



CHEM SYSTEMS

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Dear Roy:

Enclosed is a copy of the analysis of global PVC environmental/health/safety challenges that I discussed with you. Thanks for your help in preparing this. If you have any comments, I would of course appreciate hearing them.

Regards,

Ronald F. Cascone
Senior Consultant

RFC:glr
Enclosure

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IV. ENVIRONMENTAL ASSESSMENT

- A. Summary**
- B. Issues and Background**
- C. The United States**
- D. Western Europe**
- E. Japan**

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IV.A. SUMMARY

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Summary

- Resin sales for packaging is at risk from environmental, health, and safety challenges
- PVC will be more vulnerable than polyolefins to deselection caused by plastics recycling issues especially in automotive industries
- Architectural, plumbing, electrical, and other durable applications are not expected to be reduced
- Levels of threats are somewhat different among the United States, Western Europe and Japan; the issues are essentially related to political and social differences
- Each individual issue appears to be largely under control through strenuous industry efforts in both the United States, Western Europe and Japan
- Most responses to threats are cooperative, not competitive, through industry associations

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IV.B. ISSUES AND BACKGROUND

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Generic issues raised about PVC

- Manufacture
- Use
- Waste
- Recycling

Issues involve health and safety as well as environmental concerns

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Manufacturing issues

Raw material depletion

- Petroleum
 - Natural gas
- Fossil energy use, resulting in CO₂ and other pollutant release
 - Emissions
 - Petroleum production, refining, transportation
 - Petrochemicals - ethylene, VCM, plasticizers
 - Chlor-alkali - mercury, chlorinated by-products
 - Affect of toxics in communities, global warming, ozone depletion

Worker safety - exposure to petrochemicals, VCM

These issues are not unique to PVC; judgements are largely false, but difficult to change

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In-use issues

- Additives
 - Plasticizers - migration into foods and other products
 - Stabilizers - contamination from cadmium, lead, and other heavy metals
 - Dyes and pigments - contamination from heavy metals, and other toxic materials
- Residual VCM in products - migration to food, water, etc.
- Performance in fire
 - Flame retardance
 - Smoke toxicity (HCl, dioxins)

Most of these issues have motivated technical developments and standards

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Waste issues: concerns/misconceptions

- Quantities
 - Plastics, especially PVC packaging, perceived to take up large volumes in collection and landfills
 - PVC seen as non-recyclable
- Landfill disposition
 - Non-degradability
 - Leaching of additives (heavy metals, etc.)
- Incineration
 - HCl contribution to acid rain
 - Dioxin - issue over uniqueness of generation versus other chlorine sources in waste incineration, fossil fuel combustion
 - HCl attack of incinerator elements

Most of these concerns are invalid or arguable, but sensitive to the public

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Recycling issues

- Feasibility of collection, separation
- Uses of recycled PVC
 - Additives required
 - Degradation during processing is greater than with polyolefins, etc.
- Incompatibility of PVC in mixed resin uses

Much progress made in recycling, but possible self-imposed industry or legislated goals may exclude PVC from some packaging applications

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Background on heavy metals issues

Heavy metals have been a concern for decades

Not acutely toxic, but bioaccumulative

- Linked to liver, kidney damage; some cancers

Cadmium is much more toxic than lead

- Barium is similar to lead, but less common; tin even less

Concern relatively light in Western Europe because

- Not acutely toxic; less newsworthy than deadlier toxins
- Emissions are complex and obscure, not easily understood by laymen
- Other concerns are more related to common activities such as eating and solid waste generation, thus of greater public interest

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Background on heavy metals issues (continued)

Types of exposure:

- Inhalation during processing - solved by precompounding and low-dust material
- Leaching from incinerator flash - avoided by special landfills and pre-extraction
- Incinerator flue gas emissions - controlled with precipitator and scrubbers
- Leaching into groundwater from landfills - solved by collecting and treatment of leachate
- Leaching lead from PVC pipe to water - limits met by manufacturers - less than from soldered copper pipe (lead stabilizers are not used in the U.S. for pipe applications, but are used in Western Europe and Japan)

Applications of heavy metals will nonetheless be banned - technical solutions are required

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Background on plasticizers issues

- Plasticizers are used in all flexible PVC
- Dioctyl phthalate (DOP) - 50 percent of all in Western Europe, dioctyl adipate (DOA) - 40 percent
 - Regulations focus on these two
- Based on National Cancer Research Institute (USA) findings in 1980, the International Agency for Research into Cancer (IARC) classified DOP "probable human carcinogen"; DOA was only "suspect"

