7. VC EPA

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JUN 1 1976
R. W. Laundrie

May 27, 1976

TO: EPA TECHNICAL COMMITTEE

FROM: JOHN R. LAWRENCE

On May 27, 1976, Mr. Edward Woolridge of the EPA Staff in Raleigh-Durham called to advise that they had been doing some studies on emissions from ethylene di-chloride plants. Apparently Allied Chemical had been conducting some pilot studies on emissions from the oxychlorination vent which they have advised they can not continue. To assist Mr. Woolridge, I gave him the names of other producers of ethylene di-chloride as listed in the SRI Directory of Chemical Producers (attached).

Mr. Woolridge indicated that they plan to have a seminar on June 17, 1976 to review their needs for additional studies. Some of you might be hearing from Mr. Woolridge.

Very truly yours,

John R. Lawrence

John R. Lawrence
Technical Director

JRL:bzp

Attachment

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SUBSTITUTABILITY COMMENTS

During the Environmental Protection Agency's (EPA) February 3, 1976 hearing, the EPA panel asked for industry comments regarding possible substitution of other materials for PVC end products following the suggestion made by one witness that non-essential uses of PVC should be phased out. In response, the industry would first remind EPA to consider basic marketing and economic principles. To penetrate a market a new product must be competitive in terms of utility, desirable properties and price. If any of these elements is missing, the probability of significant market penetration is diminished. Thus, where PVC usage is wide-spread, there is little likelihood that a close substitute, whether a new or old product, exists. If it did exist it would be competing with PVC.

Also worth consideration is the matter of the size of the end use market compared to total production. For example, one particular end use may be vital but if it accounts for only a small portion of production, this single use may be too small and not sufficiently profitable to justify production.

Obviously, the definition of "substitute" presents problems. Furthermore, it depends on that definition whether substitutability is even practical to consider. It is not the purpose of these comments either to offer such a definition or to debate, *per se*, the practicability of the concept of substitution.

If this discussion were broadened these difficulties would be made sufficiently clear by a single example such as PVC gaskets for food containers. PVC gaskets are now used in closures for almost everything from applesauce to soda pop as an aid to vacuum or pressure sealing. Such gaskets were once made from cork, rubber or rubber-like synthetics. They were replaced because PVC provided superior closure properties at less cost, and with greater safety and reliability. The resin for these PVC gaskets is made by the dispersion process, fabricated into a plastisol and applied to the closure by one of several methods. Despite widespread use, only about 25 million pounds of PVC dispersion resins were consumed during 1974 in the manufacture of food closure gaskets. This amounts to less than 10% of total PVC dispersion resin production and less than 1% of total PVC production for that year. Assuming that neither cork nor a rubber product would be a real substitute and that it is important to have closure gaskets, this small segment of the PVC industry probably does not utilize enough resin nor is it so profitable that it could keep more than one line at one PVC plant open all year. Substitution in such a case would very likely be uneconomical ab initio.

In industry's view, the EDF testimony at the February 3 hearing is simplistic and, at best, suggests far too broad a scope of inquiry. We believe a more realistic view must be taken. To begin with, it must be realized that, as a class of materials, plastics are extremely versatile and will continue to be recognized as such by the public. As the second most widely used plastic, PVC has been proven to be a desirable material. Among its many characteristics are: light weight, resistance to flammability, chemical and biological inertness, ability to insulate against electricity and water, an oxygen permeability that can be varied at will */, durability, ease of fabrication and low cost. These multiple qualities account for the fact that PVC is second only to polyethylene in domestic production and is first in end product variety.

*/ Depending on formulation, PVC plastics will be excellent oxygen barriers or exhibit a high degree of oxygen permeability.

What may not be so readily recognized, however, is that plastics have become a basic material. They are no longer ersatz or substitutes for "real" materials. In fact, virtually every expert on mineral resources predicts plastic materials will be increasingly important as traditional resource material supplies continue to dwindle. Today plastics are basic building block materials which provide superior properties. Materials they replaced have become very scarce or extinct and would make inferior products were they available again. Plastics can also be used in combination with other basic materials to improve the performance of the latter. Further, in many instances plastics provide the only material available to supply a specific need.

PVC is the most versatile of modern plastics. In some areas it is virtually irreplaceable; in others, it is very highly valued as a supplement or complement to other raw materials; and in still others, it has become the standard material because of the rarity, non-existence or non-acceptability of the substances previously used.

Because of the special nature of PVC it would not be possible to duplicate the exact properties of vinyl plastic products by using substitute raw materials. Even if it were possible, the cost of production and the resulting selling prices of the final products would probably be prohibitive in most cases. Furthermore, were true substitutes available, it would take three to four years to complete the necessary research and development leading to the required changes in product, process and equipment design, as well as the actual delivery and installation of new plant and equipment in order to make non-PVC "equivalent" products available on a commercial scale.

