

representative. If a hearing is deemed necessary, the applicant requests it be held at Pomona or Los Angeles, Calif.

No. MC 141476 (Correction), filed October 23, 1975, published in the *FEDERAL REGISTER* issue of November 28, 1975, and republished as corrected this issue. Applicant: C. T. TRANSPORTATION COMPANY, 2301 Bridgeport Drive, P.O. Box 1410, Sioux City, Iowa 51102. Applicant's representative: George L. Hirschbach, 5000 South Lewis Blvd., P.O. Box 417, Sioux City, Iowa 51102. Authority sought to operate as a contract carrier, by motor vehicle, over irregular routes, transporting: (1) *Towers, antennas, and equipment, materials and supplies* used in the manufacture, sale, distribution and erection of towers and antennas, and (2) *reflectors, redomes, pylons, buildings, building panels, building parts, and accessories, materials and supplies* used in the installation, construction, and erection of buildings, building panels and building parts, from the plant site and storage facilities of Advance Industries at Sioux City, Iowa, to points in the United States (except Hawaii); (3) *towers, antennas and equipment, materials and supplies* used in the manufacture, sale, distribution, and erection of the commodities described in (1) and (2) above, from points in the United States (except Alaska and Hawaii), to the plant site and storage facilities of Advance Industries located at Sioux City, Iowa, the commodities in (1), (2) and (3) above are restricted against transportation in bulk and further restricted to traffic transported under a continuing contract or contracts with Advance Industries; (4) *trenching machines*, from the plant site and storage facilities of Digz-All, Inc., located at Merrill, Iowa, to points in the United States (except Hawaii); and (5) *equipment, materials and supplies* used in the manufacture, sale and distribution of trenching machines, from points in the United States (except Alaska and Hawaii), to the plant site and storage facilities of Digz-All, Inc., located at Merrill, Iowa, the commodities in (4) and (5) above are restricted against transportation in bulk and further restricted to traffic transported under a continuing contract or contracts with Digz-All, Inc.

NOTE.—The purpose of this republication is to clarify the commodities in (1) and (2) above. Common control may be involved. If a hearing is deemed necessary, the applicant requests it be held at either Sioux City, Iowa, or Omaha, Nebr., or Chicago, Ill.

No. MC 141484, filed October 29, 1975. Applicant: HARRY L. ROTHSTEIN, 40 Poplar Street, P.O. Box 1386, Scranton, Pa. 18501. Applicant's representative: Richard M. Goldberg, 700 United Penn Bank Building, Wilkes-Barre, Pa. 18701. Authority sought to operate as a contract carrier, by motor vehicle, over irregular routes, transporting: (1) *General commodities*, from the facilities of Distribution East located at or near Scranton (Lackawanna) County, Pa., to

points in Pennsylvania and New York; and (2) *reflected or refused merchandise and empty containers*, from points in Pennsylvania and New York, to the facilities of Distribution East located at or near Scranton, Pa., under a continuing contract or contracts in (1) and (2) above with E. H. Trethaway Co., and James A. Weaver Company.

NOTE.—Applicant holds common carrier authority in MC 54698 sub No. 2, therefore dual operations may be involved. If a hearing is deemed necessary, applicant requests it be held at either Scranton or Wilkes-Barre, Pa.

No. MC 141492, filed November 10, 1975. Applicant: WHITETOP SAFEWAY & YELLOW CHECKER CABS, INC., doing business as MISSISSIPPI COURIER SERVICE, 670 South West Street, Jackson, Miss. 39201. Applicant's representative: Douglas R. Duke, Suite 552, First National Bank Building, Jackson, Miss. 39205. Authority sought to operate as a common carrier, by motor vehicle, over irregular routes, transporting: *Data processing materials, bank paper, securities and financial instruments* (except coin and currency), between Memphis, Tenn., New Orleans, La., and points in Mississippi.

NOTE.—If a hearing is deemed necessary, applicant requests it be held at either Jackson, Miss., Memphis, Tenn., or New Orleans, La.

No. MC 141526, filed November 14, 1975. Applicant: TERRELL TRUCKING, INC., P.O. Box 11, Converse, La. 71419. Applicant's representative: Thomas Joe Cassell, 1115 E. San Antonio Avenue, Many, La. 71449. Authority sought to operate as a common carrier, by motor vehicle, over irregular routes, transporting: *Sand, gravel, rock, riprap, crushed rock and lignite coal*, in bulk, between points in Louisiana and Arkansas and that part of Texas on and east of Interstate Highway 35 at the Oklahoma-Texas State Boundary line, thence along U.S. Highway 35 to Fort Worth, Tex., thence along Interstate Highway 20 to Dallas, Tex., thence along Interstate Highway 45 to Galveston, Tex.

NOTE.—If a hearing is deemed necessary, applicant requests it be held at either Shreveport, New Orleans, La. or Dallas, Tex.

No. MC 141528, filed November 19, 1975. Applicant: EXPRESS DELIVERIES, INC., 3040 Greenmount Avenue, Baltimore, Md. 21218. Applicant's representative: Alan J. Bloom, Suite 406, 401 Washington Avenue, Towson, Md. 21204. Authority sought to operate as a contract carrier, by motor vehicle, over irregular routes, transporting: *Photograph and photofinishing materials and supplies*, between points in Maryland, Virginia, Delaware, Pennsylvania, and the District of Columbia, under a continuing contract or contracts with Paramount Photo Service and Supply, Inc.

NOTE.—If a hearing is deemed necessary, applicant requests it be held at either Baltimore, Md., or Washington, D.C.

No. MC 141539, filed November 20, 1975. Applicant: GORDON HART, doing business as HART TRANSPORT, P.O. Box 109, Harris Road, Dexter, Mo. 63841. Applicant's representative: Joseph E. Rebman, 314 North Broadway, St. Louis, Mo. 63102. Authority sought to operate as a common carrier, by motor vehicle, over irregular routes, transporting: *Mufflers, exhaust pipe, tail pipe, steel, machinery, machinery parts, motors, transformers, converters, filters, flanges, tubing, asbestos, strapping, cartons, boxes, drums, pallets, steel racks, scrap metal, oil, solvents and cleaning products*, used in manufacturing (except commodities in bulk), between Dexter, Mo., on the one hand, and, on the other, points in Alabama, Arkansas, Georgia, Illinois, Indiana, Kentucky, Michigan, Missouri, Tennessee and Mississippi.

NOTE.—If a hearing is deemed necessary, applicant requests it be held at St. Louis, Mo., or Indianapolis, Ind.

#### FREIGHT FORWARDER APPLICATIONS

No. FF-350 (Sub-No. 1), filed November 21, 1975. Applicant: GLOBAL FORWARDING, INC., Number One Global Way, Anaheim, Calif. 94803. Applicant's representative: Alan F. Wohlstetter, 1700 K Street NW., Washington, D.C. 20006. Authority sought to engage in operation, in interstate commerce, as a freight forwarder, through use of the facilities of common carriers by rail, motor, water and express, in the transportation of (a) *Used household goods and unaccompanied baggage*, and (b) *used automobiles*, between points in the United States, including Hawaii and Alaska, restricted in (b) above to the transportation of export and import traffic.

NOTE.—The purpose of this application is to add Alaska to applicant's present authority. If a hearing is deemed necessary, the applicant requests it be held at San Francisco, Calif.

No. FF-477, filed November 21, 1975. Applicant: CROWN OVERSEAS FORWARDERS, 180 Quint Street, San Francisco, Calif. 94124. Applicant's representative: Daniel W. Baker, 100 Pine Street, Suite 2550, San Francisco, Calif. 94111. Authority sought to engage in operation, in interstate commerce, as a freight forwarder, through use of the facilities of common carriers by rail, motor, water, and express, in the transportation of (a) *Used household goods and unaccompanied baggage*, and (b) *used automobiles*, between points in the United States, including Alaska and Hawaii, restricted in (b) to the transportation of export and import traffic.

NOTE.—If a hearing is deemed necessary, the applicant requests it be held at San Francisco, Calif.

By the Commission.

[SEAL] ROBERT L. OSWALD,  
Secretary.

[FR Doc.75-34728 Filed 12-23-75; 8:45 am]



**ENERGY RESEARCH AND  
DEVELOPMENT ADMINISTRATION  
SOLAR ENERGY RESEARCH INSTITUTE  
Policy Relating To Establishment**

The Solar Energy Research, Development, and Demonstration Act of 1974 (P.L. 93-473) establishes a Solar Energy Research Institute (SERI) to conduct research, development and other related tasks in furtherance of the use of solar energy. The Act states that SERI may be located at a new or an existing Federal Laboratory and authorizes ERDA to determine its location. Over the past months, the Energy Research and Development Administration (ERDA) has been developing criteria for evaluating SERI's site as well as formulating the role and mission, and the type of management organization for SERI.

ERDA expects to announce criteria for evaluating the SERI site in January, 1975, and plans to solicit proposals for the site at that time. In this regard, it is ERDA's policy that no organization should be given unfair advantage over others interested in submitting proposals. This policy was expressed in a memorandum dated November 25, 1975, from Michael I. Yarymovych, Assistant Administrator for Laboratory and Field Coordination to all ERDA offices. For

the benefit of the interested public, the memorandum is quoted in its entirety below.

Dated: December 22, 1975.

**ROBERT A. SUMMERS,  
Acting Assistant Administrator  
for Laboratory and Field  
Coordination.**

**HEADS OF DIVISIONS AND OFFICES, HQ  
HEADS OF FIELD ORGANIZATIONS**

**POLICY FOR NATIONAL LABORATORIES AND OTHER  
ERDA INSTALLATIONS IN RELATION TO ERDA'S  
QUEST FOR A SOLAR ENERGY RESEARCH INSTITUTE  
(SERI) SITE AND MANAGEMENT ORGANIZATION**

NOVEMBER 25, 1975.

It is the policy of this Agency that all parties be treated equally and fairly in their dealings with the Federal Government. This policy is very important in the management team and site selection quest for SERI. No citizen or organization should be allowed to have a preferred position, or even appear to have knowledge which would give an unfair advantage over any other organization or person. Assuring fair treatment has been the overriding consideration in the adoption of procedures regarding the establishment of SERI and this fairness must continue to guide our future conduct.

It is anticipated that parties interested in making proposals relative to SERI may seek information from ERDA Laboratories and installations. If ERDA Laboratories or installations are approached for information relating

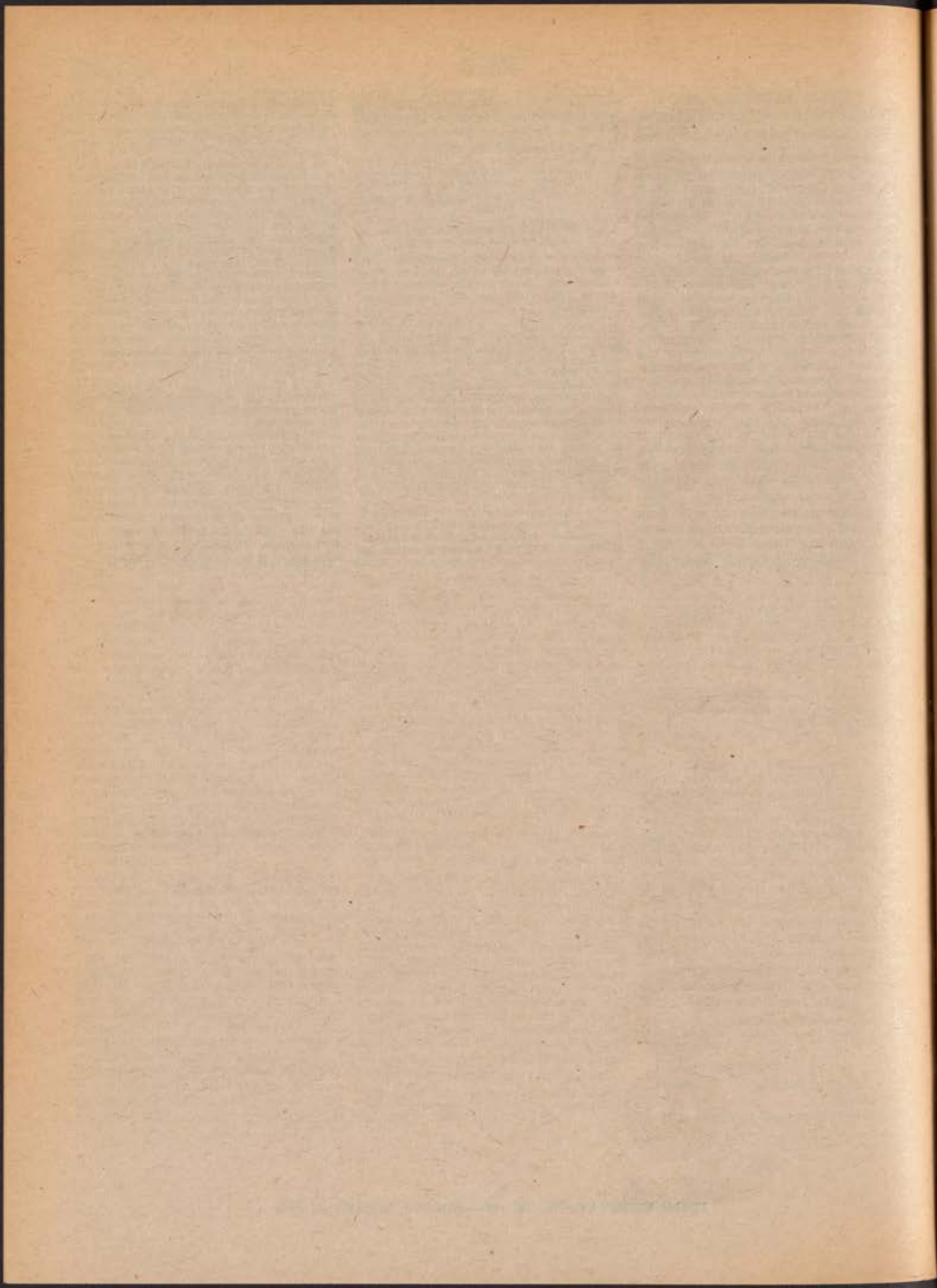
to SERI, they shall notify the Solar Energy Research Institute Project Office (SIPO) of such requests in detail and shall obtain instructions or advice from the SIPO before proceeding further.

It is also anticipated that parties interested in making proposals concerning SERI may seek the participation of ERDA Laboratories or installations. If so approached, the Laboratory or installation must promptly advise the cognizant Operations Office, the SIPO, and this office in detail and obtain instructions or advice before proceeding further. This office shall have the final responsibility for determining the nature and extent of participation by ERDA Laboratories and installations with other parties relative to the SERI search. In any event, the ERDA Operations Offices shall not assume, nor appear to assume, any form of partisan role and must maintain the strictest objectivity and impartiality with respect to the SERI search and selection process.

ERDA Operations Offices are expected to advise all ERDA field installations of these policy guidelines and assure appropriate implementation.

ERDA Headquarters offices will assure that no information concerning ERDA's own planning or decisions relating to SERI is communicated in any form to any parties relative to SERI in advance of full public announcement. Furthermore, such public announcements shall set forth the above policy relating to ERDA Laboratories and other installations.

[FR Doc.75-34923 Filed 12-23-75; 10:24 am]





# **federal register**

WEDNESDAY, DECEMBER 24, 1975



---

PART II:

## **ENVIRONMENTAL PROTECTION AGENCY**



### **NATIONAL EMISSION STANDARDS FOR HAZARDOUS AIR POLLUTANTS**

Proposed Standard for Vinyl Chloride



# ENVIRONMENTAL PROTECTION AGENCY

[FRL 454-1]

[40 CFR Part 61]

## NATIONAL EMISSION STANDARDS FOR HAZARDOUS AIR POLLUTANTS

### Proposed Standard for Vinyl Chloride

Notice is hereby given that under the authority of section 112(b)(1)(B) of the Clean Air Act, as amended, the Administrator is proposing a national emission standard for vinyl chloride emissions from ethylene dichloride-vinyl chloride and polyvinyl chloride plants. As prescribed by section 112(b)(1)(A) of the Act, this proposal of the standard was preceded by the Administrator's determination that vinyl chloride is a hazardous air pollutant as defined in section 112(n)(1) of the Act. Accordingly, the Administrator is revising the list of hazardous air pollutants by adding vinyl chloride; notice of this revision is published in the notice section of this issue of the FEDERAL REGISTER. [FRL 454-2] FR Doc. 75-34512.

In accordance with section 117 of the Act, publication of this proposed standard was preceded by consultation with appropriate advisory committees, independent experts, and Federal departments and agencies.

Interested persons may participate in this rulemaking by submitting written comments (in triplicate) to the Emission Standards and Engineering Division, Environmental Protection Agency, Research Triangle Park, North Carolina 27711, Attention: Mr. Don R. Goodwin. All relevant comments postmarked not later than February 23, 1976, will be considered. Comments received will be available for inspection and copying at the U.S. Environmental Protection Agency, Public Information Reference Unit, Room 2922 (EPA Library), 401 M Street, SW., Washington, D.C. 20460.

A public hearing will be held as required by section 112(b)(1)(B) of the Act. A notice of the time, date and place for the public hearing will be published in the FEDERAL REGISTER within 30 days of the publication date of this proposed standard.

The Environmental Protection Agency (EPA) has prepared a "Standard Support and Environmental Impact Statement" which contains background information on the manufacture and processing of vinyl chloride, the health effects of vinyl chloride, the available control technologies for vinyl chloride emissions, the rationale for the proposed standard, and an analysis of the environmental, economic, and inflationary impacts of the proposed standard. More detailed information on the health effects of vinyl chloride is contained in a second document prepared by EPA, which is entitled the "Scientific Technical Assessment Report on Vinyl Chloride and Polyvinyl Chloride." Requests for these documents should be addressed to the Emission Standards and Engineering Division, Environmental Protection Agency,

Research Triangle Park, North Carolina 27711, Attention: Mr. Don R. Goodwin, MD-13. The information contained in these documents with regard to health effects, the rationale for the proposed standard, and the potential environmental and economic impacts is summarized in the following paragraphs. All references in the summary are to be found in the two EPA documents.

### RATIONALE FOR REGULATING VINYL CHLORIDE UNDER THE AUTHORITY OF SECTION 112 OF THE CLEAN AIR ACT

In January 1974, the B. F. Goodrich Chemical Company reported to the National Institute of Occupational Safety and Health that several of its employees had died from angiosarcoma of the liver (a rare form of cancer) and that these deaths may have been related to occupational exposure to vinyl chloride gas. This report resulted in growing concern over the potential health effects of vinyl chloride and spurred efforts by various government agencies to take steps to obtain data needed to assess in more detail the impact of vinyl chloride on human health and to reduce vinyl chloride exposure both to the worker and to the general population. EPA established a Task Force on vinyl chloride in February 1974, to identify the environmental problems resulting from the manufacture and use of vinyl chloride and polyvinyl chloride. While air, water, and solid waste disposal are all possible routes for entry of vinyl chloride into the environment in the vicinity of manufacturing facilities, the Task Force concluded that, based upon current information, the air route poses the most significant environmental problem to the population located there. Potential sources of exposure to the general population due to the use (as opposed to the manufacture) of vinyl chloride include aerosol containers, plastics used for containing or wrapping food products, and drinking water.

On April 26, 1974, EPA published in the FEDERAL REGISTER an emergency suspension order for specific indoor aerosol pesticides containing vinyl chloride. In May 1974, EPA initiated a study to determine whether Federal regulation of atmospheric emissions of vinyl chloride from manufacturing facilities is needed, and if so, which of the regulatory alternatives under the Clean Air Act would be most appropriate. For the purpose of the study, data were gathered on health effects, air quality concentrations, control techniques, and costs. Based on this analysis, EPA concluded that vinyl chloride meets the specifications of the definition of "hazardous air pollutant" in section 112 of the Clean Air Act and should be regulated as such. "Hazardous air pollutant" is defined in section 112 of the Clean Air Act as "an air pollutant . . . which in the judgment of the Administrator may cause or contribute to, an increase in serious irreversible, or incapacitating reversible illness." The reasons for concluding that vinyl chloride is a hazardous pollutant are discussed in the following paragraphs.

