

THE NEW YORK ACADEMY OF SCIENCES
WORKING GROUP
ON
TOXICITY OF VINYL CHLORIDE-POLYVINYL CHLORIDE

ROSS V. BFS

"ENVIRONMENTAL CONCERNS BEYOND THE WORKPLACE"

Glenn E. Schweitzer
Director, Office of Toxic Substances
Environmental Protection Agency
401 M Street, S. W.
Washington, D. C. 20460

Presentation to the Working Group on
Toxicity of Vinyl Chloride-Polyvinyl Chloride
The New York Academy of Sciences
New York City, New York
May 11, 1974

"ENVIRONMENTAL CONCERNS BEYOND THE WORKPLACE"

Glenn E. Schweitzer
Director, Office of Toxic Substances
Environmental Protection Agency
Washington, D. C.

During the past several months vinyl chloride has awakened all elements of the environmental community to the presence of the plastics industry. In some respects it is fortunate that we have been alerted in a rather dramatic fashion to the need for greater attention to this important segment of our industrial base which will surely continue to expand in the years ahead. While this symposium is directed to the existing and potential risks involved in the manufacture, distribution, and use of vinyl chloride monomer (VCM) and polyvinyl chloride (PVC), many of the types of considerations and uncertainties that punctuate these deliberations undoubtedly characterize a far broader swathe of concerns over chemicals in general. Hopefully, we can extrapolate from our current experiences with VCM and PVC in identifying problems with other potentially important commercial chemicals early in their embryonic stage and thus minimize the economic dislocations attendant to corrective actions.

Unfortunately, the proposed Toxic Substances Control Act has been lodged in a Joint Committee of the Congress for ten months. Thus, a very powerful tool for addressing the vinyl chloride problem, and similar problems with other chemicals, in an adequate manner is not available to the Federal Government. We must rely on other statutory authorities and on the power of persuasion in our efforts to insure that our population is not being unnecessarily exposed to concentrations of VCM and other chemicals used in connection with VCM. It is particularly distressing that until this statutory authority is on the books, the Federal Government will not be equipped -- in terms of experienced personnel and supporting resources -- to grapple with the intricacies of this type of toxic substance problem in a manner which will insure full attention to the balancing of risks and benefits.

Today I will report to you on the preliminary investigations undertaken by the Environmental Protection Agency during the past three months. We are still several weeks away from reaching even tentative conclusions as to what additional steps, if any, should be taken by the Agency concerning VCM/PVC activities. Our monitoring data are not yet

in hand. Similarly, our analytical studies are not yet completed. Nevertheless, we are pleased to share with you some of our initial thoughts. We will welcome your comments on the efforts to date and on further steps which are necessary. In this regard, the prioritization of our efforts is particularly important in view of the speed with which this problem is evolving and the limitations on our resources.

At the outset it is important to underscore that the progress made to date would not have been possible without the extensive cooperation of other federal agencies, industry, and environmental groups. We have profitted greatly from our discussions with these organizations, through our on-site industrial visits, and through constructive suggestions that we have received.

EPA Regulatory Authorities

To date EPA has exercised its authority in the pesticides area to suspend the use of vinyl chloride as a propellant in all pesticide products registered for indoor use in homes, food handling establishments, hospitals, and other enclosed areas, with a mandatory recall of stocks in the channels of trade. In addition, in response to the Agency's request, all registrants of pesticides which are used outdoors have agreed either to withdraw their registrations or to amend them to provide for the substitution of another propellant in their products.

We are currently investigating what regulatory actions, if any, are needed with regard to air emissions, water effluents, and solid waste disposal at facilities involved in VCM and PVC activities. In addition the Agency has responsibility in the areas of drinking water standards, ocean disposal, and municipal waste disposal -- all areas of some relevance to the VCM/PVC concerns.

As previously mentioned a principal authority which is currently missing is the Toxic Substances Control Act. The requirements for reporting of industrial production data envisaged in the Act would enhance our knowledge of the types and extent of different uses of VCM. The testing provision would enable us to obtain much needed data -- and particularly data on toxicity and persistence -- for assessing the risks associated with low concentration levels of VCM, including those levels that are likely to persist beyond the workplace. The proposed regulatory provisions would provide a mechanism for addressing those products using VCM not now subject to regulation under other laws. Also, if considered appropriate, steps might be taken to limit the amount of unreacted VCM in certain PVC products which may eventually migrate out of these products to pose an unnecessary risk.

The Materials Balance

EPA's initial concern in this area centered on reports in February of a materials loss of six percent in the PVC production process. Our detailed investigations indicate that these initial reports were in the correct range. Clearly, the percentage of losses will vary with the type of process, the age of the plant, the level of technology that is employed, and manufacturing practices. However, there is no doubt that in the United States substantial amounts of VCM -- probably exceeding 200 million pounds annually -- and large quantities of PVC -- probably exceeding 50 million pounds -- are being discharged into the environment during the PVC production process. Most of the VCM escapes directly into the atmosphere as air emissions, with lesser amounts dissolved in water effluent streams and entrapped in sludge and solid wastes. PVC losses occur as particulate in air emissions, suspended solids in water effluents, and components of solid wastes.

