federal register

Tuesday
October 28, 1980

Part IV

Environmental Protection Agency

Standards of Performance for New Stationary Sources: Graphic Arts Industry; Publication Rotogravure Printing; Proposed Rule and Notice of Public Hearing

ENVIRONMENTAL PROTECTION AGENCY

40 CFR Part 60

[1579-1]

Standards of Performance for New Stationary Sources; Graphic Arts Industry: Publication Rotogravure Printing

AGENCY: Environmental Protection Agency (EPA).

ACTION: Proposed rule and notice of public hearing.

SUMMARY: Standards of performance are proposed to limit emissions of volatile organic compounds (VOC) from new, modified, and reconstructed publication rotogravure printing presses. Emissions would be limited to 16 percent of the total VOC solvent volume used at the press. Reference Method 29 is also proposed for determination of the VOC volume content of solvent-borne inks and related coatings.

The proposed standards implement Section 111 of the Clean Air Act and are based on the Administrator's determination that the graphic arts industry contributes significantly to air pollution which may reasonably be anticipated to endanger public health or welfare. The intent is to insure that new, modified, and reconstructed publication rotogravure printing facilities use the best demonstrated system of continuous emission reduction, considering costs, nonair quality health and evnironmental impacts, and energy requirements.

A public hearing will be held to provide interested persons an opportunity for oral presentation of data, views, or arguments concerning the proposed standards.

DATES: *Comments.* Comments must be received on or before December 29, 1980.

Public Hearing. A public hearing will be held on November 25 (about 30 days after proposal) beginning at 9:00 a.m.

Request to Speak at Hearing. Persons wishing to present oral testimony must contact EPA by November 18 (1 week before hearing).

ADDRESSES: *Comments.* Comments should be submitted (in duplicate if possible) to: Central Docket Section (A-130), Attention: Docket Number A-79-50, U.S. Environmental Protection Agency, 401 M Street, S.W., Washington, D.C. 20460.

Public Hearing. The public hearing will be held at Environmental Research Center Auditorium RTP, NC. Persons wishing to present oral testimony should notify Ms. Deanna Tilley, Standards Development Branch (MD-13) U.S. Environmental Protection Agency, Research Triangle Park, North Carolina 27711, telephone number (919) 541-5477.

Background Information Document. The Background Information Document (BID) for the proposed standards may be obtained from the U.S. EPA Library (MD-35), Research Triangle Park, North Carolina 27711, telephone number (919) 541-2777. Please refer to "Publication Rotogravure Printing—Background Information for Proposed Standards," EPA-450/3-80-031a.

Docket. Docket No. OAQPS-79-50, containing supporting information used in developing the proposed standards, is available for public inspection and copying between 8:00 a.m. and 4:00 p.m., Monday through Friday, at EPA's Central Docket Section, West Tower Lobby, Gallery 1, Waterside Mall, 401 M Street, S.W., Washington, D.C. 20460. A reasonable fee may be charged for copying.

FOR FURTHER INFORMATION CONTACT: Mr. Gene W. Smith, Section Chief, Standards Development Branch, Emission Standards and Engineering Division (MD-13), U.S. Environmental Protection Agency, Research Triangle Park, North Carolina 27711, telephone number (919) 541-5421.

SUPPLEMENTARY INFORMATION:

Proposed Standards

The proposed standards would apply to new publication rotogravure production presses. Existing presses would not be subject to the proposed standards unless they undergo a modification or a reconstruction as defined in 40 CFR 60.14 and 40 CFR 60.15, respectively. The smaller four-unit proof presses, used only to check the quality of the image formation of newly etched or engraved printing cylinders, would not be affected by the proposed standards. Emissions of volatile organic compounds (VOC) from publication rotogravure presses would be limited to 16 percent of the total VOC solvent volume used at the press. Total VOC solvent used would include all VOC solvent in the purchased raw inks and related coatings used at the press, all VOC solvent added to the inks and coatings, and all VOC solvent used as a cleaning agent at the press. For compliance purposes, the emission percentage could be reported as rounded-off to the nearest whole number.

The proposed standards are based on the use of solvent-borne ink systems, with a solvent vapor cpture system and a fixed-bed carbon adsorption/solvent recovery system for VOC emission control. For the use of waterborne ink systems, the proposed emission limit is expressed as a maximum allowed VOC volume to solids volume ratio of 0.64 in the purchased raw inks and related coatings, with only water addition allowed for dilution. Emission control equipment and metering devices would be required with waterborne ink systems only if the specified waterborne conditions are not met.

Initial compliance with the proposed emission limit would have to be demonstrated in a long-term performance test. This initial test would cover normal operations over 30 calendar days instead of an average of three runs as prescribed under 40 CFR 60.8. Actual press emissions and the average control system performance over the 30 days would be determined by an overall VOC solvent volume balance. The total volume amount of recovered solvent would be compared to the total volume amount of solvent used at the press. The amount of recovered solvent would include all VOC solvent recovered by the emission control system, all waste VOC solvent, and all waste inks removed from the affected facility. VOC volume analyses of raw solvent-borne inks and related coatings, as purchased, would be obtained from the ink manufacturer or determined by the proposed Reference Method 29. VOC analyses of air streams from the facility or the control system, and any waste water streams would not be required.

Once the initial performance test is completed, the affected facility would be required to monitor and calculate the amount of VOC emissions as a percentage of the VOC solvent volume used each month at the press. Emissions would be determined using the same procedures used in the initial performance test. These monthly test records of emissions would serve to determine compliance on a continuing basis, but would be reported only for the months during which non-compliance is determined. Compliance with the proposed standards would thus be determined for 12 periods each year from monthly performance test records. As an alternative, four-week performance test averaging periods could be chosen in order to coincide with the plant's normal accounting procedures. This alternative would require 13 compliance periods per year.

Affected facilities using waterborne ink systems would also be subject to continual compliance after completion of the initial performance test. Determination of compliance procedures would be the same as previously described, except that the VOC volume analyses of raw waterborne inks and related coatings, as purchased, would be from only the ink manufacturer's data. A reference test method for verification of the VOC content of waterborne ink systems is not being proposed.

The proposed emission limits can also be met through the use of solvent destruction (i.e. oxidation) control systems. However, specific procedures for determination of compliance with solvent destruction are not being proposed since this control technique is not expected to be used on any new, modified, or reconstructed press. The Administrator will welcome comments on whether this expectation and the exclusion of compliance provisions for solvent destruction devices are reasonable.

Summary of Environmental, Energy, and Economic Impacts

The environmental, energy, and economic impacts of the proposed standards are expressed as incremental differences relative to a baseline level. A 75 percent overall VOC reduction efficiency, or 25 percent emission level, was chosen as the baseline for the impact analyses. This baseline level corresponds to the recommendation in EPA's control techniques guideline (CTG) document, "Control of Volatile Organic Emissions from Existing Stationary Sources—Volume VIII: Graphic Arts—Rotogravure and Flexography" (EPA–450/2–78–033 [CTG]). The states are expected to use this document in developing their revised State Implementation Plans (SIP) for existing publication rotogravure printing facilities. The impact analyses are based on the use of fixed-bed carbon adsorption/solvent recovery systems for control of VOC emissions from both existing and affected facilities. All existing facilities installed before the year 1980 are assumed to be controlled at the 75 percent baseline level.

The projected impacts are based on the expectation that, most of the time, only 15 percent (85 percent overall control) of the total VOC solvent used at affected facilities would be emitted. Emissions are expected to increase to the 16 percent level (84 percent overall control) during only one or two months per year.

Compared to the baseline control level, the proposed standards would further reduce VOC air pollutant emissions from typical affected facilities by 40 percent. A typical sized new plant in this industry would have four production presses, each consisting of eight printing units, and would have the capacity for a total annual solvent usage of about 6,400 megagrams. The potential reduction in VOC emissions from a typical sized plant controlled under the proposed standards would be about 700 megagrams per year more than that for control at the baseline level. The proposed standards would reduce the industrywide VOC emissions from both affected and existing facilities by about 7,900 megagrams per year in the year 1985, the fifth year after the appliable date of the standards. This would represent about 13 percent less industry emissions than with control of affected facilities at the baseline level. This projection is based on the expectation of 7 percent annual real growth rate in this industry.

Potential water pollution from a facility controlled under the proposed standards would be 3 percent greater than that from one controlled at the baseline level. The incremental potential wastewater discharges from a typical four-press plant would be about 2.6 million liters per year more than for baseline control. Dissolved organic compounds in this effluent would amount to an incremental increase of about 0.5 megagram per year. Projected national discharges for 1985 would be increased by about 32 million liters above that for control at the baseline level. In the year 1985, dissolved organic solvents in the nationwide effluent would potentially amount to about 6 megagrams per year more than for control at the baseline level. This would represent about a five percent incremental increase. The dissolved solvent content could be virtually eliminated on-site by demonstrated, inexpensive removal systems. The resultant solvent-free water could be recycled as make-up feed water to the plant steam boiler. Alternatively, the waste water could be discharged to a conventional biological waste treatment system.

The solid waste impact resulting from the proposed standards would increase proportionally over those for baseline control because of additional amounts of spent carbon, carbon fines, and used solvent laden air (SLA) filters. In 1985, the amount of nationwide waste carbon would be increased by about 85 megagrams above that for control at the baseline level. An estimate of the incremental bulk quantity of waste filters was not attempted, but should be a very small impact.

The only significant source of noise would be from the large SLA fans. However, these are normally installed in an enclosed housing, and should not affect the surrounding environment.

In the Administrator's opinion, the proposed standards' environmental impacts as just described are reasonable.

The energy impact of the proposed standards is not unreasonable on an industry basis and is entirely favorable when viewed from a national perspective. The direct energy consumption by a facility controlled under the proposed standards would be about 18 percent higher than if controlled at the baseline level. The direct annual energy consumption for a typical four-press plant would be increased by about the equivalent of 2,200 barrels of fuel oil. The industry's total direct energy consumption for the year 1985 would be about 40,200 barrels of fuel oil above that required for baseline control. This would represent an energy consumption increase of about 9 percent more than with control of affected facilities at the baseline level.

The national energy impact of the proposed standards would result in net national energy savings when the fuel energy value of the recovered solvent is considered. Under the proposed standards, nationwide energy consumption for the year 1985 would be actually decreased by about the equivalent of 21,800 barrels of fuel oil from that required for baseline control. The Administrator believes that the direct energy impact on the industry is reasonable, particularly in view of the net national energy savings which would result from decreased solvent demand.

The proposed standards would increase the required total plant capital investment and annualized operating costs over that for emission control at the baseline level. However, the high cost value of the recovered solvent would enable the installation of solvent recovery control systems to provide a net profit (negative annualized costs) and positive return on investments for emission controls under the proposed standards. The capital investment for a typical four-press plant would be increased by about $650,000, or about two percent more than for control at the baseline level. Industry's cumulative five-year capital investments, through the year 1985, would be increased by about $17 million. For the typical plant, the annualized control cost with solvent recovery credit would be about −$345,000 at baseline level and −$271,000 under the proposed standards, for an incremental cost increase of about $74,000. In the year 1985, the industrywide total annualized control cost with solvent recovery credit would be an estimated −$4.2 million at baseline control level and −$1.7 million under the proposed standards, for an incremental cost increase of about $2.5 million.

The increase in capital requirements and annualized control cost under the proposed standards would have a negligible impact on industry growth, profitability, and product prices. First, the two percent incremental increase in initial capital costs is not large enough to reduce capital availability and, therefore, would not restrict industry growth. Secondly, the industry's average pre-tax profit of eight percent at the baseline control level would not be reduced below 7.8 percent under the proposed standards. Finally, there would be no significant price increases for publication gravure products. The Administrator, therefore, believes that the economic impacts of the proposed standards are reasonable.

Rationale—Selection of Source

The publication rotogravure printing industry is a significant source of volatile organic compound (VOC) emissions. The EPA has ranked the graphic arts industry, of which publication rotogravure is a part, sixth out of 59 on the "Priority List and Additions to the List of Categories of Stationary Sources". This list for New Source Performance Standards was promulgated at 44 FR 49222 on August 21, 1979. This priority list ranks the emission sources on a nationwide basis in terms of quantities of air pollutant emissions from the source category, the mobility and competitive nature of each source category, and the extent to which each pollutant endangers public health and welfare.