Vinyl chloride has been shown to cause cancer in both sexes of three species of rodents by the inhalation route, the primary route by which humans, in the vicinity of plants manufacturing or processing vinyl chloride, are exposed. Angiosarcoma of the liver has been observed in rats, hamsters, and mice exposed to vinyl chloride. In two of these species, rats and mice, liver angiosarcoma has been produced at exposure levels as low as 50 parts per million (ppm), which is the lowest level for which studies have been completed thus far. In one experiment, exposures at this level for four hours per day, five days per week for a 12 month period produced nephroblastomas and liver angiosarcomas after 135 weeks. In a second experiment angiosarcoma in mice has been produced by exposures as low as 50 ppm for 7 hours for a 26 week duration. Furthermore, these animal studies showed a multiple-cancer risk from vinyl chloride, i.e., tumors in organs other than the liver such as the brain, lungs, kidneys, and mammary glands.

As of June 1975, the National Cancer Institute had confirmed 27 cases of liver angiosarcoma among workers with a history of exposure to vinyl chloride, 15 in the United States and 12 in Europe and Canada. Additionally 11 cases had been reported and not yet confirmed. Most, but not all, of these confirmed cases have been among workers involved directly in polyvinyl chloride production. Cases of liver angiosarcoma have been reported in one U.S. and three European workers exposed to vinyl chloride, but not directly involved in polyvinyl chloride production. These cases suggest that exposure to vinyl chloride at lower levels than usually encountered in polyvinyl chloride production plants is capable of causing liver angiosarcoma. To date, angiosarcoma of the liver has been considered an extremely rare disease among the general population. In a survey by the American Cancer Society, only one case of liver angiosarcoma was recorded per 78,000 deaths. Compared with this record, the data indicating the frequency of liver angiosarcoma among workers exposed to vinyl chloride show that the relative risk to these workers of developing this disease is approximately 3,000 times greater than that to the general population. Such a relative risk represents a statistically significant difference ( $p < 0.001$ ) in the frequency of liver angiosarcoma among those exposed to high levels of vinyl chloride compared with those in the general population.

Occupational exposure studies have strongly implicated vinyl chloride as a human chemical carcinogen which causes tumors in many different sites, only one of which is the liver. Other manifestations in humans include acroosteolysis and liver dysfunction. Similar toxicology studies have verified the occurrence of tumors in other body organs such as the brain and lungs. Bioassay studies have shown the potential of vinyl chloride to be a chemical mutagen and teratogen. (More details on these animal and occupational studies may be



found in the "Scientific Technical Assessment Report on Vinyl Chloride and Polyvinyl Chloride.")

These data strongly indicate that vinyl chloride causes or contributes to the development of angiosarcoma, other cancers, and noncarcinogenic disorders in people with occupational exposure and in animals with experimental exposure to vinyl chloride. Reasonable extrapolations from these findings cause concern that present ambient levels of vinyl chloride may cause or contribute to the same or similar disorders. Data obtained in the spring of 1974 from U.S. plants that produce or process vinyl chloride indicate that approximately 100 million kg of vinyl chloride are emitted to the atmosphere annually. The majority of these emissions are from ethylene dichloride-vinyl chloride and polyvinyl chloride plants. Results from a preliminary ambient monitoring program conducted by EPA in the spring of 1974 indicate that persons living in the immediate vicinity of these plants are generally exposed to average daily concentrations of less than 1 ppm with some 24 hour average excursions to 1 and 3 ppm and some occasional peak concentrations as high as 33 ppm. Results from a more extensive ambient monitoring program conducted by EPA from November 1974 to June 1975 are not discussed in detail here because they are still being analyzed. The results are generally in the same range as reported here for the preliminary ambient monitoring program except there are no concentrations as high as 33 ppm. Approximately 4.6 million people live within a five-mile radius of ethylene dichloride vinyl and polyvinyl plants. There are no dose-response data, and thus there is no absolute proof of adverse effects, at the concentrations of vinyl chloride found in the ambient air. However, for carcinogens there may be no atmospheric concentration which poses absolutely no public health risk. Also, data from studies of occupational exposure indicate that there is a latency period as long as 20 years between initial exposure to vinyl chloride and occurrence of disease. The latency period could possibly be longer for lower levels of exposure. Production of polyvinyl chloride did not begin to operate on a large scale until relatively recently. Only about 10 of the approximately 40 polyvinyl chloride plants are 20 years old or older, and the oldest one is 40 years old. These considerations led to the conclusion that EPA should take action now to reduce exposure levels to vinyl chloride before retrospective evidence of risk is allowed to show itself. By taking steps now to reduce emissions, EPA will be able to reduce substantially the risk that severe illness and death will occur in the future as a result of present and prolonged community exposure to vinyl chloride.

EPA's conclusions are supported by "The Evaluation of Environmental Carcinogens" which was completed on April 22, 1970, by the Ad Hoc Committee on the Evaluation of Low Levels of Environmental Chemical Carcinogens. The

Ad Hoc Committee was formed in response to a request by the Deputy Assistant Secretary for Health and Scientific Affairs of the Department of Health, Education, and Welfare (HEW). The Committee was to review the problems relating to the evaluation of low levels of environmental chemical carcinogens, to consider the scientific bases on which such evaluations can be made, and to advise the Department of HEW on the implications of such evaluations. The report to HEW includes the following conclusions and recommendations:

(1) "Any substance which is shown conclusively to cause tumors in animals should be considered carcinogenic and therefore a potential cancer hazard for man."

(2) "Because the latent period in human carcinogenesis is so long, epidemiologic evidence develops only over periods of 15 to 20 years. Timely decisions to exclude materials from uses involving exposure to man, therefore, must be based solely on adequately conducted animal bioassays. Retrospective human evidence of risk must not be allowed to show itself before controlling action is taken. Chemicals should be subjected to scientific scrutiny rather than given individual rights; they must be considered potentially guilty unless and until proven innocent."

(3) "No chemical substance should be assumed safe for human consumption without proper negative lifetime biological assays of adequate size. The minimum requirements for carcinogenesis bioassays should provide for adequate numbers of animals of at least two species and both sexes with adequate controls, subjected for their lifetime to the administration of a suitable dose range, including the highest tolerated dose, of the test material by routes of administration that include those by which man is exposed."

(4) "No level of exposure to a chemical carcinogen should be considered toxicologically insignificant for man. For carcinogenic agents a safe level for man cannot be established by application of our present knowledge. The concept of 'socially acceptable risk' represents a more realistic notion."

Several court decisions also support EPA's decision. In *Environmental Defense Fund, Inc. v. Environmental Protection Agency*, 510 F.2d 1292 (D.C. Cir., 1975), which questioned the protection of the manufacture and sale of aldrin and dieldrin, Judge Levanthal recognized (1) consideration of the long latency period in cancer; (2) the finding that the concept of threshold level has no practical significance for carcinogens; and (3) the extrapolation to humans from animal test data, as valid grounds for EPA's decision making. See also *Environmental Defense Fund, Inc. v. Ruckelshaus*, 142 U.S. App. D.C. 74, 439 F.2d 584 (1971) on animal test data. Furthermore, in the preamble to the October 4, 1974, Occupational Safety and Health Administration (OSHA) regulation for vinyl chloride, *The Evaluation of Environmental Carcinogens* was cited as partial support for the level of the standard. This regulation

was upheld by the U.S. Court of Appeals for the Second Circuit in the case of *Society of the Plastics Industry, Inc. v. Occupational Safety and Health Administration*, 509 F.2d 1301 (1975); cert. den. sub. nom. *Firestone Plastics Co. v. U.S. Department of Labor*, 43 U.S. L. W. 3623 (1975). In its decision, the Court of Appeals stated that much of OSHA's evidence for the regulation was based on animal exposure to vinyl chloride, with only indirect human evidence, but that

... nevertheless, it remains the duty of OSHA to protect the working man, and to act even in circumstances where existing methodology or research is deficient.

The panel also stated that the evidence on vinyl chloride's dangers was "quite sufficient" to merit OSHA's regulations.

EPA considered several approaches to dealing with air emissions of vinyl chloride other than regulating under section 112. The main alternatives were taking no action, delaying action until more health effects data are available at lower concentrations of vinyl chloride, regulating under section 109 and regulating under section 111.

The alternative of taking no action was rejected because vinyl chloride is a carcinogen and poses a risk to public health. Vinyl chloride emissions are expected to be reduced to some degree as a result of the OSHA standard which was promulgated on October 4, 1974, (39 FR 35890) and which became effective on April 1, 1975 (40 FR 13211), some State regulations for new construction of ethylene dichloride-vinyl chloride and polyvinyl chloride plants and for ethylene emissions, and voluntary installation of controls by some companies. The degree to which these other efforts will reduce emissions is uncertain at this time, but it is not expected that it will be uniform or that ambient concentrations will be reduced to the same degree as they would as a result of the proposed standard. In fact, increased ventilation to the atmosphere as well as emission control equipment is being used to meet the OSHA standard.

The alternative of delaying the standard setting would allow acquisition of additional information but it is likely that gaps in the relevant information would still remain. Due to the expected long latency period between initial exposure to vinyl chloride and occurrence of disease, it will be many years before useful epidemiological data will be available on the effects of lowered occupational exposure resulting from the OSHA regulation. EPA has concluded that the available evidence indicates that ambient concentrations of vinyl chloride pose a public health risk and should not be allowed to persist until all information gaps are filled. If EPA were to wait until all needed data were available to establish precise dose-response relationships, a standard could be long delayed and the public might be exposed to substantial and irreversible harm in the interim. Moreover, the risks to the public could increase as the industries expand.



The alternative of regulating under section 109 (National Ambient Air Quality Standards) was rejected by EPA because vinyl chloride is a localized problem and section 109 is usually more appropriate for regulating pollutants whose presence in the ambient air is ubiquitous. Also, the National Ambient Air Quality Standards/State Implementation Plan process does not provide the expedited means of control which Congress meant to be used for a hazardous air pollutant.

The remaining alternative of section 111 (Standards of Performance for New Stationary Sources) was examined very closely. Section 111(d), which would provide for control of existing facilities if new source performance standards were promulgated for vinyl chloride, has the following features: (1) regulation development under section 111(d) takes longer than under section 112; (2) the level of control may differ from State to State; (3) States may grant variances based on cost considerations only; and (4) the standard development mechanism is a State rather than a Federal process. EPA concluded that these features are not appropriate in the case of a pollutant which fits the definition of hazardous air pollutant under section 112. Section 112 was designed in part to avoid these features for certain types of pollutants, and EPA has determined that vinyl chloride is such a pollutant.

A concurrent issue before EPA was what level of emission control could or should be required under section 112. Section 112 provides that the Administrator shall set an emission standard "at the level which in his judgment provides an ample margin of safety to protect the public health from such hazardous air pollutants." The problem presented was how this provision should be interpreted when dealing with an apparent non-threshold pollutant that is hazardous at some level. The term "non-threshold pollutant" refers to a substance which creates a risk of adverse health effects at all ambient levels (other than zero). An "apparent non-threshold pollutant" is, quite simply, a substance which, on the basis of available information, appears to be a non-threshold pollutant. An apparent non-threshold pollutant may be known to be "hazardous" within the definition of section 112 at some levels, and create a risk to public health at all levels. Vinyl chloride is such a pollutant. It clearly causes angiosarcoma, other cancers, and noncarcinogenic disorders in animals, which have been experimentally exposed to vinyl chloride, and in people with occupational exposure. However, an emission standard for vinyl chloride cannot be established below a threshold level of effects because no dose-response data are available for the concentrations of vinyl chloride found in the ambient air. Further, it is EPA's position that for a carcinogen it should be assumed, in the absence of strong evidence to the contrary, that there is no atmospheric concentration that poses absolutely no public health risk. The issue was how far the

level of such pollutants should be reduced to provide "an ample margin of safety."

EPA considered that section 112 might be interpreted to require a complete prohibition of emissions of any apparent non-threshold pollutant. This zero emission limitation would be the only emission standard which would offer absolute safety from ambient exposure. This interpretation was rejected, however, and EPA has determined that, in some cases, prohibition of all emissions of apparent non-threshold pollutants is not required under section 112. This determination is based on the following considerations.

Complete prohibition of all emissions could require closure of an entire industry. This would occur in a case such as vinyl chloride where there is no technology to achieve a zero emission limitation and development of such technology is not foreseen. Closure would result in extensive economic costs in some cases, such as when the affected industry is of large size or there are no available substitutes for the products produced. The costs of a prohibition in some cases would be extremely high for elimination of a risk to health that is of unknown dimensions. Banning production of vinyl chloride and polyvinyl chloride would have a negative impact on the producing companies, especially on the three or four companies which, according to EPA's evaluation, are highly dependent on sales of vinyl chloride and polyvinyl chloride and might therefore be expected to fail if vinyl chloride and polyvinyl chloride production were banned. There would be an even greater impact on unemployment at the approximately 8,000 fabrication plants which depend at least partially on polyvinyl chloride as a raw material. This impact would persist unless and until these plants could adapt their equipment to manufacturing substitutes. With regard to the consumer, there are substitutes for about 85 percent by weight of the uses of polyvinyl chloride, but these substitutes would generally not be available for at least two years, would generally be more expensive than polyvinyl chloride products, and would not necessarily have some of the desirable characteristics, such as nonflammability, of polyvinyl chloride. In view of the beneficial uses of vinyl chloride products for which desirable substitutes are not readily available, the potentially adverse health and environmental impacts from substitutes which have not been thoroughly studied, the number of employees, particularly in fabrication industries, who would become at least temporarily unemployed, and the availability of control technology which is capable of substantially reducing emissions of vinyl chloride into the atmosphere, EPA concluded that setting zero emission limits would be neither desirable nor necessary.

An alternative interpretation of section 112 is that it authorizes setting emission standards that require emission reduction to the lowest level achievable by use of the best available control tech-

nology in cases involving apparent non-threshold pollutants, where complete emission prohibition would result in widespread industry closure and EPA has determined that the cost of such closure would be grossly disproportionate to the benefits of removing the risk that would remain after imposition of the best available control technology. EPA recognizes that consideration of technology in standard setting is not explicitly provided for under section 112. Congress never discussed the particular problem associated with apparent non-threshold pollutants. EPA, however, believes that Congress did not intend to impose the costs associated with complete emission prohibition in every case involving such a pollutant. The best available control technology approach will produce the most stringent regulation of hazardous air pollutants short of requiring a complete prohibition in all cases. This interpretation of section 112 is the one which has been adopted for vinyl chloride. This approach was used in the case of asbestos, but has never been judicially tested. The purpose of the proposed standard is thus to minimize risk to public health by establishing an emission standard which will reduce emissions to the level attainable with best available control systems. An emission standard based on best available control technology will result in different total emission levels and different ambient air concentrations at different plants due to variations in plant sizes and configurations. However, it will further the protection of public health by minimizing the health risks to the people living in the vicinity of these plants and to any additional people who are exposed as a result of new construction.

#### SELECTION OF SOURCE CATEGORIES

There are two major source categories of vinyl chloride emissions: polyvinyl chloride plants (41 existing plants) which are responsible for approximately 85 percent of the total nationwide emissions and ethylene dichloride-vinyl chloride plants (17 existing plants) which are responsible for about 11 percent of the total emissions. Both of these source categories are covered by the proposed standard. (For the purpose of clarification, ethylene dichloride and vinyl chloride are typically produced at one plant, but this is not necessarily the case. The proposed standard would apply to plants which produce either ethylene dichloride or vinyl chloride as well as to plants which produce both.)

The remaining emissions are from about 8,000 polyvinyl chloride fabricating plants and several other miscellaneous sources. A monitoring program conducted by EPA at five fabricating plants indicated that ambient concentrations around the perimeter of these plants are almost negligible. At three of the plants, no vinyl chloride was detected, and where it was found, the highest concentration was 6 parts per billion (ppb). As far as can be determined, all vinyl chloride emissions from the fabricating plants are due to residual vinyl chloride



in the raw materials coming from the polyvinyl chloride plants. Consequently, vinyl chloride emissions from fabricating plants will be minimized indirectly as polyvinyl chloride plants, in response to the proposed standard and the OSHA standard, reduce vinyl chloride in these raw materials from as high as 1000 ppm to less than 10 ppm. For the foregoing reasons, EPA has concluded that no standard for fabricating plants is necessary at the present time.

Studies under contract to EPA have been conducted to identify miscellaneous sources, their emissions and possible control technology. For purposes of EPA action, sources of vinyl chloride emissions other than ethylene dichloride-vinyl chloride plants, polyvinyl chloride plants, and fabricating plants are classified as miscellaneous sources. In general, these sources either use vinyl chloride for purposes other than polyvinyl chloride production or processing, or produce vinyl chloride as a by-product. Preliminary reports indicate that there are 8 such plants and that they accounted for about 3 percent of the total estimated 1974 emissions from all sources. EPA is continuing its research on vinyl chloride emissions from miscellaneous sources. Although the proposed standard does not cover these sources, there is a possibility that EPA will conclude that regulations for them should be proposed at a later date. For the present, therefore, the proposed standard is applicable only to ethylene dichloride-vinyl chloride and polyvinyl chloride plants, which are the largest sources.

The proposed standard for polyvinyl chloride plants covers any plant where vinyl chloride alone or in combination with other materials is polymerized. Thus, the proposed standard includes plants which produce homopolymers in which vinyl chloride is the only polymerized constituent and/or copolymers, terpolymers, or any other polymers in which other raw materials in addition to vinyl chloride are polymerized. EPA considered exempting from the proposed standard plants (six of the approximately 41 existing plants) which produce a polymer in which vinyl chloride is less than 50 percent of the raw material polymerized. EPA decided not to exempt these plants from the proposed standard, because the total vinyl chloride emissions from a plant are more a function of the total quantity of vinyl chloride processed in the plant than the percent vinyl chloride contained in the resin. Furthermore, available data indicate that the processing equipment in these six plants is the same as in the plants producing resins with higher percentages of vinyl chloride, so that the same control technology can be applied and separate standards are not required. Since the available data on production of polyvinyl chloride resins containing less than 50 percent vinyl chloride are more limited than the data on the production of resins containing higher percentages of vinyl chloride, EPA urges all interested persons to submit factual data

on the production of these resins during the comment period.

The proposed standard covers the production of ethylene dichloride only by oxychlorination of ethylene. Available data indicate that there are no vinyl chloride emissions from direct chlorination of ethylene.

As proposed the standard would apply to any ethylene dichloride-vinyl chloride or polyvinyl chloride facility, regardless of size. EPA recognizes that some small research and development facilities may exist where the emissions of vinyl chloride are insignificant and covering these facilities under the standard would be unnecessary and inappropriate; however, EPA does not have sufficient information available to clearly define which facilities should be excluded from the standard. EPA urges all interested persons to submit factual information during the comment period describing the size and operation of research and development facilities for ethylene dichloride-vinyl chloride and polyvinyl chloride, the emissions of vinyl chloride from these facilities, the amount of product produced and the disposition of the products.

#### SELECTION OF EMISSION POINTS FOR REGULATION

The sources of vinyl chloride emissions within typical ethylene dichloride-vinyl chloride and polyvinyl chloride plants and their relative contributions to total uncontrolled emissions are shown in Table 1.

TABLE 1

Emission source:	Percent of total uncontrolled emissions at the average plant
(A) Ethylene dichloride-vinyl chloride plants:	
(1) Fugitive emission sources.....	27
(2) Ethylene dichloride purification .....	11
(3) Vinyl chloride formation and purification .....	54
(4) Oxychlorination reactor.....	8
	100
(B) Polyvinyl chloride plants:	
(1) Fugitive emission sources.....	39
(2) Reactor opening.....	3
(3) Relief valve discharge.....	5
(4) Stripper.....	8
(5) Monomer recovery system.....	13
(6) Sources following the stripper (slurry blend tanks, centrifuges, dryers, bulk storage, etc.).....	32
	100

The proposed standard applies to all of the sources in ethylene dichloride-vinyl chloride and polyvinyl chloride plants. There are control technologies which have been used for each of the emission sources, and regulation of only some of the sources was determined to be less than best available control technology. Emissions from both normal operation and from relief discharges are to be regulated. Relief discharges are included because they cause short-term high level emissions which can be prevented in almost all cases.

Two sources of vinyl chloride need explanation. First, the reactor may, in some

polyvinyl chloride plants, serve also as the stripper. When this is the case, the regulation controlling reactors is applicable. Second, the definition of stripper for all resins except bulk resins includes "in the slurry form" so that other vessels, e.g. silos, following this stage of the process will not be considered strippers. Likewise, the definition of stripper for bulk resins does not include silos.

