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SPI

JOINT MEETING
HEALTH, SAFETY & ENVIRONMENT AND LEGAL COMMITTEES

The Omni Hotel
130 Market Street
Charleston, South Carolina

Tuesday
May 25, 1993
2:00 p.m.

I. **OPENING OF MEETING AND SELF-INTRODUCTIONS** — F. Borrelli

II. **APPROVAL OF MINUTES OF PREVIOUS MEETINGS (HSE - 2/4/93)** — Group

III. **LEGAL COUNSEL'S REPORT** — P. dela Cruz

REDACTED

IV. **UPDATE ON CHLORINE INSTITUTE PROJECTS (CANTOX)** — R. McCre dy

V. **UPDATE ON ACTIVITY OF INTERNATIONAL JOINT COMMISSION** — M. Scheck

VI. **OLD BUSINESS** — Group

A. Hazardous Organic NESHAP (April 19 submittal)
B. Literature Review
C. VI Awards Program
D. ATSDR - Toxicological Profile
E. Other

VII. **NEW BUSINESS** — M. Scheck /Group

A. Proposed Amendments to New Jersey Community Right to Know (April 19): Hearing May 21 - Written Comments Due June 10
B. BTu Tax - Status of Administration Proposal and Impact on PVC Industry
C. Assistance of HSE to New Ad Hoc Task Force on Assessment and Evaluation of Risk
D. Other

VIII. **ENFORCEMENT UPDATE** — Group

IX. **UPDATE ON OTHER VINYL INSTITUTE ACTIVITIES** — M. Scheck

X. **NEXT REGULAR MEETING - OCTOBER 6, 1993/ADJOURNMENT**

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Antitrust Reminder

Group activities of competitors are inherently suspect under the antitrust laws. Many agreements among competitors, however, are both legal and beneficial to the industry. The best vehicle for enjoying the benefits of permitted agreements among competitors while avoiding the pitfalls of illegal agreements is by belonging to a trade association like SPI which takes its obligations in this regard very seriously.

All SPI staff members are well versed in antitrust matters and the association relies heavily on their judgment to see that topics which may give an appearance of an agreement that would violate the antitrust laws are not discussed at SPI meetings. The fact that an SPI staff member is present at a meeting, however, should not invite probing to determine how far a discussion can proceed before it becomes apparent that it is improper and is cut off. It is the responsibility of each member in the first instance to avoid raising improper subjects for discussion. This reminder has been prepared to assure that participants in SPI meetings are aware of this obligation.

The Dos and Don'ts presented below highlight only the most basic antitrust principles. Each participant in an SPI meeting should be thoroughly familiar with the SPI Bulletin, "The Antitrust Laws and You — A Guide and Introduction to an Understanding of the Federal Antitrust Laws," and should consult counsel in all cases involving specific situations, interpretations, or advice.

DON'T

1. Do not, in fact or appearance, discuss or exchange information regarding:

   (a) Individual company prices, price changes, price differentials, mark-ups, discounts, allowances, credit terms, etc., or data that bear on price, e.g., costs, production, capacity, inventories, sales, etc.

   (b) Industry pricing policies, price levels, price changes, differentials, etc.

   (c) Changes in industry production, capacity or inventories.

   (d) Bids on contracts for particular products; procedures for responding to bid invitations.

   (e) Plans of individual companies concerning the design, production, distribution or marketing of particular products, including proposed territories or customers.

   (f) Matters relating to actual or potential individual suppliers that might have the effect of excluding them from any market or of influencing the business conduct of firms toward such suppliers or customers.

2. Do not discuss or exchange information regarding the above matters during social gatherings incidental to SPI-sponsored meetings, even in jest.
3. Do not meet without SPI staff or counsel present.

DO

1. Adhere to prepared agendas for all SPI meetings and object any time meeting minutes do not accurately reflect the matters which transpired.
2. Understand the purposes and authority of each SPI group in which you participate.
3. Consult with the SPI General Counsel and your company counsel on all antitrust questions relating to SPI meetings.
4. Protest against any discussions or meeting activities which appear to violate the antitrust laws; disassociate yourself from any such discussions or activities and leave any meeting in which they continue.

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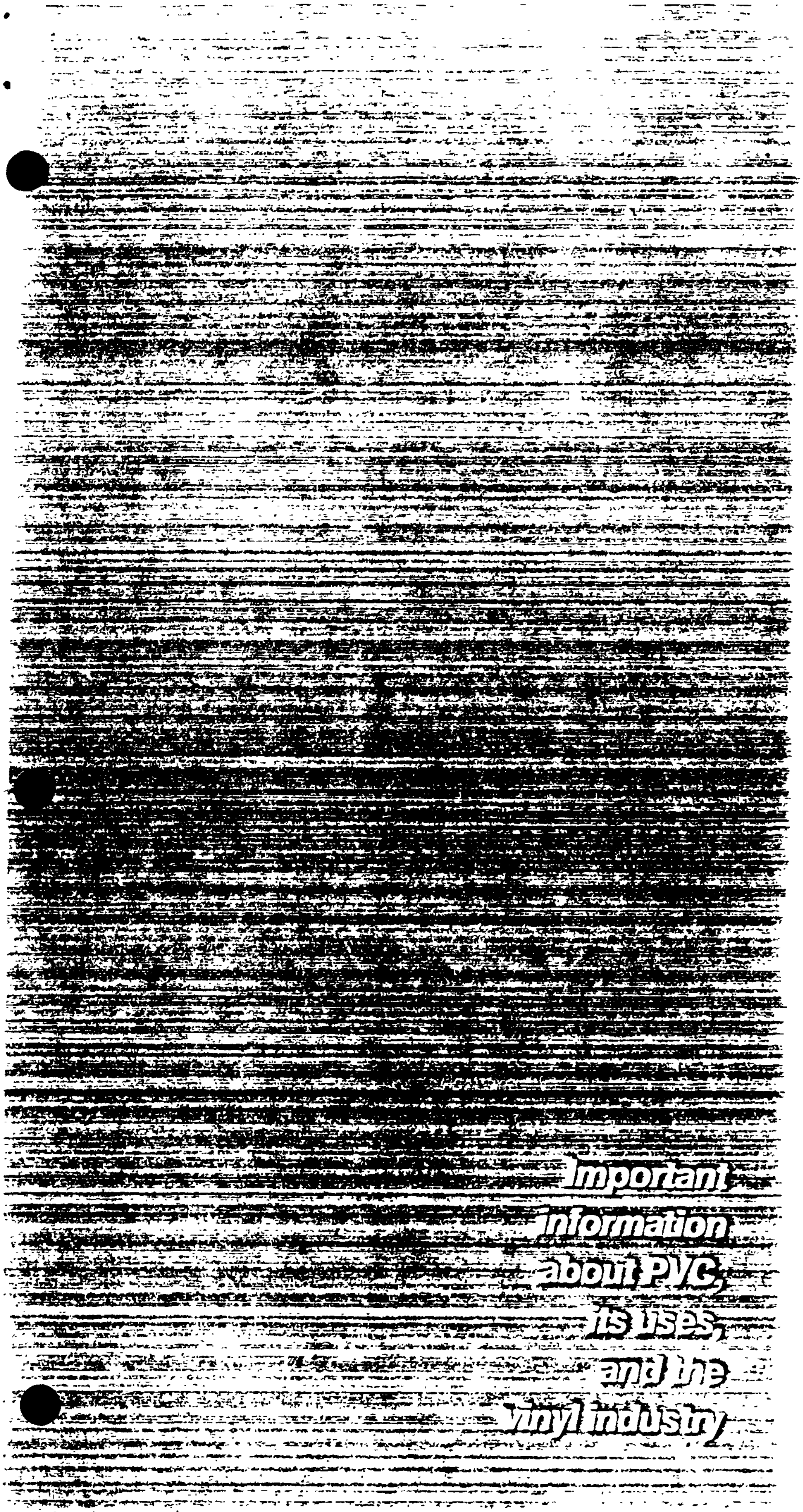

Important information about PVC, its uses, and the vinyl industry

The Vinyl Institute

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Points to Consider When Reviewing "PVC: Toxic Waste in Disguise"

At first glance, this packet produced by Greenpeace International looks very credible — it contains footnotes and quotes supposed experts. But as the old saying goes, "Paper will stand still while you print anything on it." Here are some thoughts to keep in mind as you judge the validity of the charges Greenpeace has made against PVC.

1) What's the motive? Greenpeace has stated that PVC is merely a piece in the chess game it is orchestrating against the entire petrochemical industry.

2) What are the sources being quoted? Many of the resources footnoted are not cited in English, making it virtually impossible to ascertain their validity.

3) Who are the experts being quoted? Do they have the education, training and experience to speak with authority on these issues? At least one of the American "experts" cited has been widely debunked for lacking expertise in an area where it is claimed.