They are not considered acute toxins in any case

These plasticizers have been studied further by the European Pharmacopoeia, Germany, UK, Switzerland, and the United States - today DOP is absolved as a carcinogen

- Much misinformation has recently surfaced in the UK over hazards of plasticizers used in cling film
 - Concerns are for:
 - Ingestion of migrated plasticizer from packaging of fatty foods
 - Evaporation of plasticizer from floor tiles, wall coverings, and auto interiors
 - Migration of plasticizer to blood or medicines from medical devices

Political bans on plasticizers unlikely, but exposure minimization initiatives are likely

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Background on issues over VCM ingestion

- VCM has been a concern for 20 years
- Recognized carcinogen with no toxicological threshold
- Typical ambient exposures not acutely toxic
- Much media attention has been given to worker exposure

Ingestion concerns are:

- a. Ingestion of residual VCM which has migrated to food from packaging
- b. Ingestion of residual VCM which has migrated into drinking water from PVC pipe
- c. Groundwater contamination by leaching from discards in municipal landfills

a and b are regulated in United States and Europe; limits are 10 times lower in United States; it is not expected that the European Community will reconcile with United States because different detection methods are used

- Groundwater contamination issue has been raised in United States, but not in Europe and Japan; no regulations yet

***Groundwater contamination concern will spread to Europe,
but no regulations are expected in either region***

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Background on hazardous combustion emissions issues

Accidental fires or waste incinerations can generate hydrochloric acid (HCl) and "dioxins" (sometimes characterized as 2,3,7,8-trichlorobenzodioxin - TCDD)

- Incineration

- HCl and dioxins

"Dioxins" are actually a group comprising about 200 compounds in categories of:

- Polychlorodibenzo-para-dioxins
- Polychlorinated dibenzofurans

HCl can potentially contribute to "acid rain" - most acute in Northeastern United States, Scandinavia, and Germany; sulfur dioxide and nitrogen oxides are regulated

European Community regulations now cover HCl from waste incinerations; PVC accounts for less than half of the emission; no direct regulation expected

- Dioxin release incidents in Seveso, Italy and "Agent Orange" controversy in the United States have captured press attention - very sensitive issue

WHO considers TCDD occupational-exposure hazardous; risks in ambient exposures are being widely debated

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Background on hazardous combustion emissions issues (continued)

- There are two types of dioxin exposure concerns:

- Inhalation of airborne dioxins
- Ingestion in food (fish and milk)

Dioxins in incinerator flue gas and ash could be from:

- Combustion of PVC, other chlorinated hydrocarbons and inorganic chlorides (such as salt with food)
- Dioxins are present in waste feeds that pass through incineration
- Production from precursors such as PCBs, pentachlorophenols, and chlorinated aromatics

- Two solutions have been proposed:

- Reduce chlorine in feed, including from PVC
- Run incinerators so that dioxins are not formed or are destroyed

Dioxins will be controlled in Europe by a combination of better incineration designs and some attempts to reduce chlorine in feed by reducing disposable PVC products

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Background on hazardous combustion emissions issues (continued)

Smoke Toxicity

Environmental and safety have been concerns since the 1970s with U.S. building codes adopting combustion-toxicity provisions

- The principle is that PVC should be no more toxic when burned than wood
- Two methods have been used to determine this:
 - University of Pittsburgh Test - shows PVC more toxic
 - U.S. Bureau of Standards Test - shows PVC less toxic(also differ on ranking fabrics, paints, and other plastics)

Most authorities see statistical error at fault and accept PVC as a standard material (exceptions - NYC subway system due to lobbying by metal conduit interests)

- Some German municipalities also banned PVC wire and cable (and some floor tiles) during the late 1980s, but some have rescinded

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Background on issues over limited waste disposal capacity

Complex local issues of national proportions involving land use, litter, sustainable development, and trade-offs of landfill with incineration and source reduction efforts

- Affects PVC on:
 - Content laws - requiring new products to contain certain levels of recycled materials
 - Mandatory use of biodegradable materials or components
 - Ability to separate PVC wastes from other plastics
 - Ability to reuse PVC recycled resin

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IV.C. THE UNITED STATES

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The United States - overview

- Political structure and environmental initiatives are key
- Some differences exist state to state
- Lobbying by competing trade associations and labor unions have created strong challenges
 - Plumbers, electrical, other construction
 - American Institute of Architects
 - Aluminum, steel, glass and paper interests
 - PET (and some polyolefins) marketers
- There have been few specific bans, but much delay and conflict
- Most responses have been cooperative and non-competitive through:
 - Vinyl Institute (sponsoring Vinyl Package Lifecycle Assessment by Chem Systems)
 - Society of Plastics Industry
 - Chlorine Institute
- Some individual companies are leaders in technical support and education
 - OxyChem, BFGoodrich, Georgia Gulf, Vista, Klockner-Pentaplast, etc.