The proposed standard also applies to all known fugitive emission sources, including equipment used for loading (or unloading) vinyl chloride monomer into transfer equipment from storage vessels, slip gauges, leakage from seals on pumps, compressors, and agitators, leakage from relief valves, manual venting of gases, opening of equipment such as for maintenance and inspection, flasks used in obtaining samples of vinyl chloride monomer, leakage from equipment, and in-process wastewater. Although the emissions from each of these sources when considered individually may appear relatively small, they are included in the proposed standard because when combined they represent a significant portion of the total plant emissions. Based on data reported to EPA by individual companies in the spring of 1974, fugitive emissions represented approximately 40 percent of the total emissions from polyvinyl chloride plants and approximately 25 percent of the total emissions from ethylene dichloride-vinyl chloride plants. In-process wastewater is included in the list of fugitive emission sources subject to the proposed standard because available data indicate that vinyl chloride contained in water exposed to the atmosphere is lost rather rapidly. Precise measurements have not been made to prove that this vinyl chloride is emitted to the air. However, data on the solubility of vinyl chloride in water indicate that this is likely to be the case.

For several of the fugitive emission sources, the proposed standard applies only to those pieces of equipment "in vinyl chloride service." This term is defined to exclude pieces of equipment such as pumps and storage containers which are used to handle materials other than vinyl chloride and which contain essentially no vinyl chloride.

Two fugitive emission sources which were considered for specific regulation but which are not included in the proposed standard as such are vacuum pumps and steam jets. It was concluded that a separate regulation is unnecessary because more general regulations are included which already cover vacuum pumps and steam jets. For example, steam jets used to displace vinyl chloride or other contaminants from equipment are covered by general regulations controlling the removal of vinyl chloride from equipment by any means.

#### RATIONALE FOR THE EMISSION LIMITS

The purpose of the proposed standard is to minimize the risk to the public health by setting emission limits which will reduce emissions to the level attainable with the best available control technology for each emission source in



ethylene dichloride-vinyl chloride and polyvinyl chloride plants. There are many technical decisions involved in developing a standard on the basis of "best available control technology." Therefore, EPA established two criteria for making these technical decisions as follows:

(a) First, the control technology must be in use in one or more plants in the chemical industry and be generally adaptable for use at the plants subject to the standard within the time allowed for compliance under section 112, and

(b) Second, costs were considered only when they were grossly disproportionate to the emission reduction achieved.

In this interpretation of best available control technology the degree of consideration of costs was limited. The proposed standard was adjusted for cost reasons only to avoid the large economic impact of industry closure and control costs that are grossly disproportionate to the emission reduction achieved. For example, the types of conceivable control measures which were rejected because they did not meet the established criteria for best available control technology included installing control technologies for which research is currently being conducted or is planned, but which have not been used commercially; placing a bubble around an industrial complex and venting all the air from the complex through an enormous control device; and installing double control measures, such as two incinerators in series, which could achieve a small increment in emission reduction at a disproportionately high cost. A fine balancing of costs against benefits was not undertaken.

A further comment on this interpretation is in order to reveal one other consideration that went into the decision on this matter. EPA recognizes that some sources may still have economic difficulties in meeting a standard based on best available control technology. EPA does not intend to guarantee that no facility will have to close in order to meet such a standard. It is intended only that EPA have an alternative to setting an emission prohibition standard which would force widespread closures.

In order to develop an emission standard for each of the sources in ethylene dichloride-vinyl chloride and polyvinyl chloride plants based on the guidelines which had been established for "best available control technology," data on control systems were obtained through requests for information under the authority of section 114 of the Clean Air Act, on-site observation of plant processes, consultation with industry representatives and control equipment vendors, one emission test, and two studies completed under contract to EPA.

#### STACK EMISSIONS

The proposed standard limits emissions from all equipment used in the ethylene dichloride purification process and the vinyl chloride formation and purification processes in ethylene dichloride-vinyl chloride plants and from all reactors, strippers, containers for mixing, weighing and holding which pre-

cede the stripper; and monomer recovery systems in polyvinyl chloride plants to a concentration of 10 ppm vinyl chloride. The proposed standard also requires venting of captured fugitive emissions through a control system from which the concentration of vinyl chloride does not exceed 10ppm. In EPA's judgment, an outlet concentration of 10 ppm represents best available control technology for these sources and can be achieved by incineration, carbon adsorption, or solvent absorption. None of these control systems has been used by ethylene dichloride-vinyl chloride or polyvinyl chloride plants until recently, and then by only a few plants. Therefore, even though EPA has made a concentrated effort to obtain data on application of these control systems for reduction in vinyl chloride emissions, there are few data available demonstrating the effectiveness of these control systems when installed at ethylene dichloride-vinyl chloride or polyvinyl chloride plants. EPA did conduct a source test on one incinerator installed at an ethylene dichloride-vinyl chloride plant. The test demonstrated control to a level below the proposed limit of 10 ppm. One polyvinyl chloride producer has recently installed a carbon adsorption unit to control vinyl chloride emissions from the monomer recovery system and the blend tanks. During the time in which the unit has been operated, it has gone through more than 700 regenerating cycles, and the vinyl chloride content in the exit gas stream has been reported to be below 10 ppm. In addition, one vendor of activated carbon has submitted data from laboratory studies on the control of vinyl chloride by carbon adsorption. The vendor's conclusions from the studies, based on 15 cycles of operation, were that activated carbon readily adsorbs vinyl chloride in concentrations ranging from 50 ppm to over 300,000 ppm; 100 percent removal of vinyl chloride is technically feasible using dual beds of activated carbon; activated carbon saturated with vinyl chloride can be regenerated in-place using either steam or hot nitrogen to desorb the vinyl chloride; and no polymerization of vinyl chloride occurs on the bed. Data are available for a solvent absorption unit which controls emissions from the monomer recovery system in a polyvinyl chloride plant to a concentration of 15 ppm; in EPA's judgment, however, this particular system, which is relatively old and was not designed specifically for vinyl chloride control, does not represent the full capability of solvent absorption in reducing vinyl chloride emissions. EPA believes, however, that an updated solvent adsorption unit, as well as an incinerator or a carbon adsorption unit, will be capable of meeting the proposed standard.

The proposed standard limits vinyl chloride emissions from the oxychlorination reactor in ethylene dichloride-vinyl chloride plants at 0.02 kg/100 kg ethylene dichloride product. Based on individual plants' measurements of vinyl chloride reported to EPA under section 114 of the Clean Air Act, this emission

level represents the best available control technology through control of process variables and can be met at most plants by maintaining operations so that the emission rate (kg/100 kg) does not increase. Incinerators or equivalent add-on control technology may have to be used to attain the proposed standard at a maximum of one existing plant which has relatively large emissions (in addition to a few companies which have already installed, or are already planning to install, incinerators).

EPA considered proposing an emission limit for the oxychlorination reactor representing best available control technology by incineration or equivalent control at all plants. This, in conjunction with the proposed emission limits for the other sources in ethylene dichloride-vinyl chloride plants, would reduce the total emissions from the average plant by 97 percent. Incineration has been demonstrated as a method of control for the three major emission sources in ethylene dichloride-vinyl chloride plants. The oxychlorination reactor, however, has a large volume, low hydrocarbon concentration effluent gas stream, and large quantities of supplemental fuel would be required for combustion of its emissions (296,000 million cu. ft. of gas/yr at an average plant). In comparison, combustion of emissions from the other two major emission points would require negligible supplemental fuel. One company has reduced the gas volume from the oxychlorination reactor and the associated energy costs by recycling the process gas stream using oxygen instead of air to feed into the process. A second company is also planning to install this technology. Although the recycling and oxygen feed methodology can be used for two types of oxychlorination reactors, further research would be needed to determine whether this technology can be used for each of the types of processes at all of the plants. A third company is conducting a pilot study on controlling the oxychlorination reactor emissions with catalytic oxidation, another method for reducing the high energy costs. This system has not been used commercially for the oxychlorination reactor, and it is not known at this time whether it will be technically feasible for the plants to use. The oxychlorination reactor represents a relatively small emission source (8 percent of the uncontrolled emissions) at an average plant. EPA concluded that the energy costs of incinerating the large volume, low concentration effluent gas stream from the oxychlorination reactor at the average plant would be grossly disproportionate to the emission reduction achieved, and the measures which are being used or studied for reducing the energy costs are not available for all of the types of oxychlorination processes. Thus, the alternative requiring incineration or equivalent control at all plants was rejected.

Since the oxychlorination reactor does contribute only a small percentage of the total emissions at an average plant, EPA also considered proposing no standard



for it at all. The proposed emission limits for the other two emission points and the fugitive emission sources would still reduce emissions by 90 percent at an average plant. Due to process variables, however, there is a wide range in the reported emissions from the oxychlorination reactor at the various plants from 0.0024 kg/100 kg to 0.106 kg/100 kg ethylene dichloride product (0.0024 lb/100 lb to 0.06 lb/100 lb). In terms of mass emissions per unit time, the emission rates vary between 0.5 to 46.3 kg/hr (1.2 to 103 lb/hr). In EPA's judgment, the energy costs associated with incineration of the emissions from the oxychlorination reactor would not be grossly disproportionate to the emission reduction achieved at those plants with the emission rates at the upper end of this range.

Thus, the proposed emission limit is essentially a cut-off point which requires the plants at the upper end of the range to reduce emissions preferably by instituting process changes, and if this is not possible, by installing incinerators or equivalent add-on control. Based on available data, emissions from the oxychlorination reactor at the majority of the existing plants meeting the proposed standard would be below 4.5 kg/hr (10 lb/hr) and the emissions from no plant would exceed 9.0 kg/hr (20 lb/hr). Although establishing the standard in this way does not result in as great an emission reduction as installation of incinerators or equivalent control for the oxychlorination reactor at all of the plants, the proposed standard is based on a consideration of costs only where the energy costs would be grossly disproportionate to the emission reduction achieved. Furthermore, as technologies using less energy for controlling the oxychlorination reactor are developed, EPA will evaluate the desirability of proposing standards which would require a higher degree of control at all plants.

The proposed standard limits, for polyvinyl chloride plants, the emissions from process equipment following the stripping operation in the manufacture of dispersion resins (except latex resins) to 0.2 kg/100 kg product and in the manufacture of all other resins (including latex resins) to 0.04 kg/100 kg product. One way in which these emission levels can be attained is by reducing the residual vinyl chloride monomer in dispersion resins to 2000 ppm or less and in all other resins to 400 ppm or less during the stripping operation. This reduction must be completed before the resins continue through the processing equipment following the stripper. This type of control is referred to as improved stripping technology. The proposed standard permits averaging of emissions to the extent that the vinyl chloride content in all grades of any one resin type completing the stripping operation at a plant site in one calendar day can be averaged over the 24 hour period. ["Resin type" refers to the broad classification of a resin according to the process by which it is manufactured (e.g. dispersion, suspension, bulk, latex, and solution). "Resin grade" is the subcategory of "resin type" which describes a resin as a unique resin,

i.e. the most exact description of a resin with no further subdivision.] These emission levels can also be met by add-on control devices, such as incinerators. EPA discourages use of the add-on control devices, however, because unlike improved stripping they do not result in a lower vinyl chloride content in the polyvinyl chloride resin going to fabricating plants. Furthermore, these devices are far more energy consuming for these particular emission sources than improved stripping technology and achieve no more emission control. In fact, these devices have not been used commercially to control the emissions from most of this particular process equipment, because they are much more expensive for the plants to use than improved stripping technology. In EPA's judgment, however, there is no technical reason why they could not be applied.

In developing the proposed standard for process equipment following the stripper, it was necessary for EPA to make decisions concerning the levels of control which should be required for the various resin types and the desirability of allowing averaging among resin grades. Stripping technology has been used commercially at polyvinyl chloride plants in the past, but the technology has been designed to perform only to the extent necessary to recover raw materials for economic purposes rather than for emission reduction. More recently, as a result of the October 4, 1974, OSHA standard polyvinyl chloride resin producers have been motivated to develop stripping technology to reduce further the vinyl chloride content in resins during the stripping operation. By improving stripping technology producers will not only reduce in-plant exposure levels as required but will also satisfy fabricator demand for resins which have low concentrations of vinyl chloride and thus do not cause the fabricators to be in violation of the OSHA standard. Some companies have devoted more time and resources to improve the effectiveness of stripping as an emission control measure than have other companies. Optimum stripping consists of a set of operating conditions which must be developed experimentally on an individual basis for the many resins. Based on information supplied to EPA by individual companies which have devoted time and resources to develop improved stripping, EPA concluded that technology is currently available to strip the majority of resins, except dispersion resins, to 400 ppm or lower. This same degree of control is achievable through add-on devices.

Some resins are more difficult to strip than other resins due to differences in characteristics such as porosity and heat sensitivity. Whereas current stripping technology can reduce the residual vinyl chloride content in the majority of the resins other than dispersion resins to below 400 ppm (and in some cases far below 400 ppm), it can reduce the vinyl chloride content in a few resins only to levels as high as 4000 ppm. EPA considered proposing a separate standard based on best available control technology for each of the different grades of resin. This

could have conceivably been done based on theoretical factors. However, EPA concluded that it would be difficult, if not impossible, to do this, because the reductions that can be achieved depend on a given system and must be determined by actual measurements on a particular resin for a particular set of conditions. The large number of resin grades makes it impractical for EPA to conduct individual testing for each one. Available data indicate that most of the companies produce several grades of resin simultaneously and that when the grades are averaged on a daily basis, the number of resins which can be stripped to lower than 400 ppm is sufficient to offset the few resins which cannot be. The proposed standard allows an averaging time of 24 hours because, if a plant were processing several grades simultaneously and one grade could not be stripped to 400 ppm, the total emissions from stripping all grades to an average of 400 ppm would be no greater than stripping each grade to 400 ppm. The alternative of increasing the averaging time to a week or month was rejected because this would permit higher peak emission levels than averaging on a 24-hour basis.

Since stripping technology is currently in the development stage, it is possible that lower levels of emissions will be achievable before promulgation of the proposed standard. Interested parties are invited to submit, during the comment period, factual data on the status of stripping technology. If data become available which warrant a substantial change in the level of the emission limitation, EPA will announce a revision to the proposed standard in the FEDERAL REGISTER and invite the public to comment on it. Interested persons are also invited to comment on the averaging concept included in the proposal, because EPA recognizes that permitting averaging across resin grades on a daily basis may give an advantage to the larger companies producing a number of resin grades each day.

A separate standard is being proposed for dispersion resins. EPA considered the alternative of proposing the standard so that dispersion resins would have to be stripped to the same level as other resins. For several reasons, however, technology to strip residual vinyl chloride monomer from dispersion resins has not been developed to the same degree as it has for other resins. First, information submitted to EPA under section 114 of the Act indicates that dispersion resins are more difficult to strip with conventional techniques than are other resins, because the higher temperatures which can be applied to other resins destroy the stability of dispersion resins and thus the quality of the product. Second, polyvinyl chloride producers have devoted more research and development time to improving conventional stripping for other resins than to developing new technology for dispersion resins, because dispersion resins represent only about 13 percent of the total production. Furthermore, the incentive to improve stripping to satisfy fabricator demands for low-monomer content product does not exist for dis-



person resins, because the product has always been low in monomer content as a result of loss of almost all of the residual monomer to the atmosphere during the drying operation which occurs after stripping. In general, the loss in drying dispersion resins is proportionately higher than in drying other resins. For these reasons, technology has not been demonstrated for stripping dispersion resins to the degree that the proposed standard requires other resins to be stripped to (400 ppm). Based on information received under section 114 of the Clean Air Act from individual companies on research and development of stripping technology for dispersion resins, it appears that the most optimistic company will not be able to achieve stripping to levels of 400 ppm for at least four years. Thus, EPA concluded that the time required for research and development of such technology far exceeds the maximum time allowed by section 112 for compliance (two years from the date of promulgation or two and a half years from the date of proposal). Furthermore, this level of control cannot be achieved in the manufacture of dispersion resins by add-on controls, and therefore no options to undeveloped stripping technology would be available for use by the plants. Therefore, this alternative could necessitate closure of dispersion resin plants until the controls could be developed. As already stated, EPA concluded that best available control technology rather than closure of plants would be the approach adopted for the proposed standard.

EPA also considered the alternative of proposing the standard to require a level of stripping which has been demonstrated for all dispersion resin grades at all plants; i.e., essentially no control of emissions from sources following the stripper. This alternative was rejected because, as has already been explained, the polyvinyl chloride companies have just recently begun to improve stripping technology for dispersion resins, and EPA determined that currently used techniques do not represent best control technology. Based on available data, it is judged that by the time the proposed standard must be implemented, improved stripping technology could be available for plants to use. If this alternative were selected as the basis for the proposed standard, it would provide no incentive to further develop existing stripping techniques to control emissions. Furthermore, although they are more costly in terms of energy, environmental, and economic impacts, add-on controls (e.g. incinerators) are available which could be used to reduce emissions to a much lower level than that represented by this alternative.

EPA, therefore, attempted to determine the degree of stripping which could be accomplished for dispersion resins by best control technology. Section 112 requires existing plants to comply with a standard within 90 days of promulgation, but it provides for waivers up to two years (two and a half years from proposal) for control if "steps will be taken during the period of waiver to assure that the health of persons will be

protected from imminent endangerment." EPA therefore endeavored to determine the degree of control technology development that is likely over the next two and a half years. Under the authority of section 114 of the Act, EPA contacted the ten companies that manufacture dispersion resins and requested information regarding the degree to which these resins can be stripped with technology developed in the next two and a half years. Two of the companies do not plan to make dispersion resins in the future. Two of the companies responded that they could not reach levels below 6,000 ppm. However, some companies have devoted more time and resources to improve the effectiveness of stripping as an emission control measure than other companies. Three of the companies, which appeared to have devoted more time to research and development of stripping technology for dispersion resins, reported they would be able to strip all resin grades to levels of 2,000 ppm or lower. One of these companies is already stripping each of its resin grades to this level and another of the companies is stripping some of its resin grades to this level. A fourth company, which did not make any predictions, is also stripping some of its resin grades to a level of 2,000 ppm. The predictions of the other two companies ranged between 4,000 and 6,000 ppm depending on the resin grade. Based on information received from all companies that are known to make dispersion resins, it is EPA's judgment that, for dispersion resins, best available control technology through stripping can achieve levels of 2,000 ppm averaged, as for the other resins, on a 24-hour basis. Add-on control devices are capable of reducing emissions to a level equivalent to stripping to 2,000 ppm. Add-on control devices cannot reduce total mass emissions from the equipment following the stripper in dispersion plants as low as they can in the manufacture of other resins, due to the type of dryer which is used at these plants.

EPA considered proposing the standard to allow averaging of residual vinyl chloride concentrations in dispersion resins with those in other resins, so that a plant could compensate for higher levels in dispersion resins by stripping other resins to a lower level. This concept is judged to be inequitable because for some plants dispersion resins compose less than 5 percent of the total resin production and at other plants they compose 60 or more percent. EPA concluded that it would be more reasonable to recognize the significant differences between dispersion resins and other resins and require application of best available control technology to the processing of each.

EPA considered proposing a standard which would require the emissions from slurry blend tanks and inprocess wastewater from equipment following the stripping operation to be controlled by add-on devices as well as by improved stripping technology. One relatively new plant decreased the gas volume of the exit stream from slurry blend tanks by

replacing air with nitrogen and enclosing the tanks. A carbon adsorption unit was then installed to control emissions in the reduced gas volume. Although it has not been done by any plant in the industry, there is no technical reason why the inprocess wastewater from centrifuges which follow the stripper cannot be controlled by a water stripper. Such control systems were included in the economic analysis conducted by EPA. The analysis showed that, if plants used improved resin stripping (as opposed to add-on controls) to meet the proposed standard, the costs of these additional systems for slurry blend tanks and inprocess wastewater would be grossly disproportionate to the emission reduction achieved. Based on available information on the emissions from slurry blend tanks after stripping has been used to reduce to 400 ppm the residual vinyl chloride content in the resin produced by an average plant, the addition of an add-on control device would further reduce emissions by approximately 0.5 kg/hr (1 lb/hr), i.e. the device would remove an additional 0.1 percent of the original uncontrolled emissions. Collecting the 0.5 kg/hr would increase the capital costs of control to an average plant by about 19 percent and the annual costs by about 13 percent. Similarly, the installation of an add-on control device in addition to improved stripping for the vinyl chloride in centrifuge water would reduce emissions by no more than the add-on control device for slurry blend tanks, and would increase the capital costs of control to an average plant by about 13 percent and the annual costs by 46 percent. The large increase in annual costs would be due to the large quantity of steam which would be required to remove the vinyl chloride from a large volume, low concentration water stream. Furthermore, if these additional controls were required, plants using add-on control technology would not be able to attain the same level of control as plants using improved stripping technology. The reason for this is that these plants would already be using add-on controls and installing additional add-on controls would have little, if any, effect.