4) What sleights of hand have been done with the scientific method? Several are apparent in the Greenpeace packet including:

   - Using inappropriate or invalid analogies.
   - Referencing out of date data or research when newer, contradictory work is widely known.
   - Presenting hypotheses as proven theories.
   - Assuming that anything hazardous in theory is automatically hazardous in fact.
   - "Trimming" data, or dismissing those statistics or results that fall outside a desired range and therefore, destroy a hypothesis.
   - "Cooking" data, or selecting those results that only support a hypothesis.
   - Fabrication, or making unsubstantiated claims.
   - Using sophistry to draw incorrect conclusions (otherwise known as leaps in logic).

5) What manipulations have been done to the English language? There are numerous examples:

   - Creating broad generalizations without justification.
   - Inappropriately using absolutist language (e.g.: using "must" instead of "may")
   - Using inflammatory language without justification to create a mood of alarm.

If nothing else convinces you to review the Greenpeace packet about PVC with skepticism, consider this quote from Paul Watson, the co-founder of Greenpeace:

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"It doesn't matter what is true, it only matters what people believe is true."

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The Vinyl Institute

A Division of The Society of The Plastics Industry, Inc.

ABOUT THE VINYL INSTITUTE

The Vinyl Institute is a national trade association representing the leading manufacturers of vinyl (polyvinyl chloride, or PVC) plastics, as well as makers of vinyl feedstocks, additives, and film and sheet products. The Institute is a division of The Society of the Plastics Industry and is headquartered in Wayne, New Jersey.

The Institute maintains an active program of technical research designed to help integrate vinyl products into all phases of the solid waste management process. This work includes cosponsorship, along with nine state and federal government agencies, of the New York State Energy Research and Development Authority (NYSERDA) study on incinerators and dioxin production, funding of market development research at Vermont Republic Industries in St. Albans, Vermont and at the University of Toledo, funding of market development programs at Recoverable Resources Boro Bronx (R2B2), and funding of research at the Center for Plastics Recycling Research, Rutgers University, and at National Recovery Technologies, Nashville, Tennessee. Additional activities are supervised by VIGOR, the Vinyl Institute's Group on Recycling.

The Vinyl Institute was established in 1982, with a dual charter to promote and protect the growth of the vinyl industry. In addition to its support of solid waste research, the Institute conducts a broad education program to build understanding about the environmental performance of vinyl products. For more information, contact the Vinyl Environmental Resource Center at 1-800-969-VINYL (1-800-969-8469).

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- ★ PVC plasticizers are well-researched; found to be safe.
- ★ Heavy metal stabilizers being phased-out; those used in PVC make a small contribution to landfills.
- ★ Additives do not hamper the recyclability of PVC.

Environmental Profile: Facts About the Safety of PVC Additives

The additives found in PVC help to make it one of the most versatile, cost-efficient materials in the world. Without additives, literally hundreds of commonly used PVC products would not exist. Many materials are useless until they undergo a similar modification process. Steel, for instance, contains among other things, chromium, nickel and molybdenum.

Individual additives include stabilizers, colorants, impact modifiers, processing aids and plasticizers. Each typically constitutes a small part of the overall PVC formulation and their use is closely regulated by a number of agencies including the Environmental Protection Agency, the Food & Drug Administration and the National Sanitation Foundation. All additives used in food and drug applications must be those that have been declared "generally recognized as safe" by the FDA, or have specific regulatory clearance. Because of PVC's physical nature, many of the ingredients are locked or tightly held in the polymer, limiting the potential for human contact or release to the environment. The potential health and safety effects of all PVC additives, as well as all feedstocks, are fully detailed by each manufacturer in "material safety data sheets (MSDS)," which are required by U.S. law. These are available to anyone who wishes to review them, and must be provided to all plant workers.

Plasticizer Research

Plasticizers and stabilizers in particular have been researched at length to determine their potential impact on human health and the environment. In the case of plasticizers, there has been much debate over that impact due to the differing methods used to evaluate them. For example, while the U.S. National Toxicology Program and the International Agency for Research on Cancer have classified the plasticizer DEHP (di-2-ethylhexyl-phthalate) as a possible human carcinogen, their methodologies have been criticized for potentially inaccurately ascribing results obtained with rodents to humans.[1] The Specialized Experts Working Group of the European Commission for instance, has concluded that there is no evidence to warrant the classification of DEHP as a carcinogen.[2]

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Nor is DEHP regulated as a carcinogen by the U.S. Food & Drug Administration, which has long governed the plasticizer's use in medical devices and in food contact applications. Additional evidence indicates that replacing DEHP-plasticized PVC in medical applications like blood bags will create a new problem. For instance, while DEHP is known to actually protect red blood cells from deterioration, one proposed PVC-replacement, EVA (ethyl vinyl acetate), can hydrolyze to form acetic acid, thereby affecting the pH of the blood product being stored in it. With blood products, EVA also has a shorter shelf life and is far more expensive than PVC.

Conversely, DEHP has long been known to be incompatible with fatty foods, and is no longer used in food wrap (cling film) for products like cheese. However, flexible PVC film is considered the most desirable material for wrapping meats, as it is oxygen-permeable and maintains the bright red color needed to make meats salable to consumers, as well as extending the shelf life of meats.

DEHP is also widely used in applications such as wallcoverings and resilient flooring, and has been examined for its potential contribution to "indoor air pollution." In the most recent study, conducted by the Environ Corporation for the Chemical Manufacturers Association Phthalate Esters Panel, results indicate that plasticizers volatizing from this type of product present an "insignificant" risk as defined by the California Health and Welfare Agency guidelines for consumer products.[3]

Stabilizer Replacement

Heavy metal-based heat stabilizers containing cadmium and lead are generally recognized as undesirable additives in PVC formulations and are being phased out of use. In the United States, cadmium stabilizers are primarily used in general purpose plasticized PVC applications and it is estimated that approximately 50 percent of these stabilizers have already been replaced by non-cadmium products.

Lead stabilizers are used in PVC wire and cable insulation, where the electrical properties lead provides have been difficult to attain with replacement stabilizer systems. However, new non-lead stabilizers for wire and cable applications are now being introduced and are expected to eventually replace the use of lead. In the meantime, specific programs have been developed to capture and recycle scrap wire and cable insulation so that the material can be diverted from landfills and incinerators. One such program uses reclaimed PVC wire and cable "fluff" to make traffic cones to U.S. Department of Transportation specifications. Other uses for lead stabilizers have essentially been eliminated.

Rigid vinyl compounds used to make such items as siding, window frames and pipe are stabilized with tin compounds to provide durability and weatherability. Inorganic tin, the ultimate product when tin stabilizers break down, is accepted as non-toxic. Both rigid and flexible PVC compounds intended for food-contact applications use FDA-regulated stabilizers based on calcium and zinc, or tin.

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It's important to note that heavy metals are found in numerous non-PVC applications such as car batteries (lead), and in ceramic glazes, rubber products and galvanized water pipe (cadmium).[4] According to a study conducted by Franklin Associates, only about 15 percent of the cadmium found in municipal solid waste can be traced to PVC.[5] Eliminating PVC or the use of heavy metal stabilizers in it will not eliminate the need for precautionary solid waste management practices that address the presence of these stabilizers in incinerators and landfills. It should also be noted, in a study conducted by NUS Corporation of Pittsburgh, that cadmium leaching from landfills has been measured on a parts per million basis, which is considered too small to be a health problem.[6] Ironically, PVC liners have been used for a number of years in landfills to contain such leaching, specifically because they are so resistant to the aggressive conditions typically found there.

Recycling Developments

PVC additives in general do not decrease the recyclability of PVC since individual PVC formulations are typically compatible within limits, and second generation compounds can be modified to include properties that are missing from the original recyclate. In general, PVC is recycled from a first-generation product with very demanding properties to a second generation product that is less demanding. If anything, the additives present in the first generation product will enhance the performance of the second generation product.

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[1] "Plasticisers: A Consideration of Their Impact on Health and the Environment," paper presented by D.F. Cadogan, Plasticisers Sector Group, CEFIC, Brussels.

[2] Official Journal of the European Communities, No. C 94/9.

[3] "Effects of Vinyl Products on Indoor Air Quality," The Vinyl Institute, January 1990.

[4] Heavy Metals in Combustion of Plastics," J.P. Wagner, M.A. El-Ayyoubi, R.B. Konzen, The National Environmental Journal, November/December 1991.

[5] "PVC is a Good Bet to Survive Its Global Environmental Travails," Modern Plastics, June 1990.

[6] Modern Plastics.

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- ★ Chlorine and chlorine-based compounds occur in abundant quantities throughout nature.
- ★ Chlorine chemistry is essential to all life.
- ★ Organochlorines predate industrial society.
- ★ Chlorine gives PVC many unique properties.