The publication rotogravure printing industry is a rapidly growing segment of the graphic arts industry, and a rapidly increasing source of potential VOC air pollutants. In the year 1977, the entire graphic arts industry was responsible for about 380,000 megagrams of organic solvent vapor emissions in the United States. Although in sales, publication rotogravure constituted only about five percent of the graphic arts industry, it was responsible for almost 15 percent of the total graphic arts VOC emissions in 1977. Growth projections show that the publication rotogravure industry will experience about a seven percent annual real growth rate through the year 1985. Potential uncontrolled emissions from a typical four-press plant amount to about 6,400 megagrams per year. In the year 1985, the cumulative potential uncontrolled VOC emissions from this industry are projected to be about 236,000 megagrams.

Selection of Pollutants and Affected Facilities

Volatile organic compounds (VOC) are the only air pollutants emitted from publication rotogravure printing facilities. The sources of the VOC emissions are the solvent components in the inks and related coatings used at the printing presses, as well as solvent added for printing and cleaning. The gravure printing method usually involves only four colors of inks—yellow, red, blue, and black. The related coatings are usually referred to as extenders or varnishes. There are two general types of solvents used by the publication rotogravure industry. In a few cases only toluene is used, but the more common solvent is a toluene-xylene-lactol spirits (naphtha) mixture. The various solvent components exhibit a range of moderate to high photochemical reactivity. VOC along with nitrogen oxides are precursors to the formation of ozone and other oxidants. Photochemical oxidants result in a variety of adverse impacts on health and welfare, including impaired respiratory function, eye irritation, necrosis of plant tissue, and deterioration of selected sysnthetic materials, such as rubber. Further information on these effects can be found in the U.S. Environmental Protection Agency (EPA) document entitled "Air Quality Criteria for Ozone and Other Photochemical Oxidants" (EPA–600/8–78–004).

At present, this industry uses only solvent-borne ink systems. The proposed standards would also allow the use of waterborne inks, but none have been successfully developed yet for the rotogravure printing method. Current research is being directed toward development of low-VOC, waterborne inks so that the proposed emission limit could be met without the use of emission control systems. The industry expects to develop waterborne inks in the next five to ten years.

All new web-fed (roll-fed) rotogravure presses used to print salable products, described under SIC Code numbers 27541 and 27543, would be the "affected facilities." These presses typically consist of 8 to 12 printing units. They are used to print magazines, catalogs, newspaper supplements, and advertising products, as well as other products. Existing rotogravure production presses in this industry which are determined to have been modified or reconstructed in accordance with 40 CFR.14 or 40 CFR.15 would also be subject to the proposed standards. There are expected to be very few, if any, such facilities. Installation of the higher speed, more efficient, and better electronically controlled newer presses will be more attractive than upgrading existing presses because of the highly competitive and fast growing nature of this industry. In addition, it would be easier to control VOC emissions from newer pressses than from older presses because modern presses are designed, for economic reasons, to minimize fugitive solvent vapor losses.

VOC emissions from ink and solvent storage and transfer facilities, as well as emissions from other printing operations would not be affected by the proposed standards. The emissions from storage and transfer facilities should normally be negligible compared to the printing press emissions. Additional presses that print other gravure products and different types of printing processes are sometimes housed within the same plant. The other sectors of gravure printing are slightly smaller and are not growing as rapidly as the publication sector. In addition, each gravure printing sector and other printing processes have different operating and emissions control characteristics. An attempt to cover entire printing plants would have, therefore, dramatically increased the complexity of the proposed standards. Air pollutant emissions from these other gravure presses and other printing processes may be regulated under future standards.

The smaller four-unit proof presses, used only to check the quality of the image formation of newly engraved or etched printing cylinders, would not be affected. These proof presses are operated intermittently and at much slower speeds compared to the production presses. The inks and solvents used at the proof presses are normally not metered, but are handled out of drums. The total solvent usage by proof presses in this industry is estimated to be about only one percent of the usage by production presses.

Selection of the Basis of the Proposed Standards

VOC emissions from publication rotogravure printing facilities could be controlled by either emission control systems, or by using low-VOC, waterborne ink systems. Emission control devices in this industry presently involve only solvent recovery, although solvent destruction (i.e. oxidation) could be used. The overall performance of control devices can be enhanced by installation of well-designed fugitive VOC vapor capture systems.

Control Technologies

The complete emission control system in a modern publication rotogravure printing plant consists of two sections: the capture system and the emission control device system. The capture system is designed to gather the VOC vapors emitted from the presses. The captured vapors are then directed to a control device where they are either recovered or destroyed.

Most of the solvent used in the rotogravure printing process is driven off in the drying operation after the ink has been applied to the paper web. All new and existing presses have dryer enclosures and ductwork to capture and convey dryer exhaust vapors away from the press (e.g., to a control device). Vapors that are not captured by the dryers are called fugitive emissions. Of the total amount of solvent used at the press, 80 to 90 percent is captured by the dryers and the rest is fugitive. Fugitive emission capture systems can be designed to capture part of all of the fugitive vapors in the pressroom.

The capture efficiency of the dryers is limited by their temperature and the operating speed of the newer presses. Dryer temperatures range from ambient to about 120°C (250°F). The higher temperatures in this range can only be used on the units printing with black ink. Higher temperatures impair product quality and increase the frequency of web breaks. The increasing operating speeds of modern presses of over 10 m/s (2,000 fpm) limit the web's residence time in the dryers. Thus, significant amounts of fugitive vapors are emitted from the presses because of the limited dryer capture efficiency.

Facilities that capture only the dryer exhausts must install some type of ventilation to remove the fugitive solvent vapors from the pressroom. The solvent vapor concentration in the pressroom air must be kept below the level of OHSA regulations (29 CFR 1910.1000). The present OSHA time-weighted average (TWA), 8-hour exposure limit for toluene vapors is 200 ppmv. The allowable vapor concentration limits for the components of the naphtha-based mixed solvents range from 100 ppmv up to 500 ppmv. OSHA has a proration formula for determining compliance with vapor component mixtures.

A highly efficient capture system is necessary to achieve high overall emission reduction efficiencies. Fugitive solvent vapors, as well as the concentrated dryer exhausts must be captured. Some of the fugitive solvent vapors result from evaporated solvent in the ink fountains, from the exposed part of the gravure printing cylinder, and from exposed portions of the paper web before entering the dryers. Enclosed ink fountains and extended enclosed dryer designs of newer presses help to minimize the escape of fugitive vapors from these locations during press operation. However, these areas must be uncovered to obtain access to the press during shutdowns for web breaks, cylinder changes, or maintenance items. The major source of fugitive vapors from newer presses during operation is the paper web after exiting the dryers. Fugitive vapors are emitted from this source even during press shutdowns. In addition, the final printed product retains some of the solvent used at the press, and continues to be a source of fugitive vapors from the cutting and folding areas after leaving the press.

All of the products printed in this industry retain a small amount of solvent. The amount of retained solvent appears to vary from about one to seven percent of the total solvent used at the press, depending on the finished product. Product solvent retention is apparently influenced by the ink coverage, the use of varnish and other coatings, and the type of paper and inks used. The ultimate efficiency of any capture system is, therefore, limited by the amount of solvent retained in the printed product.

Three types of capture systems were evaluated. The first type, demonstrated at the facilities of Texas Color Printers, Inc., captured only dryer exhaust vapors while pressroom ventilation air was discharged to the atmosphere. Naphtha-based mixed solvents were used at these tested facilities. Test data for this capture system showed that the amount of ventilation air required represented about 30 percent of the total dryer exhaust and ventilation air removed from the pressroom. In addition, the solvent vapor content in the ventilation air accounted for about eight percent of the total solvent volume used at the press. The test results showed that the dryers alone captured as must as 85 to 89 percent of the total solvents used at the press. Calculated addition of the discharged fugitive solvent vapors to the dryer exhausts showed potential total capture effciencies of 93 to 97 percent. The remaining 3 to 7 percent represents solvent retained in the product.

A second type capture system was demonstrated at the newest facilities of Meredith/Burda, Inc. Cabin enclosures were installed over the top portion of the printing presses. Fugitive solvent vapors (toluene only at these tested facilities) from the paper web and from around the printing presses were pulled up through the cabin enclosures and then directed along with the dryer exhausts to a carbon adsorption system. Pressroom ventilation fans were not installed at these facilities. Test data showed capture efficiencies ranging from 94 to 97 percent. Solvent retained in the printed product thus represented the remaining 3 to 6 percent of the solvent used at the presses.

Application of the demonstrated Meredith/Burda cabin enclosure design may, however, present difficulties in meeting some OSHA regulations. Toluene vapor concentrations inside the enclosures were measured to be as high as 200 to 300 ppmv, during press shutdowns. These vapor concentration levels are within the ceiling limits of OSHA regulations; however, repeated exposure to these high concentrations, combined with pressroom ambient vapor concentration levels, measured at 40 to 200 ppmv, may cause some press operators to be exposed in excess of the 8-hour TWA limit. In addition, Meredith/Burda handles larger volume print orders than some printers in this industry. Some of the shorter-run products not handled by Meredith/Burda may cause more frequent web breaks and press shutdowns. The printing of these more troublesome products could require the press operators to enter a cabin enclosure more often than required at Meredith/Burda, thereby increasing their potential for exposure to solvent vapors. Press operating data supporting this reasoning were obtained for two types of products printed during tests conducted at both the Merdith/Burda and Texas Color facilities. The test results showed a wide range of actual press printing times of about 62 to 86 percent of the total test time, with shutdown frequencies averaging about 10 to 12 press shutdowns per equivalent 24 hour period. The magazine product printed at Meredith/Burda caused twice as many press shutdowns and a lower percentage printing time than the advertising product. At Texas Color, the advertising product caused more press shutdowns, but resulted in a slightly higher percentage printing time than the magazine product. Press shutdown data for other products printed in this industry were not available; however, these test results were consistent with general information provided by industry on typical operations.

The Administrator believes that for most facilities in this industry cabin enclosures could be designed to very effectively capture fugitive solvent vapors without violating OSHA regulations. As explained in Chapter 4 of the BID (Section 4.2.1), the Meredith/Burda capture system design could be improved to easily meet OSHA regulations by (1) modifications of the cabin enclosure design, (2) modification of the pressroom air handling system, and (3) increasing the ventilation air flow rate through the cabin. The required increase in air flow rate would cause a decrease of less than 0.5 percent in the carbon adsorber efficiency. In addition, the use of naphtha-based mixed solvents rather than toluene would pose fewer problems in meeting OSHA regulations because of the higher allowable vapor concentration limits. On the other hand, the Administrator acknowledges that printing of some products handled by this industry might cause more press down time than other products, and thus a cabin enclosure design may not be a suitable capture system for some facilities.

A third type control system which captures all the pressroom air was demonstrated at the facilities of Standard Gravure, Inc. Naphtha-based mixed solvents are used at these facilities. This capture system is similar to what the potential Texas Color capture system would be with the fugitive ventilation air directed to the control device system. In addition, ventilation air from the cutting, folding, and product storage areas are captured at this plant and sent to a carbon adsorption system. EPA testing was not conducted at this plant because its control system was assumed to be less cost effective than the other systems just described. The amount of captured air needed to be treated with this design is much greater than for the other systems, causing it to be less economical. Plant data was obtained from Standard Gravure, however, and the Administrator believes these are of sufficient accuracy to be used in support of the proposed standards.

There are three alternative emission control devices which can effectively reduce the VOC emissions from a publication rotogravure press: solvent destruction (i.e. oxidation), fixed-bed carbon adsorption, and fluidized-bed carbon adsorption. Any of these systems can control 95–99 percent of the vapors they receive, but fixed-bed carbon adsorption is currently used almost exclusively in this industry.

Some modern solvent destruction devices could possibly be economical in certain cases. Conventional thermal oxidation would require large amounts of supplemental fuel. The operating costs could be reduced somewhat by utilizing waste heat recovery designs. Catalytic oxidation permits lower oxidation reaction temperatures, and therefore, requires about 50 percent less energy than thermal oxidation. A third technique involves regenerative thermal combustion. This method would probably be the most energy efficient, and thus most economical solvent destruction device. However, as the solvents used in this industry are refined from crude oil, they are expected to become increasingly expensive in the future. Recovery rather than destruction of captured solvent vapors is, therefore, expected to be the only economically justifiable control alterative for new publication rotogravure printing presses.