The attached end use chart shows how PVC is used in more individual end products than any other type of plastic material. It is possible to identify more than 25 general end use product areas for PVC, each of which accounted for between 1 and 29% of the total PVC resin market in 1973. **/ A review of these market categories indicates that over half of all PVC resin manufactured in 1973 was used to make products that can be classified as building and construction materials. This includes all

**/ The 1973 statistics are extracted from a study by Arthur D. Little, Inc. and have probably fluctuated somewhat in the last two years but are, nevertheless, indicative of resin usage. The study, prepared for industry in conjunction with the OSHA hearings in 1974, is entitled Polyvinyl Chloride - The U.S. Industry: An Impact Analysis.

kinds of pipe, conduit, flooring, wire and cable insulation, siding, paneling, window frames, wall covering, trim, and gasket and sealing materials. Home furnishings and household goods, taken together, represented about 12% of the overall PVC resin usage. This broad grouping of products contains furniture upholstery and decorative laminants (using printed PVC films) for wall coverings, furniture and TV cabinets, table covers and shower curtains, garden hose, appliance components and window shades.

The "consumer goods" market represented approximately 12% of PVC resin use and includes items such as phonograph records, footwear, toys, dolls and games, apparel and other outer wear, athletic goods, luggage, handbags and many other products.

Packaging materials, such as flexible and rigid film used for packaging fresh and processed meats, produce, cookies and candies together with bottle, can and closure linings, coating and gasket materials, accounted for about 8% of total PVC resin sales. Use by the transportation equipment industry, mainly in motor vehicles, represented about 6% of the PVC resin market. The major products in this category are upholstery materials, trim, headliners, wire and cable insulation, floor mats and external vinyl car tops.

The remaining 9% of the domestic PVC resin market is composed of miscellaneous products. Among the hundreds of individual applications, the most significant are medical products such as intravenous tubing, surgical implant materials, catheters, open heart surgery "bubble" oxygenators and blood bags. Stationary supplies, book covers and bindings, conveyor belting, credit cards, tools and hardware, and agricultural products including reservoir liners are among the other specialty uses of PVC.

As to direct material substitution, let us look at just a few PVC product lines. The market which is probably the most sensitive to substitution is medical devices. Although the products in this area consume only 1% of production, they are probably the least sensitive to economic considerations because the end uses tend to dictate the materials of construction. Since the physical and chemical properties desired include biocompatibility, tissue compatability, stability under sterilization conditions, flexibility, clarity, safety and the like, it is no wonder that PVC is the material of choice for many medical applications. For example, the pyrogenic hazard associated with the use of rubber for medical tubing in applications such as intravenous sets has been eliminated by the availability of PVC tubing. A wide variety of catheters is available because of the tissue compatibility, flexibility, and ability to sterilize PVC. The blood storage system we use is completely dependent on PVC blood bags which, unlike old glass bottles with rubber stoppers and hoses, can easily be heat sealed and compactly stored and used without any pyrogenic or other safety hazard. As for PVC as the material of initial choice, consider the "bubble" oxygenator developed so that open heart surgery could be performed. A clear, flexible, biologically compatible material that could be sterilized was needed so the surgeon could observe blood as it was being routed to by-pass the heart and lungs. This device is made entirely of PVC. Thus, any suggestion that these life saving devices be constructed of materials of second choice would seem wholly irresponsible.

In the larger wire and cable market for PVC, inherent flame resistance and high temperature stability has created a situation where current potential substitute materials (i.e., those previously used) are judged unsatisfactory on the basis of safety alone for most industrial, commercial and institutional applications as well as all military applications where high service temperatures and a high degree of reliability are required. On the other hand, because of lower temperatures, there is less of a safety problem with automotive wiring. In this case, commercial competition from other plastic products exists today. Nevertheless, on an across-the-board basis and assuming an adequate substitute could be developed, it would take at least four years to commercialize the alternative product. The foregoing estimate, of course, does not involve the time that might be required to change applicable local and federal regulations.

For pipe, conduit and fittings, the largest PVC market, only about 25% could be replaced by other plastics, given two or three years lead time. Although some PVC pipe uses could conceivably be replaced by metal pipe, the metal pipe industry could not supply the necessary additional operating capacity in less than two years.

Food packaging, especially meat wrap, can coatings and crown and closure liners, account for another large market that is highly dependent on PVC. New canning techniques have been developed to take advantage of PVC properties. A return to old materials would involve redesigning the process. Assuming that potential substitutes were commercially available and already acceptable from a regulatory point of view, the lead times required for material changeovers would range from one to four years.

In the automotive industry where most PVC usage is in upholstery, seat covers and trim, where substitution could be achieved the textile industry would need several years before it could supply the commercial quantities of material fibers demanded by automotive manufacturers. On the other hand, because vinyl upholstery is more durable and more easily cleaned than the textile products, the automotive industry has chosen to experiment with other synthetic products even though other plastics as yet have failed to meet the requirements for a broad scale of application.