Clearly, a principal area of VCM leakage is associated with the operation of the polymerization kettles, including losses when they are opened for recharging, cleaning, or sampling. Other losses occur during the transfer of VCM from tank cars to storage, during the drying process, and from leaks at a variety of valves, flanges, and pump seals throughout the process. Polymer losses are similarly distributed among a variety of activities including dust collector losses, disposal of oversize particles, and sampling losses. The enclosed flow diagram for a typical suspension process reflects such losses which according to our estimates usually range from four to eight percent. In this regard two aspects are particularly significant: there are a variety of PVC processes with differing problems and control possibilities, and in every case the number of potential leakage points is very large.

For economic reasons and in view of the fire hazard from VCM, industry has always been concerned with reducing its losses down to a point. Now some plants are taking steps to reduce these losses further in view of worker and environmental concerns. We understand that the tightening up on maintenance and housekeeping activities can indeed have a significant impact, and several PVC plants reportedly are now operating close to the four percent level for total losses.

The data needed for conducting material balance analyses during VCM production and PVC compounding and fabrication processes are less readily available. However, we do not believe that these activities pose as serious an environmental concern beyond the fence line of the plant, at least at the present time, as the polymerization process. At the same time in the absence of constant vigilance VCM losses to the atmosphere during the latter phases of the VCM production process and during transfer to and from storage can be significant. Also, throughout the process there are many seals and valves which inevitably lead to leaks. With regard to compounding and fabrication, unreacted monomer is inevitably

associated with the polymer following the polymerization process. In some cases this monomer concentration reaches 7000 ppm although a more representative level probably is in the range of 500 to 1000 ppm. During the mixing and heating processes in the compounding and fabrication plants, some of this VCM undoubtedly escapes into the environment. Now, in efforts to reduce further the level of unreacted VCM in the final product many companies are introducing new techniques which increase the migration rates during this phase of production.

The Need for Epidemiological and Toxicological Studies

Since some elements of our population in addition to the plant worker are being exposed to some level of VCM, we must address the question: What is the risk of such exposure?

In considering non-worker populations, we are confronted with a host of new unanswered questions. How relevant to this concern are the data generated for estimating worker exposure risks? Can meaningful extrapolations be made from toxicological tests at relatively high dose levels to the lower levels of the dose-response relationship? Can realistic extrapolations be made from intermittent exposure, which characterizes the past and present toxicological and epidemiological investigations (e.g. eight hours per day, five days per week) to sustained exposure at the same dose level or at lower levels? Are synergistic effects that result from exposure to other chemicals as well as VCM influencing the worker's response to VCM, and are there similar opportunities for such synergism within a non-worker population?

There are not sharp answers to these questions, and indeed they go to the heart of many of the fundamental uncertainties of the biological sciences. To date the epidemiological and toxicological data that have been generated have been directed almost exclusively to concerns over workers. This is the data base that we in EPA presently have available. I doubt that anyone is more aware of its inadequacy than are those of us responsible for regulatory actions based on this data. Unfortunately, we often have no choice but to make judgemental decisions using whatever scientific information is available.

Other reports presented at this symposium review past, current, and future studies directed to VCM. While they will undoubtedly be helpful to our assessment of the environmental problem, from our point of view they are clearly not adequate in improving the basis for estimating non-worker risks. Let me cite three examples of the types of studies which appear to be needed:

- Epidemiological investigations of populations near chemical plants that are likely to have been exposed to low ambient levels of VCM over a prolonged period of time. It is the

responsibility of industry to support such efforts which will help clarify whether manufacturing activities pose a risk to neighborhood residents. At the same time we recognize the complexities involved in designing and carrying out such studies, the advantages of drawing on governmental experience in this area, and the prototypic nature of such an undertaking. Therefore, it seems likely that EPA will be prepared to participate in such efforts along with industry and other interested parties.

- Toxicological tests at appropriate dose levels, with a sufficiently large number of animals, and with appropriate exposures to provide the basis for meaningful conclusions concerning the likely health effects of VCM in ambient air near chemical plants. Such tests are clearly the responsibility of industry. Indeed, industrial responsibility for the testing of the safety of its products is a basic tenet of the Toxic Substances Control Act. At the same time, we are aware that some industrial firms are concerned about the possible inadequacy of commercial test facilities to accommodate the needed tests. Therefore, if necessary, the National Center for Toxicological Research, which is supported by FDA and EPA, is prepared to work with industry toward suitable arrangements for utilizing available buildings in Jefferson, Arkansas.
- Research on animals and in vitro experiments to help clarify the toxicological significance of impurities in VCM, synergistic effects due to exposure to other chemicals in addition to VCM such as vinylidene chloride, and metabolic reactions induced by VCM. Government, industry, and academia all have responsibilities in this area, and EPA is currently considering specific steps that might be taken to contribute to advancing the frontiers of our knowledge.

