GREENPEACE'S SECRET SAMPLING AT U.S. VINYL PLANTS: DIOXIN FACTORIES EXPOSED

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EXECUTIVE SUMMARY

Greenpeace conducted a two-and-one-half-year investigation into the vinyl industry's production of dioxins to obtain data that the U.S. Environmental Protection Agency (EPA) and the vinyl industry have failed to provide. Greenpeace took 27 samples of vinyl industry wastes from nine facilities and found dioxins or dioxin precursors in 100 percent of the samples tested, with some samples containing levels rivaling those found in wastes from the production of the infamous defoliant, Agent Orange.

This is the first sampling project of its kind in the United States, providing new and alarming information on the dioxins found in vinyl industry wastes. Greenpeace's data stands in stark contrast to the preliminary data provided by the vinyl industry. Industry's data pertain to dioxin contamination of wastewater and vinyl products, the two areas with the lowest and most difficult to detect concentrations of dioxins. There are no data on the dioxins in vinyl industry wastes that account for the vast majority of dioxin emissions when these wastes are burned. These data are important, since they add to the growing body of evidence pointing to the lifecycle of polyvinyl chloride (PVC) plastic as one of the largest single sources of the nation's total dioxin burden.

Dioxins are the most thoroughly studied toxic chemicals in history. In February of 1997, the most potent of dioxins was classified by the International Agency for Research on Cancer as a known human carcinogen. Cancer is just the tip of the iceberg with respect to human health effects linked to dioxins. Other health effects linked to dioxin exposure include diabetes, endometriosis, birth defects, reduced sperm count, decreased fertility, immune system suppression, developmental and reproductive effects and disruption of the hormone system. According to EPA's dioxin reassessment, the general population carries levels of dioxins in their bodies that are at or close to those levels associated with health effects.

The vinyl industry is a glaring example of environmental racism and injustice. Vinyl production is confined primarily to low-income and African American communities in Louisiana and Texas, resulting in a disproportionate amount of the vinyl industry's toxic burden being dumped on these communities. The environmental, human health and social impacts of the PVC industry have no place in a healthy and just society.

As part of an overall dioxin prevention strategy, Greenpeace calls on the EPA to impose a moratorium on permits for new vinyl facilities or expansion of existing facilities, and to modify permits at existing plants to require that dioxin releases to all media, including waste destined for disposal, be brought to

zero within five years. This recommendation is part of an overall dioxin prevention strategy that ultimately leads to a phaseout on the production and use of PVC plastic. Any plan to phaseout PVC would prevent or compensate for economic or social dislocation that result from these measures to protect human health and the environment from PVC-related dioxin.

GREENPEACE COMPELLED TO ACT

For the past two-and-one-half-years, Greenpeace has been conducting an undercover investigation into the vinyl (a) industry's production of dioxins (b), a family of chemicals that includes the most toxic synthetic chemicals known to humankind. The results of this investigation are startling. Greenpeace found dioxins or dioxin precursors in 100 percent of the vinyl industry wastes tested, with some samples containing levels rivaling those found in wastes from the production of the infamous defoliant, Agent Orange. This is the first sampling project of its kind in the United States, providing new and alarming information on the high levels of dioxins found in vinyl industry wastes.

Greenpeace conducted this investigation to obtain data that the U.S. Environmental Protection Agency (EPA) and the vinyl industry have failed to provide. Greenpeace made several requests directly to vinyl industry companies including Dow Chemical and the EPA asking for data, permission to sample, and an investigation into the dioxins produced by the vinyl industry. After all of these requests were denied or unfulfilled, Greenpeace decided to undertake its own sampling project.

