BENEFITS

The TSCA mandates that EPA regulate the disposal of PCB's. The purpose of disposal is to prevent additional PCBs from entering the environment. At present, the EPA recognizes landfilling and thermal destruction as allowable disposal methods. A few chemical methods, SUNOHIO and Goodyear, have recently been announced and others are still under development. SUNOHIO has demonstrated their process for EPA, but the Goodyear process, while available, has not been commercialized. For the most part these chemical methods are in the experimental stages. Even those which have passed the pilot plant level are still being tested and evaluated. The developers of those chemical destruction methods closest to being approved have focussed their efforts on removing PCB from oils which are less than 500 ppm. The approval of a chemical destruction method which could handle liquids with PCB concentrations in excess of 500 ppm is not expected before the end of 1981. It is not certain what the capacities of these systems will be for high concentration fluids.

The storage requirements outlined in the rule are intended to be preliminary to disposal; not a substitute for disposal. The utility industry has estimated that it costs about $34,000 per utility for construction of capacitor storage facilities every six months of delay in approving a disposal method. It costs about $17,000 per utility for transformer and transformer liquid

storage every six months. There are 3,400 utility companies in the United States. With approximately 2 million gallons of PCB liquids presently in storage, and more PCBs being removed from service every day, the potential for a spill during handling or transportation associted with storage makes it imperative that EPA encourage disposal by all available methods while continuing to explore new and better ways to achieve this end. The environmental burden resulting from a spill is substantially greater than that which results from the operation of an incinerator which meets the requirements of Annex I. Avoiding such spills would be one important benefit of approving commercial incinerators. The benefit involves both economic and environmental factors associated with continued storage. PCBs are being stored across the country at great expense. Persons storing PCBs could avoid this expense in two ways. First, there is the temptation to avoid this expense through illegal disposal. Second, the absence of approved incinerators gives persons storing PCBs an incentive to bring legal action against EPA for having issued an unworkable regulation. A court may be moved to weaken the existing disposal regulation to allow such alternatives as landfilling liquids with high PCB concentrations. Approval of commercial incinerators will lessen the danger that companies holding PCBs will pursue either of these environmentally harmful courses of action.

I. Introduction

A. Background

In 1976 the Toxic Substance Control Act (TSCA) was signed into law. This legislation is designed to protect human health and the environment from unreasonable risk connected with the manufacture, distribution, use, and disposal of commercial chemical substances. Authorities are granted to the Administrator of EPA which permit the regulation and control of chemicals which pose such risks.

In addition, Congress included in Section 6(e) of TSCA specific provisions related to the control and disposal of polychlorinated biphenyls (PCBs). These materials have demonstrated a wide range of health and environmental effects (Table 1-1). The legislative history indicates that Congress decided that, in general, it was in the national interest to ~~remove PCBs from the~~ tightly control PCBs to prevent further escape into the environment ~~as soon as possible.~~

In 1979 the Office of Pesticides and Toxic Substances (OPTS) of EPA issued regulations governing the disposal of PCBs (~~Federal Register~~ 44FR 31514, May 31, 1979). ~~Materials~~ Capacitors containing PCBs in concentrations greater than 500 ppm, are to be landfilled at especially approved sites, which have been so designated because of their ability to retain hazardous wastes in such a manner that there is

little likelihood that these substances will enter the general environment. This option, however, will be ~~withdrawn after~~ expire March 1, 1981. Materials containing PCBs in concentrations less than 50 ppm can be disposed of by burning in industrial boilers. For materials containing PCBs in concentrations between 50-500 ppm the regulations specify landfilling or ~~incineration~~ burning or boilers for liquids with PCB concentrations greater than 500ppm, the only option is incineration. in especially approved PCB incinerators. In the interim until an incinerator is approved, PCBs must be stored according to specifications contained in 40 CFR 761.42 . No commercial incinerators have yet been approved.

Consequently, the Agency has initiated a program for encouraging the approval of such incinerators. A canidate incinerator must ~~if required to do so~~ conduct a test burn in order to demonstrate that it is capable of efficiently destroying PCBs. These data are reviewed by EPA and a final approval is granted by the local EPA Regional Administrator. ~~if required to do so~~ as required to do so by the EPA Regional Administrator.