Environmental Profile: Facts About Chlorine, The Material Used to Make PVC

Chlorine is the 20th most common element on Earth, found virtually everywhere: in rocks, oceans, plants, animals and human bodies.[1] It is very reactive, and once produced, combines with other elements or compounds. As a result, it is rarely found in its natural, elemental state. Nevertheless it is essential to human life.

Many elements essential to life are similarly reactive — some so reactive that they catch fire and burn vigorously as soon as they come in contact with air or water. They are highly corrosive to human flesh and are never seen in nature. Examples of these elements include sodium, phosphorus and potassium — all essential to human body chemistry.[1]

Many other essential elements are not as reactive, are never found in their elemental state, but are nevertheless essential to life. Examples include calcium, iodine and hydrogen.[1] Even such common elements as iron and cobalt do not occur freely in nature, but must be separated from ores. Nevertheless, they too are essential to the chemical processes of life.

Compounds of all these elements are fatal if consumed in large enough doses, but in smaller quantities, are critical to human health. Without exception, it is the size of the dose which makes the poison, not the element itself.[9] For instance, strychnine and atropine are listed as supertoxic substances, but both are used medicinally in small doses.

Chlorine in the Environment

In exactly the same way, chlorine by itself is highly reactive and corrosive, and is part of many compounds which are toxic at high doses. At the same time, it is essential to life and present throughout the environment.

Free chlorine is produced geothermally within the Earth, and occasionally finds its way to the earth's surface in its natural state.[1] More usually, however, it reacts with water vapor on its way to the surface to form hydrogen chloride, which in turn forms hydrochloric acid. Hydrochloric acid reacts quickly with other elements and compounds, forming stable compounds — usually chlorides — such as sodium chloride (common salt), magnesium chloride and potassium chloride, all found in large quantities in sea water.

Chlorine, as part of these stable compounds, makes up about 0.013 percent of the earth's crust, and nearly 2 percent of all seawater. It exists in several minerals, and as a major component of rock salt, which is created by evaporating sea water.

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Organochl rines In Nature

The chlorine found in common salt water is an essential element in all body fluids, and in this form, makes up about 0.15 percent of total body weight. It is critical to maintaining the body's acid-alkali balance. One of the simplest chlorine compounds, hydrochloric acid, is also present in the stomach to aid the digestive process, and is made by the body from salt ingested from the diet.

A large number of complex organic chlorides and organochlorines are naturally produced chemicals, widely present in nature, and play many essential roles.[3,6,14,15] These exist as thiamine[1] and also as chloroperoxidase enzymes, which serve as the body's defense mechanism against toxins, microorganisms, parasites and possibly, tumors.[3] Chlorine is also an essential element of naturally occurring anti-bacterial and anti-fungal agents such as chlortetracycline, chloramphenicol and griseofulvin, which have revolutionized the treatment of human bacterial and fungal infections.

A Natural Pharmaceutical

Many different organochlorines form in seawater as a result of natural biological[15] and chemical[18] processes, and are released into the atmosphere.[4,5] For instance, it is estimated that between 5 and 28 million metric tons of chloromethane are produced by nature annually[17,2] by such sources as natural forest fires and volcanos.[2,7,16,19] Carbon tetrachloride, commonly used as an industrial degreasing agent and domestic spot cleaner, and trichloromethane, an anesthetic and pharmaceutical, are also produced in significant quantities by red algae widely dispersed in the oceans.[13] Natural production of carbon tetrachloride has been estimated at nearly two million tons per year — far more than the amount produced by industry.[11] In fact, it is estimated that the amount of all natural organochlorines may be comparable to that resulting from industrial production.[14]

Even more complex cyclic organochlorines — including dioxins and furans — are produced from burning wood and other vegetable matter, and are natural by-products of forest fires.[7,8]

Chlorine-based chemicals are everywhere, and have been so since before the existence of man. For instance, pentachlorophenol is present in lake bottom sediments dating back to the 17th century, at levels very similar to those found in modern sediment taken from lakes receiving paper mill effluent.[10] Both dioxins and furans have been found in lake sediments dating back to 1860,[12] and samples taken from ice cores in Greenland dating back to 1869 show definite "spikes" in chlorine content correlating with volcanic activity.[20]

The fact that inorganic chlorides, organic chlorides and organochlorines are naturally produced in such vast quantities, and so widely distributed in the natural world, is irrefutable evidence that they are not, as is sometimes claimed, "completely alien to nature." Banning production of chlorine compounds to keep chlorine out of the environment would be futile and would deprive the world of hundreds of products critical to society's health and well-being.

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The K y t PVC's Outstanding Performance

Not only is chlorine essential to the chemical composition of PVC (polyvinyl chloride), it provides a number of unique properties that give this versatile plastic a distinct advantage in product applications and the marketplace:

- It makes PVC inherently flame retardant, which is why vinyl is used in many construction and furnishing applications. It is the world's leading electrical material, with over 500 million pounds used annually for wire and cable insulation and sheathing, electrical conduit, boxes and components. In fact, one of the first major uses for PVC was in shipboard wiring during World War II, where it replaced rubber to reduce fires at sea.

- It makes PVC highly economical. Over 50 percent of the base polymer is composed of chlorine, making vinyl much less dependent on petrochemical feedstocks than many other materials. Instead, it is made largely from a natural, inexhaustible and inexpensive resource.

- Likewise, it makes PVC far more "environmentally friendly" than other materials that are totally dependent on petrochemical feedstocks, or those products made from metal ores or wood.

- In recycling, the chlorine in PVC acts as a "marker," enabling automated equipment to sort PVC containers from other plastics in the waste stream. This technology is expected to help make large-scale plastics recycling economically feasible.

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[1]Encyclopedia Britannica, 1988.

[12]J.E. Lovelock, Nature, 256, 193-194, 1985.

[3]S.L. Niedleman, J. Geigert. "Biohalogenation: Principles, Basic Roles and Applications," Ellis Horwood Ltd./John Wiley, 1986.

[4]W. Reifenhauser, G. Heumann, Chemosphere, 24, 9, 1293-1300, 1992.

[5]R.A. Duce, T.W. van Nahl, Journal of Geophysics Research, 70, 1775-1799, 1965.

[6]T. Leisinger, Experientia, 39, 1183-1191, 1983.

[7]R. Clement, C. Tashiro, Abstracts, Dioxin '91, S34, 1991.

[8]G. Mariani, Chemosphere, 24, 11, 1545-1551, 1992.

[9]"Clinical Toxicology of Commercial Products," Gosselin, Smith & Hodge, 5th edition, Williams & Wilkins, 1984.

[10]P. Lampi et al, Chemosphere, 24, 12, 1805-1824, 1992.

[11]J.E. Lovelock et al, Nature, 241, 194-196, 1973.

[12]R.M. Smith et al, Chemosphere, 25, 95-98, 1992.

[13]O. McConnell, W. Fenical, Phytochemistry, 16(3) 367-74, 1977.

[14]D.J. Faulkner, Handbook of Environmental Chemistry, Vol. 1, Pt.A, pp. 229-254, 1991.

[15]W. Fenical, Marine Organic Chemistry, 31, 373-393, 1981.

[16]L.E. Rasmussen, Journal of Geophysical Research, 85, 7350-56, 1980.

[17]C.R. Pearson, Handbook of Environmental Chemistry, Vol. 3, 1982.

[18]O.C. Zafiriou, Journal of Maritime Research, 33, 73-81, 1975.

[19]P. Crutzen et al, Nature, 282, 253-256, 1979.

[20]"Sulfate and Nitrate Concentrations from a South Greenland Ice Core," P.A. Mayewski et al, Science, May 1986.

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- ★ Over 50% of the PVC polymer comes from an inexpensi renewable resource.
- ★ Selected PVC products are shown to have a distinct l cycle advantage over competitive materials.
- ★ PVC's good environmental story is getting heard Europe.
- ★ PVC has demonstrated its utility and value worldwid

Environmental Profile: Facts About the Economics, Life Cycle Efficiencies and Performance Benefits of PVC

PVC has become one of the most widely used materials in part because of its cost-efficiencies. These efficiencies begin when PVC is produced, and continue throughout its lifecycle, encompassing such elements as raw material usage, energy used in processing, energy used in distribution and transportation, durability (time before the product must be disposed of or replaced), maintenance requirements, and disposal costs.