The proposed standard limits the emissions of vinyl chloride from opening of reactors, reactor entry purge, venting inert gases from the reactor, and any other contact of the reactor contents with the ambient air, to 0.001 kg/100 kg product. One way the standard may be attained is by a combination of (1) reducing the number of reactor openings by using high pressure water jets, solvent cleaning, or other means to prevent the need to hand-clean reactors and (2) displacing the vinyl chloride with water to a gasholder or recovery system before a reactor is opened. The level of the proposed standard is based on best available control technology as demonstrated by one plant, and there is no apparent reason why the same technology cannot be employed at other plants, except plants which produce bulk resins. This technology cannot be used for postpolymerization reactors in plants producing bulk resins for two reasons. First, the pro-



duction of bulk resin is a dry process and water used to displace the vinyl chloride from the reactor before opening it would cause a contamination problem. Second, since the resin product is air conveyed from the postpolymerization reactor, the reactor is opened to the atmosphere after each batch. Manufacturers of bulk resins can achieve the level of the proposed standard by evacuating the reactor several times and breaking the vacuum with nitrogen. The number of evacuations would depend on the volume of gas in the reactor and the vacuum involved.

A zero emission limit is being proposed for relief discharges which can be prevented. In most cases, such discharges from reactors can be prevented by measures including, but not limited to, properly instrumenting the reactors to detect upset conditions, injecting chemicals to stop the polymerization reaction during upset conditions, venting the reactor contents to a gasholder during upset conditions and ultimately to a recovery system, providing employees with improved training on preventing and handling upset conditions, and utilizing a stand-by source of power. For other pieces of equipment, increasing pressure due to inert gases in the system can be relieved by manual venting to a gasholder or recovery system. The conditions which lead to discharges can also be prevented in most cases by proper handling and transfer of vinyl chloride or materials containing vinyl chloride. Discharges which cannot be avoided by taking such preventive measures, such as those caused by natural disasters, will not be in violation of the proposed standard if the owner or operator notifies EPA within 10 days concerning the nature and cause of the discharge. This notification provision is necessary to permit EPA to investigate the surrounding conditions and determine whether the discharge could have been prevented. For the purposes of the proposed standard, operator error is considered to be preventable.

#### FUGITIVE EMISSIONS

The proposed standard includes emission limits for all known sources of fugitive emissions and is intended to minimize these emissions to the maximum extent possible with available control technology. Some of the emission limits are numerically defined. Where it is infeasible to state numerical limits, the standard specifies equipment and procedural requirements.

All of the equipment and procedures specified for reducing fugitive emissions, such as removal of vinyl chloride from loading and unloading lines and process equipment before exposure to the atmosphere, displacement of the contents of a sampling flask back to the process during sampling, and capture and control of the emissions, have been used by one or more ethylene dichloride-vinyl chloride or polyvinyl chloride plants and are described in plant responses to inquiries from EPA under the authority of section 114 of the Act.

For fugitive emissions, the proposed standard requires that the vinyl chloride concentration in process equipment greater than or equal to 5500 l (1250 gal) in volume (other than reactors) be reduced to 2 percent by volume at standard pressure and temperature before the equipment is opened to the atmosphere. This can be accomplished by vacuum pump or by displacement with water or inert gases. For process equipment that is smaller than 5500 l (1250 gal) in volume, the proposed standard requires that the amount of vinyl chloride in the equipment be reduced to 110 l (25 gal) at standard pressure and temperature before opening the equipment to the atmosphere. Any vinyl chloride removed from the equipment would have to be ducted through a control system.

A cut-off point which requires that the vinyl chloride be reduced by a greater percentage in the larger pieces of equipment than in the smaller ones was established because: (1) the emissions from opening large equipment are much greater than from opening small equipment, even with the standard in effect, (2) the smaller equipment is not designed to use a vacuum or purge system to remove the vinyl chloride, and in some cases it is not designed to withstand pressure, and (3) at some point the vinyl chloride emissions from disconnecting the extensive equipment needed to remove vinyl chloride from every section of pipe or other piece of small equipment and transfer it to a control system would be greater than the emissions from opening the section of pipe or other small equipment.

The proposed standard includes a more stringent limitation for emissions from opening of reactors than it does for opening of other equipment. The emission limit for opening of reactors (0.001 kg/100 kg product) has already been discussed. The reason for the more stringent limitation for reactors is that, unlike other equipment, the reactors are typically opened on a frequent and routine basis.

The same reasoning explains why the proposed standard includes a separate emission limit for emissions to the atmosphere from disconnecting equipment (hoses, couplings, valves, etc.) used in the transfer of vinyl chloride from storage to transport vessels at ethylene dichloride-vinyl plants and from transport to storage vessels at polyvinyl chloride plants. Although the loading and unloading lines are relatively small in volume compared with some of the other equipment which can be opened to the atmosphere, they are used and disconnected on a frequent and routine basis; i.e., several times per day. The proposed emission limit for each loading and unloading line requires that after each loading or unloading operation before opening any part of the line to the atmosphere, the quantity of vinyl chloride in all parts of the line that are to be opened is to be reduced to 4.4 l (1 gal), at standard temperature and pressure. Four and four tenths liters of vinyl chloride at standard temperature and pres-

sure is equal to about 0.0098 kg (0.022 lb) of vinyl chloride.

The method for attaining the standard would depend on the volume of the equipment to be opened to the atmosphere. If an entire hose is to be disconnected and opened to the atmosphere, the hose could be evacuated. However, more commonly there would be a couple of valves between the hose and the storage (or transport) vessel with a coupling between the valves. In this case, if only the coupling were to be disconnected and opened to the atmosphere, the percent reduction in vinyl chloride required would depend on the volume of the coupling. If it were 4.4 l (1 gal) in volume, it would have to be reduced to 760 mm Hg and if it were 8.8 l (2 gal) in volume, it would have to be reduced to 380 mm Hg.

Also, during loading and unloading operations, the proposed standard would require that the emissions from the discharge end of slip gauges used to measure the vinyl chloride liquid level in transport and storage vessels be captured and ducted to a control system. Essentially, there would be no emissions from slip gauges.

Leaks from seals on rotary pumps can essentially be eliminated by using double mechanical seals or pumps with no seals, such as the type with magnet to magnet drive or a canned pump in which the eddy current passes through the pump fluid. Leaks from seals on reciprocating pumps can be minimized by double outboard seals. Double mechanical seals can be used on agitators and compressors to minimize leaks. The proposed standard includes equipment specifications requiring that these methods, or equivalent, be used to minimize leaks from seals on pumps, compressors, and agitators.

The proposed standard also includes equipment specifications requiring that leaks from relief valves be minimized by installing a rupture disk between each relief valve and the equipment served by the relief valve, or equivalent. An equivalent method of control would be to connect the discharge line from a relief valve to process equipment or to a recovery system. If a rupture disk were used as the method of control, there would be a potential problem if a leak should occur from the rupture disk and cause a build-up of pressure between the rupture disk and the relief valve. This is expected to occur infrequently because the reason for requiring the rupture disk is that it is less likely to leak than a relief valve. Although the proposed standard does not require any specific equipment or procedures to prevent the potential pressure build-up, there are several methods available for the plants to use to avoid this potential problem. These include (1) installing a pressure gauge between the disk and valve and routinely checking the pressure, and (2) installing a ball check excess flow valve between the disk and the relief valve and routinely checking for any flow from the ball check excess flow valve.

The proposed standard would require capture and control of emissions of vinyl chloride bearing gases during manual venting from processing equipment. For



example, it would permit no manual venting of vinyl chloride to the atmosphere to reduce the pressure in reactors during upset conditions or to remove inert gases from vessels used to store vinyl chloride. The gases would instead have to be transferred to a gasholder, a recovery system, another piece of equipment (such as another empty reactor), or to a control system. With regard to reducing pressure in reactors during upset conditions, the issue has been raised as to whether permitting manual venting to the atmosphere could result in overall lower emissions than not permitting manual venting to the atmosphere. EPA urges all interested persons to submit factual data bearing on this issue during the comment period.

The proposed standard minimizes vinyl chloride losses from sample flasks during sample acquisition by requiring that the sample be collected in a closed system. Vinyl chloride which could be lost to the atmosphere is instead flushed back to the process using this system.

The proposed standard requires development of and adherence to a formalized program for detection of leaks from equipment in vinyl chloride service and elimination of these leaks. The formalized program must include a multipoint vinyl chloride detector and a portable hydrocarbon detector. Rather than specifying the number of points to be monitored, the sensitivities of the multipoint detector, the vinyl chloride concentration that indicates a leak, and the actions to be taken to repair leaks, the proposed standard requires each plant owner or operator to prepare a program plan containing these specifications and to submit the plan to the Administrator for approval. The plant owner or operator is at the same time required to submit data on background concentrations of vinyl chloride in different areas of the plant to use in determining the vinyl chloride concentration that should be designated as indicating a leak. Since the background concentrations vary among different areas of the plant, the definition of leak may also vary among different areas of the plant. EPA's decision on whether a program is adequate will be based on (1) the date the program will be implemented, (2) the characteristics of the multipoint detector and portable hydrocarbon detector (including the sensitivities of the instruments), (3) the number and location of points to be monitored in comparison with the number of pieces of equipment in vinyl chloride service and the size and physical layout of the plant, (4) the proposed frequency of monitoring, (5) the vinyl chloride concentration(s) designated as indicating a leak compared with the background concentrations of vinyl chloride in the plant, and (6) any other information contained in the program plan. This approach has been taken because the number of points which need to be monitored and the background concentrations of vinyl chloride vary depending on the size, configuration and age of a plant and, in the case of a polyvinyl chloride plant, on the number of reactors. Plans, therefore,

must be tailored to the design of each individual plant. This approach gives each source the flexibility to develop a plan that it believes to be the most efficient.

The proposed standard includes an emission limit for inprocess wastewater which contains at least 10 ppm by weight vinyl chloride, measured directly as the wastewater stream leaves the process equipment and before it is mixed with wastewater from any other source. This cut-off point was selected because, based on data which are available from polyvinyl chloride plants, it distinguishes between the low volume wastewater streams with high concentrations of vinyl chloride and the large volume wastewater streams with low concentrations of vinyl chloride. In effect, the proposed standard would require control of wastewater streams from pumps used in the monomer recovery system and from monomer recycle tanks where wastewater, which has been entrained with recovered monomer is separated and removed. It would also require control of wastewater which had been used, in accordance with other requirements of the proposed standard, to displace vinyl chloride in equipment before the equipment is opened. It would not require control of wastewater which had been used in the polymerization of vinyl chloride, if improved stripping technology were used to attain the proposed emission limit for the process equipment following the stripper. This wastewater stream was excluded because improved stripping technology indirectly reduces the vinyl chloride content of the wastewater as well as the resin before the wastewater is separated from the resin. However, if an add-on control device is used instead of improved stripping, the combination of all sources of vinyl chloride emissions following the stripping operation in the polyvinyl chloride plant, including inprocess wastewater, is required to meet the total mass emission limit. Thus, in this case, the concentration of vinyl chloride in the inprocess wastewater would not have to be equal to or greater than the 10 ppm cut-off point to be required to be controlled.

The proposed standard for 10 ppm vinyl chloride in the wastewater can be attained by a stripper, which uses heat and/or vacuum to remove vinyl chloride from the water. The proposed standard in effect would require the vinyl chloride which is removed to be recovered by condensing it into a liquid or to be ducted through a control device. Theoretically, by using this method, the vinyl chloride concentration could be reduced to essentially zero. However, as the applied vacuum and heat are increased, the ratio of water to vinyl chloride that vaporizes increases. During the vinyl chloride recovery process, the water as well as the vinyl chloride condenses. Since the water still contains some dissolved vinyl chloride, it would have to be recirculated through the stripper. At some point, as the amount of water which is vaporized is increased, the separation of vinyl chloride from water would be less efficient. For these reasons, the proposed stand-

ard is 10 ppm. Although the standard permits some vinyl chloride to remain in the water, it is estimated that the vinyl chloride emissions from the low volume, high concentration water streams at the average plant would not exceed 0.5 kg/hr (1 lb/hr). At ethylene dichloride/vinyl chloride plants, strippers are already used as an inherent part of the process to recover ethylene dichloride from wastewater. Vinyl chloride is also removed from the wastewater. The purpose of the proposed standard is to ensure that the practice continues and that any vinyl chloride removed from the wastewater is recovered or controlled.

#### FORMAT OF THE STANDARD

With the exception of emissions following the stripper in dispersion resin manufactures, separate standards have not been established for individual processes or companies. The applicability of carbon adsorption, incineration, or solvent absorption is not dependent on plant age, configuration or type of process.

The proposed standard specifies emission limitations for individual emission points. An alternative would have been to specify a total plant mass emission limit in terms of kg/hr. This is not possible, however, when using the best available control technology approach due to the different sizes and configurations of plants. Implementing best available control technology at different sizes of plants obviously results in different emissions per unit time. EPA also considered specifying the limits in terms of total plant emissions in kg vinyl chloride per kg product to be measured by material balance. This approach was rejected for several reasons. Due to the variations in configurations among plants, an emission factor, which would necessarily result in the application of best available control technology at each plant at all times, could not be developed. Furthermore, either long-term or short-term material balances would have to be used to measure compliance with such a standard. Long-term material balances have the disadvantage of a long averaging time so that short-term peak emissions are not detected. Short-term material balances, on the other hand, are impractical and imprecise due to the large volumes of material which are handled and must be measured, the multiple pieces of equipment in which residual materials would have to be measured, and the large number of points where loss to the atmosphere, inprocess wastewater, and solid waste would have to be measured.

Numerical emission limits are used for each emission point where possible; however, equipment and operating procedures are specified for some of the fugitive emission sources from which emissions cannot be measured or calculated or for which it would be grossly impractical to do so. Generally, the reason that these emissions cannot be measured is that they are released into an unconfined area and often from many small sources, and there is no practical testing procedure for obtaining a reliable read-



ing of emission levels. Where equipment or operating procedures are specified, plant owners or operators are generally permitted to use other equipment or procedures, demonstrated to be of equivalent effectiveness. Primarily because fugitive emissions compose such a large proportion of the total emissions at ethylene dichloride-vinyl chloride and polyvinyl chloride plants, EPA has determined that control of such emissions by specification of equipment and operating procedures is preferable to the alternative of leaving such emissions unregulated.

For example, there are procedural requirements for the reduction of vinyl chloride to a specified concentration in equipment equal to or greater than 5500 l (1250 gal) in volume before opening it to the atmosphere. Conceptually, EPA could have proposed the standard in terms of a mass emission rate. This could be done by converting the concentration of vinyl chloride to its mass emission equivalents for all sizes of equipment. Mass emissions, however, could not be measured once the pieces of equipment were opened to the atmosphere because the emissions would not be confined. Consequently, if EPA had stated the standard in terms of a mass emission rate, it would have been necessary, in order to be meaningful, to state the method for determining compliance in terms of concentration of vinyl chloride, i.e., in the same terms as the procedural requirement is now stated. Stating the standard itself in terms of concentration is a much more direct approach and the only practical one. For equipment that is less than 5,500 l (1250 gal) in volume and for loading and unloading equipment, a mass emission limit in terms of liters is proposed. However, this cannot be measured, but must be calculated based on the volume of the equipment and the pressure in the equipment.

The proposed standard includes equipment specifications for leaks from seals on pumps, compressors, and agitators and from relief valves. A numerical standard for emissions from these sources would be impractical to enforce since there is no way to test emissions released into an unconfined area. Even if a testing procedure were available, frequent routine testing of all pump, compressor, and agitator seals and relief valves to determine compliance would be burdensome.

The proposed standard requires that samples of vinyl chloride be collected in a closed system so that any vinyl chloride remaining in the sample flask from previous sampling flows back into the process. Any vinyl chloride flushed through the apparatus in an attempt to collect a representative sample also flows back into the process. Again, numerical emission limits cannot be specified because emissions are released into an unconfined space and cannot be measured. For slip gauges and manual venting, the proposed standard requires that the emissions be captured and ducted through a control system. There is a

numerical emission limit specified for the control system.

Another problem requiring special treatment is valve leakage. It would be impossible to avoid all valve leakage. However, valve leakage can be held close to zero if a system of regular valve monitoring is used to detect and repair leaks. If EPA were to specify a numerical limitation of zero, it would be impossible to meet at all times. If EPA were to specify a higher numerical limitation, it would permit more leakage than is necessary. This would be inconsistent with requiring control of vinyl chloride emissions to the level attainable by use of the best available control technology. Therefore, EPA is requiring use of a regular program for leak detection and repair.

In order to reduce the total emissions from reactors by limiting the frequency of openings, the proposed standard for reactor opening loss is specified in terms of a mass emission rate, i.e. kilograms of vinyl chloride per 100 kilograms of polyvinyl chloride produced. If a concentration standard were used, it would provide no incentive for reducing the frequency of reactor openings. Furthermore, the amount of dilution air which could be used to weaken the effect of a concentration standard is difficult to regulate. For these two reasons, EPA concluded that a mass emission rate would be the only effective way to specify the standard.

Due to the intermittent nature of the sources of the emissions, the proposed standard for control systems to which the captured emissions are required to be ducted is in terms of concentration. A major part of the polyvinyl chloride plant is a batch operation which causes intermittent emissions of vinyl chloride. In addition, the fugitive emissions which are required to be captured and ducted to a control system in both ethylene dichloride-vinyl chloride and polyvinyl chloride plants occur only on an intermittent basis. Because of the fluctuating air volumes and mass emission rates, it would be difficult, if not impossible, on the basis of available information, to determine the allowable mass emission rates from these control systems.

The emission limit for the sources following the stripper in polyvinyl chloride plants is stated in two ways which are essentially equivalent in terms of the quantity of emissions they allow. The reason the emission limit is stated in two different ways is that there are two distinctively different ways to control these sources. Different methods of measurement and enforcement are applicable to the two different control methods. If add-on control devices are selected as the method of control, stack testing must be used to measure the emissions from all the multiple sources simultaneously for a minimum of an hour. If improved stripping is selected, the emissions could be measured in the same way. It is difficult, however, to use conventional source testing procedures to establish compliance because of the large number of sources that have to be tested. A typical polyvinyl chloride plant has several slurry blend tanks, centrifuges, dryers, and storage

silos. Even if the emissions from each of these sources were determined, the resultant value would not necessarily establish the total emissions since monomer would still be escaping from the resin in bagging operations, warehouses, and railroad tank cars.

Where improved stripping is used, there is a much more practical way for determining compliance. Improved stripping technology controls emissions by removing vinyl chloride from polyvinyl chloride resin before the resin moves through the remaining equipment in the process where the vinyl chloride would otherwise be emitted to the atmosphere. Therefore, the simplest way to determine total emissions is to measure the vinyl chloride in the resin as it leaves the stripper and before it is released to the atmosphere. Thus, if add-on control devices are used, the proposed standard is stated in terms of mass emissions to the atmosphere; if improved stripping is used, the proposed standard is stated in terms of the quantity of vinyl chloride in the polyvinyl chloride resin leaving the stripper. In both cases, the standard is stated in terms of a cumulative emission limit for all sources following the stripper to be consistent with the primary technology on which the standard is based (i.e. stripping).

Another reason the emission limit for sources following the stripper is stated in two ways is the necessity for two different averaging times. For reasons already explained, a 24-hour averaging time is desirable if improved stripping technology is selected as the means of control. Determination of emissions by measuring the vinyl chloride in stripped resin is amenable to this averaging time. If add-on controls are used, however, the 24-hour averaging time does not have the same value. If only one emission limit were given, and it were stated in terms of allowable mass emissions with a 24-hour averaging time, any plants using add-on control devices to meet the proposed standard would have to test emissions from each stack for 24 hours instead of a minimum of one hour, as is required under the proposed standard. This would be unduly burdensome for these plants.