The Agency continues to consider additional disposal methods, in addition to incineration and/or landfilling. Recent announcements by Goodyear and Sunohio have informed EPA and the public of novel chemical methods for destroying liquid PCBs. Goodyear has announced that its patented process is available cost-free to any party wishing to develop it. Sunohio is commercializing its process and has demonstrated its capabilities for EPA.

B. Basis for Concern in PCB Incineration

When a test burn was conducted in El Dorado, Arkansas in 1979, in addition to a stack sampling contractor hired by the incinerator company, a team under the direction of the EPA Health Effects Research Laboratory at Research Triangle Park, North Carolina (HERL/RTP) obtained samples of the ambient air some distance downwind from the plant. Analysis of the latter samples by gas chromatography/mass spectroscopy (GC/MS) suggested the presence of tetrachlorodibenzofurans (TCDF). In order to investigate the possibility of these toxic materials being formed during the PCB incineration process, the stack samples were obtained from the company's contractor and subsequently analyzed at HERL/RTP. These results were judged to be ambiguous and inconclusive. Consequently, EPA and the company decided to conduct a second test burn designed especially to detect TCDD and TCDF. In order to be consistent, the Agency arranged for a similar re-test at a second facility in the same Region which is seeking approval to incinerate PCBs on a commercial basis.

C. The purpose of this paper

The samples from the second re-test have now been analyzed through the procedures of the Agency's Dioxin Monitoring Program (DMP) (Reference the title of the Wright State contract report). This paper has been written at the request of EPA Region VI in order to present these data and discuss their implications relative to the risks and benefits of incinerating [illegible] the two sites.

II. Risk Elements

A. Introduction

Central to the operation of TSCA is the concept of unreasonable risk" to human health or the environment. Figure I illustrates the process by which this determination is made. First, the inherent toxicity hazards posed by a chemical or process are identified. This information is generated by laboratory experiments, field studies, epidemiological investigations, etc.

Second, data are gathered on the exposures which are likely to result. This includes information on the populations which might be exposed and the frequency, duration, and the intensity with which such exposures are likely to occur. These data are observed by direct monitoring and/or mathematical modelling of the local situation.

Third, the risk is determined as a result of a consideration of toxicity and exposure. If either factor is zero, the risk is zero. In the case of cancer toxicity, the Agency has adopted a method of analysis which permits a quantitative estimate of the associated risk. In the case of other toxicities, the Agency presents a qualitative risk assessment.

Fourth, the benefits associated with the use of a chemical are usually considered. In this instance, however, Congress has mandated that any benefits of PCBs are outweighed by the risk they present and that the PCBs will be removed and will go through a disposal process. The benefits referred to here are the benefits (or reduction of risks) to be gained from the incineration of PCBs, compared to alternative modes of handling PCBs, including storage. Such an analysis should include such factors as economics and timeliness.

Finally, the judgment of unreasonable risk is made by weighing the risks and the benefits involved. Since a) only some elements of the risk analysis are quantitative in nature nature and b) the benefits are sometimes measured in non-commensurate terms (e.g., dollar costs for disposal vs. predicted number of lives saved), a quantitative statement of unreasonable risk is impossible. From an examination of the risk and benefit analysis, however, the decision-maker can render a judgment concerning the "unreasonableness" of any risk.

A. Toxicity Hazard

1. Structure-Activity Relationship of TCDF. Since the late 60's scientific and public interest has grown as information has become available about the extreme toxicity of 2,3,7,8 tetrachlorodibenzo-p-dioxin (2,3,7,8-TCDD).

McConnell, E.E. et al., "The Comparative Toxicity of Chlorinated Dibenzo-p-dioxins," Toxicology and Applied Pharmacology 44, 335-356 (1978).

Environmental Health Perspectives Experimental Issue No. 5, Sept., 1973, DHEW Publication No. (NIH) 74-218.

This concern has resulted in such events as

a. the suspension of the use of Agent Orange herbicide (contaminated with 2,3,7,8 TCDD) in Vietnam

b. the cancellation of the use of 2,4,5-T (contaminated with a,3,7.8-TCDD) in Sweden

c. the suspension of certain uses of 2,4,5-T (contaminated with 2,3,7,8-TCDD) in U.S.

While considerable attention has been directed at the toxicity of 2,3,7,8- and other isomeric forms of TSDD's, only a limited amount of information has been gathered on the analogous TCDF compounds; e.g., 2,3,7,8-TCDF.

