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Persistent, Bioaccumulative, and Toxic Chemicals

A Printer's Roadmap

By: Gary A. Jones
Graphic Arts Technical Foundation

Introduction and Background

EPA's activities surrounding the development of regulations for addressing persistent, bioaccumulative and toxic (PBT) chemicals is increasing. Since 1998, EPA has undertaken several approaches to address the identification and control of PBTs. EPA has released a multimedia strategy, instituted a voluntary initiative designed to address PBTs under the waste minimization requirements of the Resource Conservation and Recovery Act (RCRA), and finalized two rule changes for Toxic Release Inventory (TRI) reporting.

> CAUTION: It is important to understand that there are two different PBT lists, a RCRA voluntary list and a TRI List that is mandatory. Be sure to review the correct list prior to taking action.

While the impact on the printing industry is not necessarily obvious, the thresholds for some of the requirements, especially the mandatory Toxic Release Inventory (TRI) reporting, are so low that many printers may have to file reports. The TRI reporting is mandatory and any printer with more than 10 full time employees using enough material with PBTs in them are required to file an annual report with EPA. Besides dramatically lowering the reporting threshold, EPA also now requires the printer to account for the specific PBT when it is found in any concentration.

At this point it appears that EPA's multimedia strategy and waste minimization program will not affect printers to an appreciable degree. However, before the impact on the printing industry and an individual printer can be fully assessed, it is important to understand the scope of EPA's actions. Presented below is a summary of the current programs, an analysis of their impact, and an action plan for response.

Multimedia PBT Strategy

On November 17, 1998, EPA released in the *Federal Register* its multimedia PBT strategy. EPA's multimedia strategy is designed to implement the agreements made under the Canada-U.S. Binational Toxics Strategy. A full copy of the strategy can be found at www.epa.gov/pbt. The strategy includes approaches to:

1. Develop and implement national action plans for 12 priority PBT pollutants. The plans will combine regulatory, enforcement, and voluntary elements. The first to be addressed are those identified as Level 1 substances identified below.

2. Screen and select more priority PBT pollutants for action.

3. Prevent the introduction of new PBT pollutants into commerce.

4. Measure progress by linking activities to environmental results.

Level 1 Priority PBTs

Chemical	**CAS Number**
Aldrin/dieldfin	309-00-2
Benzo(a)pyrene	50-32-8
Chlordane	57-74-9
DDT (dichlorodiphenyltrichloroethane)	
Octachlorostyrene	29082-74-4
Hexachlorobenzene	118-74-1
Alkyl-lead	
Mercury and Compounds	Various
Polychlorinated biphenyls (PCBs)	Various
Dioxins and Furans	Various
Toxaphene	8001-35-2

Bold – Indicates substances that could possibly be found in printing operations.

The strategy includes an action plan for reducing mercury pollution. Under the Canada-U.S. Binational Toxics Strategy, EPA has agreed to reduce by 50% the deliberate use of mercury and a 50% reduction in releases from sources resulting from human activity. The plan focuses on controlling emissions from point sources, revising water quality criteria, seeking reductions in mercury use, developing environmentally acceptable disposal techniques, reducing exposure to highly exposed populations, enhancing enforcement on illegal use and disposal, continueing international efforts on reducing its use, and conducting further research.

PBT Waste Minimization Program

In the November 9, 1988 *Federal Register,* EPA released a preliminary list of 53 PBTs frequently found in hazardous waste. EPA's proposal for the PBTs found in hazardous waste were intended to encourage facilities that generate wastes containing the listed PBTs to either change their manufacturing process or their materials to reduce the amount of waste containing the PBTs. This would reduce the need to incinerate or otherwise treat these PBT containing wastes. EPA's goal was to reduce the amount of the 53 PBT chemicals found in the waste streams by 10% in 2000 and by 50% in 2005. A web site, www.epa.gov/wastemin, contains supporting information, fact sheets, and the list of chemicals. The following chart presents the initial 53 chemicals identified under this program.