***Packaging and VCM/PVC manufacturing are most challenged today,
but durable may be more at risk in future***

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The United States - Primary industry responses to issues

Education

Technical research and lobbying

- Health and safety effects of vinyl chloride monomer
- FDA activity related to use of PVC packaging and other regulated materials:
 - Liquor and other bottles
 - Meat wrap and other food-related films
 - Water pipe
 - Film coatings, gaskets, medical applications, etc.

- Fire performance and combustion toxicity of PVC
- Alleged problems caused by heavy metal permeation and leaching through and from PVC pipe

PVC solid waste management

- Recycling
- Alleged problems of landfill leachate contamination

***Lead has been taken by the Vinyl Institute with strong support
by BFGoodrich and OxyChem; others are cooperative***

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The United States - environmental, health, and safety effects of VCM: responses and results

- Plant and equipment modifications installed
 - VCM monitoring and alarms
 - Stripping columns
 - Incinerators for vents and other normal discharges
- EPA estimated \$766 million (1977 dollars) spent between 1977-1986 on such modifications

EPA later estimated total air pollution control for VCM/PVC plants was \$1.2 billion between 1981-1990

- Costs increased an average of 1.35 cents per pound (1972 to 1987) solely for environmental compliance

This led to increase in the average reactor size, and a drop in the number of producers of VCM from 23 in 1976 to 12 in 1987

- EPA's VCM Emission Standard requires reports for relief valve discharges, manual venting and reactor dumping within 10 days - this has led to 17 settlements of fines for \$4.3 million total since 1982

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The United States - FDA regulation of PVC in packaging: responses and results

- FDA has been struggling with the EPA and environmentalists since mid-1986 on creating regulations for PVC films, rigid containers, food processing plant water pipe, and other PVC components in food contact

FDA rule on PVC in food use started in 1975

In 1986 FDA proposed:

- 5 ppb RVCM limit for plasticized films and coatings
- 10 ppb RVCM limit for rigid and semirigid food containers
- 50 ppb RVCM limit for water pipes in food processing plants
- 50 ppb RVCM for vinyl/vinylidene chloride copolymer films and coatings
- Recognized prior status of PVC resins in films, coatings, water pipe, flexible tubing, gaskets, bottle and jar liners and rigid sheet

Issues have been raised by the EPA and environmentalists to delay approvals due to potential environmental impacts

- HCl from incineration of PVC
- Recycling compliance
- Potential solid waste impacts

Delay has allowed PET to penetrate nearly all liquor bottle markets to exclude PVC; otherwise, there will be little effect on markets after approval

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The United States - Fine performance and combustion toxicity: U.S. responses and results

- PVC comprises 40 percent of all plastics used in U.S. construction
- Metal pipe and other interests have lobbied against PVC since the mid-1970s

During the late 1970s, Vinyl Institute funded research at Southwest Research Institute (San Antonio)
- shows that HCl generated from fire is absorbed rapidly by other materials, and rarely exceeds 300 ppm

No major impact on market seen or expected

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The United States - concerns over permeation or leaching from PVC pipe: responses and results

- Plumbers' unions and others attack PVC pipe for possible solvent permeation from contaminated ground to water supplies, and leaching of solvents to water from pipe cements
- Unions fear loss of work with easier-to-install PVC systems and competition from do-it-yourselfers

Vinyl Institute sponsored research by Battelle Columbus Labs - shows equivalent permeation for cement and iron pipe

Vinyl Institute hired CH₂M Hill consultants for risk assessment on California - sponsored leaching tests - concluded PVC pipe is safe

- Permeation of PVC is a "very long" process - as shown by studies in Holland and University of California
- Concerns have stopped the use of PVC for water distribution in many cities (Chicago, New York City) and California
- Concerns over lead solder and worker safety inhaling soldering vapors (Federal ban in 1989) will help PVC pipe sales