Structure

TCDD TCDF

The data which have been generated on this substance, however, suggest comparable and parallel toxicities between ~~the~~ related isomeric forms of TCDF and TCDD. This could be expected in light of the similarity in chemcial structures involved. In addition, the stereochemical arguments of Poland, A. et al. ("Studies on the

Mechanism of Toxicity of the Chlorinated Dibenzo-p-dioxins," Environmental Health Perspectives, Experimental Issue No. 5, September 1973) predicts this behavior. Therefore, the risk assessment developed in this paper will be utilizing TCDD data as a surrogate for missing TCDF. The Agency believes that this is a conservative assumption (possibly erring on the side of public safety), given the extreme toxicity of TCDD.

2. Relative toxicity of isomers. Most of the toxicity hazard information available on TCDD's is centered on the isomer, 2,3,7,8-TCDD. The data that do exist on the relative toxicities of the other isomeric forms (Poland, A. Ibid) suggest that the 2,3,7,8 isomer is the most toxic and that the major toxicity manifestations appear when at least three of the positions--2,3,7, or 8--are substituted with Cl. Consequently, in order to more accurately assess the toxicity associated with TCDD (or TCDF), it is important to ascertain the distribution of isomeric forms in the sample.

In recent years synthetic and analytical chemists have succeeded in synthesizing all 22 of the possible TCDD isomers and in chraracterizing most of them (Nestrick et. al. Anal Chem 51 (1979) 2273). The use of these isomers as standards has made possible the analysis of environmental samples for the specific amount of 2,3,7,8-TCDD present.

Unfortunately, the same situation does not extend to the TCDFs. In this case there are a total of ___ isomers possible. EPA analysts have only ___ of these standards. Fortunately, one of the isomers in hand is the 2,3,7,8-TCDF, which is thought to be the most toxic. Therefore, a special effort has been made to characterize the samples from Region VI by the amount of 2,3,7,8-TCDF which they contain.

3. Toxicity hazard. As the accompanying Table 2-1 Environmental Health Perspectives shows, the acute LD_{50} of the TCDD's and TCDF's are comparable. In addition, there is considerable variation in the responses of different animal species to similar doses.

Smaller doses than those in the table can result in a persistent acne-like condition, called chloracne, in both rabbits and man, which, while not life threatening, can be disfiguring. Chloracne in humans has been considered to be unequivoval evidence of exposure to certain chlorinated hydrocarbons, including TCDD and TCDF.

Table 2-2 lists the toxic effects which have been associated with TCDD in humans.

The data on immunological effects are suggestive of an effect on the body's defense mechanisms. There is clear evidence of damage to the liver, reminiscent of the action of other chlorinated hydrocarbons.

The reproductive effects produced in rats (reduced numbers and weights of offspring) are of particular concern in light of the low doses at which effects are observed. In fact, the Agency has taken the position that no "no observed effect level" (NOEL) has been demonstrated for reproductive effects.

Mutagenicity studies have resulted in a range of responses in the hands of different investigators. A carefully controlled study from National Institutes of Environmental Health Sciences (NIEHS) is about to be released.

Recent studies by the National Cancer Institute (NCI) have demonstrated carcinogenicity activity of TCDD in both rats and mice. These data have formed the basis of the risk assessment developed by the Agency's Cancer Assessment Group (CAG). The NCI data have been used in a multi-stage linear extrapolation model which relates any exposure level with a predicted excess risk of cancer (CAG's reference).

The Agency has long taken the position that cancer is a "non-threshold" phenomenon; i.e., as a matter of policy there is no level (above zero) below which a carcinogen will pose no risk of cancer. A similar situation may be obtained with reference to reproduction effects, although methods to extrapolate this effect to low doses have not been adopted by the Agency.

IV. Risk Assessment

A. Assumptions

As the risk assessment is developed, it is important to keep in mind some of the underlying, as well as explicit, assumptions which are being made. These are summarized in the following table.