Composition Inherently Economic

PVC is only partially derived from petroleum feedstocks. The balance (over 50 percent) comes from rock salt. Worldwide PVC production represents less than 0.3 percent of all annual oil and gas consumption, and about 10 percent of annual rock salt consumption. Salt reserves currently are estimated at about 5,000 years.[1]

In Europe, studies have shown that the gross energy (i.e., from raw material to finished product) used to make one kilogram of PVC is 78 megajoules(MJ) compared with 102 to 103 MJ for other plastics, and 146 MJ for aluminum.[2] Further research has shown that a meter of PVC sewer pipe consumes 295 MJ, compared to 522 MJ for alternative plastic pipe and 849 MJ for cast iron pipe.[3]

In 1992, Chem Systems, of Tarrytown, New York, conducted a lifecycle assessment comparing specific packages made from glass, paperboard, paper and selected plastics. Chem Systems found that "...PVC appears to be the comparators (sic) with the lowest production energy and carbon dioxide emissions, and the lowest fossil fuel and raw material requirements of the plastics studied." Chem Systems further characterized the vinyl chloride monomer (VCM) production process (the precursor step to PVC production) to be a classic case of in-process waste-minimization since virtually all material used to make it is recycled back into the process.[4]

Installation Costs Are Less

Another study, conducted by IFT Technical Services of Berkeley, California in 1991, examined cost efficiencies related to the installation of various building materials. That study, which compared total installed costs in five major U.S. building markets, found that building contractors could save between 14 and 42 cents on every dollar by specifying PVC pipe and electrical conduit in place of copper, ductile iron or metallic electrical conduit.[5]

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New Technologies Cut Recycling Costs

The automated sorting technologies that the vinyl industry has helped developed are expected to help recyclers achieve the cost-efficiencies that will make PVC recycling practical. In particular, the industry is working with recyclers to examine the practicalities of developing regional approaches to all plastic recycling, which is believed to be the most cost-effective way to recycle the range of plastic materials that remain after milk jugs and soda bottles are culled from the feed. Since soda bottles and milk jugs represent only about 10 percent of all plastic packaging, this technology may mean dramatic increases in recycling rates for all plastics, not just PVC. As to disposal via incineration, preliminary research also indicates that the value of the energy recovered by incinerating PVC in a waste-to-energy facility may offset any additional costs incurred to scrub the HCl.

Acceptance in Europe

In Europe, where PVC's "environmental friendliness" has come under close scrutiny, several organizations have considered all of these factors and drawn favorable conclusions about the continued use of PVC:

- British retailer Marks & Spencer has announced its commitment to vinyl over other plastics because it regards PVC as a highly "environmentally friendly" material.

- Also in Britain, the Green Consumer's Supermarket Shopping Guide has called PVC "one of the most energy efficient materials."

- In Norway, the environmental group Bellona has concluded that "a generally reduced use of vinyl plastics will, given today's circumstances, lead to a worsening of the environmental situation."

- In Switzerland, the country's largest retailer, Migros, has stated that once the country's incinerators are equipped with scrubber technology, "our whole attitude to PVC will change. It has outstanding properties not easily matched by alternatives."

Worldwide Benefits

Just as important are the contributions PVC makes to an improved quality of life. Its durability, cost-efficiency and performance properties can play an especially important role in developing countries:

- Pipe made from it economically delivers pure water to places that have never had this basic necessity; PVC irrigation pipe helps increase crop yields.

- Medical goods and pharmaceutical packaging made from it help provide a higher, safer standard of health care.

- Wiring made from it makes electrical service safer and more dependable.

- Construction products made from it make housing more affordable.

- Packaging made from it reduces food spoilage and waste.

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[1]"PVC and the Environment," Norsk Hydro, 1992.

[2]EEC Directive 85/339. A report for the Industry Council for Packaging and the Environment, vols. 1-4, Open University, Milton Keynes, U.K.

[3]F. Sagvik, Totalt energiforbruk ved framstilling av ror av forskjellige materialer, 1991. Kjelforeningen Norsk Energi.

[4]"Vinyl Products Lifecycle Assessment," Chem Systems, Inc., Tarrytown, New York, March 1992.

[5]"PVC Electrical Nonmetallic Tubing vs. Electrical Metallic Tubing: A Cost/Benefit Comparison," "PVC vs. Copper Domestic Hot & Cold Water Systems: A Cost/Benefit Comparison," and "PVC Drain, Waste and Vent Pipe vs. Cast Iron Soil Pipe: A Cost/Benefit Comparison," ITF Technical Services, Berkeley, CA, July 1990. (Cost data updated 1991.)

The Vinyl Institute

A Division of The Society of The Plastics Industry, Inc.

- ★ Testing shows PVC not an unusual fire hazard.
- ★ Chlorine present in PVC helps stop fires from starting and from spreading.
- ★ Testing shows PVC no more a corrosion problem than other materials.

Environmental Profile: Facts About PVC's Fire Performance

All organic materials can burn. When burned, they release a lengthy list of chemical by-products. For instance, when wood burns, as many as 175 different fire gases may be produced, including benzene and acrolein.[1] Burning wool will produce hydrogen cyanide, and virtually any of the hundreds of chlorine-based products found in the typical home or office can, theoretically, produce small amounts of dioxin. Even the simple act of barbecuing a steak or smoking a cigarette will produce dioxin.[2]

More important, virtually all burning materials produce carbon monoxide, which is considered the greatest toxic hazard in fires because of the abundant levels produced and the low levels that cause death.[3]

Fire Deaths Down, Plastics Up

While the growing presence of synthetic materials — including PVC — has sometimes been blamed for creating a more lethal fire environment, in actuality, the U.S. fire death rate is decreasing, dropping from a rate of 76 per million in the 1940s (when most construction and decorative products were made of "natural" materials), to 29 million in the 1980s (by which time, PVC had replaced natural materials in numerous applications).[4] This downward trend can be attributed in large part to improved building codes and the broader use of sprinkler systems and smoke detectors. However, the increased use of more fire-resistant materials — like PVC, which actually stops fires from starting and from spreading because of the inherent flame retardance it gets from its chlorine content — deserves part of the credit for this improvement.

Testing Resolves Toxicity Issue

Extensive testing has examined the potential lethality of hydrogen chloride, which is produced when PVC burns. In 1986, researchers from Southwest Research Institute conducted a series of tests for the Federal Aviation Administration that studied this issue. In those studies, test animals were able to survive exposures to hydrogen chloride reaching 10,000 ppm.[5] More recent studies have confirmed those results[6] and indicate less of a potential for delayed effects on lung function than expected. In a typical fire, hydrogen chloride levels rarely exceed 300 ppm — a fact that was confirmed by the Boston Fire Department and Harvard University in 1979.[7] In hundreds of autopsies conducted on fire victims in the U.S., not one death has been linked to the presence of PVC.

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Testing Addresses Corrosion

Recently, Bell Laboratories also completed a study to determine whether wire and cable compounds made of PVC or other halogen-based compounds generate more corrosion damage when they burn than do halogen-free compounds. Bell Labs found that neither type of material presented a clear-cut advantage in a fire, and that the halogenated compounds sometimes outperformed the nonhalogenated products in terms of creating less corrosion.[8]

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[1]N.W. Hurst and T.A. Jones, "A Review of Products from Heated Coal, Wood and PVC," Fire Materials, 9,1, 1985.

[2]"World Environment and PVC," Vinyl Chloride Industry Association, Tokyo.

[3]G.L. Nelson, D.V. Canfield and J.B. Larsen, "Carbon Monoxide — Study of Toxicity in Man," 11th Int. Conf. on Fire Safety, San Francisco, CA, January 13-17, 1986.

[4]Statistics from the National Fire Protection Association.

[5]H.L. Kaplan, A.F. Grand, W.G. Switzer, D.S. Mitchell, W.R. Rogers and G.E. Hartzell, "Effects of Combustion Gases on Escape Performance of the Baboon and the Rat," Journal of Fire Science, 3, 228, 1985.

[6]H.L. Kaplan, A. Auzeuto, W.G. Switizer and R.K. Hinderer, "Effects of Hydrogen Chloride on Respiratory Response and Pulmonary Function of the Baboon," Journal of Toxicology and Environmental Health, 23:473-493, 1988.

[7]W.A. Burgess, R.D. Treitman and A. Gold, "Air Contaminants in Structural Firefighting," arvard School of Public Health, NFPCA Grant 7X008, 1979.

[8]P.R. Dickinson, "Evolving Fire Retardant Materials Issues: A Cable Manufacturer's Perspective," Fire Technology, November 1992.

The Vinyl Institute

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TO:	Vinyl Institute Members	*DATE:*	April 26, 1993
FROM:	Bob Burnett	*COPIES:*	Pat Benkner Dave Meeker/Nora Jacobs Michelle Golick
SUBJECT:	Greenpeace		

Last month, VI board members received advance copies of the enclosed fact kit, which we have prepared in response to the kit produced by Greenpeace International entitled "PVC: Toxic Waste in Disguise." Also enclosed in the packet is a brand-new piece that summarizes the economic impact of phasing out the use of PVC. This is based on a larger, just-completed study commissioned by the Chlorine Institute.