Fixed-bed carbon adsorption has undergone considerable research, development, and modification in recent years. Most of the corrosion problems of the past have been solved. Energy requirements, and thus operating costs for the fixed-bed system are greater than that of a fluidized-bed carbon adsorber system, but capital costs are less. Problems associated with the use of a fluidized-bed carbon adsorption system to control VOC emissions from publication rotogravure presses cannot be adequately assessed because available data is very limited.

The average operating efficiencies of fixed-bed carbon adsorption systems were determined during the two plant tests. The newest Meredith/Burda adsorbers operated at 97 to 98+ percent efficiency. The Texas Color plant adsorbers operated at 94 to 96 percent efficiency. The difference in performance results from higher inlet SLA vapor concentrations, lower outlet vapor concentrations, and better instrumentation controls at Meredith/Burda. The total VOC vapor concentrations at Meredith/Burda ranged from about 300 to 1,800 ppmv at the adsorber inlet and about only 10 to 30 ppmv at the outlet. The vapor concentrations at Texas Color ranged from about 70 to 1,000 ppmv at the inlet and about 20 to 300 ppmv at the adsorber outlet.

The average operating efficiency of the better designed carbon adsorption systems available to this industry should remain at or above the 97 percent level, when printing most products. Several carbon adsorption systems installed in this industry provide evidence that the carbon bed maintains the design "activity" for more than five years. Bed blockages from high molecular weight reaction products have not occurred with existing adsorption systems and solvent blends used in the publication rotogravure printing industry. Routine maintenance requires periodic filtering out of carbon fines, addition of makeup carbon, and repairing valve leaks. However, the capture system design affects the air handling requirements, as previously mentioned, and thus could result in lower adsorber efficiencies. Moreover, adsorber efficiencies may be somewhat lower when more troublesome, shorter run products are printed.

In summary, the standards as proposed are based on the use of fixed-bed carbon adsorption with a solvent vapor capture system. As previously explained, the facilities at both tested plant sites demonstrated that at least a 90 percent average capture efficiency can be expected when fugitive solvent vapors are captured along with the dryer exhausts from new presses. This conservative average efficiency allows for printing of products that retain larger amounts of solvent or that cause more fluctuations in the printing operations than were experienced during the two short-term plant tests. If only dryer exhausts are directed to the control device, then the average capture efficiency can be expected to be only about 85 percent, as demonstrated during tests at Texas Color. Older facilities treating only the dryer exhausts can be expected to achieve an average capture efficiency of about 84 percent. This lowest capture efficiency reflects an estimate of slightly more fugitive solvent vapor losses from the more exposed areas of older press designs. Modern carbon adsorber/solvent recovery control devices can be expected to achieve a long-term average performance of about 95 percent efficiency. Short-term efficiencies of the best demonstrated adsorbers may be higher at times, but this average efficiency accounts for the wide fluctuations of vapor concentrations in the solvent laden air (SLA) inlet to the adsorber. In comparison, older adsorber systems were designed to perform at about only a 90 percent average efficiency.

As an alternative emission control technique, this industry is researching the possibilities of using low-VOC, waterborne ink systems to reduce their VOC emissions. At present, waterborne inks have not been developed for publication rotogravure printing. In order not to discourage future development of waterborne inks, the proposed standards would allow printing of publication rotogravure products without air pollution control equipment if waterborne inks containing sufficiently low amounts of VOC are used. To qualify for this allowance, the VOC content would be limited to not more than 16 volume percent of the total volatile portion of the waterborne ink mixture as applied to the gravure printing cylinder.

Regulatory Alternatives

The overall reduction efficiency for VOC emission control systems is equal to the capture system efficiency times the control device efficiency. The expected average efficiencies for capture systems and control devices applicable to this industry were combined to develop three regulatory alternatives. The alternatives considered call for an overall VOC reduction at 75, 80, and 85 percent levels. Fixed-bed carbon adsorption systems were assumed as the control devices for all alternatives. Alternatives were not developed to represent VOC reduction by low-VOC, waterborne ink system usage without emission controls since waterborne inks have not been developed yet for this industry.

The first regulatory alternative is a 75 percent overall control level that represents capturing the dryer exhausts from older presses—baseline level. This corresponds to the CTG recommendation for existing facilities. This control level is achievable by capturing about 84 percent of the potential solvent vapors from the press, with a 90 percent adsorber efficiency.

The second regulatory alternative is an 80 percent overall control level that represents capturing the dryer exhausts from new, well-designed presses. In this case 85 percent capture would be required with a 95 percent efficient adsorber. This corresponds to a typical, modern facility. Overall emission reduction in the 80 to 84 percent range were determined from short-term test data and five months of plant data at Texas Color Printers. In addition, over four months of plant data from World Color Press showed four-week average overall control efficiencies ranging from 78 to 84 percent.

The third regulatory alternative is an 85 percent overall control level that represents capturing the dryer exhausts from newer presses, as well as some of the fugitive solvent vapors. This is intended to correspond to a 90 percent efficient capture system with a 95 percent efficient adsorber. This alternative represents application of the best demonstrated control technology. The fugitive vapors would be captured by—

• A partial enclosure fugitive vapor capture system that is vented to the control device; or

• A system of multiple fugitive vapor capture vents that are located around the press and collectively ducted to the control device; or

• Total pressroom ventilation air that is directed to the control device.

Overall control efficiency data for the three best demonstrated VOC emission reduction systems support the long-term average achievability of an 85 percent regulatory level. Four-week average overall control efficiencies reported by Standard Gravure range from 85 to 90 percent for over a year of typical operations. Corrected overall control efficiencies of 89 to 92 percent were demonstrated in short-term tests at the Meredith-Burda plant. In addition, data were obtained from this plant for normal operations over ten separate months indicating corrected overall control efficiencies ranging from 84 to 91 percent. Calculations using short-term test data combined with five months of plant data indicated that the Texas Color facilities might potentially achieve about 88 percent overall recovery by directing their existing floor sweep vents to the adsorber system, rather than to the atmosphere. these data show that considerable variation occurs in the long-term control performance; however, an average 85 percent overall control level is achievable, with performance dropping to a low point of about 84 percent for one or two months a year.

Environmental, Energy, and Economic Impacts

The incremental potential environmental, energy, and economic impacts of the two higher regulatory alternatives relative to the baseline alternative were determined through development of model plants, representing new facilities. Projections of these impacts were based on analyses of two model plant sizes, resulting in a total of six model plant cases. The small model plant consisted to two eight-unit presses; the large model plant consisted to four eight-unit presses. Only one press width of 1.83 meters (72 inches) with an operating speed of 10.16 m/s (2,000 fpm) was considered. There are some smaller and some larger existing presses; however, the press size chosen is the most common. Most modern rotogravure presses are designed to operate at about the speed chosen for study, although older presses operate at only about half that speed.

The control of VOC emissions from each model plant was based on solvent vapor capture systems combined with fixed-bed carbon adsorption/solvent recovery devices. Model plants were not developed for emission control by any other solvent recovery devices, such as fluidized-bed carbon adsorption, because sufficient operating information for use in this industry was not available. Also, model plants were not developed for analysis of VOC emissions control by solvent destruction devices (i.e., oxidation) since these devices are not presently used and not expected to be employed in the future by this industry. Furthermore, model plants representing the use of low-VOC, waterborne ink systems without emission control systems were not analyzed since waterborne inks are not expected to be developed for this industry for another five to 10 years. Since modified and reconstructed existing facilities are also subject to standards proposed under Section III of the Clean Air Act, model plants representing these affected existing facilities are typically developed. However, model plants representing these affected facilities were not developed because neither modification nor reconstruction is expected in this industry, as explained in a later section. The environmental, energy, and economic impacts on modified and reconstructed facilities to comply with the proposed standards would be essentially equivalent to those impacts on new facilities.

The seven percent annual real growth rate projected for this industry corresponds to about 75 new presses to be installed by the year 1985. Most of these new facilities will provide expansion capabilities; however, some of these new presses will simply replace old, worn-out existing presses, with no production expansion intended. Also, since modern presses operate at higher speeds with increased efficiency compared to older presses, the required utilization of new presses would be less than that for older presses to meet customer demands. No modifications or reconstructions are expected during this period. the annual total solvent usage in this industry will increase to about 236,000 megagrams by 1985. New Source Performance Standards (NSPS) set at the 80 percent control level would further reduce 1985 nationwide VOC emissions by about 4,000 megagrams per year over control at the 75 percent baseline level. An 85 percent regulatory control level would result in an additional reduction of 1985 VOC emissions by about 7,900 megagrams per year over that for baseline control.

Emissions of air pollutants from two secondary sources result form the energy required for operation of the carbon adsorption/solvent recovery control systems. First, required electrical power was assumed to be generated by coal/fired utilities (worst cast). Fuel combustion emissions from these power generation facilities are regulated under MSPS promulgated at 44 FR 33580 on June 11, 1979. Secondly, required steam production or regeneration of the carbon beds results in fuel combustion emissions from the uncontrolled plant steam boilers. Total resultant secondary flue gas emissions from these two sources was estimated to represent about 0.5 percent of the corresponding VOC emission reduction from the publication rotogravure presses. Control ov VOC emissions from a typical four-press printing plant at the 80 and 85 percent levels would result in total secondary emissions of about two and five megagrams per year more than for control at the baseline level, respectively. In 1985, the nationwide total secondary emissions for control at the 80 and 85 percent levels would be about 25 and 100 megagrams more than for control at the baseline level, respectively. Corresponding incremental VOC reductions would be 4,000 and 7,900 megagrams for the 80 and 85 percent levels. Therefore, the resulting total air pollutants emitted from secondary sources only slightly offset the primary impact of reducing VOC emissions.

There are three potential sources of water pollution associated with carbon adsorption/solvent recovery systems. The largest source would be the dissolved solvent in the condensate discharged from the decanter section of the adsorber system. This condensate typically contains from 130 to 200 ppm solvent, but can be as high as 1,900 ppm solvent, depending on the solvent used and the temperature. Control of VOC emissions at the 80 and 85 percent levels would result in increased potential wastewater discharges of about seven and thirteen percent over that for baseline control, respectively. The VOC content in the condensate respresents less than 0.1 percent of the respective VOC emission reductions from the presses. Also, this potential water pollution source could be virtually elimiated by air-stripping the condensate and recycling the resultant solvent-free water as make-up feed water to the plant steam boiler. The solvent laden air from the stripping tower could be recycled to the adsorption beds. Alternatively, the condensate could be discharged to a conventional biological waste treatment system. A small amount of the dissolved VOC solvent would naturally evaporate out of the waste water during biological treatment, but these vapor emissions would be part of the 16 percent emission limit allowed under the proposed standards, and would not constitute any additional primary VOC emissions or any secondary air pollutant emissions. Dissolved organics and solids in the plant cooling tower and steam boiler blowdowns represent two minor sources of water pollution. The cooling tower water and steam usages increase in direct proportion to the amount of solvent recovered. The respective blowdown rates would thus increase correspondingly. All three waste water sources are subject to State and local effluent regulations for five-day biochemical oxygen demand (BOD_5), chemical oxygen demand (COD), and some specific compound contents.

There are two potential sources of solid waste material resulting from VOC emissions control by carbon adsorption/solvent recovery systems. Activated carbon used in the absorbers should last at least five years for service in this industry before replacement is required. The total amount of activated carbon used for control at the 80 to 85 percent overall recovery levels would be larger by about seven and thirteen percent over that for baseline control, respectively. In 1985, the amount of nationwide waste carbon for control at the 80 and 85 percent levels would be, respectively, about 42 and 85 megagrams more than for control at the baseline level. The second source of solid waste is the SLA filters, which are usually made of fiberglass material. Usage of the filters increases proportionately to the SLA flow rate. The amount of waste filters for control at the 80 to 85 percent levels would, thus, increase by about nine and 40 percent over that for baseline control, respectively. Some of the spent carbon can be regenerated and recycled. Likewise, some of the air filters can be cleaned and reused. The solid waste impact from emissions control at any of the three regulatory levels is not expected to cause any significant handling problems.

In the Administrator's opinion, these incremental environmental impacts for the two higher regulatory alternatives are reasonable.

There would be direct energy consumption increases for plants with affected facilities controlled at either of the alternative regulatory levels above 75 percent baseline control. Control of VOC emissions at the 80 percent level would require about seven percent more direct energy than at the 75 percent level. Similarly, control at the 85 percent level would increase energy consumption by about 18 percent over that for baseline control.