Initial PBT Chemicals Subject To Voluntary RCRA Waste Minimization Plan

Chemical	**CAS #**	**Chemical**	**CAS #**
Dioxins and Furans		**Organonitrogens**	
Dioxins	Various	Nitrobenzene	98-95-3
Furans	Various	Cyanide	57-12-5
Chlorinated Solvents		**Nonhalogenated Phenolics**	
Chloroform	67-66-3	**Phenol**	108-95-2
1,1-Dichloroethene	75-34-3	2,4,6,-Tris-(1,1-Dimethylethel)phenol	732-26-3
1,1,1-Trichloroethane	71-55-6		
		Phthalate Esters	
Chlorobenzenes		Bis-(2-ethylhexyl) phthalate	117-81-7
1,2-Dichlorobenzene	95-50-1	Butylbenzyl phthalate	85-68-7
1,3-Dichlorobenzene	541-73-1	**Dibutyl phthalate**	84-74-2
1,4-Dichlorobenzene	106-46-7		
1,2,4-Trichlorobenzene	120-82-1	**Polycyclic Aromatic Hydrocarbons**	
1,2,4,5-Tetrachlorobenzene	95-94-3	Acenaphthene	83-32-9
Pentachlorobenzene	608-93-5	Acenaphthylene	208-96-8
Hexachlorobenzene	118-74-1	Benzo(g,h,i)perylene	191-24-2
		Fluoranthene	206-44-0
Other Halogenated Organics		2-Methylnaphthalene	91-57-6
4-Bromophenyl phenyl ether	101-55-3	**Naphthalene**	91-20-3
Hexachlorobutadiene	87-68-3	**PAH group (as defined in TRI)**	
Octachlorostyrene	29082-74-4	Phenathrene	85-01-8
		Pyrene	129-00-0
Pesticides			
Alpha-Endosulfan	959-98-8	**Metals**	
Beta-Endosulfan	33213-74-4	Antimony	7440-36-0
Heptachlor	76-44-8	**Arsenic**	7440-38-2
Heptachlor epoxides	1024-57-3	Beryllium	7440-41-7
Gamma-Hexachlorocyclohexane	58-89-9	**Cadmium**	7440-43-9
Methoxychlor	72-43-5	**Chromium**	7440-47-3
Pentachloronitrobenzene	82-68-8	**Copper**	7440-50-8
Pentachlorophenol	87-86-5	**Lead**	7440-50-8
2,4,5-Trichlorophenol	95-95-4	**Mercury**	7439-97-6
		Nickel	7440-02-0
		Selenium	7782-49-2
		Zinc	7440-66-6

Bold – Indicates substances that could possibly be found in printing operations.

The preliminary list of 53 PBTs does not contain many of the above 12 priority PBTs, since most of the original 12 are canceled or banned pesticides. The 53 hazardous waste PBTs are those chemicals that are currently used in production. It is important to note that the 53 chemicals are not final and EPA has taken comments on the initial list and a final list has not been released.

The selection process used by EPA to identify the 53 chemicals has received a significant amount of criticism. EPA relied on its new Waste Minimization Prioritization Tool, a software program that scores thousands of chemicals based on their mass generated, persistence, bioaccumulation and toxicity. EPA then identified the chemicals that exhibit persistence, bioaccumulation, toxicity, presence in soils and sediments of greatest concern on a national basis to the RCRA program, and are hard to manage, clean up or pose other RCRA issues. In response to comments received, EPA has revised some of the aspects of the Waste Minimization Prioritization Tool, but additional changes are still underway.

EPA plans on tracking the reduction in PBTs by using TRI reports under EPCRA and the biennial reports required to be submitted by Large Quantity Generators. At this time, all but 16 of the initial 53 PBTs are on the TRI list.

PBT TRI Reporting

On October 29, 1999, EPA lowered the Toxic Release Inventory (TRI) reporting threshold for 19 PBTs subject to reporting under EPCRA and on January 17, 2001, for lead and lead compounds. The complete list of substances required to be reported under the Toxic Release Inventory reporting can be found *TRI PBT Reportable Chemicals* table below.