In the coming weeks and months, a number of representatives from the Vinyl Institute and the Chlorine Institute will be using this material to make contact with the government officials and media representatives Greenpeace is likely to target in its ongoing campaign to eliminate the vinyl and chlorine industries. Much of this activity will likely focus on the Great Lakes region, which is the current target of the Greenpeace campaign.

The first two inserts in the VI packet ("PVC's Environmental Profile: Fallacy vs. Fact" and "Points to Consider When Reviewing 'PVC: Toxic Waste in Disguise'") were designed specifically for those individuals closely involved in the Greenpeace education program and are included in your copy primarily for your information purposes only. However, with those sheets removed, the kit provides an excellent overview of vinyl's environmental story that may be appropriate with a variety of other audiences. The format also lends itself well to additional modification, and you are welcome to add whatever information you deem appropriate for your particular use.

The initial print run of the kit was necessarily small. However, we likely will produce an additional quantity after June 1. Single copies of the kit will be available to members free of charge after that date. Bulk quantities of the kit (minimum order: 25 copies) can be ordered at a cost of $2.00 each ($50.00 for 25 copies) by contacting Michelle Golick at VERCE (1-800-969-VINYL).

WE MUST HAVE ALL ORDERS FOR BULK QUANTITIES BY MAY 21. All advance orders will be invoiced when the new print run is shipped.

Bob

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Estimating the Incremental Cost to Replace PVC

Those who call for the phase out of all PVC-based products typically claim that readily available substitutes exist for most applications. Aside from the fact that many of these substitutes lack the performance properties PVC provides (such as durability, fire resistance, weather resistance, etc.), or that they may consume more resources or have a larger environmental impact throughout their lifecycle, what would the impact be on our economy to replace PVC?

In April 1993, the consulting firm of Charles River Associates, Boston, issued a study that examined just this question.* Specifically, CRA looked at the cost to replace PVC with alternative materials in fourteen major applications and markets. The study calculated the amount of material needed to maintain the same market share currently held by PVC in each application. It also estimated (where appropriate) the capital cost to build new capacity or convert existing capacity to produce that material or fabricate end-products from it, and considered any incremental or additional costs to install the material compared to the current cost to install the PVC product.

The study found that the cost to totally replace PVC in these markets would require an additional investment of $974 million in new equipment and cost consumers $6.7 billion more per year to purchase substitute materials.

CRA further noted that producing substitute materials, particularly metals and concrete, is energy intensive and can create other environmental problems. For instance, ductile iron requires large amounts of coke, which creates problematic environmental emissions, as do steel mills and copper and aluminum smelting. CRA did not include the costs required to modify building codes and other regulations if PVC products were no longer available.

Details of the findings appear on the following chart (over).

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* "Assessment of the Economic Benefits of Chlor-Alkali Chemicals to the United States and Canadian Economies," prepared for the Chlorine Institute by Charles River Associates, Boston, April 1993.

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Exhibit 3-5. Benefits of Chlorine in PVC Products (U.S. and Canada)

Product Forms	Estimated 1990 Consumption (000 tons)	Substitutes	Estimated Investment Required ($Million)	Estimated Incremental Cost of Substitutes ($Million/Year)	Estimated Total Cost of Substitution ($Million/Year)
Pipe and Fittings					
Pressure water	700	Ductile iron, copper, HDPE	273	1,587	1,642
Sewer/drains	375	Ductile iron, HDPE, RCP	114	590	613
Duct and conduit	265	Aluminum, steel	24	483	487
Drain/waste/vent	300	Ductile iron, ABS	158	774	806
Irrigation	100	HDPE, AL, ABS	36	106	114
Fittings and other	160	From above	55	322	333
Fabricated Products					
Flooring, textiles, and other calendered	515	Ceramics, carpet, nylon, paper, HDPE, PET	147	1,486	1,515
Siding and accessories	410	Aluminum	9	266	267
Wire and cable	230	LDPE, TPO	4	51	51
Windows and other extrusions	305	Aluminum	7	198	199
Adhesives	60	Polyurethanes	0	224	224
Films and sheet	210	LLDPE, HDPE, TPO	88	36	54
Plastic bottles	120	PET-G	0	39	39
Other	430	Miscellaneous plastics	59	535	547
TOTAL	4,200		974	6,697	6,891

(1) HDPE = high-density polyethylene; RCP = reinforced concrete pipe; ABS = acrylonitrile butadiene styrene; PET = polyethylene terephthalate; LDPE = low-density polyethylene; TPO = thermoplastic olefins; LLDPE = linear low-density polyethylene; PET-G = polyethylene terephthalate-G.

SOURCE: Charles River Associates, 1993.

Distributed April 1993

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PVC's Environmental Profile: Fallacy vs. Fact

In its packet entitled "PVC: Toxic Waste In Disguise," Greenpeace International levels a number of charges against PVC (polyvinyl chloride, or vinyl). This material, prepared by the Vinyl Institute, provides responses to those charges. For more information about vinyl, its uses, and its impact on the environment, contact the Vinyl Environmental Resource Center at 1-800-969-8469.

Fallacy	Fact
PVC is the product of a highly dangerous industry.	The PVC production process is one of the most closely regulated manufacturing processes in existence with a documented record of safety.
Chlorine, the raw material used to make PVC, is unusually toxic — a fact documented by the fact that "natural" organochlorines do not exist.	Numerous instances of natural organochlorines exist. In fact, life itself could not exist without chlorine chemistry.
The PVC industry has grown because it serves as a convenient "sink" for excess chlorine production.	The PVC industry has grown because of the numerous properties vinyl brings to hundreds of products millions of people use every day.
PVC is an environmental threat because its production involves the transport of dangerous materials.	The PVC industry has an outstanding transportation record. Potential hazard does not necessarily mean actual hazard.
PVC is an environmental threat because it involves the use of certain chemical additives.	The use of all such materials is carefully regulated. There is no scientific evidence to indicate that these materials present a threat to human health or the environment under the conditions they are used.
Products made from PVC are hazardous to consumers because they give off dangerous gases.	No scientific evidence indicates that this is the case. PVC is a highly inert, stable material. The most commonly used additives (plasticizers) have been thoroughly researched and shown not to present cause for concern to consumers.

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Fallacy	Fact
PVC creates dioxin when it is incinerated.	Scientific research has shown that the presence of PVC has no effect on the level of dioxins produced by incinerators. Dioxin production is a result of incinerator operating conditions.
PVC decomposes and creates groundwater hazards when it is landfilled.	PVC is a highly stable material that is extremely resistant to the aggressive chemical environment found in landfills. Plasticizers released when PVC decomposes under these conditions would constitute minuscule amounts over an extended period of time and thus, present no threat to human health or the environment.
PVC is difficult to recycle because so many different formulations exist.	Different PVC formulations are highly compatible for recycling. In fact, the formulations used to make PVC packaging (the most commonly recycled type of PVC product) are actually extremely desirable for recycling because they meet very demanding requirements for purity that can be transferred to "second generation" products.
Many traditional, environmentally more acceptable products and generally "better" materials have been displaced by cheap PVC substitutes.	Not only does PVC outlast and outperform many traditional materials, but because 50 percent of its base polymer comes from common salt, an inexpensive, renewable resource, it is also much preferred to materials that rely 100 percent on petrochemical feedstocks, or those that deplete forests or ore reserves.
Many communities in Europe are starting to restrict or ban the use of PVC because of its environmental hazards.	Reacting to misinformation like that presented by Greenpeace, some organizations and communities in Europe have moved to eliminate PVC. However, once the facts have become clear, most of those bans either have fallen into disuse or have been rescinded.

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The Vinyl Institute

- ★ Second largest volume plastic produced worldwide.
- ★ Employs approximately 100,000 in U.S. alone.
- ★ First critical use came during WWII.
- ★ Formulaton flexibility makes it the most versatile plastic.
- ★ Used in hurdreds of consumer, industrial products.

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About PVC and the PVC Industry

PVC (polyvinyl chloride, or vinyl), is the second largest volume plastic produced in the world. U.S. production alone currently exceeds 10 billion pounds annually, and Canadian output is about 600 million pounds per year. Applications are found in virtually every industry, including health care, communications, aerospace, automotive, retailing, textiles, construction, durable goods and agriculture.

The industry and its direct customers employ approximately 100,000 people in the United States, and thousands more in Canada. Still more are employed in allied and supplier roles to the vinyl industry in such areas as transportation and contract services, or in end-product production that is dependent on vinyl as a raw material. Approximately 60 percent of the industry's employment is concentrated in the Great Lakes region, with other significant concentrations in the Northeast and Gulf Coast.