On the national level, there would be net energy savings for VOC emissions control at all of the regulatory alternative levels considered when the fuel energy value of the recovered solvent is included. Fuels and organic solvents can both be derived from a common source of crude oil. A decrease in the demand for solvents will thus increase the potential for fuel availability. The net energy savings in the year 1985, compared with baseline control, would be increased by about the equivalent of 15,600 and 21,800 barrels of fuel oil per year for controlling new press emissions at the 80 and 85 percent levels, respectively.

The Administrator believes that the direct incremental energy impacts on the industry for the 80 and 85 percent control levels are reasonable, particularly in view of the net national energy savings which would result from decreased solvent demand.

The economic impacts of the regulatory alternatives were analyzed in terms of capital investment requirements, total annualized costs, and affects on product price and profitability. VOC emissions control equipment would represent a significant fraction of total plant capital investment at any level of control, although the incremental capital costs required for either plant size to attain higher levels of control would be very small compared to control at the baseline level. The installed capital investment for a baseline level VOC emissions control system for a four-press plant would represent about 5.5 percent of the controlled plant's total cost; VOC controls for a two-press plant would represent about seven percent of the total costs. The total plant installed capital cost for control at the 80 and 85 percent levels, relative to the cost for baseline control, would increase by about 0.5 and two percent, respectively.

The capital investment in the model plant carbon adsorption systems were mainly influenced by the air flow handling requirements. Model plant characteristics, representing current practice in this industry, included usage of naphtha-based solvents with dryer exhaust vapor concentrations at the 19 to 20 percent of the Lower Explosive Limit (LEL) level. The LEL is the lowest vapor concentration in air, expressed as volume percent, at which the mixture could support a flame or explosion at temperatures below 121°C (250°F). Insurance safety regulations require normal operation at less than about 25 percent of the LEL. Operation up to 50 to 60 percent of the LEL is permitted when continuous vapor monitoring systems are employed to control the vapor concentration in the air.

The cost value of the recovered solvent would provide for annualized cost savings and positive return on investments (ROI) for emissions control for all six model plant cases studies.

Annualized cost savings and ROI for the emission controls increase in going from 75 to 80 percent overall control as a result of the additional solvent recovered from dryer exhausts. However, the savings and positive ROI decrease in going from 80 to 85 percent control because of the added costs of capturing and treating fugitive vapors. A profit-maximizing operation would therefore practice about 80 percent overall control. ROI for emission controls with the large model plant is about ten percentage points higher at all three control levels than that for the small plant. These analyses are based on the cost value of recovered solvent at the early 1979 market price of $0.17 per liter ($0.65/gallon). The increment in cost savings are much more favorable for both the 80 and 85 percent control levels when projected late 1979 conditions are assumed (i.e. solvent cost value at $0.24 per liter ($0.90/gallon) with 10 percent increased operating and capital costs). The late 1979 conditions reflect inflationary price increases in the cost of solvent and yield more favorable economic impacts for solvent recovery.

An 85 percent solvent recovery requirement would not pose any problems of capital availability and thus, would not restrict industry growth. The average pre-tax profit for this industry with baseline controls is about eight percent of the total sales. For control at the 85 percent level, small sized plants' profitability would only decrease by about 0.2 percentage points at both the early and late 1979 economic conditions; profitability for larger sized plants would decrease by an estimated 0.1 percentage point. No measurable price increases for gravure products would occur with VOC control at any of the three regulatory alternatives considered. The Administrator believes that the incremental economic impacts for the 80 and 85 percent regulatory alternatives are reasonable.

In summary, the model plant analyses show that the impacts associated with 85 percent overall control are the most reasonable of the three regulatory alternatives considered. The environmental impacts of the 85 percent alternative would not pose any major wastewater or solid waste problems, while providing a significant increase in the primary benefit of VOC reduction. National energy consumption would decrease compared with that for baseline control because of the fuel energy value of the extra recovered solvent. Finally, the cost value of the recovered solvent would provide for annualized control cost savings for the 85 percent alternative. While this cost savings is less than the savings that could be achieved at the 75 to 80 percent regulatory levels, the economic impact would not adversely affect profit margin and thus industry growth. Moreover, publication gravure product prices are not expected to increase noticeably.

Selection of Format for Proposed Standards

Three formats were considered for the proposed standard: (1) a mass emission rate related to unit production, (2) a concentration limitation and (3) a percentage overall reduction or emission limit.

A fixed emission percentage limit format, or overall percentage reduction, is selected because it provides the only adequate measure of actual VOC emissions control. A variable emission percentage limit corresponding to a fixed VOC emission rate allowance per unit of applied solids is not necessary for this industry. A characteristic of rotogravure printing is that the solvent to solids ratio of the applied ink mixture can only vary within a narrow range and still have the correct fluid properties for high quality printing. For solvent recovery control systems, the average emission percentage can be determined over long-term periods by simple comparison of the total liquid volume amount of recovered solvent to the total liquid volume amount of solvent used at the facility. This format allows for determination of compliance without the necessity for monitoring of any gas streams, and inherently indicates whether or not VOC vapors are being adequately captured. Also, the VOC retained by the printed product is accounted for with this format. Finally, an emission limit format is simple to use and insensitive to the many process fluctuations, upsets, variations in product types, and variations in the captured SLA VOC vapor concentration.

An allowable VOC vapor concentration in the gas streams vented to the atmosphere would appear to be the easiest format for standards enforcement. However, a typical printing facility may have numerous direct atmospheric vents, as well as, the exhaust stream out of the control device. Short-term monitoring of all the vents may be feasible, but continuous on-line monitoring of all vents would be very expensive. Moreover, monitoring of just the control device exhaust stream would not provide for sufficient indication of effective capture of VOC vapors emitted from the facility. In addition, the amount of VOC retained by the printed products can not be determined by monitoring just the VOC vapor concentration of the gas stream vents. Furthermore, concentration limitation formats are susceptible to dilution problems, which can cause poor indication of true emission rates. Thus, a concentration limitation would not be a suitable standards format for this industry.

The printing of rotogravure products is characterized by the variable amounts of solvent usage and ink coverage on the paper web. There is no fixed relationship between the amount of solvent used, or VOC emitted, and the bulk quantity of printed products. Therefore, a mass emission rate per unit of product format is inappropriate for this industry.

For solvent recovery control systems, an overall solvent volume balance around the affected facility is selected to be used with the emission percentage limit format. Most new rotogravure printing plants install liquid volume meters for process monitoring and control, and for customer billing purposes. Meters are used to measure the amount of ink and related coatings, and solvent used for printing and cleaning at the facilities. A meter also measures the amount of liquid solvent recovered by the adsorption system. The total amount of solvent used would be determined by the liquid meter readings combined with the VOC content analyses of the purchased raw inks and related coatings. The total amount of recovered solvent would be determined by the liquid meter readings combined with miscellaneous liquid volume amounts of unmetered waste solvent and waste inks from the affected facility. Subtracting the total amount of solvent recovered from the total amount of solvent used and then dividing that result by the total amount of solvent used would complete an overall solvent balance, and determine the VOC emissions percentage for the affected facility.

The same overall solvent volume balance and emission percentage limit format would be used when more than one affected facility is controlled by a common solvent recovery system. For these cases, the total amount of solvent used would be the collective volume amounts for all associated affected facilities.

The VOC emissions from some existing and affected facilities could be controlled in common by the same solvent recovery system. Some existing control systems were originally oversized in order to handle future press installations. In addition, new carbon adsorption systems could be installed to control emissions from affected presses, as well as some uncontrolled existing presses. For these combination cases, the same overall solvent volume balance and emission percentage limit format would be used. The proposed standards would still apply to only the affected facilities. Determination of compliance for the affected facilities in these combination cases is explained in the Compliance Provisions section.

Some plants may decide to capture and recover the relative small amount of solvent vapors from existing or new proof presses. Captured VOC vapors from either of these operations could be sent to the emissions control systems for affected facilities; however, the proposed standards would still apply to only the affected facilities. The ink and solvent usage at the proof press would not have to be accounted for in determining compliance with the proposed standards.

In principle, the same emission percentage format could be used with solvent destruction emission control devices. Procedures for determination of the emission percentage with these control devices are not being proposed, however, because these control devices are not presently employed by this industry, and are not expected to be used in the future. The Administrator will welcome comments on whether this expectation is a reasonable assumption.

The emission percentage format would also be used for affected facilities using low-VOC, waterborne ink systems without emission controls. The actual emission percentage would not be determined for these cases, however. Instead, the affected facility would be determined to be in compliance with the proposed emission percentage limit if the VOC content is not more than 16 volume percent of the total volatile portion of the waterborne ink mixture as applied to the gravure printing cylinder. Since there are no waterborne inks presently used in this industry, a suitable analysis method could not be developed for determination of the VOC content in the ink mixture as applied. Therefore, in the absence of test data a allowable VOC to solids volume ratio for purchased inks and coatings was developed on a theoretical basis to correspond to the proposed 16 percent emission limit. A general material balance for typical solvent-borne ink systems usage showed that the ink mixture as applied contains an average of 20 volume percent solids and 80 volume percent VOC. An allowable 16 percent emission of the VOC content shows that an equivalent waterborne ink mixture would have to have a VOC to solids volume ratio of less than or equal to 0.64. Thus, if only water were added to dilute the raw inks and related coatings, the ink manufacturer's analysis data on the purchased inks and coatings could be used to determine compliance with the proposed emission limit.

Liquid metering devices would not be required with waterborne ink systems provided that only water is added for ink dilution. If VOC solvent were added for ink dilution, liquid meters would be required to facilitate calculation of the VOC content in the applied ink mixture. The Administrator believes that the stipulation for water dilution only is reasonable for two reasons: (1) Not having to install liquid meters should provide an extra incentive for using waterborne ink systems, and (2) If ink formulation technology advances far enough to develop useable low-VOC, waterborne inks, there should be no need nor desire to dilute the ink with VOC solvent.

Selection of Numerical Emission Limits

The proposed 16 percent emission limit, or 84 percent overall reduction, is the maximum control level judged by the Administrator to be achievable on a continual basis by the best demonstrated system of emission reduction. The most stringent regulatory alternative considered, requiring 85 percent overall control or a 15 percent emission limit, is achievable most of the time and has, in the Administrator's judgment, acceptable environmental, energy, and economic impacts. However, long-term plant data showed that a 15 percent emission limit might not be achievable during one or two months over a year's operation. Therefore, the emission limit has been set at 16 percent to accommodate this expected variation in overall control efficiency. As noted previously in the control technologies and regulatory alternatives sections, the proposed overall emission control level of 85 percent has been demonstrated by existing facilities employing VOC vapor capture systems of greater than 90 percent efficiency combined with solvent recovery devices of greater than 95 percent efficiency. These efficiencies were first of all achieved during tests at the newest Meredith/Burda facilities. Secondly, tests conducted at Texas Color Printers showed that those facilities could potentially achieve the 85 percent overall control level. Thirdly, more than a year of data reflecting normal operation at Standard Gravure showed long-term achievement of the 85 percent level. Finally, evaluation of more data from Meredith/Burda covering ten months of normal plant operation caused the Administrator to select 84 instead of 85 percent overall control as the correct basis for the proposed emission limit.

The newest facilities at Meredith/Burda were tested after observation revealed that these modern facilities employed the best continuous fugitive VOC vapor capture system combined with a thoroughly instrumented, modern carbon adsorption/solvent recovery system. The two presses involved in the tests consisted of eight printing units each and were printing a magazine and an advertising product at average press speeds of 4.6 to 9.6 m/s (900 to 1,900 f/m), while using toluene as solvent. Overall liquid solvent volume balances were conducted during three separate nine-hour runs, and over 50 hours of normal printing operations. The normal operations involved numerous press shutdowns and startups for web breaks and other typical problems. Liquid meter readings and manufacturers data on the VOC content of the purchased raw inks and related coatings were used as first calculations of the overall solvent volume material balances. As explained in Chapter 4 of the BID (Section 4.1.2), the apparent overall VOC control efficiency results were then reduced by five percent to compensate for two unique characteristics at these facilities. A two percent factor was required for the density variation of the higher metered temperature of the recovered solvent over the assumed metered temperature of the raw inks and toluene used at the presses. An additional three percent factor was required for infiltration of toluene vapors from neighboring pressrooms. The results of supplemental measurements showed that some air containing 60 to 70 ppmv toluene vapors was drawn into the newest pressroom from other pressrooms and plant areas. The final adjusted tests results showed overall solvent recovery efficiencies ranging from about 89 to 92 percent. In addition to the short-term test results, ten individual months of plant material balance data were compensated for the temperature and infiltration factors resulting in adjusted overall VOC control efficiencies ranging from about 84 to 91 percent.