Stating the emission limits in two different ways potentially allows plants using add-on control devices to emit slightly more emissions than plants using improved stripping technology. The two emission limits are equivalent if it is assumed that all residual vinyl chloride in the resin leaving a stripper is emitted into the atmosphere at the polyvinyl chloride plant. In fact, however, a small proportion of the vinyl chloride might be left in the resin when it leaves the plant. The discrepancy between emissions allowed by the two emission limits could be avoided by proposing one standard based on emissions into the atmosphere. For plants using improved stripping, the method for determining compliance would be to measure the vinyl chloride in the resin leaving the stripping operation and in the same resin as it leaves the plant; the difference between these



measurements would be emissions to the atmosphere between these two points. This method, however, creates enforcement problems, because the resin which is stripped in one batch is typically blended with stripped resin from other batches, and it would be difficult, if not impossible, to trace a batch all the way through the process. Complicating this problem would be the fact that the resin may be stored at the plant for some time before it is shipped. For these two reasons, it would be difficult, if not impossible, to correlate measurements of resin leaving the stripper with those from resin leaving the plant, and EPA would therefore not be able to determine the emissions from any one batch. In addition to that, the concentrations of vinyl chloride in the resin, both in the stripper and in the product leaving the plant, would have to be averaged over a long time (more than the proposed 24 hours). The long averaging time would not be desirable because it would permit more emission peaks and it would be more cumbersome to enforce. EPA concluded, therefore, that the most practical and direct approach is to limit the concentration of vinyl chloride in the resin from the stripping operation. It should be pointed out that EPA has determined that this is an emission limitation; since residual vinyl chloride monomer left in the resin after stripping would be emitted into the atmosphere at some point, the limitation on residual vinyl chloride monomer in the resin limits emissions and is, therefore, an emission limitation; it is simply specified in a form which is compatible with the only practical method for determining compliance.

To simplify enforcement, the proposed standard for the inprocess wastewater is specified in terms of concentration of vinyl chloride rather than in mass emission limits. If it were specified in terms of mass emission limits, not only the vinyl chloride concentration but also the water flowrates from each of the pieces of process equipment would have to be measured. Due to the large number of pieces of equipment involved, this would not be practical.

#### TESTING, REPORTING, RECORDKEEPING

Provisions which specify the requirements for testing, reporting, and recordkeeping are included in the proposed standard. The purpose of these requirements is to determine compliance with the proposed standard.

#### EMISSION TESTS

Test Method 106 is proposed as a reference method primarily for measuring vinyl chloride emissions from stacks. Portable hydrocarbon detectors or Method 106 can be used, except for postpolymerization reactors in the manufacture of bulk resins, to determine the degree to which vinyl chloride has been removed from equipment prior to opening the equipment to the atmosphere. For postpolymerization reactors in the manufacture of bulk resins, these test methods are not appropriate because the

reactor would be partially filled with polyvinyl chloride resin at the time the vinyl chloride concentration within it would have to be tested. Therefore, the proposed standard includes provisions for calculating emissions due to opening of the postpolymerization reactors. Test Method 107 is proposed as a reference method for measuring the vinyl chloride content of polyvinyl chloride resin and inprocess wastewater. Multipoint vinyl chloride detectors and portable hydrocarbon detectors are proposed as methods for detecting leaks from process equipment. The proposed standard also includes a requirement that stack emissions be measured on a continuing basis with a vinyl chloride detector. This vinyl chloride detector may be the multipoint vinyl chloride detector required for leak detection, but does not have to be. Vinyl chloride in the samples collected by the detector can be measured by gas chromatography, or if it is assumed that all hydrocarbons measured are vinyl chloride, by infrared spectrophotometry or flame ion detection. The proposed standard allows, upon approval by EPA, the use of equivalent or alternative test methods.

#### REPORTING

There are reporting requirements in the general provisions of Part 61 of the Code of Federal Regulations which would apply to the sources subject to the vinyl chloride standard. In addition, there are several different kinds of reports required by the proposed standard.

First, an owner or operator must submit to EPA an initial written report containing a record of emissions from the sources from which emissions can be measured using Test Method 106. These sources include ethylene dichloride purification, vinyl chloride formation and purification, and the oxychlorination reactor in ethylene dichloride-vinyl chloride plants and reactors; strippers; monomer recovery systems; and mixing, weighing, and holding containers in polyvinyl chloride plants. Compliance with the emission limitations for reactor opening loss and the sources following the stripper in polyvinyl chloride plants must be demonstrated using appropriate test methods. Measurements of the vinyl chloride concentrations in the inprocess wastewater at both ethylene dichloride-vinyl chloride and polyvinyl chloride plants are also required as part of the initial emission testing.

For those sources which have emissions which cannot be measured (fugitive emission sources), an initial report is required containing a written statement to the effect that certain pieces of equipment have been installed and are operating. These include equipment for minimizing leaks from seals on pumps, compressors, and agitators and from relief valves and equipment used for monitoring leaks. Also required is a written statement to the effect that certain procedures have been incorporated into a standard operating procedure and are being implemented. These include such procedures as removing vinyl chloride

from equipment and from loading and unloading lines before opening them to the atmosphere and venting the vinyl chloride removed from the equipment or lines to a control system, venting vinyl chloride from slip gauges during loading or unloading operations to a control system, ducting vinyl chloride emissions from manual venting to a control system, purging the vinyl chloride in each sample flask back to the process during vinyl chloride sampling, and detecting and repairing leaks.

A semi-annual report is required which is to contain a record of any emissions in excess of the proposed standard for the formation and purification processes in ethylene dichloride-vinyl chloride plants and the reactor; stripper; monomer recovery system; and containers used for mixing, weighing or holding preceding the stripper in polyvinyl chloride plants. These emissions must be measured by a vinyl chloride detector. The vinyl chloride detector reports measurements of vinyl chloride in terms of concentration. Except for the emission limit for the oxychlorination reactor, the emission limits for all the sources for which continuing measurements of vinyl chloride with a detector are required are stated in terms of concentration. The emission limit for the oxychlorination reactor is stated in terms of mass per unit product. For the oxychlorination reactor, the vinyl chloride detector can be used to measure emissions at the same time that the initial stack test is being conducted using Test Method 106. The results of that test can then be used as a guideline in the future to determine whether the emissions measured on a continuing basis with the vinyl chloride detector are in excess of the standard.

For polyvinyl chloride plants, the semi-annual report is also required to contain measurements of emissions from reactor opening and, if improved stripping is selected as the control technology to attain the standard, from the sources following the stripper. Measurements of emissions from these two sources are required on a continuing basis because the control technologies required for these two sources are primarily procedures rather than control devices. Attainment of the standard for reactor opening would require a reduction in the number of reactor openings in addition to displacing the vinyl chloride from the reactor before opening. One emission test, made within 90 days of promulgation of the standard, would give no assurance that the standard was being met on a continuing basis. With regard to stripping, the primary limitations on the degree of stripping being carried out are product degradation and processing time as it affects production rate. The degree of stripping is more a function of operating parameters than of the specific equipment being used. For this reason, even if all the equipment for stripping is installed and operated, routine measurements must be made to ensure that the degree of stripping required by the emission limitation



is being carried out on a continuing basis.

For both reactor opening and improved stripping, it is possible that the relationship between the emissions measured and the corresponding operating procedures used to attain the emissions measured can be established. For improved stripping, for example, it may be established that for a given resin grade, a given set of operating conditions (temperature, residence time, and pressure) will result in a certain concentration of vinyl chloride in the resin which is far below the standard. Likewise, for reactor opening, it may be established that a given procedure such as water displacement coupled with a given frequency of reactor opening will result in an emission level below the standard. The general provisions and the proposed standard provide for waiver of emission tests and use of alternative or equivalent test methods. Under the authority of these provisions, EPA could, on an individual basis, permit a plant to record certain parameters (such as temperature, residence time, and pressure for improved stripping) rather than emission measurements.

Any relief discharge must be reported within ten days of its occurrence. These reports will be used to determine compliance and will permit EPA to study the circumstances surrounding the discharge to determine whether the discharge could have been prevented.

#### RECORDKEEPING

Each owner or operator is also required to keep records of certain information. It is EPA's intention to require little recordkeeping in addition to that which would normally be kept by the plants.

For example, the proposed standard would require keeping records of the concentrations of vinyl chloride measured by the vinyl chloride detector(s). Printouts from the vinyl chloride detector(s) are adequate to meet this requirement. Information on detection and repair of leaks is required to be kept in log books. The purpose of this recordkeeping is to document that the procedures detailed in the program for leak detection and elimination are being carried out. There is also a requirement for keeping records of the temperatures and pressures during reactor operation. Printouts from sensor instruments are adequate to meet this requirement. These records can be used by EPA to determine occurrence of a discharge from relief valves.

#### OTHER METHODS FOR DETERMINING COMPLIANCE

In addition to the requirements for tests, reports and recordkeeping, EPA has at anytime the authority under section 114 of the Clean Air Act to require emission tests; inspect equipment, operation procedures, or records; or obtain other information as necessary to determine compliance with the standard. For example, an authorized representative of the Administrator of EPA may inspect the seals on pumps, inspect or observe

the implementation of a Standard Operating Procedure for removing vinyl chloride from a piece of equipment before opening it, etc.

#### POLYVINYL CHLORIDE PARTICULATE

EPA considered establishing an emission limit for polyvinyl chloride particulate. Polyvinyl particulate is essentially the product resin which is lost from process equipment, such as dryers, storage bins and silos, bulk loading operations and baggers, and from resin transfer equipment at polyvinyl chloride plants. There are two potential health problems related to exposure to polyvinyl chloride particulate. First, polyvinyl chloride particulate can be a source of vinyl chloride emissions. Second, studies of people occupationally exposed to polyvinyl chloride particulate and animals exposed experimentally to polyvinyl chloride particulate have indicated that the particulate may possibly cause pneumoconiosis.

Vinyl chloride emissions due to polyvinyl chloride particulate would be due to the fact that it contains residual vinyl chloride monomer. The amount of residual vinyl chloride in the particulate is dependent on the physical properties (size and porosity) of the product being manufactured and the degree to which residual vinyl chloride has been stripped from the product before it reaches the dryer and as it goes through the dryer. The amount of residual vinyl chloride released from the particulate once it is in the environment has not been quantified.

The proposed standard would indirectly reduce the potential problem which may be associated with emissions of residual vinyl chloride from the particulate through the control techniques (improved stripping or add-on controls) which would be used to attain the proposed emission limit for the sources following the stripper. EPA evaluated the degree to which existing control equipment and the proposed standard would reduce this particulate problem. This was done by calculating the maximum quantity of vinyl chloride which could be emitted by the particulate. For the purposes of this calculation, it was assumed that an atypically large plant, equipped with the lowest efficiency particulate control reported by the plants to EPA, emitted particulate containing the maximum quantity of vinyl chloride possible if improved stripping were used to meet the proposed standard. Based on this calculation, it was estimated that the maximum vinyl chloride emissions from the polyvinyl chloride particulate would be less than a tenth of a kilogram per hour or a fraction of a percent of the estimated total vinyl chloride emission rate from the same plant in compliance with the proposed standard. (If the plant used add-on controls instead of improved stripping to comply with this standard, the vinyl chloride emission rate from the particulate would be even lower, because the add-on control equipment would indirectly result in better particulate control). Therefore, with regard to the potential problem of polyvinyl chloride particulate as a source of vinyl chloride

emissions, EPA has determined that the indirect impact of the proposed standard on vinyl chloride emissions from the particulate makes direct regulation of the particulate unnecessary.

With regard to the potential problem of polyvinyl chloride particulate as a possible cause of pneumoconiosis, NIOSH is currently involved in experimental studies on the effects of the particulate on animals. The extent of public exposure (as opposed to occupational exposure) to ambient concentrations of the particulate is unknown at this time. Ambient measurements of polyvinyl chloride particulate have not been made by EPA in the vicinity of industrial sources because no technology is currently available for separating polyvinyl chloride particulate from total suspended particulate. Most polyvinyl chloride plants are already equipped with relatively high efficiency particulate control devices. As data become available from NIOSH and other sources on the health effects of polyvinyl chloride particulate, however, EPA may find that it is necessary to reevaluate the need to propose regulations for polyvinyl chloride particulate.

#### IMPACTS

The Energy Supply and Environmental Coordination Act of 1974 exempted proposed actions under the Clean Air Act from the requirements of the National Environmental Policy Act (NEPA) of 1969 that Federal agencies prepare environmental impact statements on major Federal actions significantly affecting the quality of the human environment. EPA has concluded, however, that voluntary preparation of environmental impact statements would be beneficial for some regulatory actions and has, therefore, prepared such a statement for the proposed vinyl chloride standard. However, this voluntary preparation of environmental impact statements in no way legally subjects EPA to NEPA requirements.

The beneficial, or primary, environmental impacts of the proposed standard would be reductions in vinyl chloride emissions from ethylene dichloride-vinyl chloride and polyvinyl chloride plants, and consequently, corresponding reductions in ambient air concentrations of vinyl chloride and risks to health in the vicinity of these sources. Although the proposed standard would not eliminate all vinyl chloride emissions, it would further the protection of public health by minimizing emissions. For a typical average-sized ethylene dichloride-vinyl chloride plant, the proposed standard would reduce hourly vinyl chloride emissions from 176 kg to 10kg. This is approximately a 94 percent reduction. For a typical average-sized polyvinyl chloride plant, the hourly vinyl chloride emissions would be reduced from 330 kg to 16 kg, or by approximately 95 percent. Percentage numbers for both source categories are based on an estimated 90 percent reduction in fugitive emissions.

There are several potential adverse, or secondary, environmental impacts of the proposed standard. These include in-



creased atmospheric emissions of hydrogen chloride, lowered pH of inprocess wastewater due to hydrogen chloride, increased water consumption, small increases in the quantity of vinyl chloride released into inprocess wastewater, increased solid waste disposal due to carbon used for adsorption and increased energy consumption. The types and degree of the secondary impacts resulting from the proposed standard would vary from plant to plant depending on the type of control selected to meet the standard.

The potential secondary or adverse environmental impacts of the proposed standard are either insignificant or will be minimized without additional action, except for two. First, EPA is currently investigating the impact of the proposed standard and its effects of increasing water consumption and lowering the pH of plant effluent on the current effluent regulations, and will make adjustments to the effluent regulations as deemed necessary by the study. Second, hydrogen chloride is already emitted by process equipment at ethylene dichloride-vinyl chloride plants and by other petrochemical plants in the complexes where ethylene dichloride-vinyl chloride plants are typically located. An incinerator used to attain the proposed standard at an ethylene dichloride-vinyl chloride plant could increase its hydrogen chloride emission by several fold. Typically, however, due to the corrosion problems which would otherwise occur both on plant property and in the community, plants use scrubbers to control already existing hydrogen chloride emissions. Hydrogen chloride emissions resulting from control of vinyl chloride emissions are expected to also be controlled for the same reason. If even a moderately efficient scrubber (98 percent control) were used to control the hydrogen chloride emissions resulting from incineration of vinyl chloride emissions, the increase in hydrogen chloride emissions from a typical ethylene dichloride-vinyl chloride plant due to the proposed standard would be reduced to 35 percent. However, since diffusion model results indicate that under "worst-case" meteorological conditions, the hydrogen chloride emissions from the process equipment and the incinerator combined would cause maximum ambient concentrations of hydrogen chloride in the vicinity of ethylene dichloride-vinyl chloride plants to be in the same range or somewhat higher than existing foreign standards and National Academy of Sciences (NAS) guidelines for public exposure, EPA plans to further evaluate the need to control hydrogen chloride emissions. NAS is currently preparing a report on the health effects of hydrogen chloride for EPA. A final draft of that report is scheduled for completion by the end of 1975. At that time, EPA will assess the hydrogen chloride problem.

In accordance with Executive Order 11821 and OMB Circular A-107, EPA has carefully evaluated the economic and inflationary impacts of the proposed standard. The economic analysis is contained in the "Standard Support and

Environmental Impact Statement" and includes the costs of control systems which can be used to attain the proposed standard and alternative control levels and the impact of these costs on the vinyl chloride industries and the public consumer. The total capital cost for existing plants to meet the proposed standard is \$198 million and the total annualized cost is \$70 million.

Also, included in the economic analysis were the costs of the EPA water effluent guideline limitations which the plants will be subject to in 1983 and the OSHA standard for vinyl chloride. The total capital cost for existing plants to meet the EPA water effluent guideline limitations is \$83 million and the total annualized cost is \$17 million. The costs to the industry of meeting the OSHA standard cannot be quantified at this time, but they are expected to overlap to some degree with the costs to meet the fugitive emission regulations. The capital cost of meeting the fugitive emission regulations is \$37 million and the annualized cost is \$25 million.

The proposed standard would not deter construction of new ethylene dichloride-vinyl chloride plants or most types of new polyvinyl chloride plants. For one type of polyvinyl chloride plant (dispersion process) that represents 13 percent of the industry production, the proposed standard would significantly deter the construction of new plants that have capacities of less than 45 million kg/yr (100 million lb/yr) but would not deter construction of plants larger than 45 million kg/yr. Total costs for attainment of the proposed standard and the effluent limitations are estimated to result in the closing of no ethylene dichloride-vinyl chloride plants and four small polyvinyl chloride plants. These four plants are estimated to employ 30 people and account for approximately 0.5 percent of existing industry capacity. It is estimated that the four plant closures resulting from imposition of the proposed standard would have occurred if only the costs of fugitive emission controls were imposed.

It is estimated that the price of polyvinyl chloride resins would rise by approximately 7.3 percent in order to maintain precontrol profitability and also to recover the total annualized control costs necessitated by the proposed standard at ethylene dichloride-vinyl chloride plants and polyvinyl chloride plants. This increase is estimated to translate into a maximum consumer price increase in goods fabricated from polyvinyl chloride resins of approximately 3.5 percent. Recovery of effluent annualized costs plus maintenance of precontrol profitability is estimated to add approximately 2 percent to polyvinyl chloride resin prices and result in an additional maximum consumer price increase of 1 percent.

The notice of proposed rulemaking is issued under the authority of sections 112 and 114 of the Clean Air Act, as amended Pub. L. 91-604 (42 U.S.C. 1857c-7, 1857c-9).

It is hereby certified that the economic and inflationary impacts of this proposed

regulation have been carefully evaluated in accordance with OMB Circular A-107.

Dated: December 16, 1975.

RUSSELL E. TRAIN,  
Administrator.

#### Subpart F—National Emission Standard for Vinyl Chloride

##### § 61.60 Applicability.

This subpart applies to plants which produce:

- (a) ethylene dichloride by reaction of oxygen and hydrogen chloride with ethylene.
- (b) vinyl chloride by any process, and/or
- (c) one or more polymers containing any fraction of polymerized vinyl chloride.

##### § 61.61 Definitions.

Terms used in this subpart are defined in the Act, in subpart A of this part, or in this section as follows:

- (a) "Ethylene dichloride plant" includes any plant which produces ethylene dichloride by reaction of oxygen and hydrogen chloride with ethylene.
- (b) "Vinyl chloride plant" includes any plant which produces vinyl chloride by any process.
- (c) "Polyvinyl chloride plant" includes any plant where vinyl chloride alone or in combination with other materials is polymerized.
- (d) "Slip gauge" means a gauge which has a probe that moves through the gas/liquid interface in a storage or transfer vessel and indicates the level of vinyl chloride in the vessel by the physical state of the material the gauge discharges.
- (e) "Type of resin" means the broad classification of resin referring to the basic manufacturing process for producing that resin, including, but not limited to, the suspension, dispersion, latex, bulk, and solution processes.
- (f) "Grade of resin" means the subdivision of resin classification which describes it as a unique resin, i.e., the most exact description of a resin with no further subdivision.
- (g) "Dispersion resin" means a resin manufactured in such a way as to form fluid dispersions when dispersed in a plasticizer or plasticizer/diluent mixtures.
- (h) "Latex resin" means a resin which is produced by a polymerization process which initiates from free radical catalyst sites and is sold undried.
- (i) "Bulk resin" means a resin which is produced by a polymerization process in which no water is used.
- (j) "Inprocess wastewater" means any water which, during manufacturing or processing, comes into direct contact with vinyl chloride or polyvinyl chloride or results from the production or use of any raw material, intermediate product, finished product, by-product, or waste product containing vinyl chloride or polyvinyl chloride but which has not been discharged to a wastewater treatment process or discharged untreated as wastewater.



(k) "Wastewater treatment process" includes any process which modifies characteristics such as BOD, COD, TSS, and pH, usually for the purpose of meeting effluent guidelines and standards; it does not include any process the purpose of which is to remove vinyl chloride from water to meet requirements of this subpart.

(l) "In vinyl chloride service" means that a piece of equipment contains either a liquid that is at least 10 percent by weight vinyl chloride or a gas that is at least 10 percent by volume vinyl chloride.