Greenpeace knew it would be impossible to accurately characterize the amount of dioxins produced by the vinyl industry if dioxin levels in particular wastes remained uninvestigated or were being held secret. Greenpeace wanted to know if certain vinyl industry wastes had high levels of dioxins in them because if this was the case -- which it turned out to be -- then sending these wastes to an incinerator would result in the release of dioxins into the environment. (For more information on the dioxins produced when vinyl industry wastes are incinerated, see the Greenpeace reports "The Burning Question: Chlorine and Dioxin" and "The PVC Lifecycle: From Cradle to Grave")

Greenpeace was compelled to take this action as a step towards combating the profound environmental, human health and social impacts of the vinyl industry. The results of this investigation add to a growing body of evidence pointing to the lifecycle of polyvinyl chloride (PVC) plastic as one of the largest single sources of the nation's total dioxin burden. (For more information on the dioxins associated with the lifecycle of vinyl, see the Greenpeace report "The PVC Lifecycle: Dioxin from Cradle to Grave".") The intent is that this evidence will convince the EPA that PVC production is a significant source of dioxins and other toxic chemicals. The hope is that the results of this investigation will assist citizens living near PVC

producers in their efforts to halt the expansion of this harmful industry.

Greenpeace's investigation revealed an arsenal of toxic byproducts in vinyl industry wastes including PCBs (polychlorinated biphenyls), hexachlorobenzene and dioxins. Appendix 1 provides an illustrative list of toxic chemicals Greenpeace identified in one sample of vinyl industry waste.

Dioxins are the most thoroughly studied toxic chemicals in history. In February of 1997, the most potent of dioxins was classified by the International Agency for Research on Cancer as a known human carcinogen. Cancer is just the tip of the iceberg with respect to human health effects linked to dioxins. Other health effects linked to dioxin exposure include diabetes, endometriosis, birth defects, reduced sperm count, decreased fertility, immune system suppression, developmental and reproductive effects and disruption of the hormone system.

According to EPA's dioxin reassessment, the general population carries levels of dioxins in their bodies that are at or close to those levels associated with health effects. Studies are also beginning to show that many of dioxin's effects are "transgenerational," meaning they show up in the children of dioxin-exposed parents.1

Vinyl production is a case study in environmental racism and injustice. The U.S. is home to 15 plants that make vinyl chloride monomer (VCM) and ethylene dichloride (EDC), the basic building blocks used to make vinyl, and 14 of them are in Louisiana and Texas. (Appendix 2 lists the locations of these plants.) Vinyl production in these states is confined primarily to low-income and African American communities, resulting in a disproportionate amount of the vinyl industry's toxic burden being dumped on these communities. Likewise, a disproportionately high number of the incinerators in which discarded PVC products are burned are located in low-income communities and communities of color.

The environmental racism perpetrated by the vinyl industry has resulted in entire communities being literally wiped off the map. In 1987, 106 residents of Reveilletown, Louisiana, a small African American community about ten miles south of Baton Rouge, filed a lawsuit against Georgia Pacific and Georgia Gulf arguing that they had suffered health problems and property damage. After settling out-of-court for an undisclosed amount, Georgia Gulf relocated the remaining families and then tore down every structure in town including the church. Management at Dow Chemical's neighboring factory in Plaquemine followed suit soon afterwards, buying out all of the residents of the small town of Morrisonville.2
Today, two communities in Louisiana are fighting the expansion of the vinyl industry. The Shintech corporation is proposing to construct the world's largest proposed vinyl plant in a predominantly African American neighborhood in St. James Parish. Likewise, the Westlake company is seeking to expand its vinyl production in a predominantly poor community in the town of Lake

Charles. Both the Shintech and Westlake proposals are being met by fierce community opposition, yet the companies continue to railroad these communities into accepting a larger burden of the vinyl industry's dioxin and other toxic wastes.

Greenpeace offers the results of its vinyl industry investigation to the EPA as further evidence that the production of vinyl is a significant source of dioxins. As part of an overall dioxin prevention strategy, Greenpeace recommends the EPA impose a moratorium on permits for new vinyl facilities or expansion of existing facilities, and modify permits at existing plants to require that dioxin releases to all media, including waste destined for disposal, be brought to zero within five years.

This recommendation is part of an overall dioxin prevention strategy that ultimately leads to a sunset on the production and use of PVC plastic.

ADDITIONAL STEPS IN THE STRATEGY INCLUDE:

* A moratorium on permits for new incinerators and other waste combustion facilities, and modification of existing permits to require that dioxin emissions to all media be brought to zero within five years by eliminating the input of chlorinated wastes and products.