The test results and reported plant data on the overall VOC control efficiency by liquid meter readings are believed to be based on the most accurate measurements that continuous modern instrumentation can provide. The meters were not calibrated before testing, however the tests were conducted within six months after the new meters were installed and should still have been within the original factory calibrations. Also, the meter readings were not cross-checked with storage tank level readings, but the Administrator believes that the liquid meters should be more accurate than solvent inventory by tank level readings.

The capture system demonstrated at Meredith/Burda consisted of dryer exhaust collection combined with fugitive vapor cabin enclosures around the top portion of each press. The cabin enclosures represent the most effective VOC vapor capture system, requiring the least amount of SLA handling to capture essentially all fugitive vapors from the presses. However, as explained in the "Control Technologies" section, application of this type enclosure may require some modifications to alleviate potential OSHA violations.

The product mix handled at Meredith/Burda is somewhat specialized and is therefore not fully representative of the entire publication rotogravure printing industry. Meredith/Burda handles special long run products, while most other plants print shorter run products. The shorter run products cause more frequent web breaks and press shutdowns during printing, as well as more press downtime between job runs. In addition, some of the industry's products may retain more solvent than the products printed at Meredith/Burda, although there is no known satisfactory method for this determination. Therefore, the high VOC vapor capture efficiencies demonstrated at Meredith/Burda may not be representative of that achievable by the rest of the industry.

It was realized that the Meredith/Burda facilities had several unique features so facilities at a second plant site were tested. The two Texas Color Printers facilities were tested because they were modern printing facilities which use the more common mixed, naphtha-based solvent. Unfortunately, the facilities did not employ a fugitive vapor capture system and the solvent recovery system was not as well instrumented as that at Meredith/Burda. The tested presses consisted of eight and twelve printing units each and were printing a magazine and advertising products at average press speeds of 4.6 to 9.1 m/s (900 to 1,800 f/m). Overall liquid solvent volume balances and gas phase monitoring of pressroom ventilation air streams were conducted during three four and one-half hour runs. In addition, a solvent volume balance was conducted over a 27 hour period of normal operation. The test results from direct liquid meter readings, ink manufacturers data, and the gas phase monitoring showed that overall solvent recovery efficiencies ranging from about 91 to 93 percent could potentially be achieved if the pressroom ventilation air streams were directed to the control device rather than to the atmosphere. However, combination of the test data with five months of plant data indicated potential overall solvent recovery efficiencies of only about 88 to 90 percent. The lowest calculated potential efficiency, in each case, was based on a one percent decrease in adsorber efficiency which would result from the 30 percent increase in the captured SLA flowrate. The highest calculated potential efficiencies would correspond to increased adsorber efficiencies from modification and better instrument controls comparable with those at Meredith/Burda.

A third data source considered in setting the proposed emission limit level consists of over a year of plant data from Standard Gravure. This plant is regarded as having the most thorough capture system; however, the average adsorber efficiency is probably lower than Meredith/Burda's because of the lower solvent vapor concentration in the inlet SLA. At this plant, the VOC emission control system performance is determined by overall liquid solvent mass balances, instead of volume balances. Converted recovered solvent meter readings are compared to total amount of solvent used, determined from converted solvent addition meter readings plus tank truck weighings of purchased raw inks combined with ink manufacturers VOC analysis data. Six rotogravure production presses, consisting of eight to 16 printing units each, are used to print only newspaper supplements at average press speeds of 6.6 to 7.6 m/s (1300 to 1500 fpm). The mixed, naphtha-based type solvents are used at these printing facilities. The long-term plant data showed individual four-week averaged overall recovery efficiencies ranging from 85 to 90 percent. The plant suggested that the inlet SLA vapor concentration, and thus the adsorber efficiency, is lower during periods of less solvent usage because the SLA capture system has no turndown or valve diverting mechanisms. The overall recovery versus solvent usage data, however, does not show any definite correlation.

The Administrator believes that the Standard Gravure plant data should be included as part of the data base for setting the proposed emission limit level, even though EPA testing was not conducted at this plant. These plant data serve as additional sources of long-term performance data, which have been shown to be more realistic than short-term tests for evaluating the achievable overall emission control performance. The Standard Gravure plant data show overall efficiencies continually above the proposed standard 84 percent level (16 percent emission limit). The normal plant procedure for determining the emission control system performance does not follow the exact format for the proposed standards, but the Administrator believes that the method used should provide sufficient accuracy for supporting the proposed emission limit.

The variations in press widths, press operating speeds, and number of printing units per press can significantly affect the overall efficiency of a carbon adsorption/solvent recovery system. Operating conditions such as a narrow web being printed on a wide press, decreased ink coverage, and technological advancements allowing press speeds of over 10.2 m/s (2,000 fpm) could cause decreased capture efficiency and excessive dryer exhaust SLA dilution. These effects were shown during the two plant tests while printing both narrow and full width webs with several different products and ink coverages.

The Administrator acknowledges these potential effects and believes that they can be minimized by careful design of new presses and the SLA capture system. A VOC vapor monitor could be installed in the dryer exhausts streams to control the amount of internal air recirculation; this would maximize the VOC vapor concentration in the SLA stream treated by the control device. Adjustable width openings for the dryer inlets and outlets could be designed to help minimize the amount of dilution air drawn into the dryer. These adjustments could be made when the printing cylinders are changed between job runs. More thorough dryer designs will need to be utilized to handle the higher press speeds. In addition, fugitive vapor capture-air systems incorporating valve-diverting or turndown mechanisms could be installed for periods of low production and press shutdowns. The Administrator believes that the proposed standards allow for these effects, since the emission limit is based on long-term, typical operations while printing various types of products at three different plants.

In conclusion, the Administrator selected the proposed 16 percent emission limit after a thorough evaluation of the data base and a careful consideration of factors which influence control system performance. The data base consists of short-term test data and long-term plant data for facilities at the Meredith/Burda and Texas Color plant sites, along with long-term plant data from Standard Gravure. The data base shows that 90 percent overall control is achievable under some conditions; however, the Administrator realized that 90 percent control is not representative of all conditions for the entire affected industry. The Administrator believes that the proposed 16 percent emission limit (84 percent overall control) is reasonable and is continually achievable. The proposed emission limit level allows for control efficiency variations resulting from such factors as low solvent usage, solvent retention in the product, and printing products that cause frequent production delays.

Selection of Compliance Provisions

Performance Averaging and Reporting

After the required initial performance test is completed, continual compliance with the proposed standards would be determined on a calendar month averaging basis. Each calendar month would be considered a performance test. The results of the monthly compliance determinations would have to be reported within ten calendar days following the end of any calendar month for which non-compliance is determined. Reporting of performance test results showing compliance with the standards would not be required. As an alternative, four-week averaging compliance periods may be chosen by an owner or operator in order to coincide with the plant's normal accounting procedures. Affected facilities would be subject to potential enforcement action for any compliance period in which a violation of the proposed standards is determined.

The variability of rotogravure printing requires a long-term averaging period to adequately assess the true performance of fixed-bed carbon adsorption/solvent recovery systems. Several different types of publication and advertising products are printed with a wide range of coverage of ink and related coatings. Operating parameters such as press speed, web width, production run length (number of printed copies), press shutdown frequency, product solvent retention, liquid hold-up volume of printing unit ink fountains, and solvent hold-up volume in carbon adsorbers vary substantially within this industry on a daily basis. The combination of these factors influences the amount of solvent vapors generated and the performance of the emission control system. The Administrator believes that calendar monthly or four-week period averaging would allow enough time for printing operation fluctuations to average out.

The necessity for longer-term averaging periods, such as over several months, was considered. The emission limit increase from 15 to 16 percent on a calendar month averaging basis was selected for proposal instead of an option for allowing performance averaging over several months with the 15 percent emission limit alternative. The long-term adjusted Meredith/Burda data showed that a minimum averaging time of four calendar months would have been required on a rolling calendar month basis to meet continual achievability of the 85 percent regulatory alternative.

Initial Performance Test

For affected facilities controlled by solvent recovery systems, the initial performance test would cover 30 consecutive calendar days. The long-term test period was chosen to allow sufficient time for averaging of process variations. A certain number of test days is specified rather than a calendar month so that the initial test could begin as soon as the facility is ready without having to wait until the first day of a month. Determination of compliance during the initial performance tests during the succeeding months or four-week periods, as described in the FORMAT section.

The apparent overall solvent volume balance calculation would have to be density corrected to a base temperature to compensate for the temperature differences between the recovered solvent and the ink/solvent used at the press. This requirement is necessary because of the volumetric expansion of liquid solvent with temperature. Temperature indicators would have to be installed by each meter for the inks, coatings, and solvent used at the press. An automatic temperature compensator would have to be installed for the recovered solvent meter. The temperature of the metered liquids used at the press would probably represent a constant and uniform base temperature at about 20°C (69°F) since the liquids should be at ambient temperature and the meters would be located inside the pressroom. The temperature of the metered recovered solvent can vary from ambient to over 40°C (104°F), depending on the condenser and cooler designs and performance. Since automatic temperature compensators are employed, only direct meter readings would be required.

For affected facilities controlled in common with existing facilities by the same solvent recovery system, the initial performance test would also cover 30 consecutive calendar days. The existing facilities involved would have to install liquid meters and temperature monitoring devices just as required of affected facilities. Raw ink and related costing supplies used at the subject existing facilities would have to be analyzed for VOC content just as for affected facilities. The initial performance test would be performed with both affected and existing facilities simultaneously connected to the solvent recovery system, although only the affected facility would be subject to the proposed standards. For these combination cases, one of two options may be chosen for the initial determination of compliance for the affected facilities.

The first compliance determination option would require a separated initial emission test for the controlled existing facilities involved before the initial performance test is conducted. To determine the true control performance for the affected facilities involved, the amount of VOC emissions from the existing facilities would first need to be subtracted from the total emissions for the combined facilities controlled in common. The separate emission test would determine the average operating emission percentage for the controlled existing facilities by using the overall solvent volume balance procedures developed for affected facilities. The emission test would be performed on the controlled existing facilities without the affected facilities being connected to the emission control system. The emission test would cover 30 consecutive calendar days. Only on existing facilities sharing control systems with affected facilities would emission testing be required. Initial compliance of the affected facilities would then be determined by the initial performance test after being connected to the emission control system with the existing facilities. The existing facilities' tested average emission percentage would then be multiplied by the 30-day total volume of solvent used at only the existing facilities during the initial performance test to determine the amount of VOC emissions from only the existing facilities. The performance of the affected facilities would finally be determined by subtracting the VOC emissions of the existing facilities from the total solvent volume balance for the combined affected and existing controlled facilities.

The second compliance determination option for the combination cases would not require separate testing of existing facilities, but would require more thorough control of emissions from existing facilities.The combined performance of the affected and existing controlled facilities would have to show compliance with the proposed 16 percent emission limit. Fugitive emissions would have to be captured at the existing facilities to meet the emission limit. From an environmental impact view, this option would be the more favorable choice.

Initial performance test compliance provisions for affected facilities controlled by solvent destruction devices (i.e. oxidation) are not being proposed. These control devices are not presently used by this industry and are not expected to be employed in the future.

For affected facilities using low-VOC, waterborne ink systems without emission control systems, the initial performance test would cover 30 calendar days. Determination of compliance during the initial test would be by VOC analysis data of the purchased raw inks and related coatings used at the affected facility. The affected facility would be in compliance with the proposed 16 percent emission limit provided that the VOC to solids volume ratio is less than or equal to 0.64 for each shipment of all purchased raw inks and related coatings, and only water addition is used as dilution.

Subsequent Performance Tests

For solvent recovery controlled facilities, the second performance test would start with the first day of the next calendar month following completion of the initial performance test or the following Monday for facilities using the four-week averaging period. The period between completion of the initial performance test and the start of the second performance test would not constitute a performance test.