Under the PBT rule changes, any facility that manufacturers, processes, or uses certain PBTs in quantities greater than 10 pounds (4.5 kilograms) per year or others greater than 100 pounds (45 kilograms) per year must be reported. The 10-pound per year threshold applies to highly persistent and bioaccumulative chemicals while the 100-pound per year threshold applies to less persistent and bioaccumulative chemicals. A reporting threshold of 0.1 gram per year has been established for dioxins and dioxin-like compounds (e.g., polychlorinated dibenzo-p-dioxins and polychlorinated dibenzofurans) that are either manufactured or coincidentally manufactured (e.g., byproduct or impurity). Unless a printer is burning a substantial amount of wood, reporting on dioxins would not normally be required.

The criteria for distinguishing between a highly persistent and bioaccumulative chemical and a less persistent and bioaccumulative chemical are based on the chemical's half-life and its bioaccumulation and bioconcentration factor (BAF/BCF). BAF is the ratio of a substance's concentration in tissues of an aquatic organism to its concentration in ambient water in situations where both the organism and its food are exposed and the ratio does not change over time. BCF is the ratio of a substance's concentration in tissues of an aquatic organism to its concentration in ambient water in situations where the organism is exposed through water only and the ratio does not change over time.

Any PBT that has a half-life of 6 months or more and a BAF/BCF value greater than 5000 will have the lower 10-pound reporting threshold. Any PBT with a half-life of 2-6 months in soil, sediment, or water and a BAF/BCF value between 1000 and 5000 will have the 100-pound reporting threshold. The list of chemicals and their reporting thresholds are as follows:

TRI PBT Reportable Chemicals

Compound	**CAS #**	**Reporting Threshold (In Lbs, Unless Noted)**
Aldrin	00309-00-2	10
Benzo[g,h,I]perylene	00191-24-2	10
Chlordane	00057074-9	10
Heptachlor	00076-44-8	10
Hexachlorobenzene	00118-74-1	10
Isodrin	0046507306	10
Lead (Exception For Stainless Steel, Brass, or Bronze Alloys) **	7440-50-8	100
Lead Compounds	Various	100
Mercury and **Mercury Compounds**	07439-97-6 Various	10 10
Methoxychlor	00072-43-5	100
Octachlorostyrene	29082-74-4	10
Pendimethalin	40487-42-1	100
Pentachlorobenzene	00608-93-5	10
Polychlorinated Biphenyls (PCBs)**	01336-36-3	10
Polychlorinated Dibenzodioxins and Dibenzofurans* & **	17 Different Compounds	0.1 gram
Polycyclic Aromatic Compounds (see table below)	21 Different Compounds	100
Tetrabromobisphenol A	00079-94-7	100
Toxaphene	08001-35-2	10
Trifluralin	01582-09-8	100

* Limited to only those operations where dioxin and dioxin-like compounds are present as contaminants in a chemical and of they were created during the manufacturing of that chemical.
** The specific compounds are defined in the rule.
Bold – Indicates substances that could be possibly found in printing operations.

Chemicals Included in the EPCRA Section 313 PAC Category (a)