1992 U.S. PVC Production By Market
(in millions of pounds)

Pipe	3,305	Windows	279
Electrical	1,015	Furniture/furnishings	231
Siding	1,007	Transportation	154
Packaging	651	Electronic/appliances	140
Consumer goods	384	Other	250
Flooring	368	Resellers	359
Other construction	307	Export	1,323
Medical	283		
		TOTAL	10,056

(Source: Modern Plastics, January 1993)

The Discovery of PVC and the Industry's Development

PVC was first discovered in the 1920s, but remained a laboratory curiosity until the 1930s, when the first commercial application, a rubber replacement for shock absorber seals, was developed. Uses for the earliest forms of the product — flexible vinyl and vinyl plastisol (a solution of vinyl resin in plasticizer for coatings and molded goods) — grew quickly. When World War II brought shortages in natural rubber, the vinyl industry responded by supplying critical rubber-replacement products for the armed forces. One of the most important uses was as a replacement for rubber wire insulation on board naval vessels, where PVC's inherent flame retardant properties helped reduce the spread of shipboard electrical fires.

Markets for vinyl expanded rapidly during the 1950s, when irrigation piping made from rigid, or stiffened, PVC was introduced. Since that time, the industry has grown and diversified steadily. Today, over 30 billion pounds are produced worldwide.

How PVC Is Made

PVC is made by combining ethylene (derived from petroleum, natural gas or coal) and chlorine (derived from common salt). The resulting product, ethylene dichloride (EDC) is transformed into a gas called vinyl chloride monomer (VCM). A final step, called "polymerization," converts the monomer into vinyl polymer, a fine-grained, white powder or resin known as PVC, or simply, "vinyl."

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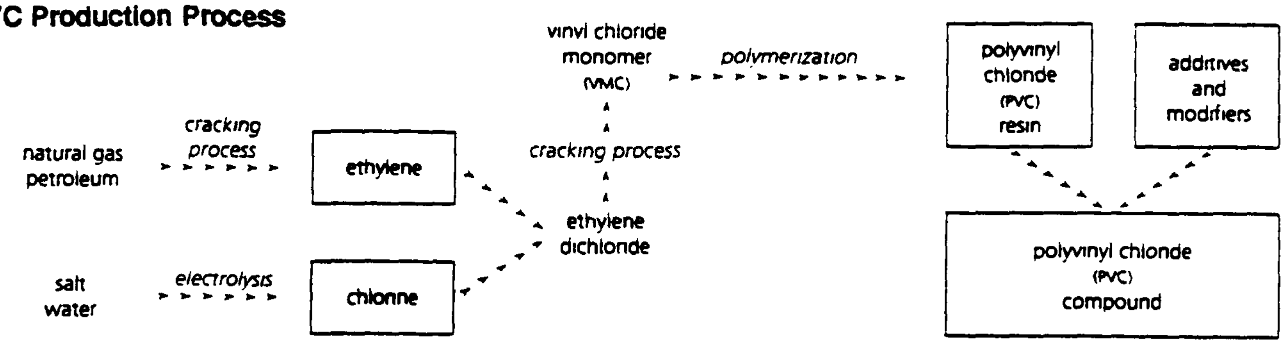
In order to use vinyl in finished products, it must be combined with special chemical additives and modifiers to achieve the various properties these applications require. These additives make vinyl suitable for an almost limitless range of products, making it rigid or flexible, weather and heat resistant, impact resistant, and virtually any color of the rainbow. PVC is the only plastic that can be modified in so many ways to suit so many applications.

The PVC Production Process



Making Products From PVC

Because vinyl is used in so many types of products, it is processed in a number of ways, including:

- *Extrusion*, to produce high-volume items like house siding, pipe, and wire and cable coverings.
- *Injection molding*, to make highly complex, three-dimensional parts such as valves and television backs.
- *Calendering*, to produce film and sheet products ranging from upholstery fabric and food wrap to rigid sheet.
- *Thermoforming*, which uses heat to shape rigid sheet into such items as "blister" packaging or bathtub enclosures.
- *Blow molding*, to make hollow objects such as bottles and jars.
- *Dispersion molding and coating*, which uses vinyl resin dispersed in a solution to make molded items such as toys, as a coating for carpet backing and floor tiles, or as a protective coating on items like dishwasher racks, wire fencing and tool handles.

Major Uses for PVC

- Construction — house siding; water distribution piping (including irrigation pipe); wire and cable insulation; electrical conduit; floor and wall coverings; window frames; gutters and downspouts; single-ply roofing; landfill liners; piping used in food processing, chemical processing and other manufacturing; fire-sprinkler piping; fencing.

- Electronics/appliances — keyboards; component housings; jacketing for electrical cords; fiber optics; floppy disk jackets; various parts and components in phone systems, power tools, refrigerators, washers, air conditioners, computers.

- Automotive — body side moldings, windshield system components, interior upholstery, under-the-hood wiring, under-the-car abrasion coatings, floor mats; other structural components such as dashboards and arm rests.

- Consumer goods — toys, sporting goods, footwear, credit cards, swimming pool liners, patio furniture, garden hoses, upholstery fabric, shower curtains.

- Packaging — rigid bottles, flexible meat wrap, shrink wrap, blister packaging, tamper-evident shrink bands, bottle cap liners.

- Medical products — surgical gloves, blood bags, IV bags, tubing, heart catheters, single-dose medication packaging.

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- ★ Operating conditions, not PVC, govern dioxin formation in incinerations.
- ★ Scrubbing removes virtually all HCl from PVC wastes.
- ★ Medical products made from PVC can be safely incinerated.
- ★ PVC is not an acid rain contributor.

Environmental Profile: Facts About the Safety of Incinerating PVC Wastes

In 1987, the New York Energy Research and Development Authority conducted extensive studies on the issue of PVC incineration and dioxin formation. Those tests revealed that the presence or absence of PVC had no effect on the amount of dioxin produced during the incineration process. Rather, NYSERDA found that incinerator operating conditions (primarily, temperature) were the key to controlling dioxin formation. At temperatures in the range of 1500 to 1800°F -- typical of modern municipal waste incinerators -- generation of dioxins is minimal. The U.S. Department of Energy was a cosponsor of this research, as were seven state agencies.[1]

Scrubbing Removes Hazard

Research has also found that incinerator scrubbing systems can remove about 99 percent of the hydrogen chloride (HCl) generated by incinerating vinyl plastics and other chlorine-containing compounds and materials.[2] Preliminary research also indicates that the value of the energy recovered by incinerating PVC in a waste-to-energy facility may offset any additional costs incurred to scrub the HCl.

New requirements from the U.S. Environmental Protection Agency will make scrubbers mandatory on all incinerators so that they can neutralize a range of acid gases, including sulfur dioxide and nitrogen oxide, which are produced by a variety of materials. Since about 50 percent of the HCl generated in incinerators comes from sources such as table salt and paper products, scrubbers will be necessary whether or not PVC is present in the waste feed.[3] One of the leading manufacturers of incinerator systems, Ogden Martin Systems, has advised the Environmental Protection Agency that its equipment "can tolerate reasonable increases in acid-producing waste components without adverse effect," and does not "perceive the anticipated increases in PVC food packaging to be problematic."[4]

Hospital Incineration in Flux

Hospital incinerators will also come under the new EPA requirements, and it is likely that hospitals will move toward cooperative systems for handling biomedical waste on a regional basis rather than individually making the investments necessary to upgrade existing facilities. Given the new standards for scrubbing acid gases, incineration of PVC blood bags, tubing and other medical materiel should not be problematic. This is especially true if some of these items can be successfully recycled. A group of the country's leading hospitals has already launched a pilot program to recycle PVC bags used for IV saline solution.[5]

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PVC a Minuscule Acid Rain Contributor

Although incinerators are often targeted as a primary cause of acid rain, power plants burning fossil fuels, which produce sulfur dioxide and nitrogen oxide, are considered to be the leading cause, along with automotive exhaust.[6] In Europe and Japan, studies show that only about 0.3 percent of all atmospheric acidity can be traced to incineration of PVC, which in turn represents only 0.02 percent of all acid rain.[7] Other studies in Europe have demonstrated that HCl produced in incinerators can be treated with sodium hydroxide and converted into industrially usable salt.[8]

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[1] "Results of the Combustion and Emissions Research Project at the Vicon Incinerator Facility in Pittsfield, Massachusetts," prepared by Midwest Research Institute for the New York State Energy Research and Development Authority, Final Report, June 1987.

[2] "Air Emission Tests at Commerce Refuse-to-Energy Facility," May 26 - June 5, 1987, Vol. I test results ESA 20522-449, Energy Systems Associates, Pittsburgh, PA, July 1987.

[3] "The Chlorine Content of Municipal Solid Waste from Baltimore County, Maryland and Brooklyn, New York," K.L. Churney, A.E. Ledford, S.S. Bruce and E.S. Domalski, National Bureau of Standards, Gaithersburg, Maryland, (NBSIR 85-3213), April 1985.