Determination of compliance with solvent recovery systems would be by liquid meters and analysis of all solvent-borne inks and related coatings used at the press. Non-resettable totalizer meters would have to be permanently installed to determine the volume quantities of solvent addition and inks and related coatings used at the press. In addition, a non-resettalbe totalizer meter would be required for the recovered solvent stream from the solvent recovery decanter. Meter readings would have to be taken and recorded during each day of press operation. Daily meter readings would also serve to detect meter malfunctions, and account for the times when the totalizer's reading turns over to zero. Volumetric quantities of any waste inks and waste solvent from the tested facility would be determined using any suitable means approved by the Administrator and recorded as they occur. The VOC volume content analysis of each shipment of ink and related coatings could be obtained from the ink manufacturers. Alternatively, a routine weekly average VOC content could be determined by analysis of the liquid mixtures in the respective storage tanks.

The overall solvent volume balance format, previously described, would then be applied at the end of each performance test averaging period to determine the actual averaged emission percentage and compliance. The total volume amount of solvent in the inks and related coatings would be determined from a summation of several calculated quantities. The VOC volume fraction of each purchased liquid mixture would be multiplied by the respective volume amount of liquid used. This proration is required to compensate for liquid mixture analyses which may change somewhat with each shipment. Alternatively, a weekly average VOC volume fraction for each liquid used could be multiplied by the volume amount of the respective liquid mixture used that week. In either case, the volume amounts of each liquid mixture used at the press would be determined directly from meter readings. The amount of solvent added for printing and cleaning at the press, and metered recovered solvent would be determined directly from meter readings. The quantities of waste inks and waste solvent would be included directly as recovered solvent. Analyses of these two sources of solvent would not be required since they should normally represent relatively insignificant quantities.

The proposed standards would require that the liquid meters necessary for determining compliance be calibrated at least every six months. This requirement is in accordance with maintenance recommendations by most meter manufacturers. This calibration would be done onsite, or the meter could be removed for calibration while a calibrated spare meter is used in its place. The confidence limits of each calibration must be determined and kept on record. Manufacturer's data on some of the liquid meters currently installed in this industry were used to set meter accuracy requirements. Meters used for the inks and related coatings would have to show an accuracy of within ±1.5 percent. Meters used for solvent added at the press and recovered solvent would have to show an accuracy of within ±0.5 percent, since solvent doesn't contain any solids and is an easier metering service.

For affected facilities controlled in common with existing facilities by the same solvent recovery system, the subsequent performance tests would follow the same procedures used during the initial performance test. If prior to the initial performance test the option to test the existing facilities separately was chosen, the averaged performance of the affected facility during each month or four-week performance averaging period would be calculated considering the existing facilities' tested emission percentage. Each existing facility's tested emission percentage would be assumed to remain constant for each performance average period until the Administrator requests another emission test for that existing facility. If the option to not test the existing facilities prior to the initial performance test was chosen, the combined performance of the affected and existing controlled facilities would have to show compliance with the proposed 16 percent emission limit during each month or four-week averaging period.

Procedures for determination of compliance with solvent destruction devices are not being proposed, as previously explained.

The affected facility must be in compliance with the proposed emission limit during all periods of normal operations. Non-compliance would be allowed during periods of startups, shutdowns, and malfunctions of the emission control system as provided for under 40 CFR 60.8(c). However, the startups and shutdowns caused by web breaks and other typical operations upsets would be considered normal operation of printing presses.

Determination of compliance for affected facilities using waterborne ink systems, without emission controls, would be by VOC analysis data from the ink manufacturer, as explained for the initial performance test. Liquid meters would not be required, provided that only water is added for ink dilution.

Selection of Performance Test Methods

Reference methods, equivalent methods, alternative methods, or procedures specified in a regulation must be used for performance tests. This section describes the methods and procedures proposed for this standard.

The proposed Reference Method 29, "Determination of Volatile Matter Content and Density of Printing Inks and Related Coatings", would be employed to determine the VOC volume content of all solvent-borne inks and related coatings used at presses controlled by solvent recovery systems. As an alternative, an owner or operator may obtain analysis data on the VOC content of the purchased inks used from the ink manufacturer. Reference Method 29 could be used for verification of the ink manufacturer's data, if needed. Reference Method 29 would be applicable for analysis of only solvent-borne inks and related coatings. The proposed method could not be used for verification of ink manufacturer's data on the VOC content of waterborne inks.

The proposed Reference Method 29 determines the total amount of volatile matter content in solvent-borne inks and related coatings. Employment of this method for determination of VOC content requires that the volatile portion of the solvent-borne coating must be assumed to consist of essentially all organic compounds. That is, as proposed, the method does not provide procedures for determination of any water content (e.g. by Karl Fischer titration) and subsequent correction for the actual VOC content. It is the Administrator's understanding that all present and future solvent-borne inks and related coatings will usually contain much less than one percent water in the volatile portion, but, at most, up to about five weight percent water. The Administrator will welcome comments on the proposed Reference Method, especially regarding (1) the assumed range of water content in solvent-borne inks and related coatings, (2) the necessity for correcting the Reference Method analysis for water content, and (3) any recommended analytical procedures for accurately determining the water content.

The VOC content data supplied by the ink manufacturer for the purchased raw inks and related coatings should be based on the best method available to the manufacturer. Calculated compositions from liquid meter readings or weigh-tank outages used for measuring the amounts of the individual components that go into making up the product ink mixture may be considered. An analysis method similar to the proposed Reference Method 29 may be used. In general, however, formulation guidelines data are not regarded as the most reliable method since the actual composition of the ink mixture shipment can vary somewhat from the formulation recipe.

For affected facilities using low-VOC, waterborne ink systems without air pollution control equipment, no Reference Methods would be applicable. The owner or operator could determine the VOC content analysis of the purchased inks and coatings by any method acceptable to the Administrator. A reference method for verification of waterborne ink analysis is not being proposed.

Modification/Reconstruction Considerations

Any number of printing units is considered a single press if all the units are capable of printing simultaneously on the same continuous substrate. Since additional units could be added to an existing press to increase its versatility, it is highly unlikely that other units of the same press would be shutdown. Each unit is potentially an equal source of emissions; therefore, the addition of units would cause an incremental increase in emissions and would be considered a modification as defined in 40 CFR 60.14.

A major renovation in which substantial portions of an existing press are replaced is considered a reconstruction according to the provisions under 40 CFR 60.15. If the capital cost of the new components exceeds 50 percent of the total replacement capital cost of a new printing press, the existing press would be considered reconstructed and subject to the proposed standards. This could be achieved by replacement of more than half the units of a press. It is unlikely that only a portion of the units of a press would be replaced, since all the units receive the same use and care. If extensive replacement is indicated, it is more likely that all units will be replaced at once.

As previously mentioned, model plants representing modified and reconstructed existing facilities were not developed because these cases are not expected in this industry. Advanced technological designs of modern printing presses and associated equipment makes the installation of newer presses much more attractive over attempts to upgrade older presses. However, the Administrator believes that both modified and reconstructed existing facilities could achieve the proposed emission limit with reasonable environmental, energy, and economic impacts. These impacts would be essentially equivalent to those impacts for new facilities. Installation of a fugitive vapor capture system would be necessary for each subject facility or for the entire associated pressroom, if fugitive vapors are not already captured. In addition, improvements or modernization of older emission control devices and associated instrumentation may be necessary. Alternatively, low-VOC, waterborne ink systems could be employed to comply with the proposed standards.

Impacts of Reporting Requirements

The "Reports Impact Analysis of New Source Performance Standards for the Publication Rotogravure Printing Industry" is located in Docket No. A-79-50, category 77/8-II-A-11. The results of the analysis are summarized in this section.

The authority for the reporting requirements necessitated by the proposed standards is provided in Section 114 of the Clean Air Act. Several types of reports would be required. The industry would be required to submit notifications of the following: construction, anticipated start-up, actual initial startup, physical or operational changes, and initial performance tests. A report of the initial performance test results would be required. Monthly non-compliance reports would be required; the industry would not be required to submit monthly performance test results when compliance with the standards is determined. Records of startups, shutdowns, and malfunctions of the air pollution control systems, and monthly performance test results would have to be maintained for two years. The industry would also be required to maintain records of daily meter readings, ink analyses, and liquid meter calibrations.

The reporting requirements would necessitate the industry to hire about five additional personnel to cover about 22 person-years over the five years of applicability of the standard. There are presently 17 parent companies in this industry. Thus, less than one-third of an extra person's time would be required per company. This estimate was based on the projection of 7 percent annual real growth in the publication rotogravure industry. Seventy-five new presses would be affected over the five-year period, for an average of 15 presses per year.

Public Hearing

A public hearing will be held to discuss the proposed standards in accordance with Section 307(d)(5) of the Clean Air Act. Persons wishing to make oral presentations should contact EPA at the address given in the ADDRESSES section of this preamble. Oral presentations will be limited to 15 minutes each. Any member of the public may file a written statement before, during, or within 30 days after the hearing. Written statements should be addressed to the Central Docket Section address given in the Addresses section of this preamble.

A verbatim transcript of the hearing and written statements will be available for public inspection and copying during normal working hours at EPA's Central Docket Section in Washington, D.C. (see Addresses section of this preamble).

Docket

The docket is an organized and complete file of all the information submitted to or otherwise considered in the development of this proposed rulemaking. The principal purposes of the docket are (1) to allow interested parties to readily identify and locate documents so that they can intelligently and effectively participate in the rulemaking process, and (2) to serve as the record in case of judicial review.

Miscellaneous

As prescribed by Section 111, establishment of standards of performance for publication of rotogravure printing presses in the graphic arts industry was preceded by the Administrator's determination (40 CFR 60.16, 44 FR 49222, dated August 21, 1979), that the graphic arts industry contributes significantly to air pollution which may reasonably be anticipated to endanger public health or welfare. In accordance with Section 117 of the Act, publication of this proposal was preceded by consultation with appropriate advisory committees, independent experts, and Federal departments and agencies. The Administrator will welcome comments on all aspects of the proposed regulation, including economic and technological issues, and on the proposed test methods. Comments are especially welcomed concerning the exclusion of compliance procedures for solvent destruction devices.

It should be noted that standards of performance for new sources established under Section 111 of the Clean Air Act reflect:

> . . . application of the best technological system of continuous emission reduction which (taking into consideration the cost of achieving such emissions reduction, any nonair quality health and environmental impact and energy requirements) the Administrator determines has been adequately demonstrated [Section 111(a)(1)].

Although there may be emission control technology available that can reduce emissions below those levels required to comply with standards of performance, this technology might not be selected as the basis of standards of performance due to costs associated with its use. Accordingly, standards of performance should not be viewed as the ultimate in achievable emission control. In fact, the Act required (or has the potential for requiring) the imposition of a more stringent emission standard in several situations.

For example, applicable costs do not necessarily play as prominent a role in determining the "lowest achievable emission rate" for new or modified sources locating in nonattainment areas, i.e., those areas where statutorily-mandated health and welfare standards are being violated. In this respect, Section 173 of the Act requires that new or modified sources constructed in an area where ambient pollutant concentrations exceed the National Ambient Air Quality Standard (NAAQS) must reduce emissions to the level that reflects the "lowest achievable emission rate" (LAER), as defined in Section 171(3) for such category of source. The statute defines LAER as that rate of emissions based on the following, whichever is more stringent:

> (A) the most stringent emission limitation which is contained in the implementation plan of any State for such class or category of source, unless the owner or operator of the proposed source demonstrates that such limitations are not achievable, or
>
> (B) the most stringent emission limitation which is achieved in practice by such class or category of source.

In no event can the emission rate exceed any applicable new source performance standard [Section 171(3)].

A similar situation may arise under the prevention of significant deterioration of air quality provisions of the Act (Part C). These provisions require that certain sources [referred to in Section 169(1)] employ "best available control technology" (BACT) as defined in Section 169(3) for all pollutants regulated under the Act. Best available control technology must be determined on a case-by-case basis, taking energy, environmental and economic impacts and other costs into account. In no event may the application of BACT result in emissions of any pollutants which will exceed the emissions allowed by any applicable standard established pursuant to Section 111 (or 112) of the Act.

In all events, State Implementation Plans (SIP's) approved or promulgated under Section 110 of the Act must provide for the attainment and maintenance of NAAQS designed to protect public health and welfare. For this purpose, SIP's must in some cases require greater emission reduction than those required by standards of performance for new sources.