Chemical Name	CAS Number	Sources(1)
Benzo(a)anthracene	56-55-3	Product of incomplete combustion (PIC); fossil fuels (FF)
Benzo(a)phenanthrene (chrysene)	218-01-9	PIC; FF; coke plant exhaust
Benzo(a)pyrene	50-32-8	PIC; FF; coal tar; municipal incinerator emissions
Benzo(b)fluoranthene	205-99-2	PIC; FF
Benzo(j)fluoranthene	205-82-3	PIC; FF; coal tar
Benzo(k)fluoranthene	207-08-9	PIC; FF; coal tar
Benzo(j,k)fluorene (fluoranthene)	206-44-0	PIC; FF; coal tar
Benzo(r,s,t)pentaphene	189-55-9	PIC; FF; coal tar
Dibenz(a,h)acridine	226-36-8	PIC (particularly coal burning processes)
Dibenz(a,j)acridine	224-42-0	PIC (particularly coal burning processes)
Dibenzo(a,h)anthracene	53-70-3	PIC; FF; coal tar; gasoline engine exhaust tar
Dibenzo(a,e)fluoranthene	5385-75-1	PIC
Dibenzo(a,e)pyrene	192-65-4	PIC; FF
Dibenzo(a,h)pyrene	189-64-0	PIC; FF; coal tar
Dibenzo(a,l)pyrene	191-30-0	PIC; coal gasification
7H-Dibenzo(c,g)carbazole	194-59-2	Coal burning processes; coal tar and coal distillates
7,12-Dimethylbenz(a)anthracene	57-97-6	Produced in small quantities as a research chemical, not formed during combustion
Indeno(1,2,3-cd)pyrene	193-39-5	PIC; FF; coal tar
3-Methylcholanthrene	56-49-5	Produced in small quantities as a research chemical, not formed during combustion
5-Methylchrysene	3697-24-3	PIC
1-Nitropyrene	5522-43-0	Diesel and gasoline engines; coal fired energy conversion plants; aluminum smelter stack gases

1 Reference: Aronson, D., and Howard, P.H. *Sources of Individual PAHs Listed in the PBT Chemical Pool*, January 2000.

a In addition to the PAC chemical category, the list of EPCRA Section 313 chemicals includes benzo (g,h,i) perylene (a polycyclic aromatic compound). The reporting threshold for the PAC category is 100 lb/yr and the reporting threshold for benzo (g,h,i) perylene is 10 lb/yr.

In addition to lowering the reporting threshold, EPA also revised the mechanics associated with PBT reporting. The changes are as follows and apply to all PBTs:

1) Elimination of the de minimus (i.e., minimal) concentration exemptions for PBT chemicals subject to the reporting requirement. Under the rule changes, if the chemical is present in any concentration, its amount is reportable. However, EPA did not eliminate the de minimus thresholds for the supplier notification requirement, which means that the manufacturer or supplier of any product does not need to identify any PBT present in their products at concentrations less than 1% for noncarcinogenic PBT chemicals and 0.1% for carcinogenic PBT chemicals.

2) Elimination of the range reporting and alternative Form A reporting for the above PBT chemicals. Form A is a shorter form for those facilities that meet certain criteria for nonPBT reportable chemicals.

3) Requires all reportable amounts to be identified down to 1/10 (0.10) of a pound, except for dioxin and dioxin-like compounds, which is 100 micrograms (0.0001 gram). If a facility's release or other calculations can support reporting an amount more precise than two significant digits, then the more precise amount must be reported.

Even though EPA did eliminate the de minimus concentration for those facilities manufacturing, processing, or otherwise using PBT substances and PBT containing products, it did maintain the exemption for not requiring any additional testing or monitoring for PBT chemicals. Therefore, PBT chemicals only have to be reported if the printer has "readily available" information identifying both the name and concentration of the PBT chemical if it is present in concentrations of less than 1% for noncarcinogenic and 0.1% for carcinogenic PBT chemicals.

Information on PBT chemicals, reporting requirements, and reporting guidance documents can be found on-line at: http://www.epa.gov/tri/guide_docs/index.htm.

Analysis of Implications for Printers

In examining the proposed waste minimization plan and final TRI reporting rules to address PBTs, the PBT requirements that pose the most concern for printers are those revisions to the TRI reporting thresholds. The dramatic lowering of the thresholds for reporting will require printers, who had never had to file a Form R TRI report to now meet this requirement. While not specifically required, it is anticipated that the new reporting requirements may require the printer to obtain from their supplier or through testing, the exact concentration of any PBT chemical in the products used.

The RCRA PBT hazardous waste proposal is, at this time, only a voluntary waste minimization plan and not yet mandatory. Unless EPA changes the regulations to make it a mandatory requirement, printers who are large quantity generators will only have to continue meeting the current mandatory waste minimization plan requirements.