* A phase-out of medical and municipal solid waste incineration, having been identified as priority dioxin sources. Ample evidence points to PVC as the primary source of chlorine for the dioxins that are generated by these incinerators.3

* Rapid phaseouts of:

* All short-life PVC uses (packaging, toys, furniture, wall paper, medical devices such as intravenous bags, etc.);

* PVC products in areas susceptible to fire (cabling and other construction materials, appliances, and vehicles); and

* Metals with PVC residues that are recycled in combustion-based processes (i.e., automobiles).

Any plan to phaseout PVC would prevent or compensate for economic or social dislocation that result from these measures to protect human health and the environment from PVC-related dioxin. Greater detail on Greenpeace's dioxin prevention strategy for PVC can be found in the Greenpeace report "The PVC Lifecycle: Dioxin from Cradle to Grave"."

THE GREENPEACE INVESTIGATION

Greenpeace undertook this sampling project in two phases, the first in the summer of 1994, the second in the summer of 1996. All told, Greenpeace took 27 waste samples from nine vinyl

plants in Louisiana and Texas: 25 in the first phase and two and in the second phase. Greenpeace members obtained these samples by entering vinyl factories under the cover of darkness and in full protective gear, and by following accepted occupational safety and health guidelines and sampling procedures.

The specific compounds being produced by these vinyl facilities are vinyl chloride monomer (VCM) and ethylene dichloride (EDC), the basic building blocks used to manufacture vinyl. Manufacturing VCM and EDC results in the production of highly toxic and dioxin-laden wastes commonly referred to as "heavy ends," "distillation bottoms" or "tars."

The Greenpeace sampling team chose to focus on these wastes for two reasons. First, these wastes are not being addressed in the vinyl industry's voluntary "self-characterization" study of its dioxin emissions. The vinyl industry has submitted data to the EPA on dioxin contamination of wastewater and vinyl products -- the two areas with the lowest and most difficult to detect concentrations of dioxin -- but no data on dioxins in wastes. This overlooks some of the most dioxin-intensive aspects of vinyl production. (For more detail on the vinyl industry's voluntary "self-characterization" study, see "Myth 2" on page 7 of this report.)

Second, these wastes are not subject to the special regulations applied to dioxin-containing wastes and are usually burned in all manner of incinerators, boilers, furnaces and flares. This results in emissions of dioxins into the environment. (For more information on the dioxins associated with the incineration of vinyl industry wastes, see the Greenpeace reports "The Burning Question: Chlorine and Dioxin" and "The PVC Lifecycle: Dioxin from Cradle to Grave.")

THE 1994 INVESTIGATION

The first stage of the investigation took place in the summer of 1994. Greenpeace took 25 waste samples from nine VCM and EDC facilities in Louisiana and Texas. (Appendix 2 includes a complete list of facilities sampled.) The waste samples were screened and analyzed for organochlorine and heavy metal content by the Greenpeace International Laboratory at the University of Exeter in Exeter, England. (See Appendix 1 for an illustrative list of toxic chemicals identified in one of these samples). Certain organochlorines can act as "smoking guns" for dioxins, meaning if these chemicals are detected in a waste sample, then dioxins are likely present as well. Although the exact amount of dioxins could not be measured, Greenpeace International's lab detected the presence of these dioxin indicators in all 25 samples, signaling that dioxins were also likely present in all of the waste samples.

Greenpeace chose to have four waste samples analyzed directly for dioxins and two for PCBs due to the high cost of analysis (approximately $2,000 per sample for dioxins and a comparable amount for PCBs). The analysis was performed by AEA Technology, an independent and accredited lab in Oxfordshire, England. (See

Appendix 3 for concentrations of dioxins and PCBs in samples tested by AEA Technology). Greenpeace chose the first three waste samples because they were traceable to a part of the VCM or EDC process that is associated with the production of "heavy end" waste.