Finally, States are free under Section 116 of the Act to establish even more stringent emission limits than those established under Section 111 or those necessary to attain or maintain the NAAQPS under Section 1110. Accordingly, new sources may in some cases by subject to limitations more stringent than standards of performance under Section 111, and prospective owners and operators of new sources should be aware of this possibility in planning for such facilities.

This regulation will be reviewed four years from the date of promulgation as required by the Clean Air Act. This review will include an assessment of such factors as the need for integration with other programs, the existence of alternative methods, enforceability, improvements in emission control technology, and reporting requirements. The reporting requirements in this regulation will be reviewed as required under EPA's sunset policy for reporting requirements in regulations.

Section 317 of the Clean Air Act requires the Administrator to prepare an economic impact assessment for any new source standard of performance promulgated under Section 111(b) of the Act. An economic impact assessment was prepared for the proposed regulations and for other regulatory alternatives. All aspects of the assessment were considered in the formulation of the proposed standards to insure that the proposed standards would represent the best system of emission reduction considering costs. The economic impact assessment is included in the Background Information Document.

Dated: October 16, 1980.

Douglas M. Costle,

Administrator.

It is proposed that 40 CFR Part 60 be amended as follows:

1. A new Subpart QQ is added as follows:

Subpart QQ—Standards of Performance for the Graphic Arts Industry: Publication Rotogravure Printing

Sec.

60.430 Applicability and designation of affected facility.
60.431 Definition and notations.
60.432 Standards for volatile organic compounds.
60.433 Compliance provisions.
60.434 Performance test procedures.
60.435 Emission monitoring and recordkeeping.
60.436 Reporting requirements.
60.437 Test methods and procedures.

Authority: Sec. 111 and 301(a) of the Clean Air Act, as amended (42 U.S.C. 7411, 7601(a)), and additional authority as noted below.

Subpart QQ—Standards of Performance for the Graphic Arts Industry: Publication Rotogravure Printing

§ 60.430 Applicability and designation of affected facility.

(a) The affected facility to which the provisions of this subpart apply is each publication rotogravure printing press.

(b) Any facility under paragraph (a) of this section which commences construction, modification, or reconstruction after [date of publication in the **Federal Register**] is subject to the requirements of this subpart.

§ 60.431 Definitions and notations.

(a) All terms used in this subpart that are not defined below have the meaning given to them in the Act and in Subpart A of this part.

"Automatic temperature compensator" means a device which continuously senses the temperature of the fluid flowing through a metering device and automatically adjusts the registration of the measured volume amount to the corrected equivalent volume amount at a base temperature.

"Base temperature" means the average temperature of the total amount of VOC solvent as metered at a publication rotogravure printing press.

"Density" means the mass of a unit volume of liquid, expressed as the weight in grams per cubic centimeter, at a specified temperature.

"Gravure cylinder" means a plated cylinder with a printing image consisting of minute cells or indentations, specially engraved or etched into the cylinder's surface to hold ink when continuously revolved through a fountain of ink.

"Performance averaging period" means 30 calendar days, one calendar month, or four consecutive weeks as specified in the sections of this subpart.

"Publication rotogravure printing press" means any number of publication rotogravure printing units used to print saleable products described under SIC code numbers 27541 and 27543, and capable of printing simultaneously on the same continuous web or substrate, which is fed from a continuous roll, but does not include proof presses which are used to check the quality of the image formation of newly engraved or etched gravure cylinders.

"Publication rotogravure printing unit" means any device designed to print one color ink on one side of a continuous web or substrate using the intaglio printing process with a gravure cylinder.

"Raw ink" means all purchased ink.

"Related coatings" means all non-ink purchased liquids and liquid-solid mixtures containing VOC solvent, usually referred to as extenders or varnishes, that are used at publication rotogravure printing presses.

"Solvent-borne ink systems" means raw ink and related coatings whose volatile portion consists essentially of VOC solvent with not more than five weight percent water.

"Solvent recovery system" means an air pollution control system by which VOC solvent vapors in air are captured and directed through a control device containing beds of activated carbon or other adsorbents. The vapors are adsorbed, then desorbed by steam or other media, and finally condensed and recovered.

"Total amount of VOC solvent used" means all VOC solvent added to the ink used at the subject facility, all VOC solvent included by the ink manufacturers in the inks and related coatings used at the facility, and all VOC solvent used as a cleaning agent at the facility.

"VOC" means volatile organic compound as defined in § 60.2(dd).

"VOC solvent" means an organic liquid mixture consisting of VOC components.

"Waterborne ink systems" means raw ink and related coatings whose volatile portion consists of a mixture of VOC solvent and more than five weight percent water.

(b) Symbols used in this subpart are defined as follows:

B_c = the average metered temperature of each respective color or raw ink and each related coating used at the subject facility (or facilities).

B_d = the average temperature of the metered VOC solvent added to dilute the ink used at the subject facility (or facilities) over one performance averaging period.

B_g = the average temperature of the metered VOC solvent used as a cleaning agent at the subject facility (or facilities) over one performance averaging period.

B_t = the calculated base temperature for the subject facility (or facilities) over one performance averaging period.

L_c = the liquid volume amount of each respective color of raw ink and each related coating used at the facility of a corresponding VOC content, V_o.

L_d = the total liquid volume amount of VOC solvent added to dilute the ink used at the subject facility (or facilities) over one performance averaging period.

L_g = the total liquid volume amount of VOC solvent used as a cleaning agent at the subject facility (or facilities) over one performance averaging period.

L_m = the liquid volume amount of recovered VOC solvent registered by meter devices from the subject facility (or facilities) over one performance averaging period.

L_o = the total liquid volume amount of VOC solvent contained in the raw inks and related coatings used at the subject facility over one performance averging period.

L_r = the total liquid volume amount of VOC solvent recovered from the subject facility (or facilities) over one performance averging period.

L_t = the total liquid volume amount of VOC solvent used at the subject facility (or facilities) over one performance averaging perod.

L_u = the liquid volume amount of miscellaneous unmetered recovered VOC solvent from the subject facility (or facilities) over one performance averaging period.

P = the average VOC emission percentage for the subject facility (or facilities) over one performance averaging period.

V_o = the liquid VOC content, expressed as a volume fraction, of such respective color of raw ink and each related coating stream used at the facility.

(c) The following subscripts are used in this subpart with the above symbols to denote the applicable facility:

a = affected facility

b = both affected and existing facilities controlled in common by the same air pollution control equipment.

e = existing facility.

§ 60.432 Standards for volatile organic compounds.

(a) Over the period of the initial performance test required to be conducted by § 60.8 and on and after the first day of the next performance averaging period following completion of the initial test, no owner or operator subject to the provisions of this subpart and using solvent-borne ink systems shall cause to be discharged into the atmosphere from any affected facility more than 16 percent of the total amount of VOC solvent volume used at that facility over any one performance averaging period. The averaging period for the initial performance test is 30 calendar days. The averaging period for subsequent performance tests is a calendar month or four consecutive weeks, at the option of the owner or operator.

(b) No owner or operator subject to the provisions of this subpart and using waterborne ink systems shall use a raw ink or related coating with a ratio of VOC volume content to solids volume content which is greater than 0.64, nor shall that raw ink or related coating be diluted with anything other than water addition.

§ 60.433 Compliance provisions.

(a) The owner or operator subject to the provisions of this subpart shall show compliance with the standards set forth in § 60.432 at all times, except as provided under § 60.8(c) and paragraph (b) of this section. The startup, shutdown, and malfunction provisions in § 60.8(c) apply only to the air pollution control equipment and not to the process equipment.

(b) After the initial performance test required for all affected facilities under § 60.8, compliance with the VOC emission limitation under § 60.432 is based on the emissions for one calendar month or one four-week averaging period. A separate performance test is completed at the end of each calendar month or each four-week averaging period after completion of the initial performance test. A new calendar month or a four-week averaging period VOC emission percentage is then calculated to show compliance with § 60.432(a) or new VOC volume to solids volume ratios for waterborne ink systems are calculated to show compliance with § 60.432(b).

(c) The owner or operator of an effected facility controlled by a solvent recovery system shall use the following procedures to determine compliance with the emission limit in § 60.432(a) for each performance averaging period:

(1) the total liquid volume amount of VOC solvent in all the raw inks and related coating used at the effected facility is determined by the following equation:

$$(L_o)_a = \sum_{i=1}^{k} (V_{oi})_a (L_{ci})_a$$

The indexing subscript, i, designates the "ith" coating for the number of coatings with different VOC contents ranging from 1 to k. V_o is determined in accordance with § 60.437(a). L_c is determined from direct readings of the metering devices required under § 60.435(a)(2).

(2) The total liquid volume amount of VOC solvent used at the affected facility is determined by the following equation:

$$(L_t)_a = (L_o)_a + (L_d)_a + (L_g)_a$$

L_d and L_g are determined from direct readings of the respective metering devices required under § 60.435(a)(1) and § 60.435(a)(3).

(3) The total liquid volume amount of VOC solvent recovered from the affected facility is determined by the following equation:

$$(L_r)_a = (L_m)_a + (L_u)_a$$

L_u is determined as stipulated in § 60.435(j). L_m is determined from direct readings of the metering devices required under § 60.435(a)(4).

(4) The average VOC emission percentage for the affected facility is determined by the following equation:

$$P_a = \left[\frac{(L_t)_a - (L_r)_a}{(L_t)_a}\right] \times 100$$

(d) The owner or operator of two or more affected facilities that are controlled by same solvent recovery system shall use the procedures specified in paragraph (c) of this section to determine compliance, except that $(L_t)_a$ and $(L_r)_a$ are the collective VOC solvent amounts corresponding to all the affected facilities controlled by that solvent recovery system. The average VOC emission percentage for each of the affected facilities controlled by that same solvent recovery system is assumed to be equivalent.

(e) The owner or operator of an existing facility (or facilities) and an affected facility (or facilities) that are controlled in common by the same solvent recovery system shall use one of the following procedures to determine compliance with § 60.432(a):

(1) The owner or operator shall determine compliance for the affected facility (or facilities) by first conducting an emission test on only the controlled existing facility (or facilities) and then conducting a performance test on the combined controlled facilities as follows:

(i) The average VOC emission percentage for the existing facility (or facilities) is first determined separately by using the following equation in accordance with the conditions stipulated in § 60.434(c):

$$P_e = \left[\frac{(L_t)_e - (L_r)_e}{(L_t)_e}\right] \times 100$$

$(L_t)_e$ and $(L_r)_e$ are determined by the procedures specified in articles (c)(1), (2), and (3) of this section for one facility or by paragraph (d) of this section for more than one facility, except that the VOC solvent amounts pertain only to the existing facility (or facilities).

(ii) The average VOC emission percentage for the affected facility (or facilities) is then determined by using the following equation with both existing and affected facilities connected to the solvent recovery system:

$$P_a = \left[\frac{(L_t)_b - (L_r)_b - (L_t)_e\left(\frac{P_e}{100}\right)}{(L_t)_a}\right] \times 100$$

$(L_t)_b$ and $(L_r)_b$ are determined by the procedures specified in articles (c)(1), (2), and (3) of this section, except that the VOC solvent amounts pertain to all the facilities controlled in common by the solvent recovery system over one performance averaging period. $(L_t)_a$ and $(L_t)_e$ pertain to the VOC solvent amounts used at the affected facility (or facilities) and the existing facility (or facilities), respectively, over one performance averaging period, as determined by the procedures specified in articles (c)(1), (2), and (3) of this section. P_e is assumed to be constant during each performance averaging period and is equivalent to the VOC emission percentage determined in the latest emission test in accordance with article (1)(i) of this paragraph.

(2) The owner or operator shall show compliance of the combined performance of existing and affected

facilities controlled in common. A separate emission test for existing facilities is not required. The average VOC emission percentage for the combined facilities with both existing and affected facilities connected to the solvent recovery system is determined by the procedures specified in paragraph (c) of this section with the following equation:

$$P_b = \left[\frac{(L_t)_b - (L_r)_b}{(L_t)_b}\right] \times 100$$

(f) The owner or operator of an affected facility using waterborne ink systems shall install air pollution control equipment to comply with the emission limit in § 60.432(a) if the standard in § 60.432(b) cannot be met. Compliance with the standard in § 60.432(b) for each performance averaging period is determined by—

(1) Obtaining from the ink manufacturer analyses of the VOC volume and solids volume contents of each purchased shipment of all color raw inks and all related coatings used at the affected facility (or facilities); and

(2) Calculating the ratio of VOC volume content to solids volume content from the ink manufacturer's analsyses data for each shipment of raw ink and related coatings used at the affected facility during each performance averaging period.

