



Technical Solutions

Spokane River Regional Toxics Task Force Workshop
October 8-9, 2019, Spokane, WA

Industry Regulatory Drivers

North America:

- USEPA Premanufacturing Notices (PMN) - no guarantee of commercial use in EU or Asia with PMN
- FIFRA Registrations
- USFDA Food Contact Notifications
- Canada New Substances Notifications (NSN)
- PMRA Registrations



Environment and
Climate Change Canada



Health
Canada

Global:

- EU REACH Dossiers
- Turkey REACH, Korea REACH, Taiwan, China, Etc.



Take-away:

- Limited timelines for registering new substances that are commercially viable

Industry Technical Solutions



All chemical reactions have by-products and side reactions



Industry initiated solutions (1990 to present) include reduced use of chlorinated solvents, modified buffers and process optimization equipment design



Color pigments industry strategically aligned with downstream customers (supply chain)



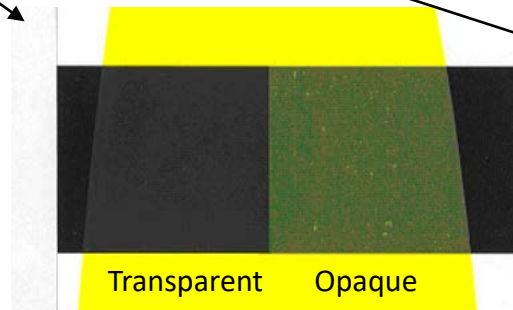
Changes in formulations must meet customer technical & performance requirements

Color Pigments Characteristics & Customer Requirements

- ✓ Chroma
- ✓ Broad shade functionality
- ✓ Durability/lightfastness
- ✓ Opacity/transparency
- ✓ Low metamerism
- ✓ Dispersibility
- ✓ Heat stability
- ✓ Solvent resistance
- ✓ Gloss retention
- ✓ Color strength



- ✓ Fitness for purpose (performance level)
- ✓ Regulatory status
- ✓ Cost
- ✓ Availability



Good Dispersibility



Bad Dispersibility



Good Durability



Poor Durability



Washington State Regulatory Framework 2015-2019

- PCB Chemical Action Plan (2015)
- DOE PCBs in Products Study (2015)
- EPA Region 10 Water Quality Regulations (2016)
- Orca Whale Task Force (2018)
- Environmentally Preferable Purchasing Guidelines (2019)
- Safer Products Legislation (2019)
- EPA Region 10 Water Quality Regulations (2019)

Table A1: US EPA list of manufacturing processes likely to generate inadvertent PCBs

The following was transcribed from EPA rulemaking records from “Polychlorinated Biphenyls (PCBs); Manufacturing, Processing, Distribution in Commerce, and Use Prohibitions: Exclusions, Exemptions and Use Authorizations” Doc No. OPTS-62032. This was transcribed for Panero *et al.* (2005).

Chlorinated Compounds Produced Using Direct Chlorination	Chlorinated Compounds Produced Using Chlorinated Feedstocks	Non-chlorinated Compounds Produced Using Chlorinated Feedstocks	IPPE U No.
Petroleum Feedstock: BENZENE			
Chlorinated benzenes	Chloronitrobenzenes	Phenol	8
Chlorinated phenols	Dichloronitrobenzenes	Aniline	9
Hexachlorocyclohexane	Dichloroanilines	o-Phenylenediamine	28
Chloranilines	Chlorinated methyl phenols	o-,p-Nitroanilines	29
Trichloroanilines	Chlorophenyl phenylethers	Diphenylamine	34
	Chlorinated benzidines	Acetanilide	17
Petroleum Feedstock: ETHYLENE			
Mono, di-chloroacetic acid	Ethyl chloroacetate	Glycine	108
Sodium chloroacetate	Vinyl chloride	Cyanoacetic acid	111
Chlorinated ethanes	Vinylidene chloride	Sodium, carboxymethyl cellulose	112
Chlorinated ethylenes	Bis (2-chloroethyl) ether	Ethyl cellulose	118
Ethylene chlorohydrin	Chlorinated acetophenones	Ethylene diamine	134
Chlorinated, fluorinated ethanes	Choline chloride	Aminoethylethanolamine	135
Chlorinated, brominated ethylenes	Hexachlorobutadiene	Mono-, di-, and triethylene glycol ethers	150
Chlorinated, fluorinated ethylenes		Tetramethylethylene diamine	(3341)
Chlorinated acetaldehyde			
Chlorinated acetyl chloride			
Hexachlorobenzene			
Petroleum Feedstock: METHANE			
Chlorinated methanes	Chlorinated, fluorinated methanes	Carbon tetrabromide	162
Phosgene	Chlorinated, brominated methanes	Carbon tetrafluoride	(812)
Tetrachloroethane	Bis (chloromethyl) ether		
Chlorodifluoroethane (?)	Cyanuric chloride		
Perchloromethyl mercaptan (?)	Trichloroethylene		
Cyanogen chloride			

Chlorinated Compounds Produced Using Direct Chlorination	Chlorinated Compounds Produced Using Chlorinated Feedstocks	Non-chlorinated Compounds Produced Using Chlorinated Feedstocks	IPPE U No.
Petroleum Feedstock: NAPHTHALENE			
Chloronaphthalenes			
Tetrachlorophthalic anhydride			
Petroleum Feedstock: PARAFFINS			
n-Propyl chloride		n-Propylamine	231
Carbon tetrachloride		Butyronitrile	232
Perchloroethylene		Amyl amines	243
Hexachloroethane		Amyl alcohols	244
Amyl chlorides		Amyl Mercaptans	245
Chloroprene		Benzophenone	249
Hexachlorocyclopentadiene		Linear alkylbenzenes	(2417)
Methallyl Chloride			
Petroleum Feedstock: PROPYLENE			
Dichlorohydrin	Epichlorohydrin	Isopropylphenols	272
Chloranil	Bis (2-chloroisopropyl) ether	Propylene oxide	280
Propylene chlorohydrin		Anisols	302
Chlorinated propanes		Allyl alcohol	317
Chlorinated propylenes		Glycerol	318/319
		Propyl amines	(1446)
Petroleum Feedstock: TOLUENE			
Benzyl chloride	Benzoyl chloride	Benzyl alcohol	334
Benzyl dichloride		Benzyl amine	335
Benzyl trichloride		Benzamide	337
Chlorotoluenes		Toluenesulfonamide	358
Chlorobenzaldehyde		Benzoyl peroxide	(495)
Chlorobenzoic acids & esters			
Chlorobenzoyl chlorides			
Toluenesulfonyl chloride			
Chlorobenzotrichlorides			

*The IPPEU No. refers to the process description in the 1977 EPA summary (EPA, 1977). Those numbers bracketed by parentheses refer to the OCPDB numbers in the 1980 EPA summary (EPA, 1980)

Northwest Green Chemistry, 16 October 2018.
Inadvertent PCBs in Pigments: Market Innovation for Circular Economy, Final Report.

Practical Considerations

- Very low limits for PCBs in NPDES permits → not feasible for regulated entities
- Current Washington State water quality testing (Spokane River) incomplete → not all sources of PCBs have been identified
- Current Washington State regulatory approach inconsistent with existing global regulatory landscape and global supply chain requirements



Thank you!

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