Finding high levels of dioxins in these three "heavy end" wastes that would most likely be burned in an incinerator contradicts the vinyl industry's assertion that it releases minute amounts of dioxins. The fourth sample tested for dioxins was a sediment sample taken downstream from a VCM plant, chosen since it could counter industry's claim that dioxins do not escape from VCM plants.

Concentrations of dioxins in the first three samples were extraordinarily high:

1. Vulcan Chemicals, Geismar, Louisiana: 200,750 parts per billion (ppb) dioxins in a sample of "heavy end" waste.

2. Formosa Plastics, Point Comfort, Texas: 761 ppb dioxins in a sample of "heavy end" waste.

3. Georgia Gulf, Plaquemine, Louisiana: 1,248 ppb dioxins in a waste sample from a tank labeled to contain "heavy ends," "tars" and other similar types of highly contaminated wastes.

As a point of comparison, dioxin concentrations found in these "heavy end" vinyl industry wastes rival levels of dioxins found in Agent Orange wastes (c).

The fourth sample tested for dioxins was a sediment sample taken slightly downstream from the discharge point of the Geon Corporation's VCM facility in LaPorte, Texas. Dioxins were measured at 2,911 parts per trillion (ppt), a concentration approximately four times higher than the average concentration reported for North American sediments in the EPA's 1994 draft dioxin reassessment.4

Significant amounts of dioxins were found in all four samples tested, and dioxin indicators were found in all 21 remaining samples. Greenpeace presented this information as part of its official comments on the EPA's draft dioxin reassessment. Although the EPA noted these very significant sampling results, the Agency has continued to this day to allow the vinyl industry to voluntarily measure its own dioxin production. The vinyl industry reacted to the data by questioning the methodology and safety of obtaining the samples.

THE 1996 INVESTIGATION

In the summer of 1996, Greenpeace went back to Louisiana for another round of sampling at two additional VCM facilities to confirm its previous findings. Greenpeace members were accompanied by a videographer to document the procedure.

Once again, analysis by an independent lab, AEA Technology,

revealed significant dioxin contamination in both waste samples:

1. Borden Chemicals, Geismar, Louisiana: 36 ppb dioxins in a sample of "light end" waste.

Compared with dioxin concentrations Greenpeace found in "heavy end" wastes, 36 ppb sounds relatively low. However, given the toxicity of dioxin, this concentration is significant. In addition, the sample was taken from a type of waste commonly referred to as "light ends" that is produced in vast quantities. Thousands of tons of dioxin contaminated "light ends" are produced each year, and most, if not all, are burned in incinerators.

2. PPG Industries in Lake Charles, Louisiana: 5,448 ppb dioxins in a sample taken from a barrel containing soils contaminated with "heavy end" waste.

The soil in this sample was contaminated with the same kind of "heavy end" waste sampled at Vulcan Chemicals in Geismar, Louisiana with a dioxin concentration of 200,750 ppb. The dioxin concentration in the sample taken from PPG Chemicals is lower because the "heavy end" waste had been mixed and diluted with soil. Again, this waste was destined for an incinerator.

Greenpeace once again submits these data to the EPA and calls on the Agency to begin its own independent investigation of the production and release of dioxins associated with the manufacture of PVC.

VINYL INDUSTRY MYTHS AND FACTS

The vinyl industry touts a number of misleading arguments about the toxic pollution it produces. Here are a few of the most common myths industry perpetuates about vinyl production and dioxins:

MYTH NUMBER 1:
Dioxins in the wastes sampled by Greenpeace are destroyed in on-site incinerators, thereby eliminating any exposure to the public or the environment.

FACT:
Incinerators do not eliminate dioxins, whether on or off the premises of a vinyl factory. Nor do they eliminate the PCBs, hexachlorobenzene and furans Greenpeace found in the sampled wastes.

