Commitment

SRRTTF Established by Memorandum of Agreement 2012.

Members of the community, stewards of the river.
The Problem:

- The Spokane River does not meet the Water Quality Standards for polychlorinated biphenyls and other toxics.
- > 98% reduction in PCB loading is needed.
- Permitted discharges have a disproportionate responsibility for cleanup.
- End of pipe clean up is expensive and may not be possible.
- Using Pollution Prevention principles is the only viable option.
Can We Achieve our WQS?

• Assume all PCB from pigments becomes available to the river.
  • (trash, decomposition, burning, wastewater, stormwater, etc.)

• 225 cf/s average annual flow into Long Lake
  • $7 \times 10^{12}$ kg water/yr.

• PCB Concentrations in the river:
  • From pigments alone: $2 \times 10^{-7}$ ppm
  • Current WQS target: $0.07 \times 10^{-7}$ ppm
Why this is important

PCB is a national water quality concern

EPA Watershed Assessment, Tracking and Environmental Database
Waste Management Hierarchy

• Prevent Waste Generation
• Minimize Waste Generation
• Reuse Waste Materials
• Recycle Wastes: Doesn’t work for PCB!
• Utilize for Energy Recovery
• Disposal
In Other Words:

• Don’t make it
• Don’t use it
• Use less of it
• Manage it better
• Dispose of it properly
• Clean up and/or Treat at End of Pipe
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In Other Words:

• Don’t make it: Stop or reduce inadvertent production.
• Don’t use it: Regulatory & market incentives.
• Use less of it: Public awareness.
• Manage it better: Enforcement of rules.
• Dispose of it properly.
• Clean up and/or Treat at End of Pipe.
End
But, Is This Really a Problem?

- Color Pigments Manufacturers Association (2010):
  - 90 million lbs pigments imported/manufactured in US.
  - Estimated 1000-2000 lbs PCB/year.

- Estimated amount released in Spokane metro area based on per capita consumption.
  - $2000/lb \times 0.5 \text{ million Spokane} / 316 \text{ million USA}$
  - $1435 \text{ g/yr}\ "\text{inadvertently produce PCB}" \text{ potentially enters the Spokane River watershed.}$

- Correlation with the 2005 loading assessment:
  - Total PCBs at Long Lake: $3664 \text{ mg/day} = 1337 \text{ g/year.}$
Why this is important

PCB is a Spokane River health concern.
Source Reduction Strategies

Six strategies to achieve source reduction:

• Toxic chemical substitution
• Production process modification
• Finished product reformulation
• Production modernization
• Improvements in operations and maintenance
• In-process recycling of production material
Green Chemistry Solutions

• Green Chemistry is doing chemistry the way nature does:

“the design, development and implementation of chemical products or processes that reduce or eliminate the generation of hazardous substances”

• PCB – free pigments are a green chemistry opportunity.
References
PCB in Paint Pigments

33 commercial pigments

> 50 PCB congeners

Several dioxin-like pigments also used in:
- Inks
- Textiles
- Paper
- Cosmetics
- Leather
- Plastics
- Food

Hu and Hornbuckle, 2010: http://www.ncbi.nlm.nih.gov/pmc/articles/PMC2853905/figure/fig2/
Yellows, Oranges, Reds

PCB 11 from Diarylide Yellows

Diarylide yellow

3,3’-dichlorobenzidine

PCB 11 (3,3’-diCB)

\[
R_1, R_2, R_3 = H \quad \text{Pigment yellow 12}
\]

\[
R_1, R_2 = \text{CH}_3, R_3 = H \quad \text{Pigment yellow 13}
\]

\[
R_1 = \text{OCH}_3, R_2, R_3 = H \quad \text{Pigment yellow 17}
\]

\[
R_1, R_3 = \text{OCH}_3, R_2 = \text{Cl} \quad \text{Pigment yellow 83}
\]

All listed in EPA’s Toxic Substances Control Act (TSCA) inventory

Blues and Greens

Hu and Hornbuckle, 2010: http://www.ncbi.nlm.nih.gov/pmc/articles/PMC2853905/figure/fig3/
PCBs 206, 208, 209

Produced inadvertently during the making of titanium tetrachloride

\[ 2 \text{FeTiO}_3 + 7 \text{Cl}_2 + 6 \text{C} \rightarrow 2 \text{TiCl}_4 + 2 \text{FeCl}_3 + 6 \text{CO} \]

Often sold to water treatment plants as a flocculant

This carbon is chlorinated to form PCBs

Most TiCl\(_4\) is then used to make TiO\(_2\) (white pigment)

\[ \text{TiCl}_4 + \text{O}_2 \rightarrow \text{TiO}_2 + 2\text{Cl}_2 \]