Assumptions

Similarity in the toxicities of TCDG and TCDD

Accuracy of dispersion models in predicting human exposures

Utility of animal data in anticipating effects in humans

Agency assumptions in considering cancer (Federal Register/Vol. 44, No. 131/July 6, 1979)

Average breathing rate = 20 m^3/day

Average mass of human female = 60 kg

B. Exposure assessment

(Insert description of computer model which results in an estimate of maximum and average exposures in the air)

Assumption total length of exposure

C. Qualitative risk assessment

The following table summarizes

a. the toxic effects observed in animals treated with 2,3,7,8-TCDD
b. the species of animal under test
c. the lowest dose tested at which an effect is observed (*), or the highest dose tested at which no effect is observed (@)
d. the dose expected to be received by a 60 kg female breathing the estimated average concentration of TCDF emitted by the El Dorado facility
e. the same value at Deer Park, Texas

Benefits/Alternatives

As noted by legislation, the removal and disposal of PCBs from the environment, Congress effectively decided that there were no benefits associated with these materials that would justify the risks they posed. Consequently, the only point at issue here is whether the risks associated with incineration are justified in terms of alternative forms of disposal. The alternatives to be considered are:

a. landfilling
b. storage
c. chemical destruction

As background it is important to keep in mind certain facts concerning the nation's inventory of PCBs

1. Volume: it is estimated that there are _____lbs of PCBs to be disposed of in the U.S.

2. Type: Of this amount __lbs are in "totally enclosed" forms (capacitors and transformers) which will come out of service over the next 20 years. These are referred to as "solid PCBs" since the solid enclosures, as well as the liquid contents face disposal. The remainder of the PCB inventory, ___lbs are referred to as "liquid PCBs and face disposal as soon as possible.

3. Amount subject to incineration: The following table shows the approximate amounts of PCBs (>500 ppm) which are proposed for incineration.

MONS 211600

	Ready for immediate disposal	Coming out of service within 20 years
TRANSFORMER Liquids	20,000,000 lbs	280,000,000 lbs.
CAPACITOR ~~Solids~~	10,000,000 lbs	440,000,000 lbs

A. Landfilling

In the PCB regulations, the Agency views landfilling as a less desirable ultimate answer to PCB disposal. Given the pressure to provide some disposal means until incineration facilities could be approved, the Agency established a limited, tightly restricted landfill option FOR CAPACITORS which will expire in March of 1981. The risks, and cost limitations involved with this option include the following:

a. Small, but finite, possibility of movement of PCBs from the landfill site. Risk is reduced by trying to insure near-zero exposure. As long as PCBs continue to exist, however, the potential for risk exists.

b. Expense: $1/gal plus $3/loaded mile for transportation

c. Limited capacity: ? no number available
we have to keep approving sites if no incineration

B. Storage

The strategy here is the same as that for landfilling: reduce the risk by reducing the exposure. A similar list of risks, costs and limitations exist for this option.

ie our
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a. The possibility for leaks, accidents, etc. which result in exposures to PCBs are greater for this option than for landfilling; cf. incidents reported at Montana, etc. This increased risks is only somewhat compensated by the fact that resulting exposure might be more easily detected in above ground storage than in landfilling.

b. Expense: $17K/utility/6 months for transformers) $34 K/utility/6 mont for capacitors

c. Limited capacity: Keep building

MONS 211601

c. Chemical destruction methods

As noted above, at least two chemical destruction methods have recently been developed which hold considerable promise.

Advantages associated with one or both of these systems include

a. Reduction of risk by reduction of hazard. By transforming the toxic PCBs into innocuous materials, the risk is absolutely and permanently eliminated.

b. Promise of portability? Portable rigs can be constructed to go to the PCBs, rather than vise versa. This removes the risk associated with the transport of PCBs.

These advantages are accompanied by certain limitations

a. Current technology is designed to only handle dilute (<500ppm) solution of PCBs

500

b. The methods cannot handle the "solid problem;" i.e., destruction of the solid containers of PCBs; e.g., transformer and capacitor casings.

c. Limited accessibility: No group has come forward to develop the Goodyear process. Sunohio is developing mobile units which will service PCBs in transformers

d. Capacity: about $1000 gal/day per sanction unit only one exists at present but they are thinking of building

Byproduct incinerators have the following advantages: 3 or 4 more.

a. Permanent removal of risk by thermal transformation of PCBs

b. Large capacity: The PCB inventory in this country could be eliminated by the two incinerators under investigation if continuous operation were to be devoted to this task for ___ years.

c. Capability of handling both liquids (Rollins and ENSCO) and solids (ENSCO)

d. Elimination of the storage or lendfilling costs

Disadvantages include:

a. Risks discussed in Section III

b. Expense $2.50 per gal plus $3/loaded mile transportation

Transporation of PCBs to incineration site

DEF-SET BY TRANSPORTATION TO LANDFILL SITES