On the contrary, EPA officials and private research scientists admit that hazardous waste incinerators emit hundreds of times more dioxins and other toxic air pollutants than is allowed by EPA regulations, which require 99.99% destruction and removal efficiency.5

Some portion of the original dioxins are emitted undestroyed, and new dioxins are actually created as by-products of the incineration process when chlorinated wastes such as those

produced by the vinyl industry are incinerated. Studies also show a correlation between the amount of chlorine going into an incinerator and the amount of dioxin that is produced. The presence of copper and other metals in vinyl industry wastes can act as a catalyst in further increasing dioxin formation.6 For more information on the dioxins associated with the incineration of vinyl industry wastes, see the Greenpeace report "The Burning Question: Chlorine and Dioxin."

Overall dioxin emissions are estimated based on one-time stack tests called trial burns. This is tantamount to predicting how little a car will pollute over the course of its lifetime based on emission tests conducted on the factory assembly line. Trial burns are conducted under carefully controlled conditions, using a single chemical or simple mixture of chemicals. There are a number of reasons why this fails to give an accurate measure of what's coming out of the incinerator stack.

First, under normal operating conditions, a cocktail of constantly changing chemicals is burned, resulting in a variety of chemical-thermal reactions and emissions. Second, trial burns do not account for accidents, leaks, spills, explosions, power interruptions and other upset conditions. Third, trial burns fail to account for the majority of dioxins that are merely transferred to fly ash, bottom ash, scrubber water and other toxic leftovers from the incineration process. Finally, analytical methods may measure only a quarter of the dioxins actually emitted.7

The vinyl industry has not revealed the quantity of dioxins or any other hazardous chemicals emitted from its incinerators. In fact, there are no dioxin emission data from the vast majority of these incinerators since the companies are not required by the EPA to do regular stack emissions testing or waste analysis to determine how much of the dioxin in the waste is actually destroyed. These companies also regularly burn off wastes in flares, an operation requiring no pollution control, and not accounted for as part of the incinerator tally. The amount of dioxin emitted by these facilities is therefore currently unknown and likely unknowable for the foreseeable future.

MYTH NUMBER 2:
The vinyl industry monitors the amount of dioxins it produces and emits to the environment, and is voluntarily providing information to EPA for the Agency's dioxin reassessment. Preliminary results from analysis of wastewater discharges and resins show little to no dioxin is released to the environment or in PVC products themselves.

FACT:
EPA has made no attempt to collect or analyze samples of waste, wastewater, or air emissions from the nation's 15 VCM and EDC facilities or the incinerators that burn wastes from these plants. Instead, the EPA is allowing the industry trade organization, the Vinyl Institute, to voluntarily sample and "self-characterize" the industry's dioxin emissions.

The industry will collect samples from its own plants, analyze their dioxin content, interpret the data, and submit it to EPA. Although there is a "peer review" committee to examine the methodology and results of the vinyl industry's self-characterization, the industry will ultimately choose where, when, and how samples will be taken and analyzed, and which data are suitable for submission. The industry has already submitted data to EPA on dioxin contamination of wastewater and products, the two areas with the lowest and most difficult to detect concentrations of dioxin. No data have been submitted on dioxins in wastes, tars, sludges, or incinerator emissions, ashes, or sludges, which are responsible for the vast majority of dioxin emissions. The vinyl industry does not intend to do so.

A complete and accurate account of the vinyl industry's dioxin production is only a first step towards total elimination of this toxic chemical. Due to dioxin's persistence in the environment and its extreme toxicity, even small amounts pose serious threats to human health and the environment. Low levels of dioxin in wastewater discharges can be magnified many thousands of times as they build up in the food chain. For example, fish swimming downstream from a chlorine-using paper mill have had levels of dioxins in their bodies that are thousands of times higher than the paper mill effluent they swim in. This type of "bioconcentration" continues up the food chain. Species at the top of the food chain -- notably humans -- receive the largest dose.

MYTH NUMBER 3:
The Greenpeace investigation does not prove that dioxins are released into the environment around vinyl chloride production facilities. Only one environmental sample analyzed for dioxins showed positive results.