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The United States - Management of PVC in solid waste responses and results

- A disproportionate effort is focused on PVC
- Legislative bans have been proposed in New York, Minnesota, and elsewhere
- The Center for Plastics Packaging Recycling at Rutgers University (New Jersey) is financially supported by Vinyl Institute for PVC recycling research
- The Vinyl Institute/NYSERDA (Albany, NY) - ran tests on dioxin generation with and without PVC present - shows PVC to be a minor or negligible factor in incinerator dioxin generation; dioxins can be controlled with incinerator scrubbing, etc.

PVC bans are not expected to have significant market impacts

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The United States - education emphasis: the "PVC Story" as told by the Vinyl Institute

Chlorine may be dangerous, but in PVC it is intrinsically bound (a safe "resting place")

- Combustion does not release free chlorine, but hydrogen chloride (stomach acid)

VCM and PVC plastics are already subject to drastic emissions and safety controls

PVC products are essentially monomer free

Cadmium, lead, and other heavy metals in stabilizers are gradually being substituted - use is restricted to durables (window frames, electrical insulation, etc.)

- Plasticizers are low volatility liquids - only minute migration occurs when in contact with oily or alcoholic products
- PVC is approved by toxicologists, and used with pharmaceuticals and medical devices

U.S. EPA is reconsidering TCDD (dioxin) risk issues, questioning the use of animal tests to gauge human health risks

- PVC recycling is feasible, economic, and desirable

A similar conclusion was drawn by a private study by Bellona, a Norwegian radical environmental group, leaked to press

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The United States - educational literature emphasis of U.S. companies

- Plastics/PVC play relatively minor role in solid waste; most landfill do not biodegrade materials
- PVC components (liners, pipe, etc.) are useful and preferred in "building" proper landfills
- Controls are needed on incinerators, in which case emissions from PVC are not a problem
- There are benefits in using plastics/PVC - otherwise solid waste volume would increase if plastics are disallowed
- Recyclability of plastics/PVC
 - Commingled resin durables and PVC durables (pipe) are proven uses
 - Much experience already exists with industrial/commercial/consumer recycling
 - PVC can now be automatically (electronically) identified during the sorting process

PVC is based primarily on salt and natural gas, not petroleum, in the United States (more petroleum for ethylene is used in Europe)

- PVC in food packaging has lowest contribution to taste and odor among all the plastics

"Vinyl-it's recyclable, clear, proven, versatile, taste free and economical"

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The United States - salient U.S. company involvements in technical responses to challenges

	Fire	Food Contact	Recycling
BFGoodrich	R&D for low-smoke additives	✓	✓
OxyChem		✓	✓
Georgia Gulf	✓	✓	
Vista	R&D for low-smoke additives		

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IV.D WESTERN EUROPE

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Western Europe - overview

Western Europe is highly individual, by country, as to views on PVC

There are many socioeconomic, political, as well as technical differences as compared to the United States

- "Green politics," rather than commercial/industrial lobbying, has more effect
- International competition versus an EC "restraint-of-trade" issue is a growing factor
- Some deselection and packaging bans are in place
- Greater garbage incineration is typical
- Ethylene is made primarily from naphtha/gas oil, not NGLs
- Alternate source of soda ash (as caustic substitute for some uses) is from the Solvay process (more polluting) not trona
- Leaded gasoline is still used in Europe

Responses to challenges has been primarily by producers

- Norsk Hydro
- Atochem
- EVC
- Hoechst
- Solvay

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Western Europe overview (continued)

- Some cooperative responses are starting
 - AGPR Group in Germany
 - European Council of Vinyl Manufacturers - patterned on U.S. - Vinyl Institute
 - Association of Plastics Manufacturers in Europe (APME) - formed Plastics Waste Management Institute for Europe (PWMI), and is sponsoring an ecobalance for Europe

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Western Europe - primary PVC environmental, health, and safety issues

Ingestion/inhalation of heavy metals

Ingestion/inhalation of plasticizers

Ingestion/inhalation of free VCM

- Emissions of hazardous products formed in combustion of PVC - HCl and dioxins
- Limited public waste disposal capacity

Unfavorable ecobalances (total energy and emissions in manufacture, use, and disposal) versus competing materials

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Western Europe - forecast of direct regulations of PVC use, 1990-2000