In the Canadian-US Binational strategy, the only chemical identified that can be found in printing operations in any appreciable quantity is mercury, which is found in fluorescent lights, bulbs for plate imaging, lamps for UV curing operations, fuel oil, and some inks as trace contaminants. Under the uniform strategy to reduce mercury air releases, EPA is primarily focusing on regulations to cut emissions from coal fired electrical generation utilities. Printers should not be a principal focus of any efforts associated with implementing this program, but any regulations resulting from this agreement will have to be monitored.

To address mercury releases from light bulbs, EPA issued a final rule classifying mercury containing bulbs as universal wastes, thus encouraging their collection and recycling by easing the regulatory burden. Technically, without the new Universal Waste regulations, these bulbs would be classified as hazardous wastes subject to full regulation under RCRA. For more information on Universal Wastes, see PNEAC's Universal Waste fact sheet.

Some of the chemicals identified on both the RCRA and TRI PBT lists can be found in printing operations. Lead is one of the more common metals found in printing. While the use of lead chrome yellow pigment based inks is not common, lead is found in batteries, computer monitors, and lead used to cast type. From a TRI perspective, it would appear that the use of lead pigments, and trace concentrations of lead in inks and casting lead type via linotype machines would be reportable. To confirm the presence of lead and lead compounds in inks, contact the ink vendor for more information.

Since batteries, thermostats, and now light bulbs are classified as universal and not hazardous wastes, they would not qualify for the waste minimization plan. Other lead bearing hazardous wastes such a computer monitors, ink, and lead bars would be subject to the waste minimization plan. Batteries, thermostats, light bulbs, and monitors are considered "articles" and not subject to reporting under TRI.

Other PBT chemicals found on the RCRA and TRI PBT list include:

1. Phenol that can be found in some film and plate chemistry.

2. Naphthalene that can be found in some cleaning solvent blends containing aromatic hydrocarbon blends.

3. Dibutyl phthalate and the other phthalates could possibly be found as plasticizers in inks, coatings, and laminates.

4. Arsenic that can be found in some film chemistry but is not very common.

5. Cadmium can be found in some pigments, especially orange, red, and yellow colors.

6. Chromium that can be found in film cleaners, some fountain solutions, gravure cylinder preparation, some inks, and yellow, brown, orange, and red pigments.

7. Copper that can be found in some inks with blue and green pigments (although copper phthalacyanine pigments have been delisted by EPA), anti-bacterial agents in some fountain solutions and boiler treatment chemistry, and a component in some water-based inks.

8. Zinc that can be found in water-based coatings, lubricants, some white pigments and grinding wheels.

9. Lead that can be found in some inks and coatings pigments (although not common), electrodes, solder, battery plates (if maintenance is performed on batteries), and paper – but is reportable only if 0.5 lbs or more of lead is released in the form of dust.

10. Polycyclic Aromatic Compounds are found in fuel oil and created during fuel oil and other fossil fuel combustion. Note: It would take storing and burning as little as 5,084 gallons of #4 fuel oil to trigger TRI reporting for this PBT category.

11. Mercury that can be found in some inks and pigments (although not common), fuel oil and is created during combustion of fuel oil and other fossil fuels, fluorescent bulb and other UV-curing bulb crushing. Note: It would take storing and burning 1,250,000 gallons of #6 fuel oil per year to trigger TRI reporting for this PBT category.

The above chemicals are those that are generally known to exist or possibly be found in printing input materials. However, specific concentrations of each chemical in each product are not known and it is important to understand that the elimination of the de minimus reporting threshold requires the reporting of any of the TRI PBTs found in any concentration. EPA's position is that it believes information on below de minimis quantities is readily available through sources such as EPA's Technology Transfer Network, AP-42 revisions, guidance documents, and trade associations. Information for the printing industry on the existence of PBT chemicals is scarce, and the industry's biggest challenge is whether or not additional testing will be required by either the printer or the supplier.

The core issue regarding the listing of PBTs is the criteria used for identifying and listing. Questions regarding the science and assumptions used to identify a particular chemical as a PBT continue to be raised. In reviewing the current lists of RCRA and TRI PBTs, it appears that EPA did not use the same criteria to establish the two lists. The criteria used to establish the PBT list under the Canada-U.S. Binational Toxics Strategy was not identified in the strategy. The lack of uniform and consistent criteria for determining a PBT presents a serious problem and as a result has given rise to inconsistent lists and conflicting priorities.