FACT:
Numerous studies show dioxins can and do migrate off site from vinyl plants. Although Greenpeace did not undertake a comprehensive survey of dioxin levels around all 15 U.S. VCM and EDC facilities in its investigation, a sediment sample taken slightly downstream from a discharge outside the Geon facility in LaPorte, Texas contained 2,911 parts per trillion dioxins. This is close to four times greater than the average dioxin concentration reported for North American sediments in USEPA's draft dioxin reassessment.8

A number of studies conducted by regulatory officials and university researchers in the U.S. and Europe point to VCM plants as a major source of dioxins and other toxic chemicals in the environment:

* In 1989, researchers from the University of Amsterdam published a paper tracing high levels of dioxin in Rhine River sediment to a VCM plant upstream.9

* In a follow-up study in 1996, officials from the University of Amsterdam and the National Institute for

Coastal and Marine Management in the Netherlands published studies on levels of dioxins and related chemicals in North Sea coastal sediments. Their findings revealed that vinyl chloride production continues to be a significant source of dioxins and furans in Rhine River and coastal estuary sediments.10

* In 1996, the National Oceanic and Atmospheric Administration's Contaminants Review Branch released a synthesis of seven studies which show high levels of PCBs, hexachlorobutadiene and hexachlorobenzene (all dioxin indicator chemicals) in the sediment and fish outside the PPG and Vista Chemicals VCM plants in Lake Charles, Louisiana.11

* Sediment samples taken by the British EPA from the Weston Canal by the ICI vinyl plant in Cheshire, England show significant dioxin contamination. Sediments near two outfalls contained 125 and 2,964 parts per trillion dioxins, and further analysis points to the ICI site as the source. The agency's report says that dioxin levels in sediment "rise significantly downstream of the site, but further downstream fall back to the 'polluted' levels typical of the area."12

* In 1993, Greenpeace estimated that some 5-10g TEQ 4 of dioxin are released per 100,000 tons of VCM manufactured.13 The figure was dismissed as an exaggeration by the industry's trade body, the European Council of Vinyl Manufacturers, which produced its own figure of only 0.3g TEQ. In fact, ICI's data showed that the Runcorn process produces 13.5g TEQ for every 100,000 tons of VCM manufactured, a figure higher than Greenpeace's estimate.14

* Greenpeace investigations have found high levels of dioxins in sediments outside VCM plants in Tarragona, Spain as well as the historic Venice lagoon in Italy.15

MYTH NUMBER 4:
Vinyl manufacturing results in barely detectable levels of dioxin. Far greater amounts are produced from other sources such as municipal waste incinerators and medical waste incinerators. The public interest would be better served if Greenpeace concentrated on the largest sources of dioxin.

FACT:
By focusing its efforts on the vinyl industry, Greenpeace is concentrating on one of the largest source of dioxin. A full, accurate and independent accounting will reveal that the lifecycle of PVC plastic -- from production of the raw materials to disposal in incinerators or accidental fires -- is one of the largest sources of dioxin. As explained above in myth #2, industry has yet to provide data on the most dioxin intensive aspects of its production process.

Ample evidence points to PVC as the primary source of chlorine

for the dioxins that are generated by municipal and medical waste incinerators.16

MYTH NUMBER 5:
PVC production levels have nearly doubled since 1970, while environmental levels of dioxins are declining, providing objective evidence that PVC is not the major source of dioxins, as Greenpeace claims.

FACT:
If the PVC industry is successful in its plans for expansion, any drop in dioxin levels will most likely be seen as temporary or as a fluctuation in an overall increase of dioxin levels. The current decline may be due in part to prohibitions on open burning of garbage, improved pollution control technologies and the phaseout of chlorinated chemicals in leaded gasoline. Unfortunately, decreases in chlorine consumption in one industrial sector and pollution control only act to reduce the amount of dioxins formed or move it from one environmental medium to another (i.e., from incinerator emissions into the air to ash in a landfill). They fail to eliminate dioxins and human exposure.

A lot of dioxin will be produced if and when the vast amount of PVC manufactured since 1970 winds up in an incinerator or is burned in accidental building fires. Because dioxin is formed when chlorinated products like PVC plastic are burned, logic dictates that dioxin levels will be on the rise in coming years if the massive amounts of PVC manufactured in the last few decades are burned.