Monitoring, Persistence, and Migration Studies

We are obviously concerned about current and future background levels of VCM in the air and in the water throughout the country. Our more immediate efforts, however, are being directed to determining ambient and peak levels near chemical plants.

Recently, we initiated a nationwide sampling and analysis program to determine, at least in a preliminary fashion, the VCM levels in ambient air and in water and semi-solid effluents at about ten PVC plants. These activities are currently underway, and we hope to have the results within several weeks.

As a precursor to this nationwide effort, several weeks ago we conducted a preliminary monitoring program at the B. F. Goodrich plant in Louisville using inadequately tested sampling and analysis methods. At that time VCM levels were detected of 1 to 2 ppm in the ambient air outside the plant, 2 to 3 ppm in the primary water effluent, and 100 to 200 ppm in the sludge at the plant site. However, these numbers could be in error by as much as an order of magnitude due to the pioneering nature of the effort, and no conclusions should be drawn at this time.

During the past several weeks we have made a major effort to develop credible and standardized sampling and analysis procedures, building on this initial experience. Our current monitoring efforts are based on this recently improved methodology. The limit of detection for our current technique is approximately .06 mg/liter in water and .06 ppm (volume/volume) in air. However, when vacuum cans are used, the detection limit is .2 ppm because the gas sample must be diluted. The technique we are using is now publicly available with the hope that our efforts toward standardization will lessen the chaos characterizing current monitoring efforts of several federal agencies and industry.

While the near-term objective of these monitoring efforts is to gain a limited perspective of the levels of VCM near PVC plants, we should also learn more about the persistence of VCM in air and water from our measurements. Samples are to be taken during daytime and at night, and there undoubtedly will be a range of temperature and humidity conditions. However, we have not structured the measurements with research as a principal objective, and we will not be able to quantify persistence characteristics with any degree of precision.

Limited laboratory experiments are also being attempted to clarify persistence characteristics of VCM. Related to our decision to suspend pesticide sprays containing VCM, one laboratory test showed that in an unventilated and unlighted chamber, less than one percent of the VCM initially present was dissipated after four days. Current efforts are directed to clarifying the rate of retention of VCM entrapped in water effluent streams, as well as further work to understand the effect of light, heat, and moisture on VCM in air.

There has been considerable discussion of the amount of unreacted VCM monomer remaining in PVC and the rates of migration out of the PVC. Many companies are now seized with this problem, and I suspect the number of samples being taken to determine VCM concentrations and migration rates has increased considerably in recent weeks. We do not know whether such migration from finished products contributes significantly to background levels of VCM, but as you are aware FDA is seized with several aspects of this problem directly related to food. Should there be high levels of VCM background in the environment, then our concern over all sources of VCM -- including migration from many products -- should intensify.

In all of these areas industry has a major responsibility for determining and alerting the public about the behaviour of its products. I would hope that in the months and years ahead industrial monitoring efforts at the fence line will increase dramatically; persistence will become a key concern; and the ultimate fate of chemicals will be less uncertain. Already some chemical establishments have rather broad sampling and analysis programs, and as a direct result of VCM concerns, others are also making new efforts in this regard.

At the same time EPA has a responsibility to help insure the adequacy of the national effort in keeping abreast of the chemical cross-section of our environment.

Concerns over Disposal of PVC

While we tend to lump all types of PVC into one category, I am sure you are aware of the variances in the chemical and physical properties of different grades of PVC. Also, end products made from PVC include a variety of other chemicals which are added throughout the production cycle.

To date EPA's principal concerns relating to PVC have been directed to possible problems attendant to its disposal -- either in incinerators or landfills. We have not investigated in depth any of the special problems associated with inhalation or ingestion of low concentrations of PVC particulate.

With regard to incineration, HCl is a primary product of concern. Also, toxic metals may be present as additives and thus cause inhalation problems, either as metal or oxide vapors.

Landfill disposal operations have traditionally assumed that PVC is stable with little likelihood of biological degradation or undesirable leachates. Taking a long-term perspective these assumptions seem clearly overly simplistic, and we should address in greater depth problems attendant to the disposal of plastics. Experiences in the tropics, for example, have demonstrated the effect of bacteria on PVC which has not been specially treated for use in humid areas.

The Risks, the Benefits, and the Costs

The current problems with VCM have brought into sharp focus the practical aspects of balancing the risks and benefits associated with commercial chemicals. The costs involved to reduce these risks substantially may be formidable -- or indeed may be prohibitive. The aspect which is perhaps the most troublesome goes to the heart of this meeting -- What is the risk now and under alternative regulatory approaches?

In the years ahead more chemicals will be in commerce, the properties of many chemicals will be better understood, and consequently the list of chemicals considered to be hazardous to man and the environment will undoubtedly be much longer. Also, improved research and analytical capabilities will show that the effects of these chemicals -- acting individually and synergistically -- are much farther reaching than currently suspected effects.

As these realities of the chemical age unfold, there must be a far greater sophistication in approaches to responsible regulation. Fully, we will develop the necessary precautionary measures that will limit exposure to chemicals when necessary, but not unnecessarily curtail commercial activities.

ROSS V. BFS