(m) "Vinyl chloride detector" means a device which obtains air samples from one or more points on a continuous sequential basis and analyzes the samples with gas chromatography or, if the owner or operator assumes that all hydrocarbons measured are vinyl chloride, with infrared spectrophotometry, flame ion detection, or an equivalent or alternative method.

(n) "Portable hydrocarbon detector" means a device which measures hydrocarbons with a sensitivity of at least 5 ppm and is of such design and size that it can be used to measure emissions from localized points.

(o) "Standard operating procedure" means a formal written procedure officially adopted by the plant owner or operator and available on a routine basis to those persons responsible for carrying out the procedure.

(p) "Run" means the net period of time during which an emission sample is collected.

(q) "Ethylene dichloride purification" includes any part of the process of ethylene dichloride production which follows ethylene dichloride formation and in which finished ethylene dichloride is produced.

(r) "Vinyl chloride purification" includes any part of the process of vinyl chloride production which follows vinyl chloride formation and in which finished vinyl chloride is produced.

(s) "Reactor" includes any vessel in which vinyl chloride is partially or totally polymerized into polyvinyl chloride.

(t) "Reactor opening loss" means the emissions of vinyl chloride occurring when a reactor is vented to the atmosphere for any purpose other than an emergency relief discharge as defined in § 61.65(a).

(u) "Stripper" includes any vessel in which residual vinyl chloride is removed from polyvinyl chloride resin, except bulk resin, in the slurry form by the use of heat and/or vacuum. In the case of bulk resin, stripper includes any vessel which is used to remove residual vinyl chloride from polyvinyl chloride resin immediately following the polymerization step in the plant process flow.

#### § 61.62 Emission standard for ethylene dichloride plants.

An owner or operator of an ethylene dichloride plant shall comply with the requirements of this section and § 61.65.

(a) Ethylene dichloride purification: The concentration of vinyl chloride in

all exhaust gases discharged to the atmosphere from any equipment used in ethylene dichloride purification is not to exceed 10 ppm, except as provided in § 61.65(a). This requirement does not apply to equipment that is open and meets the requirement in § 61.65(b) (6) (i).

(b) Oxychlorination reactor: Except as provided in § 61.65(a), emissions of vinyl chloride to the atmosphere from each oxychlorination reactor are not to exceed 0.02 kg/100 kg (0.02 lb/100 lb) of the 100 percent ethylene dichloride product from the oxychlorination process.

#### § 61.63 Emission standard for vinyl chloride plants.

An owner or operator of a vinyl chloride plant shall comply with the requirements of this section and § 61.65.

(a) Vinyl chloride formation and purification: The concentration of vinyl chloride in all exhaust gases discharged to the atmosphere from any equipment used in vinyl chloride formation and/or purification is not to exceed 10 ppm, except as provided in § 61.65(a). This requirement does not apply to equipment that is open and meets the requirement in § 61.65(b) (6) (i).

#### § 61.64 Emission standard for polyvinyl chloride plants.

An owner or operator of a polyvinyl chloride plant shall comply with the requirements of this section and § 61.65.

(a) Reactor: The following requirements apply to reactors:

(1) The concentration of vinyl chloride in all exhaust gases discharged to the atmosphere from each reactor is not to exceed 10 ppm, except as provided in paragraph (a) (2) of this section and § 61.65(a).

(2) The reactor opening loss from each reactor is not to exceed 0.001 kg vinyl chloride/100 kg (0.001 lb vinyl chloride/100 lb) of polyvinyl chloride product, with the product determined on a dry solids basis. This requirement applies to any vessel which is used as a reactor or as both a reactor and a stripper. In the bulk process, the product means the gross product of prepolymerization and postpolymerization.

(b) Stripper: The concentration of vinyl chloride in all exhaust gases discharged to the atmosphere from each stripper is not to exceed 10 ppm, except as provided in § 61.65(a). This requirement does not apply to equipment that is open and meets the requirement in § 61.65(b) (6) (i).

(c) Mixing, weighing, and holding containers: The concentration of vinyl chloride in all exhaust gases discharged to the atmosphere from each mixing, weighing, or holding container in vinyl chloride service which precedes the stripper (or the reactor if the plant has no stripper) in the plant process flow is not to exceed 10 ppm, except as provided in § 61.65(a). This requirement does not apply to equipment that is open and meets the requirement in § 61.65(b) (6) (i).

(d) Monomer recovery system. The concentration of vinyl chloride in all ex-

haust gases discharged to the atmosphere from each monomer recovery system is not to exceed 10 ppm, except as provided in § 61.65(a). This requirement does not apply to equipment that is open and meets the requirement in § 61.65(b) (6) (i).

(e) Sources following the stripper(s): The following requirements apply to emissions of vinyl chloride to the atmosphere from the combination of all sources following the stripper(s) [or the reactor(s) if the plant has no stripper(s)] in the plant process flow, including but not limited to, centrifuges, concentrators, blend tanks, filters, dryers, conveyor air discharges, baggers, storage containers, and inprocess wastewater:

(1) In polyvinyl chloride plants using stripping technology to control vinyl chloride emissions, the weighted average residual vinyl chloride concentration in all grades of polyvinyl chloride resin processed through the stripping operation on each calendar day, measured as the resin leaves the stripper, may not exceed:

(i) 2000 ppm for polyvinyl dispersion resins, excluding latex resins;

(ii) 400 ppm for all other polyvinyl chloride resins, including latex resins, averaged separately for each type of resin; or

(2) In polyvinyl chloride plants controlling vinyl chloride emissions with technology other than stripping or in addition to stripping, emissions of vinyl chloride to the atmosphere may not exceed:

(i) 0.20 kg/100 kg (0.20 lb/100 lb) product from the stripper(s) [or reactor(s) if the plant has no stripper(s)] for dispersion polyvinyl chloride resins, excluding latex resins, with the product determined on a dry solids basis;

(ii) 0.04 kg/100 kg (0.04 lb/100 lb) product from the strippers (or reactor(s) if the plant has no stripper(s)) for all other polyvinyl chloride resins, including latex resins, with the product determined on a dry solids basis.

#### § 61.65 Emission standard for ethylene dichloride, vinyl chloride and polyvinyl chloride plants.

An owner or operator of an ethylene dichloride, vinyl chloride, and/or polyvinyl chloride plant shall comply with the requirements of this section.

(a) Relief valve discharge: Except for an emergency relief discharge, there is to be no discharge to the atmosphere from any relief valve on any equipment in vinyl chloride service. An emergency relief discharge means a discharge which could not have been avoided by taking all available measures to prevent the discharge. Within 10 days of any relief valve discharge, the owner or operator of the source from which the relief valve discharge occurs shall submit to the Administrator a report in writing containing information on the source, nature and cause of the discharge, the date and time of the discharge, the approximate total vinyl chloride loss during the discharge, the method used for determining the vinyl chloride loss, the action that



was taken to prevent the discharge, and measures adopted to prevent future discharges.

(b) Fugitive emission sources:

(1) Loading and unloading lines: Vinyl chloride emissions from loading and unloading lines are to be minimized as follows:

(i) After each loading or unloading operation and before opening a loading or unloading line to the atmosphere, the quantity of vinyl chloride in all parts of each loading or unloading line that are to be opened to the atmosphere is to be reduced so that the parts combined contain no greater than 4.1 l (1 gal) of vinyl chloride, as standard temperature and pressure; and

(ii) Any vinyl chloride removed from a loading or unloading line in accordance with paragraph (b)(1)(i) of this section is to be ducted through a control system from which the concentration of vinyl chloride in the exhaust gases does not exceed 10 ppm, or equivalent as provided in § 61.66.

(2) Slip gauges: During loading or unloading operations, the vinyl chloride emissions from each slip gauge in vinyl chloride service are to be minimized by ducting any vinyl chloride discharged from the slip gauge through a control system from which the concentration of vinyl chloride in the exhaust gases does not exceed 10 ppm, or equivalent as provided in § 61.66.

(3) Leakage from pump, compressor, and agitator seals:

(i) Rotating pumps: Vinyl chloride emissions from seals on all rotating pumps in vinyl chloride service are to be minimized by installing sealless pumps, pumps with double mechanical seals, or equivalent as provided in § 61.66. If double mechanical seals are used, vinyl chloride emissions from the seals are to be minimized by maintaining the pressure between the two seals so that any leak that occurs is into the pump; by ducting any vinyl chloride between the two seals through a control system from which the concentration of vinyl chloride in the exhaust gases does not exceed 10 ppm; or equivalent as provided in § 61.66.

(ii) Reciprocating pumps: Vinyl chloride emissions from seals on all reciprocating pumps in vinyl chloride service are to be minimized by installing double outboard seals, or equivalent as provided in § 61.66. If double outboard seals are used, vinyl chloride emissions from the seals are to be minimized by maintaining the pressure between the two seals so that any leak that occurs is into the pump; by ducting any vinyl chloride between the two seals through a control system from which the concentration of vinyl chloride in the exhaust gases does not exceed 10 ppm; or equivalent as provided in § 61.66.

(iii) Compressor: Vinyl chloride emissions from seals on all compressors in vinyl chloride service are to be minimized by installing compressors with double mechanical seals, or equivalent as provided in § 61.66. If double mechanical seals are used, vinyl chloride emis-

sions from the seals are to be minimized by maintaining the pressure between the two seals so that any leak that occurs is into the pump; by ducting any vinyl chloride between the two seals through a control system from which the concentration of vinyl chloride in the exhaust gases does not exceed 10 ppm; or equivalent as provided in § 61.66.

(iv) Agitator: Vinyl chloride emissions from seals on all agitators in vinyl chloride service are to be minimized by installing agitators with double mechanical seals, or equivalent as provided in § 61.66. If double mechanical seals are used, vinyl chloride emissions from the seals are to be minimized by maintaining the pressure between the two seals so that any leak that occurs is into the pump; by ducting any vinyl chloride between the two seals through a control system from which the concentration of vinyl chloride in the exhaust gases does not exceed 10 ppm; or equivalent as provided in § 61.66.

(4) Leakage from relief valves: Vinyl chloride emissions due to leakage from each relief valve on equipment in vinyl chloride service are to be minimized by installing a rupture disk between the equipment and the relief valve, or equivalent as provided in § 61.66.

(5) Manual venting of gases: All gases which are manually vented from equipment in vinyl chloride service are to be ducted through a control system from which the concentration of vinyl chloride in the exhaust gases does not exceed 10 ppm, or equivalent as provided in § 61.66.

(6) Opening of equipment: Vinyl chloride emissions from opening of equipment are to be minimized as follows:

(i) Before opening any equipment for any reason, the quantity of vinyl chloride is to be reduced so that the equipment contains no more than 2.0 percent by volume vinyl chloride or 110 l (25 gal) of vinyl chloride, whichever is larger, at standard temperature and pressure; and

(ii) Any vinyl chloride removed from the equipment in accordance with paragraph (b)(6)(i) of this section is to be ducted through a control system from which the concentration of vinyl chloride in the exhaust gases does not exceed 10 ppm, or equivalent as provided in § 61.66.

(7) Sample flask: There are to be no vinyl chloride emissions to the atmosphere due to the vinyl chloride left in any sample flask after an analysis is made or due to the vinyl chloride passed through any flask during sampling in order to obtain a representative sample.

(8) Leak detection and elimination: Vinyl chloride emissions due to leaks from equipment in vinyl chloride service are to be minimized by instituting and implementing a formal leak detection and elimination program. The owner or operator shall submit a description of the program to the Administrator for approval. The program is to be submitted within 45 days of the effective date of these regulations, unless a waiver of compliance is granted under § 61.11.

If a waiver of compliance is granted, the program is to be submitted on a date scheduled by the Administrator. Approval of a program will be granted by the Administrator provided he finds:

(i) It includes a reliable and accurate vinyl chloride detector for detection of major leaks and identification of the general area of the plant where a leak is located;

(ii) It includes a reliable and accurate portable hydrocarbon detector to be used routinely to find small leaks and to pinpoint the major leaks indicated by the vinyl chloride detector;

(iii) It provides for an acceptable calibration and maintenance schedule for the vinyl chloride detector and portable hydrocarbon detector;

(iv) The location and number of points to be monitored and the frequency of monitoring provided for in the program are acceptable when they are compared with the number of pieces of equipment in vinyl chloride service and the size and physical layout of the plant;

(v) It contains an acceptable plan of action to be taken when a leak is detected; and

(vi) It contains a definition of leak which is acceptable when compared with the background concentrations of vinyl chloride in the areas of the plant to be monitored by the vinyl chloride detector. Measurements of background concentrations of vinyl chloride in the areas of the plant to be monitored by the vinyl chloride detector are to be included with the description of the program. The definition of leak for a given plant may vary among the different areas within the plant and is also to change over time as background concentrations in the plant are reduced.

(9) Inprocess wastewater: Vinyl chloride emissions to the atmosphere from inprocess wastewater are to be reduced as follows:

(i) The concentration of vinyl chloride in each inprocess wastewater stream immediately as it leaves a piece of equipment and before being mixed with any other inprocess wastewater stream is to be reduced by 10 ppm by weight before being exposed to the atmosphere, or before being discharged to a wastewater treatment process or discharged untreated as a wastewater. This paragraph does apply to water which is used to displace vinyl chloride from equipment before it is opened to the atmosphere in accordance with § 61.64(a)(2) or paragraph (b)(6) of this section, but does not apply to water which is used to wash out equipment after the equipment has already been opened to the atmosphere in accordance with § 61.64(a)(2) or paragraph (b)(6) of this section.

(ii) Any vinyl chloride removed from the inprocess wastewater in accordance with paragraph (b)(9)(i) of this section is to be ducted through a control system from which the concentration of vinyl chloride in the exhaust gases does not exceed 10 ppm, or equivalent as provided in § 61.66.

(c) The requirements in paragraphs (b)(1), (b)(2), (b)(5), (b)(6), (b)(7) and (b)(8) of this section are to be in-



incorporated into a standard operating procedure, and made available upon request for inspection by the Administrator. The standard operating procedure is to include provisions for measuring the vinyl chloride in equipment  $\geq 550$  l (1250 gal) in volume for which an emission limit is prescribed in § 61.65(b) (6) (i) prior to opening the equipment and using Test Method 106, a portable hydrocarbon detector, or an equivalent or alternative method. The method of measurement is to meet the requirements in § 61.67(g) (5) (i) (A) or (g) (5) (i) (B).

#### § 61.66 Equivalent equipment and procedures.

Upon written application from an owner or operator, the Administrator may approve use of equipment or procedures which have been demonstrated to his satisfaction to be equivalent in terms of reducing vinyl chloride emissions to the atmosphere to those prescribed for compliance with a specific paragraph of this subpart.

#### § 61.67 Emission tests.

(a) Unless a waiver of emission testing is obtained under § 61.13, the owner or operator of a source to which this subpart applies shall test emissions from the source.

(1) Within 90 days of the effective date in the case of an existing source or a new source which has an initial startup date preceding the effective date, or

(2) Within 90 days of startup in the case of a new source, initial startup of which occurs after the effective date.

(b) The owner or operator shall provide the Administrator at least 30 days prior notice of an emission test to afford the Administrator the opportunity to have an observer present during the test.

(c) Any emission test is to be conducted while the equipment being tested is operating at the maximum production rate at which the equipment will be operated and under other relevant conditions as may be specified by the Administrator based on representative performance of the source.

(d) Each emission test is to consist of three runs. For the purpose of determining emissions, the average of results of all runs is to apply.

(e) All samples are to be analyzed, and vinyl chloride emissions are to be determined within 30 days after the emission test. The owner or operator shall report the determinations to the Administrator by a registered letter dispatched before the close of the next business day following the determination.

(f) The owner or operator shall retain at the plant and make available, upon request, for inspection by the Administrator, for a minimum of 2 years records of emission test results and other data needed to determine emissions.

(g) Unless otherwise specified, the owner or operator shall use test Test Methods in Appendix B to this part for each test as required by paragraphs

(g) (1), (g) (2), (g) (3), (g) (4), and (g) (5) of this section, unless an equivalent method or an alternative method has been approved by the Administrator. If the Administrator finds reasonable grounds to dispute the results obtained by an equivalent or alternative method, he may require the use of a reference method. If the results of the reference and equivalent or alternative methods do not agree, the results obtained by the reference method prevail, and the Administrator may notify the owner or operator that approval of the method previously considered to be equivalent or alternative is withdrawn.

(1) Test Method 106 is to be used to determine the vinyl chloride emissions from any source for which an emission limit is prescribed in §§ 61.62(a) or (b) § 61.63(a), or §§ 61.64(a) (1), (b), (c), or (d), or from any control system to which reactor emissions are required to be ducted in § 61.64(a) (2) or to which fugitive emissions are required to be ducted in §§ 61.65(b) (1) (ii), (b) (2), (b) (5), (b) (6) (ii), or (b) (9) (ii).

(i) For each run, one sample is to be collected. The sampling site is to be at least two stack or duct diameters downstream and one half diameter upstream from any flow disturbance such as a bend, expansion, contraction, or visible flame. For a rectangular cross section an equivalent diameter is to be determined from the following equation:

$$\text{equivalent diameter} = 2 \frac{(\text{length})(\text{width})}{\text{length} + \text{width}}$$

The sampling point in the duct is to be at the centroid of the cross section. The sample is to be extracted at a rate proportional to the gas velocity at the sampling point. The sample is to be taken over a minimum of one hour, and is to contain a minimum volume of 50 liters corrected to standard conditions.

(ii) For those emission sources where combustion is used to reduce vinyl chloride emissions, the concentration of vinyl chloride as determined by Test Method 106 is to be corrected to 10 percent oxygen (wet basis) for determination of emissions by using the following equation:

$$C_{\text{corrected}} = C_{\text{a}} \frac{10.9}{20.9 - \text{percent } O_2}$$

where:

$C_{\text{corrected}}$  = The concentration of vinyl chloride in the exhaust gases, corrected to 10 percent oxygen.

$C_{\text{a}}$  = The concentration of vinyl chloride as measured by Test Method 106.

20.9 = Percent oxygen in the ambient air at standard conditions.

10.9 = Percent oxygen in the ambient air at standard conditions, minus the 10 percent oxygen to which the correction is being made.

Percent  $O_2$  = Percent oxygen in the exhaust gas as measured by Reference Method 3 in Appendix A of Part 60 of this chapter.

(iii) For those emission sources where the emission limit is prescribed in terms of mass rather than concentration, mass emissions in kg/100 kg product are to be determined by using the following equation:

$$C_{\text{BX}} = \frac{[C_{\text{a}} (2.60) Q 10^{-6}] [100]}{Z}$$

where:

$C_{\text{BX}}$  = kg vinyl chloride/100 kg product.

$C_{\text{a}}$  = The concentration of vinyl chloride as measured by Test Method 106.

2.60 = Density of vinyl chloride at one atmosphere and 20°C in kg/m<sup>3</sup>.

$Q$  = Volumetric flow rate in m<sup>3</sup>/hr as determined by Reference Method 2 of Appendix A to Part 60 of this chapter.

$10^{-6}$  = Conversion factor for ppm.

$Z$  = Production rate (kg/hr).

(2) Test Method 107 is to be used to determine the concentration of vinyl chloride in each inprocess wastewater stream for which an emission limit is prescribed in § 61.65(b) (9) (i).

(3) Where a stripping operation is used to attain the emission limit in § 61.64(e), emissions are to be determined using Test Method 107 as follows:

(i) The number of strippers and samples and the types and grades of resin to be sampled are to be determined by the Administrator for each individual plant at the time of the test, based on the plant's operation.

(ii) Each sample is to be taken immediately following the stripping operation as the resin is transferred out of the stripper.

(iii) The corresponding quantity of material processed by each stripper is to be determined on a dry solids basis and by a method submitted to and approved by the Administrator.

(iv) At the prior request of the Administrator, the owner or operator shall provide duplicates of the samples required in paragraph (g) (3) (i) of this section.

(4) Where control technology other than or in addition to a stripping operation is used to attain the emission limit in § 61.64(e), emissions are to be determined as follows:

(i) Test Method 106 is to be used to determine atmospheric emissions from all of the process equipment simultaneously. The requirements of paragraph (g) (1) of this section are to be met.

(ii) Test Method 107 is to be used to determine the concentration of vinyl chloride in each inprocess wastewater stream subject to the emission limit prescribed in § 61.64(e). The mass of vinyl chloride in kg/100 kg product in each in process wastewater stream is to be determined by using the following equation:

$$C_{\text{BX}} = \frac{[C_{\text{a}} R 10^{-6}] [100]}{Z}$$

where:

$C_{\text{BX}}$  = kg vinyl chloride/100 kg product.