PCBs in the environment are a harbinger of what is likely to happen with dioxin since both chemicals are persistent in the environment. PCB production was banned, resulting in declining levels for some time, after which they steadied at levels still considered dangerous. But the production of dioxin has not been eliminated, and in fact, chlorine use continues to rise, mainly to feed an ever expanding vinyl industry.

In terms of the current health threat posed by dioxin, the general population carries levels of dioxins in their bodies that are at or close to those levels associated with health effects.17 The generation and release of any additional dioxin must be avoided.

APPENDIX 1

Greenpeace Analysis of Organic Compounds in Waste Feed Tank Adjacent to Hazardous Waste Incinerator at Georgia Gulf Vinyl Facility in Plaquemine, Louisiana.

This list of chlorinated and other toxic chemicals was found in one sample of vinyl industry waste. It is an illustrative example of the vast spectrum of toxic chemicals Greenpeace found in 27 samples of vinyl industry waste. Lists of organic compounds identified in each of the 27 waste samples analyzed are available upon request.

Laboratory sample reference: PU4016
Total number of compounds detected in sample: 188
Number of compounds listed below: 63
Number of compounds listed that are chlorinated: 41

* Denotes chlorinated compound

Compounds identified with greater than 90% certainty:

tetrachloroethene*
nonane
1,1,2,2-tetrachloroethane*
pentachloroethane*
decane
undecane
1,2,3-trichlorobenzene*
dodecane
1,1,2,3,4,4-hexachloro-1,3-butadiene*
tridecane
tetradecane
pentachlorobenzene*
hexadecane
1,3,5-trichloro-2-nitrobenzene*
hexachlorobenzene*
octadecane
tetrachloropyrimidine*
pentachloro(trichloroethenyl)-benzene*

Compounds tentatively identified with 50% to 90% certainty:

1,1,1,2-tetrachloroethane*
(e)-1,2-dichloroethene*
carbonochloridic acid, 2-chloroethyl ester*
1,4-dichlorobutane*
1,1-dichloropropane*
(1-bromocyclohexane)carboxaldehyde ethyl methyl acetal
1,4-dichloro-2-butene*
3,3,3-trichloro-2-methyl-1-propene*
nitrosobenzene
hexachloroethane*
nitrobenzene
1,1,1,3,3-pentachloro-2-propanone*
1,1'-oxibys(2-chloro)ethane*
1,2,3,4-tetrchlorobutane*
1,2,3-trichloro-1-propene*
1,1-dichloroethane*
1-bromo-2-chloroethane*
1,1,1-trichloroethane*
1-(4-bromophenyl)-ethanone
1-chloro-2-nitroethane*
carbonic dichloride*
sec-bromobutane-1,1,1,2,3,3-d6
4,5-dihidro-6-methyl-3 (2h)-pyridazinone
pentadecane
(e)-3-phenyl-2-propenoic acid

1,2,3,3-tetrachloro-1-propene*
2,2-dichloropropanoyl chloride*
n-(2,3,5,6-tetrachloro-4-hydroxyphenyl)acetamide*
1,1,3,3,4,4-hexachloro-1-butene*
o,o-bis(chloroethyl)-2-chloroethane phosphonate*
1-[(2-chloroethyl)sulfonyl]-4-nitro-benzene*
trichloroethene*
3-bromo-5-chloro-2-pyridinol*
2,4-dichloro-3,5,6-trifluoropyridine*
1,2-dichloropropane*
bis-1,2-(dichloromethyl)-3-chlorobenzene*
cyclic 1,2:3,5-bis(ethylboronate)-4-(diethylborinate)-xylitol
1,2,3,4,7,7-hexachloro-bicyclo[2.2.1]hepta-2,5-diene*
pentachlorophenol*
2-(diethylamino)-benzo[c]cinnoline
4-pthalimidoazobenzene
1h-dicyclohept[e,g]isoindole-1,3(2h)-dione derivative
4,8,12-trimethyl-tridecanoic acid methyl ester
3-bromo-1,1,1-trichlorobutane*
2-(3,5-dibromo-2-methoxyphenyl)pyrrole