It does not appear that EPA developed or used any toxicity criteria to establish the PBT list under TRI. It appears that EPA focused solely upon the persistence and bioaccumulation nature of the chemical as a basis for setting the lower thresholds. EPA believes it has discretion to use other factors as part of its basis for modifying the reporting thresholds. EPA may use results from an exemption quantitation criteria (EQC) multimedia model to exclude or include a chemical as being persistent.

In defining persistence for the RCRA PBT chemicals, a chemical scored "high" if its overall regional half-life in various environmental media exceeded 580 hours (about 24 days), as computed using the EQC multimedia partitioning model. A chemical scored "medium" for persistence if its overall regional half-life was computed to be greater than 140 hours but less than 580 hours. For bioaccumulation, a chemical scored "high" if its BAF/BCF value was greater than 1000. Those with values between 250 and 1000 scored "medium".

The 11 metals identified as PBTs by EPA have been severely criticized by several industry groups. The groups argue that assigning attributes of persistence and bioaccumulation to metals is scientifically inaccurate. There is considerable criticism on the listing of the metals and not specific metal compounds that pose the greatest threat. EPA did not consider the relative toxicity, which includes toxic effects, exposure, dose, and bioavailability of the metals nor their beneficial use such as those needed for healthy metabolism and life.

The biggest limitation to the Waste Minimization Prioritization Tool, developed for use under the RCRA program, is that it is a screening tool and not a risk assessment tool. It was not developed for the purpose of establishing regulations. EPA stated that it did rely in part on the Waste Minimization Prioritization Tool to develop the preliminary list of TRI PBT chemicals.

Facilities using chemicals on the PBT list may be subject to enhanced enforcement and scrutiny because they are using "hit list" chemicals. They may also be subject to more stringent permit limits or permit application reviews. Facilities releasing any of the chemicals on the list almost certainly will be subject to enhanced community pressure to reduce and/or eliminate their use. This pressure will give rise to adverse publicity, which in turn may cause ill-founded concerns regarding the impact of such releases.

Action Items

While the basic questions regarding the definition of what constitutes a PBT have yet to be settled, it is critical that printers understand the TRI reporting requirements as they apply to their particular operation. The thresholds for reporting are low and the elimination of the de minimus concentration for reporting puts the printer in a difficult position. The printer is responsible for identifying and reporting on all PBTs present in the products they use, including those present in trace concentrations. On a positive note, EPA will not hold those printers responsible for trace concentrations unless the data is "readily available". The definition of readily available has yet to be clearly delineated and may have to be tested in the courts.

Nevertheless, the printer must approach the PBT reporting requirements with a fresh approach. The first step to meeting this requirement is to compile a list of products used that do contain reportable PBTs (see the TRI PBT Reportable Chemicals table). If the PBTs are present in concentrations greater than 1% and 0.1% for carcinogens, then the manufacturer must identify the individual substance and provide a concentration. While some suppliers choose to provide this information in a letter, the most common communication vehicle is the MSDS. For reportable TRI PBTs present in less than the 1% and 0.1% concentrations, they only have to be reported on if information on their presence and concentration is readily available. EPA has developed guidance documents to aid in the identification and calculation of PBT concentrations and releases. Other sources of information can include tests conducted due to some other requirement or by suppliers. It may be prudent to contact each supplier and inquire if any information about reportable is available. Understand that special testing for these PBTs is not required.

Once the PBT containing materials are identified, then the amount used needs to be determined. Reporting is then required if the concentration and use amount exceed the respective reporting threshold. TRI reports are due every July 1, for the previous year's usage.

For more information, please contact:

Gary A. Jones
Graphic Arts Technical Foundation
200 Deer Run Road
Sewickley, PA 15143
412/741-6860 (Phone)
412/741-2311 (Fax)
Email: garyjgatf@aol.com