$C_{\text{a}}$  = the concentration of vinyl chloride as measured by Test Method 107.

$R$  = water flow rate in l/hr, determined in accordance with a method which has been submitted to and approved by the Administrator.

$10^{-6}$  = Conversion factor for ppm.

$Z$  = Production rate (kg/hr), determined in accordance with a method which has been submitted and approved by the Administrator.

(5) The reactor opening loss for which an emission limit is prescribed in § 61.64(a) (2) is to be determined. The number of reactors for which the determination is to be made is to be specified by the



Administrator for each individual plant at the time of the determination based on the plant's operation.

(1) Except as provided in paragraph (g) (5) (ii) of this section, the reactor opening loss is to be determined using the following equation:

$$C = \frac{W(2.60)(10^{-6})(Cb)}{YZ}$$

where:

C = kg vinyl chloride emissions/kg product.  
 W = Capacity of the reactor in m<sup>3</sup>.  
 2.60 = Density of vinyl chloride at one atmosphere and 20° C in kg/m<sup>3</sup>.  
 10<sup>-6</sup> = Conversion factor for ppm.  
 Cb = ppm by volume vinyl chloride as determined by Test Method 106 or a portable hydrocarbon detector.  
 Y = Number of batches since the reactor was last opened to the atmosphere.  
 Z = Average kg of polyvinyl chloride produced per batch in the number of batches since the reactor was last opened to the atmosphere.

(A) If Method 106 is used to determine the concentration of vinyl chloride (Cb), the sample is to be withdrawn at a constant rate with a probe of sufficient length to reach the vessel bottom from the manhole. Samples are to be taken for 5 minutes within 6 inches of the vessel bottom, 5 minutes near the vessel center, and 5 minutes near the vessel top.

(B) If a portable hydrocarbon detector is used to determine the concentration of vinyl chloride (Cb), a probe of sufficient length to reach the vessel bottom from the manhole is to be used to make the measurements. One measurement will be made within 6 inches of the vessel bottom, one near the vessel center and one near the vessel top. Measurements are to be made at each location until the reading is stabilized. All hydrocarbons measured are to be assumed to be vinyl chloride.

(C) The production rate of polyvinyl chloride (Z) is to be determined by a method submitted to and approved by the Administrator.

(ii) A calculation based on the number of evacuations, the vacuum involved, and the volume of gas in the reactor is hereby approved by the Administrator as an alternative method for determining reactor opening loss for postpolymerization reactors in the manufacture of bulk resins.

#### § 61.68 Initial report.

(a) An owner or operator of any source to which this subpart applies shall submit a statement in writing notifying the Administrator that the equipment and procedural specifications in §§ 61.65 (b) (1), (b) (2), (b) (3), (b) (4), (b) (5), (b) (6), (b) (7), and (b) (8) are being implemented.

(b) (1) In the case of an existing source or a new source which has an initial startup date preceding the effective date, the statement is to be submitted within 90 days of the effective date, unless a waiver of compliance is granted under § 61.11, along with the information required under § 61.10. If a waiver of compliance is granted, the statement is to be submitted on a date scheduled by the Administrator.

(2) In the case of a new source which did not have an initial startup date preceding the effective date, the statement

is to be submitted within 90 days of the initial startup date.

(c) The statement is to contain the following information:

(1) A list of the equipment installed for compliance.

(2) A detailed engineering description of the physical and functional characteristics of each piece of equipment.

(3) A description of the methods which have been incorporated into the standard operating procedures for measuring or calculating the emissions for which emission limits are prescribed in §§ 61.65 (b) (1) (i) and (b) (6) (i).

(4) A statement that each piece of equipment is installed and that each piece of equipment and each procedure is being used.

#### § 61.69 Semiannual report.

(a) The owner or operator of any source to which this subpart applies shall submit to the Administrator on a continuing basis each 180 days a report in writing containing the information required by this section.

(b) (1) In the case of an existing source or a new source which has an initial startup date preceding the effective date, the first report is to be submitted within 180 days of the effective date, unless a waiver of compliance is granted under § 61.11. If a waiver of compliance is granted, the first report is to be submitted on a date scheduled by the Administrator.

(2) In the case of a new source which did not have an initial startup date preceding the effective date, the first report is to be submitted within 180 days of the initial startup date.

(c) Unless otherwise specified, the owner or operator shall use the Test Methods in Appendix B to this part to conduct emission tests as required by paragraphs (c) (2) and (c) (3) of this section, unless an equivalent or an alternative method has been approved by the Administrator. If the Administrator finds reasonable grounds to dispute the results obtained by an equivalent or alternative method, he may require the use of a reference method. If the results of the reference and equivalent or alternative methods do not agree, the results obtained by the reference method prevail, and the Administrator may notify the owner or operator that approval of the method previously considered to be equivalent or alternative is withdrawn.

(1) The owner or operator shall include in the report a record of any emissions in excess of the emission limits prescribed in §§ 61.62(a) or (b), § 61.63(a), or §§ 61.64(a) (1), (b), (c), or (d), or for any control system to which reactor emissions are required to be ducted in § 61.64(a) (2) or to which fugitive emissions are required to be ducted in § 61.65 (b) (1) (ii), (b) (2), (b) (5), (b) (6) (ii), or (b) (9) (ii). The emissions are to be measured with a vinyl chloride detector.

(2) The owner or operator shall include in the report a record of the quantity of emissions of vinyl chloride from the sources following the stripper(s) or the reactor(s) if the plant has no strip-

per(s) in polyvinyl chloride plants for which a stripping operation is used to attain the emission limit prescribed in § 61.64(e). Test Method 107 is to be used to determine emissions as follows:

(i) If batch stripping is used, one representative sample of polyvinyl chloride resin is to be taken from each batch of each grade of resin immediately following the completion of the stripping operation as the resin is transferred out of the stripper, and identified by resin type and grade and the date and time the batch is completed. The corresponding quantity of material processed in each stripper batch is to be recorded and identified by resin type and grade and the date and time the batch is completed.

(ii) If continuous stripping is used, one representative sample of polyvinyl chloride resin is to be taken for each grade of resin processed or at intervals of 8 hours for each grade of resin which is being processed, whichever is more frequent. The sample is to be taken as the resin flows out of the stripper and identified by resin type and grade and the date and time the sample was taken. The corresponding quantity of material processed by each stripper over the time period represented by the sample during the eight hour period, is to be recorded and identified by resin type and grade and the date and time it represents.

(iii) The quantity of material processed by the stripper is to be determined on a dry solids basis and by a method submitted to and approved by the Administrator.

(iv) At the prior request of the Administrator, the owner or operator shall provide duplicates of the samples required in paragraphs (c) (2) (i) and (c) (2) (ii) of this section.

(v) The report to the Administrator by the owner or operator is to include the vinyl chloride content found in all the samples required in paragraphs (c) (2) (i) and (c) (2) (ii) of this section, averaged separately for each type of resin, over each calendar day and weighted according to the quantity of each grade of resin processed by the stripper(s) that calendar day, according to the following equation:

$$A_{T_j} = \frac{\sum_{i=1}^n P_{G_i} M_{G_i}}{Q_{T_j}} \\ = \frac{P_{G_1} M_{G_1} + P_{G_2} M_{G_2} + \dots + P_{G_n} M_{G_n}}{Q_{T_j}}$$

A = 24-hour average concentration of type T<sub>j</sub> resin in ppm.

Q = Total production of type T<sub>j</sub> resin over the 24-hour period, in kg.

T<sub>j</sub> = Type of resin; j = 1, 2, ..., m where m is total number of resin types produced during the 24-hour period.

M = Concentration of vinyl chloride in one sample of grade G<sub>i</sub> resin, in ppm.

P = Production of grade G<sub>i</sub> resin represented by the sample, in kg.

G<sub>i</sub> = Grade of resin, e.g., G<sub>1</sub>, G<sub>2</sub>, and G<sub>3</sub>.

n = Total number of grades of resin produced during the 24-hour period.

(vi) The owner or operator shall retain at the source and make available for inspection by the Administrator for a minimum of 2 years records of all data



needed to furnish the information required by paragraph (c) (2) (v) of this section: The records are to contain the following information:

(A) The vinyl chloride content found in all the samples required in paragraphs (c) (2) (i) and (c) (2) (ii) of this section, identified by the resin type and grade and the time and date of the sample, and

(B) The corresponding quantity of polyvinyl chloride resin processed by the stripper(s), identified by the resin type and grade and the time and date it represents.

(3) The owner or operator shall include in the report a record of the emissions from each reactor opening for which an emission limit is prescribed in § 61.64(a) (2). Emissions are to be determined in accordance with § 61.67(g) (5), except that emissions for each reactor are to be determined.

#### § 61.70 Recordkeeping.

(a) The owner or operator of any source to which this subpart applies shall retain the following information at the source and make it available for inspection by the Administrator for a minimum of two years:

(1) A record of the leaks detected by the vinyl chloride detector and the action taken to repair the leaks, as required by § 61.65(b) (8), including the following information:

(i) The concentrations of vinyl chloride as measured, analyzed, and recorded by the vinyl chloride detector, including the location of each measurement and the date and approximate time of each measurement.

(ii) Where the information required by paragraph (a) (1) (i) of this section indicates that the vinyl chloride concentration at any point exceeds the concentration of vinyl chloride designated as a leak, a statement explaining the cause of the leak and any action taken to eliminate that leak and the amount of time used to take this action.

(2) A record of the leaks detected during routine monitoring with the portable hydrocarbon detector and the action taken to repair the leaks, as required by § 61.65(b) (8), including a brief statement explaining the location and cause of each leak detected with the portable hydrocarbon detector, the date and time of the leak and any action taken to eliminate that leak.

(3) A record of emissions from any source for which an emission limit is prescribed in §§ 61.62(a) or (b), 61.63(a), or §§ 61.64(a) (1), (b), (c), or (d), or from any control system to which reactor emissions are required to be ducted in § 61.64(a) (2) or to which fugitive emissions are required to be ducted in §§ 61.65(b) (1) (ii), (b) (2), (b) (5), (b) (6) (ii), or (b) (9) (ii).

(4) For the relief discharges from reactors subject to the provisions of § 61.65(b), a daily operating record for each reactor, including pressures and temperatures.

#### METHOD 106—DETERMINATION OF VINYL CHLORIDE FROM STATIONARY SOURCES

##### INTRODUCTION

Performance of this method should not be attempted by persons unfamiliar with the operation of a gas chromatograph, nor by those who are unfamiliar with source sampling, as there are many details that are beyond the scope of this presentation. Care must be exercised to prevent exposure of sampling personnel to vinyl chloride, a carcinogen.

##### 1. Principle and Applicability.

1.1 An integrated bag sample of stack gas containing vinyl chloride (chloroethylene) is subjected to chromatographic analysis, using a flame ionization detector.

1.2 The method is applicable to the measurement of vinyl chloride in stack gases from both vinyl chloride and polyvinyl chloride manufacturing processes, except where the vinyl chloride is contained in particulate matter.

##### 2. Range and Sensitivity.

The lower limit of detection will vary according to the chromatograph used. Values reported include  $1 \times 10^{-7}$  mg and  $4 \times 10^{-7}$  mg.

##### 3. Interferences.

In the course of a study to identify the interference potential of several hydrocarbons associated with vinyl chloride, none were found to prevent resolution of the vinyl chloride peak with the Chromosorb 102 column. However, if resolution of the vinyl chloride peak is not satisfactory for a particular sample, then chromatograph parameters may be altered with prior approval of the Administrator. If there is reason to believe that some other hydrocarbon with an identical retention time is present in the sample, then supplemental confirmation of the vinyl chloride peak through an absolute analytical technique, such as mass spectroscopy, should be performed.

##### 4. Apparatus.

##### 4.1 Sampling (Figure 1).

4.1.1 Probe—Stainless steel, Pyrex glass, or Teflon tubing according to stack temperature, each equipped with a glass wool plug to remove particulate matter.

4.1.2 Sample line—Teflon, 6.4 mm outside diameter, of sufficient length to connect probe to bag. A new unused piece is employed for each series of bag samples that constitutes an emission test.

4.1.3 Male (2) and female (2) stainless steel quick-connects, with ball checks (one pair without) located as shown in Figure 1.

4.1.4 Tedlar bags, 100 liter capacity—To contain sample.

4.1.5 Rigid leakproof containers for 4.1.4, with covering to protect contents from sunlight.

4.1.6 Needle valve—To adjust sample flow rate.

4.1.7 Pump—Leak-free. Minimum capacity 2 liters per minute.

4.1.8 Charcoal tube—To prevent admission of vinyl chloride to atmosphere in vicinity of samplers.

4.1.9 Flow meter—For observing sample flow rate; capable of measuring a flow range from 0.10 to 1.00 liter per minute.

4.1.10 Connecting tubing—Teflon, 6.4 mm outside diameter, to assemble sample train (Figure 1).

4.1.11 Pitot tube—Type E (or equivalent), attached to the probe so that the sampling

flow rate can be regulated proportional to the stack gas velocity.

##### 4.2 Sample recovery.

4.2.1 Tubing—Teflon, 6.4 mm outside diameter, to connect bag to gas chromatograph sample loop. A new unused piece is employed for each series of bag samples that constitutes an emission test, and is to be discarded upon conclusion of analysis of those bags.

##### 4.3 Analysis.

4.3.1 Gas chromatograph—With flame ionization detector, potentiometric strip chart recorder and 1.0 to 5.0 ml heated sampling loop in automatic sample valve.

4.3.2 Chromatographic column—Stainless steel, 2.5 m  $\times$  3.2 mm, containing 80/100 mesh Chromosorb 102.

4.3.3 Flow meters (2)—Rotameter type, 0 to 100 ml/min capacity, with flow control valves.

4.3.4 Gas regulators—For required gas cylinders.

4.3.5 Thermometer—Accurate to one degree centigrade, to measure temperature of heated sample loop at time of sample injection.

4.3.6 Barometer—Accurate to 5 mm Hg, to measure atmospheric pressure around gas chromatograph during sample analysis.

4.3.7 Pump—Leak-free. Minimum capacity 100 ml/min.

##### 4.4 Calibration.

4.4.1 Tubing—Teflon, 6.4 mm outside diameter, separate pieces marked for each calibration concentration.

4.4.2 Tedlar bags—Sixteen-inch square size, separate bag marked for each calibration concentration.

4.4.3 Syringe—0.5 ml, gas tight.

4.4.4 Syringe—60 ml, gas tight.

4.4.5 Flow meter—Rotameter type, 0 to 1000 ml/min range accurate to  $\pm 1\%$ , to meter nitrogen in preparation of standard gas mixtures.

4.4.6 Stop watch—Of known accuracy, to time gas flow in preparation of standard gas mixtures.

5. Reagents. It is necessary that all reagents be of chromatographic grade.

##### 5.1 Analysis.

5.1.1 Helium gas or nitrogen gas—Zero grade, for chromatographic carrier gas.

5.1.2 Hydrogen gas—Zero grade.

5.1.3 Oxygen gas—Zero grade.

##### 5.2 Calibration.

5.2.1 Vinyl chloride, 99.9+ %—For preparation of standard gas mixtures.

5.2.2 Calibration cylinders (3), optional—One each of 50, 10 and 5 ppm vinyl chloride in nitrogen with certified analysis.

5.2.3 Nitrogen gas—Zero grade, for preparation of standard gas mixtures.

##### 6. Procedure.

6.1 Sampling. Assemble the sample train as in Figure 103-1. Perform a bag leak check according to Section 7.4. Observe that all connections between the bag and the probe are tight. Place the end of the probe at the centroid of the stack and start the pump with the needle valve adjusted to yield a flow of 0.5 lpm. After a period of time sufficient to purge the line several times has elapsed, connect the vacuum line to the bag and evacuate the bag until the rotameter indicates no flow. Then reposition the sample and vacuum lines and begin the actual sampling, keeping the rate proportional to the stack velocity. Direct the gas existing the rotameter away from sampling personnel. At the end of the sample period, shut off the pump, disconnect the sample line from the bag, and disconnect the vacuum line from the bag container. Protect the bag container from sunlight.

\* Mention of trade names on specific products does not constitute endorsement by the Environmental Protection Agency.



6.2 Sample storage. Sample bags must be kept out of direct sunlight. When at all possible, analysis is to be performed within 24 hours of sample collection.

6.3 Sample recovery. With a piece of Teflon tubing identified for that bag, connect a bag inlet valve to the gas chromatograph sample valve. Switch the valve to withdraw gas from the bag through the sample loop. Plumb the equipment so the sample gas passes from the sample valve to the leak-free pump, and then to a charcoal tube, followed by a 0-100 ml/min rotameter with flow control valve.

6.4 Analysis. Set the column temperature to 155° C, the detector temperature to 225° C, and the sample loop temperature to 70° C. When optimum hydrogen and oxygen flow rates have been determined, verify and maintain these flow rates during all chromatograph operations. Using zero helium or nitrogen as the carrier gas, establish a flow rate in the range consistent with the manufacturer's requirements for satisfactory detector operation. A flow rate of approximately 15 ml/min should produce adequate separations. Observe the base line periodically and determine that the noise level has stabilized and that base line drift has ceased. Purge the sample loop for thirty seconds at the rate of 100 ml/min, then activate the sample valve. Record the injection time (the position of the pen on the chart at the time of sample injection), the sample number, the sample loop temperature, the column temperature, carrier gas flow rate, chart speed and the attenuator setting. Record the laboratory pressure. From the chart, select the peak having the retention time corresponding to vinyl chloride, as determined in Section 7.2. Measure the peak area,  $A_m$ , by use of the automatic integrator. Record  $A_m$  and the retention time. Repeat the injection at least two times or until two consecutive vinyl chloride peaks do not vary in area more than 5%. The average value for these two areas will be used to compute the bag concentration.

#### 7. Calibration and Standards.

7.1 Preparation of vinyl chloride standard gas mixtures. Evacuate a sixteen-inch square Tedlar bag that has passed a leak check (described in Section 7.4) and meter is 5.0 liters of nitrogen. While the bag is filling, use the 0.5 ml syringe to inject 250  $\mu$ l of 99.9+ % vinyl chloride through the wall of the bag. Upon withdrawing the syringe needle, immediately cover the resulting hole with a piece of adhesive tape. This gives a concentration of 50 ppm of vinyl chloride. In a like manner use the other syringe to prepare dilutions having 10 and 5 ppm vinyl chloride concentrations. Place each bag on a smooth surface and alternately depress opposite sides of the bag 50 times to further mix the gases.

7.2 Determination of vinyl chloride retention time. This section can be performed simultaneously with Section 7.3. Establish chromatograph conditions identical with those in Section 6.3, above. Set attenuator to X 1 position. Flush the sampling loop with zero helium or nitrogen and activate the sample valve. Record the injection time, the sample loop temperature, the column temperature, the carrier gas flow rate, the chart speed and the attenuator setting. Record peaks and detector responses that occur in the absence of vinyl chloride. Maintain conditions. With the equipment plumbing arranged identically to Section 6.3, flush the sample loop for 30 seconds at the rate of 100 ml/min with one of the vinyl chloride calibration mixtures and activate the sample valve. Record the injection time. Select the peak that corresponds to vinyl chloride. Measure the distance on the chart from the injection time to the time at which the peak

maximum occurs. This quantity, divided by the chart speed, is defined as the retention time. Record.

7.3 Preparation of chromatograph calibration curve. Make a gas chromatographic measurement of each standard gas mixture (described in Section 7.1) using conditions identical with those listed in Section 6.3 above. Flush the sampling loop for 30 seconds at the rate of 100 ml/min with each standard gas mixture and activate the sample valve. Record  $C_s$ , the concentrations of vinyl chloride injected, the attenuator setting, chart speed, peak area, sample loop temperature, column temperature, carrier gas flow rate, and retention time. Record the laboratory pressure. Calculate  $A_s$ , the peak area multiplied by the attenuator setting. Repeat until two injection areas are within 5%, then plot those points vs  $C_s$ . When the other concentrations have been plotted, draw a smooth curve through the points. Perform calibration daily, or before and after each set of bag samples, whichever is more frequent.

7.4 Tedlar bag leak checks. Before each use, make sure a bag is leak-free by checking it for leaks. To leak check, connect a water manometer and pressurize the bag to 5-10 cm H<sub>2</sub>O (2-4 in. H<sub>2</sub>O). Allow to stand for 10 minutes. Any displacement in the water manometer indicates a leak.