Restriction	Country	Implementation Period	Reason
Ban on "short-life" (disposable) applications	Denmark	1991-1993	Dioxin emissions from incinerators
Voluntary phase-out of PVC in grocery stores (80 percent)	Netherlands	1991-1993	Dioxin emissions from incinerators
Ban on PVC in beverage bottles	Switzerland	1991	Dioxin emissions from incinerators

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Western Europe - forecast of indirect regulations concerning PVC, 1990-2000

Restriction	Jurisdiction	Implementation Period	Reason
Ban cadmium in PVC	All Western Europe	1991-1993	Toxicity
Ban lead to maximum technical feasibility	All Western Europe	1995-on	Long-term toxicity
Maximum 15 percent plasticizer in fatty- food packaging	All Western Europe	1997-2000	Suspected health risks

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Western Europe - highlights of the Norwegian Bellona Study

A boycott of PVC would:

- Lower the price of chlorine, further encouraging manufacture of chlorinated solvents and propellants
- Lead to problems the disposal of excess chlorine coproduct from caustic manufacture
- Increase consumption of more environmentally harmful steel, cement, aluminum, and paper, or their composites

Increase the emissions of "greenhouse gases" and toxins to manufacture the substitutes

Lower the quality of drinking water supplies and beverages

Increase the energy required for the transportation of raw materials, finished goods, and packaging

The study concludes that PVC is a desirable choice

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Western Europe - heavy metals regulatory profile

Regulations focus on cadmium - banned in Sweden since 1987, with some exemptions; in Denmark since 1987 (except in profiles and panels)

Draft bans on all cadmium uses in EC commission, Netherlands and Austria

- Lead being investigated, a ban is likely by 1997, with exemptions for wire and cable, and window profiles

Barium being investigated in Sweden and Austria

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Western Europe - plasticizer regulatory profile

- Present legal limits:

Country	Product	Limits	Application
Belgium	DOP	Migration - 40 mg/kg	Food packaging
Germany	DOP, DOA	22% content	Meat wrap
Italy	DOP	5% content	Fatty-food packaging
Netherlands	DOP	Migration - 6 mg/kg	Food packaging
Switzerland	DOP, DOA	Ban	Toys for children under 3 years old

EC studying directive for food-contact plastics

U.S. FDA following studies by independent EC advisor - Scientific Committee for Food - report expected in two to three years

EC directive on limits, but no bans are expected

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Western Europe - free VCM (RVCM) regulatory profile

- Present legal limits on RVCM:

Polymer
<10 ppm

Belgium
Germany
UK

Packaging
<1 ppm

Belgium
Germany
EC
Austria
France
Italy
Netherlands

Migration
<0.01 ppm

Belgium
Germany
EC
France (<0.05 ppm)
Italy
Netherlands
UK
Sweden

- Migration - actually "no detection" required - limits 0.01 ppm; method in United States allows 0.001 ppm detection, which sets the limit there

No harmonization of U.S. and European standards expected in the next decade

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Western Europe - hazardous combustion regulatory profile

HCl in acid rain

- Two EC directives - limit HCl in new incinerators (of >3 tonnes/hr) to 50 mg/SCM
- Not a direct control; PVC will not be banned on this issue

Dioxin emissions regulations activities are essentially in countries that incinerate >30 percent of municipal waste:

- Denmark - 50 percent reduction of PVC in short-life uses over 1991-1993
- Germany - PVC bans proposed because of dioxin; rejected
- Netherlands - Green Party proposed ban; rejected; a major grocery chain is phasing out PVC
- Sweden - Moratorium on new incinerators; lifted; 0.1ng/SCM TCDD limits on new/old units instead; continued push to eliminate short-life PVC uses
- Switzerland - Ban on PVC bottles November 1, 1991
- Austria - ban on short-term PVC uses withdrawn to allow coordination with EC

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Western Europe - solid waste regulatory profile

- **Denmark - Voluntary Agreement (by year 2000)**
 - 85 percent reduction of PVC in incinerated packaging
 - 77 percent PVC recycled for durables (pipe, profile, flooring, etc.)
 - **Switzerland - November 1991 ban on PVC beverage containers**
 - "PVC Bottle Recycling CH" formed (Atochem, EVC, Solvay, and French Mineraliers) in response
- EC - DG X1 Packaging Waste Directive - December 4, 1991 (first draft)**
- Objectives: to stop growth in per capita packaging waste
 - Waste management targets:
 - 60 percent recycling
 - 30 percent energy conversion (incineration)
 - 10 percent landfill

