CR	TGAI	TGAI	6, 11
Subchronic Testing									
870.3100	90-Day oral toxicity - rodent	R	R	R	R	CR	TGAI	TGAI	8, 9, 15, 38
870.3150	90-Day oral toxicity - nonrodent	R	R	CR	R	CR	TGAI	TGAI	10, 15
870.3200	21/28-Day dermal toxicity	CR	CR	CR	CR	CR	TGAI	EP and TGAI	12, 13
870.3250	90-Day dermal toxicity	CR	CR	CR	CR	CR	TGAI	EP and TGAI	7, 13, 14, 15
870.3465	90-Day inhalation - toxicity - rat	CR	CR	CR	CR	CR	TGAI	TGAI	7, 15, 16, 17

Toxicology Data Requirements, 158W (Cont.)

Chronic Testing									
870.4100	Chronic oral toxicity - rodent	R	R	CR	R	CR	TGAI	TGAI	18, 19, 20
870.4200	Carcinogenicity – two rodent species – rat and mouse preferred	R	R	CR	R	CR	TGAI	TGAI	19, 21, 22
Developmental Toxicity and Reproduction									
870.3700	Prenatal developmental toxicity - rat and rabbit preferred	R	R	R	R	R	TGAI	TGAI	23, 24, 25, 26
870.3800	Reproduction and fertility effects	R	R	R	R	R	TGAI	TGAI	26, 27, 28, 29
870.6300	Developmental neurotoxicity	CR	CR	CR	CR	CR	TGAI	TGAI	28, 29, 30
Mutagenicity									
870.5100	Reverse mutation assay	R	R	R	R	R	TGAI	TGAI	31, 32
870.5300 870.5375	*In vitro* mammalian gene mutation	R	R	R	R	R	TGAI	TGAI	31, 33
870.5385 870.5395	*In vivo* cytogenetics	R	R	R	R	R	TGAI	TGAI	31, 34
Special Testing									
870.7485	Metabolism and pharmacokinetics	R	R	CR	R	CR	PAI or PAIRA	PAI or PAIRA	35, 39
870.7200	Companion animal safety	CR	CR	CR	CR	CR	NR	Choice	36
870.7600	Dermal penetration	CR	CR	CR	CR	CR	Choice	Choice	3, 37
870.7800	Immunotoxicity	R	R	R	R	R	TGAI	TGAI	8

What happens if the EPA does not have exposure data?

- Chemical-specific data are available for CCA/PCP/Creosote
- "Worker Exposure" – EPA will rely on available surrogate data
  - PT = Antimicrobial Exposure Assessment TF (AEATF)
  - Sapstain = Sapstain Industry Group (SIG) studies
- "Post-Application Exposure" - rely on default assumption
  - Assume transferable residue of 1 ug/cm^2 from the surface of dimensional lumber used in construction of playsets/decks
  - Assume ~1,700 cm^2 body surface area of a child contacts wood and some residue is incidentally ingested (hand-to-mouth activity)

Post-application Wipe Studies

- CPSC proposed wipe sampling methodology/protocol to determine transferrable residues from PT wood surfaces

- EPA recommends registrants follow CPSC wood wipe protocol

How We Use The Human Health Data

Basic Non-Cancer Risk Equation

Non-cancer Margin of Exposure (MOE)

$$MOE = \frac{\text{Toxicity (point of departure)}}{\text{Human Exposure}}$$

Ecological (Nontarget organism) Data Requirements

Basic data requirements needed for labeling purposes

These four studies are required for all chemicals to determine a baseline toxicity profile of the chemical regardless of the exposure patterns

- An acute avian oral toxicity test using the bobwhite quail or mallard duck (850.2100)
- An acute freshwater invertebrate toxicity test using *Daphnia magna (850.1010)*
- An acute freshwater fish toxicity test using the rainbow trout or bluegill sunfish (850.1075)
- An acute green algae study (850.4500)

Chronic testing requirements for wood preservatives

These two chronic toxicity tests are required for wood preservatives in order to determine chronic risk from the leaching of the chemical from the treated wood products and in the case of accidental release of the chemical into watersheds during the wood treatment process

- A fish early-life stage test (850.1400) using the most sensitive organism as determined from the results of the acute toxicity tests
- An aquatic invertebrate life-cycle test (850.1300) using the most sensitive organism as determined from the results of the acute toxicity tests

Nontarget plant protection data requirements

These two aquatic plant studies are required for the wood preservatives

- An aquatic plant growth (aquatic vascular plant) Tier II-dose response test (850.4400)
- An aquatic plant growth (algal) Tier II-dose response test using *Selenastrum capricornutum* (850.4500)

- If results of the algal test demonstrates detrimental effects (EC50 < 1ppm) then additional Tier II studies are required on four additional species (*Anabaena flos-aquae*, *Navicula pelliculosa*, *Skeletonema costatum*, and *Selenastrum capricornutum*)

Eco-toxicity study only required for wood preservatives

- Honeybee acute contact study (850.3020) is required for all wood preservatives

- Toxicity of residues to honeybees study (850.3030) is not required due to a lack of exposure to bee larvae

How we use Nontarget Organism data

Integrating Exposure and Ecotoxicity Values

- Exposure estimates are determined using the data from leaching studies
- Ecotoxicity values (LC50, EC50, and NOAEC) are determined from the aquatic testing for fish, aquatic invertebrates and aquatic plants
- Risk Quotients (RQs) are calculated by dividing exposure estimates by ecotoxicity values, both acute and chronic
  - Most sensitive endpoints are used to calculate the RQs
  - RQs are compared to levels of concern (LOCs)
  - LOCs are criteria used by OPP to indicate potential risk to nontarget organisms – if LOCs are exceeded, there is risk

References

OECD, 2013. Revised Emission Scenario Document for Wood Preservatives. ENV/JM/MONO92013/21

Morrell J et all, 2011. Managing Treated Wood in Aquatic Environments. Forest Products Society.

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