(NOTE: An alternative leak check method is to pressurize the bag to 5-10 cm H<sub>2</sub>O or 2-4 in. H<sub>2</sub>O and allow to stand overnight. A deflated bag indicates a leak.)

#### 8. Calculations.

8.1 Determine the sample peak area as follows:

$$A_s = A_m A_f$$

Equation 106-1

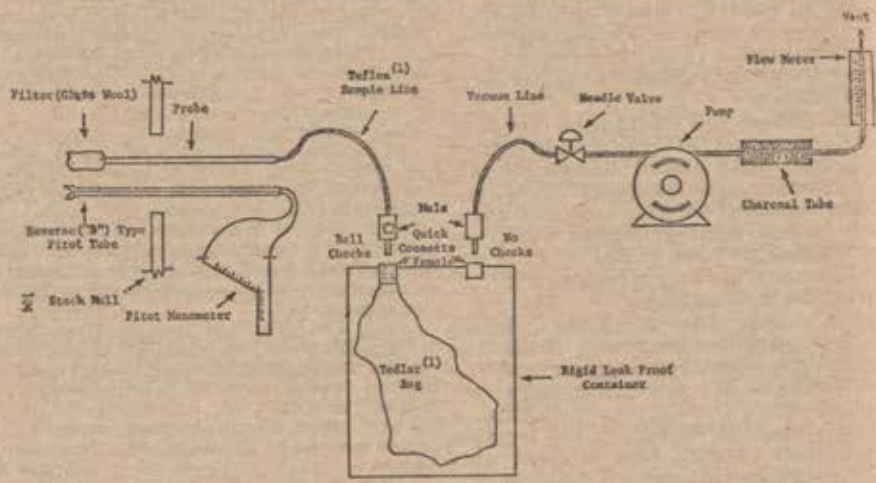


Figure 106-1. Integrated bag sampling train.

(1) Mention of trade names on specific products does not constitute endorsement by the Environmental Protection Agency.

#### METHOD 107—DETERMINATION OF VINYL CHLORIDE CONTENT OF INPROCESS WASTEWATER SAMPLES, AND VINYL CHLORIDE CONTENT OF POLYVINYL CHLORIDE RESIN, SLURRY, WET CAKE, AND LATEX SAMPLES

##### INTRODUCTION

Performance of this method should not be attempted by persons unfamiliar with the operation of a gas chromatograph, nor by those who are unfamiliar with sampling, as there are many details that are beyond the scope of this presentation. Care must be exercised to prevent exposure of sampling personnel to vinyl chloride, a carcinogen.

##### 1. Principle and Applicability.

where:

$A_s$  = The sample peak area.  
 $A_m$  = The measured peak area.  
 $A_f$  = The attenuation factor.

8.2 Vinyl chloride concentrations. From the calibration curve described in Section 7.3, above, select the value of  $C_s$  that corresponds to  $A_s$ , the sample peak area. Calculate  $C_b$  as follows:

$$C_b = \frac{C_s P_s T_s}{P_t T_t}$$

Equation 106-2

where:

$C_b$  = The concentration of vinyl chloride in the bag sample in ppm.  
 $C_s$  = The concentration of vinyl chloride indicated by the gas chromatograph, in ppm.  
 $P_s$  = The reference pressure, the laboratory pressure recorded during calibration, mm Hg.  
 $T_s$  = The sample loop temperature on the absolute scale at the time of analysis, °K.  
 $P_t$  = The laboratory pressure at time of analysis, mm Hg.  
 $T_t$  = The reference temperature, the sample loop temperature recorded during calibration, °K.

#### 9. References.

1. Brown, D. W., Loy, E. W. and Stephenson, M. H. "Vinyl Chloride Monitoring Near the B. F. Goodrich Chemical Company in Louisville, Kentucky." Region IV, U.S. Environmental Protection Agency, Surveillance and Analysis Division, Athens, Georgia, June 24, 1974.

2. "Evaluation of A Collection and Analytical Procedure for Vinyl Chloride in Air," by G. D. Clayton and Associates, December 13, 1974. EPA Contract No. 68-02-1408, Task Order No. 2, EPA Report oN. 75-VCL-1.

1.1 The basis for this method relates to the vapor equilibrium which is established between RVCM, PVC, resin, water, and air in a closed system. It has been demonstrated that the RVCM in a PVC resin will equilibrate in a closed vessel quite rapidly, provided that the temperature of the PVC resin is maintained above the glass transition temperature of that specific resin.

1.2 This procedure is suitable for determining the vinyl chloride monomer (VCM) content of inprocess wastewater samples, and the residual vinyl chloride monomer (RVCM) content of polyvinyl chloride (PVC) resins, wet cake, slurry, and latex samples. It cannot be used for polymer in fused form.



such as sheet or cubes. If a resolution of the vinyl chloride peak is not satisfactory for a particular sample, then chromatograph parameters may be altered with prior approval of the Administrator. If there is reason to believe that some other hydrocarbon with an identical retention time is present in the sample, then supplemental confirmation of the vinyl chloride peak through an absolute analytical technique, such as mass spectroscopy, should be performed.

#### 2. Range and Sensitivity.

The lower limit of detection of vinyl chloride will vary according to the chromatograph used. Values reported include  $1 \times 10^{-7}$  mg and  $4 \times 10^{-7}$  mg. With proper calibration, the upper limit may be extended as needed.

#### 3. Precision and Reproducibility.

An interlaboratory comparison between seven laboratories of three resin samples, each split into three parts, yield a standard deviation of 2.63% for a sample with a mean of 2.09 ppm, 4.16% for a sample with a mean of 1.66 ppm, and 5.29% for a sample with a mean of 62.66 ppm.

#### 4. Safety.

Do not release vinyl chloride to the laboratory atmosphere during preparation of standards. Venting or purging with VCM/air mixtures must be held to a minimum. When they are required, the vapor must be routed to outside air. Vinyl chloride, even at low ppm levels, must never be vented inside the laboratory. After vials have been analyzed, the pressure within the vial must be vented prior to removal from the instrument turntable. Vials must be vented into an activated charcoal tube using a hypodermic needle to prevent release of vinyl chloride into the laboratory atmosphere. The charcoal must be replaced prior to vinyl chloride breakthrough.

#### 5. Apparatus.

##### 5.1 Sampling.

5.1.1 Bottles—60 ml (2 oz), with waxed lined screw on tops, for PVC samples.

5.1.2 Vials—50 ml Hypo-vials,<sup>1</sup> sealed with Teflon faced Tuf-Bond discs for water samples.

5.1.3 Electrical tape—or equivalent, to prevent loosening of bottle tops.

##### 5.2 Sample recovery.

5.2.1 Vials—With seals and caps, Perkin-Elmer Corporation No. 105-0118, or equivalent.

5.2.2 Analytical balance—Capable of weighing to  $\pm 0.001$  gram.

5.2.3 Syringe, 100  $\mu$ l—Precision Series "A" No. 010025, or equivalent.

5.2.4 Vial Sealer, Perkin-Elmer No. 105-0106 or equivalent.

##### 5.3 Analysis.

5.3.1 Gas chromatograph—Perkin-Elmer Corporation Model F-40 head-space analyzer, No. 104-0001, or equivalent.

5.3.2 Chromatographic column—Stainless steel, 2 m $\times$ 3.2 mm, containing 0.4% Carbowax 1500 on Carbowax A, Perkin-Elmer Corporation No. 105-0133, or equivalent.

5.3.3 Thermometer—0 to 100° C, accurate to  $\pm 0.1$ ° C, Perkin-Elmer No. 105-0109 or equivalent.

5.3.4 Sample tray thermostat system—Perkin-Elmer No. 105-0103, or equivalent.

5.3.5 Septa—Sandwich type, for automatic dosing, 13 mm, Perkin-Elmer No. 105-1008, or equivalent.

5.3.6 Integrator—recorder—Hewlett-Packard Model 3380A, or equivalent.

5.3.7 Filter drier assembly (3)—Perkin-Elmer No. 2230117, or equivalent.

5.3.8 Soap film flowmeter—Hewlett-Packard No. 0101-0113, or equivalent.

<sup>1</sup> Mention of trade names on specific products does not constitute endorsement by the Environmental Protection Agency.

#### 5.4 Calibration.

5.4.1 Regulators—for required gas cylinders.

#### 6. Reagents.

##### 6.1 Analysis.

6.1.1 Hydrogen gas—zero grade.

6.1.2 Nitrogen gas—zero grade.

6.1.3 Air—zero grade.

#### 6.2 Calibration.

6.2.1 Standard cylinders (4)—one each of 50, 500, 2000, and 4000 ppm vinyl chloride in nitrogen, with certified analysis.

#### 7. Procedure.

##### 7.1 Sampling.

7.1.1 PVC sampling—Allow the resin or slurry to flow from a tap on the tank or silo until the tap line has been well purged. Extend a 60 ml sample bottle under the tap, fill, and immediately tightly cap the bottle. Wrap electrical tape around the cap and bottle to prevent the top from loosening. Place an identifying label on each bottle, and record the date, time, and sample location both on the bottles and in a log book.

7.1.2 Water sampling—Prior to use, the 50 ml vials (without the discs) must be capped with aluminum foil and muffled at 400° C for at least one hour to destroy or remove any organic matter that could interfere with analysis. At the sampling location fill the vials bubble-free, to overflowing so that a convex meniscus forms at the top. The excess water is displaced as the sealing disc is carefully placed, Teflon side down, on the opening of the vial. Place the aluminum seal over the disc and the neck of the vial and crimp into place. Affix an identifying label on the bottle, and record the date, time, and sample location both on the vials and in a log book. All samples must be kept refrigerated until analyzed.

7.2 Sample recovery. Samples must be run within 24 hours.

7.2.1 Resin samples—The weight of the resin used must be between 0.1 and 4.5 grams. An exact weight must be obtained ( $\pm 0.001$  gram) for each sample. In the case of suspension resins a volumetric cup can be prepared which will hold the required amount of sample. The sample bottle is opened, and the cup volume of resin is added to the tared sample vial (including septum and aluminum cap). The vial is immediately sealed and the exact sample weight is then obtained. Report this value on the data sheet as it is required for calculation of RVM. In the case of relatively dry resin samples (water content  $< 0.3$  weight %), 100  $\mu$ l of distilled water must be injected into the vial, after sealing and weighing, using a 100  $\mu$ l syringe. In the case of dispersion resins, the cup cannot be used. The sample is instead weighed approximately in an aluminum dish, transferred to the tared vial and weighed accurately in the vial. The sample is then placed in the Perkin-Elmer head space analyzer (or equivalent) and conditioned for one hour at 90° C.

Note: Some aluminum vial caps have a center section which must be removed prior to placing into sample tray. If not removed, serious damage to the injection needle will occur.

7.2.2 Suspension resin slurry and wet cake samples—Slurry must be filtered using a small Buchner funnel with vacuum to yield wet cake. The filtering process must be continued only as long as a steady stream of water is exiting from the funnel. Excessive filtration time could result in some loss of VCM. The wet cake sample (0.10 to 4.5 grams) is added to a tared vial (including septum and aluminum cap) and immediately sealed. Sample weight is then determined to 3 decimal places. The sample is then placed in the Perkin-Elmer head space analyzer (or equivalent) and conditioned for one hour at 90° C. A sample of wet cake is used to determine

TS (total solids). This is required for calculating the RVM.

7.2.3 Dispersion resin slurry samples—This material should not be filtered. Sample must be thoroughly mixed. Using a tared vial (including septum and aluminum cap) add approximately 8 drops (0.25 to 0.35 grams) of slurry or latex using a medicine dropper. This should be done immediately after mixing. Seal the vial as soon as possible. Determine sample weight accurate to 0.001 grams. Total sample weight must not exceed 0.50 grams. Condition the vial for one hour at 90° C in the analyzer. Determine the TS on the slurry sample (Section 7.3.5).

7.2.4 Inprocess wastewater samples—Using a tared vial (including septum and aluminum cap) quickly add approximately 1 cc of water using a medicine dropper. Seal the vial as soon as possible. Determine sample weight accurate to 0.001 gram. Condition the vial for two hours at 90° C in the analyzer.

#### 7.3 Analysis.

7.3.1 Preparation of gas chromatograph—Install the chromatographic column and condition overnight at 150° C. Do not connect the exit end of the column to the detector while conditioning.

7.3.1.1 Flow rate adjustments—Adjust flow rates as follows:

a. Nitrogen carrier gas—Set regulator on cylinder to read 50 psig. Set regulator on chromatograph to 1.3 kg/cm<sup>2</sup>. Normal flows at this pressure should be 25 to 40 cc/minute. Check with bubble flow meter.

b. Burner air supply—Set regulator on cylinder to read 50 psig. Set regulator on chromatograph to supply air to burner at a rate between 250 and 300 cc/minute. Check with bubble flowmeter.

3. Hydrogen supply—Set regulator on cylinder to read 30 psig. Set regulator on chromatograph to supply approximately 35 $\pm$ 5 cc/minute. Optimize hydrogen flow to yield the most sensitive detector response without extinguishing the flame. Check flow with bubble meter and record this flow.

7.3.1.2 Temperature adjustments—Set temperatures as follows:

a. Oven (chromatographic column), 50° C.

b. Dosing line, 140° C.

c. Injection block, 140° C.

d. Sample chamber, water temperature, 90° C  $\pm$  1.0° C.

7.3.1.3 Ignition of flame ionization detector—Ignite the detector according to the manufacturer's instructions.

7.3.1.4 Amplifier balance—Balance the amplifier according to the manufacturer's instructions.

7.3.2 Programming the chromatograph—Program the chromatograph as follows:

a. I—Dosing time—The normal setting is 2 seconds.

b. A—Analysis time—The normal setting is 8 minutes. Certain types of samples contain high boiling materials which can cause interference with the vinyl chloride peak on subsequent analyses. In these cases the analysis time must be adjusted to eliminate the interference. An automated backflush system can also be used to solve this problem.

c. B—Flushing—The normal setting is 0.2 minutes.

d. W—Stabilization time—The normal setting is 0.2 minutes.

e. X—Number of analyses per sample—The normal setting is 1.

7.3.3 Preparation of sample turntable—Before placing any sample into turntable, be certain that the center section of the aluminum cap has been removed. The numbered sample bottles should be placed in the corresponding numbered positions in the turntable. Insert samples in the following order:



Positions 1 & 2—Old 2000 ppm standards for conditioning. These are necessary only after the analyzer has not been used for 24 hours or longer.

Position 3—50 ppm standard, freshly prepared.

Position 4—500 ppm standard, freshly prepared.

Position 5—2000 ppm standard, freshly prepared.

Position 6—4000 ppm standard, freshly prepared.

Position 7—Sample No. 7 (This is the first sample of the day, but is given as 7 to be consistent with the turntable and the integrator printout.)

After all samples have been positioned, insert the second set of 50, 500, 2000, and 4000 ppm standards. Samples, including standards must be conditioned in the bath of 90° C for 1 hour (not to exceed 5 hours).

7.3.4 Start chromatograph program—When all samples, including standards, have been conditioned at 90° C for 1 hour, start the analysis program according to the manufacturers' instructions. These instructions must be carefully followed when starting and stopping program to prevent damage to the dosing assembly.

7.3.5 Determination of total solids (TS).

For wet cake, slurry, resin solution, and PVC latex samples, determine TS for each sample by accurately weighing approximately 3 to 4 grams of sample in an aluminum pan before and after placing in a draft oven (105 to 110° C). Samples must be dried to constant weight. After first weighing return the pan to the oven for a short period of time and then reweigh to verify complete dryness. TS is then calculated as the final sample weight divided by initial sample weight.

8. Calibration.

Calibration is to be performed each eight-hour period when the instrument is used. Each day, prior to running samples, the column should be conditioned by running two of the previous days 2000 ppm standards.

8.1 Preparation of Standards.

Calibration standards are prepared by filling the vials with the vinyl chloride/nitrogen standards, rapidly seating the septum and sealing with the aluminum cap. Use a stainless steel line from the cylinder to the vial. Do not use rubber or tygon tubing. The sample line from the cylinder must be

purged (into hood) for several minutes prior to filling vials. After purging, reduce the flow rate to approximately 500–1000 cc/min. Place end of tubing into vial (near bottom) and after one minute slowly remove tubing. Place septum in vial as soon as possible to minimize mixing air with sample. After the standard vials are sealed, inject 100 µl of distilled water.

8.2 Preparation of chromatograph calibration curve.

Prepare two 50 ppm, two 500 ppm, two 2000 ppm, and two 4000 ppm standard samples. Run the calibration samples in exactly the same manner as regular samples. Plot  $A_i$ , the integrator area counts for each standard sample vs  $C_{i,s}$ , the concentration of vinyl chloride in each standard sample. Draw a line of best fit through the points.

9. Calculations.

9.1 Response factor.

From the calibration curve described in Section 8.2, above, select the value of  $C_i$  that corresponds to  $A_i$  for each sample. Compute the response factor,  $R_i$ , for each sample, as follows:

$$R_i = \frac{A_i}{C_i} \quad \text{Equation 107-1}$$

9.2 Residual vinyl chloride monomer concentration, or vinyl chloride monomer concentration.

Calculate  $C_{r,s}$  as follows:

$$C_{r,s} = \frac{A_i P_a}{R_i T_1} \left( \frac{M_i V_s}{m_i R} + K T_2 \right) \quad \text{Equation 107-2}$$

where:

$C_{r,s}$  = Concentration of vinyl chloride in the sample, in ppm.

$P_a$  = Laboratory atmosphere pressure, mm Hg.

$T_1$  = Room temperature, °K.

$M_i$  = Molecular weight of VCM (62.5).

$V_s$  = Volume of vapor phase (vial volume less sample volume).

$m_i$  = Weight of sample, grams.

$R$  = Gas constant (82,360).

$K$  = Henry's Law constant for VCM in PVC at 90° C,  $K = 6.32 \times 10^{-4} = K_s$  for VCM in 1 cc (approximate) wastewater sample at 90° C,  $K = 5.0 \times 10^{-4} = K_s$ .

$T_2$  = Equilibration temperature, °K.

If the following conditions are met, Equation 107-2 can be simplified as follows:

1.  $T_1 = 22^\circ \text{C}$  (295° K).

2.  $T_2 = 90^\circ \text{C}$  (363° K).

3.  $P_a = 750 \text{ mm. Hg.}$

$$4. V_s = V_v - \frac{m_s}{1.4} = 23.5 - \frac{m_s}{1.4}$$

where

$V_v$  = Vial volume, cc (23.5).

5. Sample contains less than 0.5% water.

$$C_{r,s} = \frac{A_i}{R_i} \left( 4.197 \times 10^{-3} + \frac{5.988 \times 10^{-3}}{m_i} \right) \quad \text{Equation 107-3}$$

The following general equation can be used for any sample which contains VCM, FVC and/or water.

$$C_{r,s} = \frac{A_i P_a}{R_i T_1} \times \left[ \frac{M_i V_s}{R m_i} + K_s (TS) T_2 + K_w (1 - TS) T_2 \right] \quad \text{Equation 107-4}$$

where:

$T_s$  = Total solids.

Note:  $K_w$  must be determined.

For a 1 cc (approximate) wastewater sample, Equation 107-4 can be simplified to the following:

$$C_{r,s} = \frac{A_i}{R_i} \frac{5.988 \times 10^{-3}}{m_i} + (2.066 \times 10^{-3}) \quad \text{Equation 107-5}$$

Results calculated using Equation 107-4 or 107-5 represent concentration based on the total sample. To obtain results based on dry PVC content, divide by TS.

10. References.

1. Residual Vinyl Chloride Monomer Content of Polyvinyl Chloride Resins and Wet Cake Samples, B. F. Goodrich Chemical Co. Standard Test Procedure No. 1005-T. B. F. Goodrich Technical Center, Avon Lake, Ohio, January 30, 1975.

2. Berens, A. R., "The Solubility of Vinyl Chloride in Polyvinyl Chloride," ACS-Division of Polymer Chemistry, Polymer Preprints 15 (2): 197, 1974.

3. Berens, A. R., "The Diffusion of Vinyl Chloride in Polyvinyl Chloride," ACS-Division of Polymer Chemistry, Polymer Preprints 15 (2): 203, 1974.

4. Berens, A. R., L. B. Crider, C. J. Tomaneck and J. M. Whitney, Analysis for Vinyl Chloride in PVC Powders by Head-Space Gas Chromatography, to be published.

[PR Doc.75-34513 Filed 12-23-75; 8:45 am]