***The Marks & Spenser Department Store (UK) recently selected PVC over PET
and OPS as an "environmentally friendly" packaging standard***

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IV.E JAPAN

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Japan - overview

- There has been no radical environmentalist group nor anti-PVC industry lobbying in Japan who are sufficiently strong to influence politicians to initiate regulation on the PVC based on scientifically ambiguous information
- So far PVC producers have responded to the issues effectively and succeeded in avoiding unreasonable regulations, based on cooperative work through various associations

Impact on PVC demand will come not from regulatory ban but from voluntary deselection in markets related to management of plastics solid wastes

However, since the issues are emotional and global, the impact will be inevitable if strong movement against PVC should capture the U.S. and/or Western European consumers

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Japan - primary PVC environmental, health and safety issues

The issues of environmental, health and safety for PVC began overseas and then were introduced into Japan, which include:

- Ingestion/inhalation of heavy metals
- Ingestion/inhalation of plasticizers

Ingestion/inhalation of free VCM

Emission of hazardous products formed in combustion of PVC - HCl and dioxins

Municipal and industrial plastic wastes recycling

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Japan - heavy metal issues

- Notification No. 20 by the Ministry of Public Welfare - maximum 100 ppm of lead and cadmium in PVC packaging
- Japan Hygienic PVC Association set proactive self-control (PL standard), e.g., no use of lead and cadmium for food wrapping film

One package stabilizer system in granule form is a trend to avoid lead inhalation

Lead stabilizer is used in pipe but with anti-leaching aids

No major impact on market is seen or expected

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Japan - plasticizers issues

The issue of "DOP being probable human carcinogen" promoted DNP/DINP to replace DOP but caused little negative impact on PVC usage

Currently no regulatory argument on plasticizer

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Japan - VCM exposure and residual VCM

The issues of VCM worker exposure has been solved based on introduction of closed system

- Most PVC food bottles were replaced by other plastics bottles when the residual VCM issue was raised 10-15 years ago
- Currently, the level of residual VCM which can be achieved is less than 1 ppm for pipe. No significant impact on the PVC market is expected even after new EPA standards take effect in 1993

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Japan - hazardous combustion emissions issues

- All incinerators are equipped with exhaust gas treatments and no HCl emissions from incinerators are expected
- Dioxins emissions from incinerators are being controlled according to the operating procedures directed by the Ministry of Public Welfare

Scientifically there is no need to regulate PVC due to hazardous emissions. However, since it is related to municipal solid waste management, misinformation could cause source reduction and/or deselection of PVC from packaging

The issue of HCl generated from fire will not have significant impact on PVC demand even if it is regulated, since PVC house siding is not permitted for use by the Fire Defense Board

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Japan - management of PVC in municipal solid wastes

- PVC is only 1 percent of total municipal solid wastes. However, to most housewives, the name "vinyl" means all plastics - which accounts for 10 percent of the total municipal solid waste
- Although over 70 percent of municipal solid waste is incinerated, recycling will be practiced in the future

In the case of plastics recycling to reclaimed pellets and liquid fuel, PVC must be separated from the feed due to its chlorine content

PVC ban for packaging use in various Western European countries may have some influence on Japanese consumers toward reduction of PVC packaging

- As a whole, PVC is vulnerable to being targeted as a "bad actor" in municipal solid wastes and reduction or deselection of PVC could be a voluntary activity in packaging markets, although no bans are expected

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Japan - management of pvc in industrial solid wastes

- About 40 percent of agricultural film is being recycled to floor tiles and sandals
- Automotive industry is now seriously planning recycling of plastics. In such a program, PVC will become less preferable and at risk of being replaced by polyolefins, which can be recycled more easily

Recycling issues will not have an impact on PVC demand in other industrial applications

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Japan - producers response to threats

PVC producers have been very cooperative and effective in responding to threats through the Japanese PVC Association (established in 1953), Japan Hygienic PVC Association (1967) and Plastic Waste Management Institute (1967)

Japan PVC Association is responsible for public education to respond to environmental challenge through press releases and educational literature

- Japan Hygienic PVC Association has been successfully managing health and safety challenge based on proactive self-control (PL standard)

Plastic Waste Management Institute comprising various plastics industries is responsible for plastic recycling and technology development

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