APPENDIX 2

U.S. Ethylene Dichloride (EDC) and Vinyl Chloride Monomer (VCM) Plants

Total number of plants: 15
Total number of plants sampled by Greenpeace: 9

COMPANY	VCM	EDC	SAMPLED BY GREENPEACE
Borden Chemical, Geismar, LA	X*	X	1994, 1996
Dow Chemical, Freeport/ Oyster Creek, TX	X*	X	1994
Dow Chemical, Plaquemine, LA	X	X	
Formosa Platics, Baton Rouge, LA	X	X	
Formosa Plastics, Point Comfort, TX	X	X	1994
Geon Vinyl, La Porte, TX	X	X	1994
Georgia Gulf, Plaquemine, LA	X	X	1994
Occidental Chemical, Convent, LA		X	
Occidental Chemical, Corpus Christi, TX		X	
Occidental Chemical,	X	X	1994

Deer Park, TX			
Oxymar, Corpus Chrisiti, TX	X	X	
PPG Industries, Lake Charles, LA	X	X	1994, 1996
Vista Chemical, Lake Charles, LA	X	X	1994
Vulcan Chemicals, Geismar, LA		X	1994
Westlake Monomers, Calvert City, KY	X	X	

* Denotes two VCM plants at one location.Source: The Vinyl Institute, "The Vinyl Institute Dioxin Characterization Program: Interim Phase 1," submitted to the U.S. Environmental Protection Agency, November 1, 1996.

APPENDIX 3

Concentrations of Dioxins and PCBs in Vinyl Industry Waste and Sediment Samples.

SAMPLES TESTED IN 1994 INVESTIGATION

1. Company: Vulcan Chemicals,Geismar,Louisiana.
   Description: Hazardous waste taken from barrel labelled "K0 19D EDC reboiler residue."
   Laboratory sample reference: PU4017
   Laboratory results: 200,750 parts per billion (ppb) dioxins.

2. Company: Georgia Gulf, Plaquemine,Louisiana.
   Description: Sample taken from a feed tank adjacent to a hazardous waste incinerator.
   Laboratory sample reference: PU4016
   Laboratory results: 1,248 ppb dioxins, up to 118 ppb PCBs

3. Company: Formosa Plastics, Point Comfort, Texas.
   Description: VCM plant strainer hazardous waste.
   Laboratory sample reference: PU4043
   Laboratory results: 761 ppb dioxins, up to 214 ppb PCBs

4. Company: Geon Vinyl, La Porte, Texas.
   Description: Sediment sample taken 6 feet downstream of outfall pipes.
   Laboratory sample reference: PU4033
   Laboratory results: 2,921 ppt dioxin

SAMPLES TESTED IN 1996 INVESTIGATION

1. Company: Borden Chemicals, Geismar, Louisiana.
   Description: Sample of "light end" wastes taken from Borden Chemical in Geismar, Louisiana.

Laboratory sample reference: MI6049
Laboratory results: 36 ppb dioxins

2. Company: PPG Industries, Lake Charles, Louisiana.
Description: Soil sample contaminated with "heavy end" wastes.
Laboratory sample reference: MI6049
Laboratory results: 5,448 ppb dioxins.

REFERENCES

a Throughout this report, the terms "vinyl" and "PVC" are used interchangeably.

b "Dioxins" is commonly used to represent the 75 different kinds of dioxins and 135 furans that resemble dioxins in terms of their chemical structure, behavior in the environment, and toxic effects.

c Wastes from the manufacture of Agent Orange, the defoliant used on the jungles of Vietnam, is known for its dioxin contamination and for the health effects suffered by soldiers and civilians exposed to it during the Vietnam War.

d TEQ, or Toxic Equivalency, is an internationally recognized calculation that is used to express the toxicity of dioxins and dioxin-like chemicals. In addition to 75 dioxins, there are 135 furans and 209 PCBs that resemble dioxins in terms of their chemical structure, behavior in the environment, and toxic effects. TEQ expresses the toxicity of these chemicals in relationship to a benchmark, 2,3,7,8-TCDD, the most toxic of all dioxins.

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