[4] "Incineration Advances Seen Reducing Impact of PVC Food Use Increases," Food Chemical News, September 18, 1989.

[5] "Medical Devices Become New Products," Plastics News, September 7, 1992.

[6] "PVC is a Good Bet to Survive Its Global Environmental Travails," Modern Plastics, June 1990. Also, "Plastics in Municipal Solid Waste Incineration: A Literature Study," R.S. Magee, Hazardous Substance Management Research Center, New Jersey Institute of Technology, and

[7] "Does PVC Waste Incineration Contribute to Acid Rain?" P. Lightowlers and J.N. Cape, Chemistry and Industry, June 1987.

[8] "PVC: Friend or Foe?" Techpak, March 26, 1990.

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- ★ Data indicate VCM risks to workers have been virtually eliminated.
- ★ Data have revealed no community health risks from VCM.
- ★ PVC production process "a classic case of waste minimization."

Environmental Profile: Facts About the Safe Manufacture of PVC

The manufacture of PVC, like most other chemical processes, is closely regulated to minimize its impact on human health and the environment. All air and water emissions resulting from the process are regulated by the U.S. EPA and all companies that manufacture PVC or its feedstock, vinyl chloride monomer (VCM), must report their compliance with these standards. The U.S. EPA has estimated that the industry's VCM emissions have been reduced by over 99 percent since new workplace standards were introduced in the 1970s.

Revised Procedures Safeguard Environment, Workers

Like almost all manufacturing processes, the production of PVC (polyvinyl chloride) involves the use of materials that can be hazardous if improperly handled. In day-to-day operations, however, the PVC industry has amassed an outstanding record of safe operation. Today, the entire PVC production process is essentially a closed one, with most activities taking place within closed vessels. Not only does this maximize production efficiencies, it also reduces environmental emissions and minimizes potential worker exposure to VCM.

In the 1970s, a link was made between extremely high, prolonged exposure levels to VCM among PVC production workers and a rare form of liver cancer, angiosarcoma. Angiosarcoma has also been linked to thorium dioxide given medically, arsenic given medically and perhaps, to the use of anabolic steroids. Approximately 100 VCM-related angiosarcoma cases have been recorded worldwide since the link with exposure to VCM was made — all in VCM/PVC plant workers. This includes 37 cases in the U.S. However, over half of the U.S. cases were identified between 1973 and 1980.[1] The number has dropped significantly since then, and is expected to continue to drop due to extensive revisions that were made in the PVC production process after the problem was identified. Not one case of angiosarcoma has been identified in any vinyl production worker whose work history began after the introduction of revised processing technology in the late 1970s.[2]

In 1977, a study of more than 15,000 workers in PVC fabrication plants (plants that convert PVC resin or compound into finished products) found no evidence of VCM-related health effects in that group.[3]

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Monitoring W rkplace Exp sure

Today, all PVC production facilities in the U.S. continually monitor workers to track any health problems that might be associated with the production process. No hazard, other than those typically associated with an industrial process, has been identified.

The U.S. Occupational Safety and Health Administration oversees all workplace standards related to PVC production. Since 1975, OSHA has set an eight-hour time weighted average VCM occupational exposure limit of 1 ppm (part per million). OSHA standards for working with VCM also:

- restrict entry to any work area where exposures are above 0.5 ppm.
- require medical exams and maintenance of exposure records for specified employees.
- identify and require the use of acceptable respirators in restricted areas.
- require monitoring and alarm systems for the workplace, and routine measurement of worker exposure.
- mandate labels and signage in specified areas and on all containers used to ship and store VCM and materials with any significant VCM concentration.
- require safety training programs for employees.

Reducing Environmental Emissions

The U.S. Environmental Protection Agency regulates the release of many chemicals, including VCM, under several statutes: the Clean Air Act, the Clean Water Act, the Safe Drinking Water Act, and the Resource Conservation and Recovery Act. The 1976 EPA standard for VCM ensures that the annual average ambient air concentration within five miles of a ethylene dichloride (EDC), VCM or PVC manufacturing plant does not exceed 1 ppb (part per **billion**) and also:

- requires "fugitive" emission controls on pumps, compressors and other equipment.
- sets work practices for opening specific equipment.
- limits the amount of "residual" VCM in resin and wastewater.
- reduces emissions from specific points in the production process to 10 ppm.
- prohibits discharges from "relief" valves, except for emergencies, and requires reports on all such emergency releases.
- mandates extensive monitoring, reporting and recordkeeping.

The EPA has set a goal of zero for VCM in drinking water, and has established a maximum contaminant level of 2 ppb. (Two parts per billion are equivalent to one inch in 8,000 miles.)

Assessing Community Risk

Since the 1970s, individual manufacturing plants have conducted monitoring of surrounding communities to identify potential health threats to nearby residents resulting from the PVC production process. Several independent studies have also been undertaken to detect an association between angiosarcoma in the general population and exposure to VCM, as well as correlations between exposure and other types of cancer. These include studies conducted by the U.S. Center for Disease Control, and specific reviews conducted in the state of New York, Wisconsin, Great Britain, Sweden, Holland and Canada.[4] In no case could a correlation be found. Representatives of the U.S. EPA have further stated that the agency has been unable to establish a link between living near a VCM/PVC plant and angiosarcoma.

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Based on chance alone, *or due to factors other than VCM exposure,* research has shown that there is likely to be one case of angiosarcoma about every two years among the five million individuals who live within five miles of a VCM/PVC production facility.[5] However, there is no confirmed case on record in which a member of the general population has been harmed by exposure to VCM, and the actual risk among the five million individuals presumed to live within five miles of a VCM or PVC production facility has been calculated to be less than 0.1 case of cancer in the next 70 years. This compares with the risk of smoking 1.4 cigarettes; drinking one-half liter of wine; traveling 10 miles by bicycle, 300 miles by car or 1,000 miles by jet; or having one chest X-ray.[6] No other community health problem has been linked with any validity to the presence of PVC or VCM production facilities.

Production Process A Model of Resource Conservation

In 1992, an independent consulting firm, Chem Systems, of Tarrytown, New York, conducted a lifecycle assessment of several vinyl products. Among other results, Chem Systems characterized the manufacture of VCM as a "classic case of waste minimization," since virtually all material used to make VCM is recycled back into the process.[7] Solid wastes created by the PVC production process, as well as air and water emissions, are regulated by the U.S. EPA. Industry-wide, those totals are decreasing as individual plants improve their environmental controls, recycle more material back into their own production processes, and reduce accidental discharges to air and water. Additional material is recycled via resale to other industries, which use the by-products as raw materials for their own production processes.

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[1]"World Register of Cases of Angiosarcoma of the Liver (ASL) Due to VCM," Review date: February 1991. Collected by J.R. Drumwright, Vista Chemical Company.

[2]Industry records.

[3]Chiazze et al 1977, 1900.

[4] H. Popper et al, American Journal of Pathology, 92, 349; 1978.
H. Falk et al, Environmental Health Prospect, 41, 107; 1981.
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H. Iturra, Proceeds of the Air Environment Specialty Conference, Pittsburgh, 1976, page 96.

[5] J. Brady et al, Journal of the National Cancer Institute, 59, 1383; 1977. Also C.W. Heath and P.S. Landrigan, Hemangiosarcoma of the Liver, Connecticut Public Health Service, Center for Disease Control, Report EPI 74-104-2; 10/9/74.

[6]R. Wilson, "Analyzing the Risks of Life," Technology Review, 81(4), 1979.

[7]"Vinyl Products Lifecycle Assessment," Chem Systems, Inc., Tarrytown, New York, March 1992.

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- ★ PVC can, and is, being recycled.
- ★ Auto-sort technology developments by the vinyl industry will move plastics recycling to the next generation.
- ★ Uses for recycled vinyl already exist.
- ★ Demand for recycled vinyl far outstrips supply.

Environmental Profile: Facts About Recycling PVC

PVC wastes can be handled by all conventional disposal processes: recycling, incineration and landfilling. No "special handling" or special requirements are required to include it in the typical solid waste management program.

In 1991, the R.W. Beck consulting firm found that nearly 1,200 communities in the United States had access to vinyl recycling through curbside or drop-off center collection programs for mixed plastics.[1] As the economics of recycling mixed plastics improve, this figure is expected to grow. In 1991, there were nearly 60 recyclers nationwide processing post-industrial and post-consumer PVC.[2]

Once collected, vinyl can be processed with other plastics to create "commingled" products such as plastic lumber, or can be separated out for use in a number of "second generation" products ranging from packaging to pipe. A recent directory published by the Vinyl Institute lists over 40 companies that make second-generation products from recycled vinyl. They include bottles and other packaging, floor tiles, notebook covers, traffic cones, construction products and other items.[3] A number of companies produce recycled-content vinyl compound that can be used in second-generation products. Several more produce recycled-content vinyl sheet and film compounds for this purpose. A study conducted by the University of Toledo in 1989 identified nearly 100 potential applications for recycled vinyl.[4]

Vinyl containers or rigid blister packaging can be sorted by hand using The Society of the Plastics Industry voluntary coding mark, which is now law in 37 states. This marking system is now primarily used by consumers to sort their plastics for curbside collection. A vinyl container can also be identified by the "smile" or "slash" mark found on its bottom side.