As can be seen from the foregoing, approximate substitutes will not always do but even where an approximate substitute would satisfy the demand, one is not always available. Further, even where a substitute can be obtained, a sufficient lead time to order new equipment and to install new plant must be allowed.

To conclude, the second table attached hereto is a chart showing "potential" and "approximate" substitute raw material candidates for PVC-based products currently being manufactured. It also gives an estimate of the total time required for the product to be developed or produced in commercial quantities. As noted in the table, the estimates do not include the time that may be required to obtain local or federal regulatory clearance (e.g., with regard to building codes, FAA regulations, Food Additive Regulations, etc.) nor the time required to reproduce the beneficial characteristics of all PVC properties replaced. No allowance is made to reduce cost to the current cost of PVC nor for the time that may be required to test the substitutes relative to their unknown side effects vis-a-vis occupational safety and health, public health and safety, environmental effects, energy requirements, nor for trade balance (1973 exports of PVC were 138.6 million pounds or 3% of production), employment patterns, and the like.

TABLE 1

END USE BREAKDOWN OF PVC RESIN - 1973

End Use and Product	% of Market (Approximate)	Million Lbs
Building and Construction		
Pipe, conduit and fittings	29	1,345
Flooring	9	440
Wire and Cable Insulation[a]	8	365
Siding, panels	2	90
Wall covering	2	90
Other (window frames, trim, gasketing, sealants, miscellaneous)	2	90
Sub Totals	52	2,420
Home Furnishing and Household Goods		
Furniture (mainly upholstery)	7	320
Shower curtains, table covers, etc.	2	105
Appliance parts (including hoses, gaskets)	1	40
Garden hose	1	35
Other (e.g., window shades)	1	45
Sub Totals	12	545
Consumer Goods		
Phonograph Records	3	145
Footwear (shoes, rainwear)	3	140
Toys, dolls, and games	2	75
Outerwear (e.g., apparel)	2	70
Sporting and Athletic Goods (e.g., balls, bicycle grips, miscellaneous)	1	65
Other (including handbags, wallets, luggage)	1	55
Sub Totals	12	550
Transportation Equipment (mainly motor vehicles)		
Upholstery and Seat Covers	4	180
Wire and Cable Insulation	1	50
Auto Tops, headliners, trim, floor mats, other	1	45
Sub Totals	6	275

(a) Includes some wire and cable used in communications equipment.

TABLE 1 (cont'd)

END USE BREAKDOWN OF PVC RESIN - 1973

End Use and Product	% of Market (Approximate)	Million Lbs
Packaging		
Flexible film (for fresh meats and produce)	3	135
Rigid Sheet (for cookies and candy, unit packs, blister packs)	2	105
Coatings (e.g., can linings, cap liners, gaskets)	1	50
Bottles, other	2	85
Sub Totals	8	375
All Other Uses		
Medical Products (e.g., tubing, blood bags)	1	45
Stationery Supplies	1	35
Agricultural Products (e.g., reservoir liners, tubing)	1	30
Novelties (including advertisement items)	1	30
Conveyor Belting	1	30
Miscellaneous (tools and hardware, credit cards, book binders and covers, other)	4	265
Sub Totals	9	435
Grand Totals	99	4,600 (b)

(b) Domestic use only; excludes exports of about 145 million lbs.

Source: The Society of the Plastics Industry and Arthur D. Little, Inc., estimates.

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TABLE 2

SUBSTITUTION ASPECTS OF FABRICATED VINYL PRODUCTS

PVC Based Product	Primary Substitute Raw Material Candidates	Total Time Required for Substitution[a] (years)
Pipe	ABS, Polyethylene Metal	1-2
Conduit	ABS, Polyethylene Metal	1-2
Flooring		
Tile	Coumarone-indene resin, SBR	2-3
Yard Goods	Linseed oil (for linoleum)	3-4
Upholstery Material (Coated fabrics)	Polyurethane, CPE	
Automotive		2-3
Furniture		1-2
Wire Insulation	Polyethylene, Neoprene, HYPALON, EP Rubber	2-4
Phonograph Records	Polystyrene	3-4
Siding	Wood, metal (steel, aluminum)	1-2
Packaging Materials		
Flexible Film	Cellophane	1-2
Rigid Film	Cellulosic resin, polystyrene, nitrile resin	1-2
Bottles	Nitrile resin, glass	1-2
Cap liners	Cork, rubber	1-2
Can linings	Epoxy resin	1-2
Medical Tubing	Rubber (e.g., thermoplastic elastomer)	1-2

(a) Assumes that (1) sufficient quantities of substitute raw materials would be available when required by market demand; (2) production facilities are in place and operating at time required.

Source: Arthur D. Little, Inc., estimates.

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