Support for Sorting Technology

The vinyl industry was one of the first to recognize that hand-sorting is not economically feasible for large-scale recycling operations and has been at the forefront in helping to develop the technology that allows different plastics to be separated from each other automatically. These include systems developed by National Recovery Technologies (Nashville), ASOMA Instruments (Austin, Texas) and Magnetic Separation Systems (Nashville). All of these systems are in commercial use in cities and regional municipal recovery facilities throughout the U.S. Additional installations are in place in Europe. In 1991, the vinyl separation system developed by National Recovery Technologies (NRT) received the U.S. Environmental Protection Agency's award for outstanding achievement by a small business enterprise.

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The vinyl industry has sponsored a number of pilot programs to test the practicality of these systems. These programs include:

The Center for Plastics Recycling Research, Rutgers University — Testing conducted by Rutgers resulted in commercial technology that is being used today by a number of companies processing plastic waste for recycling. It has proven especially economic for smaller volume processors.

City of Nashville Drop-Off Pilot — In 1991, the Vinyl Institute teamed up with National Recovery Technologies, materials handler Steiner-Liff Iron and Metal Co. and the city of Nashville to test the feasibility of collecting mixed plastics via drop-off sites and separating them for recycling. The program, "It's As Easy As 1-2-3," recovered more than 11,000 pounds of mixed post-consumer plastic over a six-month period and demonstrated that the plastics — specifically, the PET and vinyl streams — could be separated to 99+ percent purity.

Clearvue Resource Management, Ltd. — In May 1992, the Vinyl Institute arranged for the NRT "VinylCycle" system to be located in Amsterdam, New York, at the plastics recovery facility operated by Clearvue Resource Management. Clearvue is separating vinyl containers collected throughout the country, grinding them, washing the resulting flake and returning it to designated vinyl resin suppliers for reprocessing into recycled content vinyl compound, which is used by various makers of second-generation products.

Waste Alternatives — In August 1992, the Vinyl Institute announced a pilot program with Waste Alternatives, Inc. of Ocala, Florida, designed to process post-consumer vinyl plastics collected throughout the state. Earlier, the Institute had sponsored a formal request for a proposal to site such a pilot program in Florida, which is considered to have some of the nation's most pressing landfill concerns due to a growing population and fragile groundwater conditions. Waste Alternatives is using vinyl separation equipment developed by Magnetic Separation Systems, and hopes to expand to a regional basis in the future. Regional collection of post-consumer mixed plastics is considered by many to be critical to making processing economically feasible. Waste Alternatives was selected for the pilot in part because of its proximity to a large population, and good highway and rail transportation.

North American Recycling Corp. — The Vinyl Institute is a partner in this program, sponsored by the American Plastics Council (formerly, the Partnership for Plastics Progress). The program, located at North American's facility in Fort Edward, New York, sorts vinyl plastics along with PET, HDPE, and polypropylene by resin and color. North American Recycling is using separation technology developed by Automation Industrial Control of Baltimore.

Envirothene — The Vinyl Institute has just completed an agreement with recycler Envirothene to provide the company with vinyl separation equipment from National Recovery Technologies for demonstration and testing purposes. The equipment will be located at Envirothene's Chino, California, facility. This will be the first program of its type on the West Coast, and will serve the heavily populated Los Angeles area.

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Because of its chlorine content, PVC lends itself especially well to automated sorting systems, which typically use patented scanning technology to distinguish one plastic material from another. Many of these systems are being used by PET (polyethylene terephthalate) recyclers to help purify their product for reuse.

Potential Demand

While there has been a struggle to develop uses for some recycled plastics, a host of applications already exist for recycled vinyl — many in applications that are somewhat "forgiving" of the performance properties typically found in recycled material. The University of Toledo estimates potential demand for recycled vinyl at about 500 million pounds per year.[5]

This is almost twice the amount of vinyl used annually in consumer bottles, thus indicating that demand for recycled product will most certainly exceed the supply generated from post-consumer recycling. Other potential sources for recycled vinyl include construction scrap from installation, demolition and remodeling, as well as various components found in durable applications such as automobiles, computer housings and appliance parts. Some medical applications for PVC may also lend themselves to recycling. A group of the country's leading hospitals has already launched a pilot program to recycle PVC bags used for IV saline solution.[6]

R.W. Beck estimates that about five million pounds of post-consumer vinyl are currently being recycled in the United States. This rate is comparable to that for most other plastics, with the exception of PET soda bottles and HDPE milk jugs, which are the items most commonly included in curbside recycling programs. Recycling rates for PVC and "custom" PET are equivalent.[7] "Custom" PET and PVC are both used to package non-carbonated mineral water, assorted food products and household cleaners, as well rigid film for "blister" packaging.

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[1]"1991 National Post-Consumer Plastics Collection Survey," R.W. Beck & Associates, November 1991.

[2]"Directory of Companies Involved in the Recycling of Vinyl (PVC) Plastics," The Vinyl Institute, second edition, July 1991.

[3]"Directory of Companies Manufacturing Products from Recycled Vinyl," The Vinyl Institute, January 1993.

[4]"End Use Markets for Recycled Polyvinyl Chloride," Robert A. Bennett, Ph.D., The University of Toledo College of Engineering, July 1990.

[5]University of Toledo.

[6]"Medical Devices Become New Products," Plastics News, September 7, 1992.

[7]"CSWS Study Shows Plastics Recycling Up," Recycling Times, December 3, 1991.

The Vinyl Institute

A Division of The Society of The Plastics Industry, Inc.

- Billions of pounds of VCM are shipped annually without incident.
- Only four significant VCM-related accidents in the last 10 years.
- Industry helps police the transport of VCM.
- PVC is not a transportation hazard.

Environmental Profile: Facts About the PVC Industry's Record of Transportation Safety

About 12 billion pounds of VCM (vinyl chloride monomer) are produced annually in the United States, with most of that total converted into PVC resin.[1]

In most cases, VCM is produced at one location, then shipped via rail, barge, or pipeline to another site where it is converted. However, more and more PVC production facilities are being located near VCM manufacturing sites so that minimal VCM transportation is required. In these cases, the VCM is transferred by pipeline, thereby virtually eliminating any possible transportation hazard. About half of all VCM is now transported by pipeline.

Transport Closely Regulated

In its natural state, VCM is a gas. To transport it, it is converted to a liquid — more precisely, a liquefied gas under pressure. Like other gaseous liquids, it is considered volatile and should be handled with caution. This is the same precaution that is applied to handling propane, gasoline or any other volatile material. Industry currently meets or exceeds U.S. Department of Transportation requirements for VCM railcar specifications.

About five billion pounds of VCM are shipped via railcar throughout the U.S. annually. Yet since 1982, there have been only four significant accidents involving VCM. And, while 18 railcars were damaged in these incidents, only one of the cars leaked VCM into the environment.[2] This safety record compares with a total of 3,045 freight rail accidents reported nationwide in 1990 alone.[3] Many manufacturers have replaced their VCM tank cars with "full headshield" designs, which has played a significant role in reducing the likelihood of a spill or leak in the event of impact or accident.

Industry Programs Boost Record

While the fact that so many pounds of VCM are transported each year without incident is largely due to improved railcar design, the PVC industry and the chemical industry have also established a number of voluntary programs to help improve transportation practices, provide mutual aid for incidents, enhance safety awareness among local safety forces, and share information about shipping VCM. These programs include the VCNet and ChemTrec programs operated by the Chemical Manufacturers Association, and the Compressed Gas Mutual Aid program. Safety officials throughout the country routinely rely on these programs for guidance in handling emergency response situations and for other information related to the safe transport of VCM.

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PVC Not a Hazard

Millions of pounds of PVC resin are shipped throughout the U.S. each year by rail and truck without incident. PVC resin is classified by DOT regulations as a nonhazardous material and therefore, only normal precautions are required to ship it. On occasion, PVC resin is spilled in transit, but it presents no threat to human health or the environment when this happens. Cleanup typically is limited to sweeping up the spilled material and disposing of it following standard disposal practices for nonhazardous waste, or returning it to the manufacturer for reprocessing into second generation material.

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[1]Chemical Market Associates, Inc. 1992 statistics.
[2]Chemical Market Associates.
[3]Accident/Incident Bulletin, Federal Rail Administration, July 1992