§ 60.434 Performance test procedures.

(a) Before start of the initial performance test required under § 60.8, the owner or operator subject to the provisions of this subpart shall notify the Administrator in writing as to whether a calendar month or a four-week averaging period basis will be used for determination of compliance with the standards under § 60.432.

(b) The owner or operator of an affected facility (or facilities) controlled by a solvent recovery system shall conduct an initial performance test to determine compliance with § 60.432(a) as follows:

(1) The initial performance test required under § 60.8 is based on 30 consecutive calendar days and not on an average of three runs as prescribed under § 60.8(f).

(2) The average VOC emission percentage for the affected facility (or facilities) over the 30 day test period is determined as specified in § 60.433(c), (d), or (e), whichever applies.

(c) If the procedures in § 60.433 (e)(1) are used to determine compliance of an affected facility (or facilities) controlled by a solvent recovery system which handles VOC emissions from both affected and existing facilities, the owner or operator shall conduct a separate emission test on the existing facility (or facilities) as follows:

(1) The emission test is based on 30 consecutive calendar days.

(2) The emission test is to be conducted without connection of the affected facility (or facilities) to the air pollution system.

(3) The emission test is to be conducted before both the affected and existing facilities are initially connected to the same control system, and at any other time as requested by the Administrator.

(4) § 60.435(h) applies to the existing facility (or facilities) during the emission test.

(5) The average VOC emission percentage for the existing facility (or facilities) over the 30 day test period is determined as described in § 60.433(e)(1)(i).

(6) The emission test is to be conducted under conditions that the Administrator will specify to the plant operator.

(7) The owner or operator of the existing facility (or facilities) shall provide the Administrator 30 days prior notice of the emission test to afford the Administrator the opportunity to have an observer present.

(8) The owner or operator of the existing facility (or facilities) shall furnish the Administrator a written report of the results of the emission test.

(9) After completion of this separate emission test on the existing facility (or facilities), the affected facility (or facilities) is then connected to the air pollution control system with the existing facility (or facilities). During emission tests on the existing facilities, the affected facilities are still subject to the standards stipulated in § 60.432—neither the owner nor operator shall operate affected facilities uncontrolled.

(d) The owner or operator of an affected facility (or facilities) using waterborne ink systems shall conduct an initial performance test to determine compliance with § 60.432(b) as follows:

(1) The initial performance test required under § 60.8 is based on 30 consecutive calendar days and not on an average of three runs as prescribed under § 60.8(f).

(2) The VOC volume to solids volume ratio for each shipment of raw inks and related coatings used at the affected facility (or facilities) over the 30 day test period is determined as specified in § 60.433(f).

(e) After the initial performance test, the owner or operator shall conduct successive performance tests during each calendar month or four-week averaging period as described in § 60.433(b).

§ 60.435 Emission monitoring and recordkeeping.

(a) The owner or operator of any affected facility controlled by a solvent recovery system shall install, calibrate, maintain, and continuously operate—

(1) One or more non-resettable totalizer metering device(s), accurate to within ±0.5 percent, for continuously indicating the cumulative liquid volume amount of VOC solvent added to the ink used at the affected facility;

(2) One or more non-resettable totalizer metering device(s), accurate to within±1.5 percent, for continuously indicating the cumulative liquid volume amount of each color or raw ink and each related coating used at the affected facility;

(3) One or more non-resettable totalizer metering device(s), accurate to within ±0.5 percent, for continuously indicating the cumulative liquid volume amount of VOC solvent used as a cleaning agent at the affected facility, if the cleaning solvent used is not registered by the metering devices required in article (a)(1);

(4) One or more non-resettable totalizer metering device(s), accurate to within ±0.5 percent, for continuously indicating the cumulative liquid volume amount of VOC solvent recovered by the solvent recovery system which serves the affected facility; and

(5) an automatic temperature compensator, calibrated in accordance with paragraph (i) of this section, to adjust the totalizer volume readings of each recovered solvent metering device required by article (4) of this paragraph.

(b) The owner or operator shall install all metering devices described in articles (a)(1), (2), (3) and (4) of this section with no taps upstream and no unmetered bypasses.

(c) The owner or operator shall install, maintain, and continuously operate an air eliminator and strainer upstream of each metering device required in paragaph (a) of this section in accordance with the meter manufacturer's recommendations to maintain meter calibration accuracy.

(d) The owner or operator shall install and maintain a monitoring device, accurate to within $\pm 2^\circ$ C ($\pm 4^\circ$ F), for continuously indicating the temperature of the fluid metered by each device required in articles (a)(1), (2), and (3) of this section.

(e) The metering devices described in articles (a)(1), (2) and (3) of this section shall not serve an affected facility and any existing facilities simultaneously.

(f) The owner or operator shall recalibrate all metering devices at least semi-annually, and at other times as the Administrator may require in accordance with the procedures under § 60.13(b)(3). The requirements of articles (a)(1), (2), (3), and (4) must be met before the metering device can be returned to service. The owner or operator shall record the actual calibrated accuracy of each metering device and shall maintain these records for two years.

(g) When the facility is in operation, the owner or operator shall take daily readings of each temperature monitoring device and of the totalizer of each metering device specified in this section, shall record the readings for each performance averaging period, and shall maintain these records for two years.

(h) The owner or operator of an affected facility controlled by a solvent recovery system shall record the VOC volume content analyses as determined under § 60.437(a) for all color raw inks and all related coatings used at the affected facility, and shall maintain these records for two years.

(i) The owner or operator shall calibrate annually the automatic temperature compensators required by article (a)(5) of this section and shall adjust the base temperature setting after each performance averaging period, if needed, according to the following procedures:

(1) The density variation with temperature of the metered recovered VOC solvent is determined by the methods stipulated in § 60.437(d). The recovered VOC solvent density is determined in temperature increments of 10° C, from 15° C to 45° C, or the maximum expected recovered VOC solvent metered temperature.

(2) Calibration is then carried out in accordance with the manufacturer's recommended procedures using the density-temperature profile determined in article (1).

(3) The base temperature for each performance averaging period is derived by the following equation on a weighted average, by volume, basis:

$$B_t = \left[\frac{(B_d)(L_d) + (B_g)(L_g) + \sum_{i=1}^{k} (B_{ci})(V_{oi})(L_{ci})}{L_t} \right]$$

The indexing subscripts, i and k, are defined under § 60.433(c)(1).

(4) If the base temperature calculated by article (3) deviates by more than 5° C (9° F) from the base temperature setting of the associated automatic temperature compensator, that base temperature setting is then adjusted to the newly calculated value.

(5) The base temperature calculated by article (3) and the corresponding base temperature setting of each automatic temperature compensator is recorded for each performance averaging period and the records maintained for two years.

(j) The owner or operator of an affected facility controlled by a solvent recovery system shall determine, using any suitable means approved by the Administrator, the liquid volume amounts of all unmetered solvent-borne waste inks and waste VOC solvents recovered from the facility. The owner or operator shall record these unmetered volume amounts for each performance averaging period and shall maintain these records for two years.

(k) If the air pollution control device which serves the affected facility (or facilities) also serves an existing facility (or facilities), the exisiting as well as the affected facility are subject to the requirements of paragraph (a) through (j) of this section.

(l) Affected facilities using waterborne ink systems and in compliance with § 60.432(b) are not subject to the requirements of paragraphs (a) through (k) of this section.

(m) The owner or operator of an affected facility using waterborne ink systems which comply with § 60.432(b) shall record for each performance averaging period the ink manufacturer's analysis data for—

(1) Each purchased shipment of raw inks;

(2) Each purchased shipment of related coatings; and

(3) The corresponding calculated ratios required in § 60.433(f). The owner or operator shall maintain these records for two years.

[Sec. 114 of the Clean Air Act as amended (42 U.S.C. 7414)]

§ 60.436 Reporting requirements.

(a) The owner or operator of any affected facility shall prepare a written non-compliance report for each calendar month or each four-week averaging period in which non-compliance with § 60.432 is determined. Each report shall state—

(1) The identification of whether continual compliance is determined based on calendar month or four-week averaging periods;

(2) The identification of the calendar month or four-week averaging period covered by the report;

(3) The type of air pollution control system used;

(4) The average VOC emission percentage calculated in accordance with § 60.433(c), (d), or (e), whichever applies, for the calendar month or four-week averaging period;

(5) Which procedure and equation from § 60.433 was used to calculate the emission percentage;

(6) The total liquid volume amounts of VOC solvent used and recovered at the equivalent base temperature for the affected facility during the performance averaging period;

(7) How many and which affected facilities are served together by the same air pollution control device;

(8) What existing facilities are served by an air pollution control system in common with an affected facility;

(9) The measured average VOC emission percentage for the existing facility (or facilities) when § 60.433(e)(1) is used to determine compliance for the affected facility;

(10) The date and time identifying any periods during which the required metering devices described under § 60.435(a) were inoperative and the nature of the system repairs or adjustments;

(11) Specific identification of each period of excess emissions resulting from the startup, shutdown, or malfunction of the air pollution control equipment;

(12) The nature and causes of any malfunctions of the air pollution control equipment (if known) and the corrective action taken or preventative measures adopted;

(13) For affected facilities using waterborne ink systems without air pollution control equipment, a copy of the record of ink manufacturer's data and calculated ratios required by § 60.435(m); and

(14) Affected facilities using waterborne ink systems which comply with § 60.432(b) are not subject to the requirements of articles (4) through (12) of this paragraph.

(b) The owner or operator of any affected facility shall submit to the Administrator the non-compliance reports required under paragraph (a) of this section postmarked by the 10th calendar day following the end of—

(1) The calendar month when compliance with the standards in § 60.432 is determined for each calendar month; or

(2) The four-week period when compliance with the standards in § 60.432 is determined for each four-week period.

(Sec. 114 of the Clean Air Act as amended (42 U.S.C. 7414))

§ 60.437 Test methods and procedures.

(a) The owner or operator of an affected facility (or facilities) controlled by a solvent recovery system shall determine the VOC volume content of raw solvent-borne inks and related coatings used at the affected facility through one of the following procedures:

(1) Routine weekly samples of raw ink and related coatings in each respective storage tank are analyzed using Reference Method 29.

(2) Samples of each shipment of all purchased raw inks and related coatings are analyzed using Reference Method 29, or analysis of each shipment of all purchased raw inks and related coatings may be obtained from the ink manufacturer.

(3) The results of verification analyses by Reference Method 29 is used for determination of compliance when discrepancies with ink manufacturer's analysis data occur.

(b) The owner or operator of an affected facility (or facilities) controlled by a solvent recovery system in common with any existing facilities shall determine the VOC volume content of raw solvent-borne inks and related coatings used at the existing facility (or facilities) by following one of the procedures specified in paragraph (a) of this section.

(c) The owner or operator of any affected facility using water borne ink systems shall determine, using any suitable method approved by the Administrator, the VOC volume content of raw inks and related coatings used at the affected facility.

(d) The owner or operator of an affected facility (or facilities) controlled by a solvent recovery system shall determine the density of liquid solvents according to—

(1) The procedure outlined in ASTM D 1475–60 by making a total of three determinations for each solvent sample at a specified temperature, and recording the density as the arithmetic average of the three determinations; or

(2) Other values acceptable to the Administrator.

(Sec. 114 of the Clean Air Act as amended (42 U.S.C. 7414)).

2. Method 29 is added to Appendix A as follows:

Appendix A—Reference Methods

* * * * *

Method 29—Determination of Volatile Matter Content and Density of Printing Inks and Related Coatings

1. Applicability and Principle

1.1 Applicability. This method applies to the determination of the volatile organic compound (VOC) content and density of solvent-borne (solvent reducible) printing inks or related coatings as defined in § 60.431.

1.2 Principle. Separate procedures are used to determine the VOC weight fraction and density of the coating and the density of the solvent in the coating. The BOC weight fraction is determined by measuring the weight loss of a known sample quantity which has been heated for a specified length of time at a specified temperature. The density of both the coating and solvent are measured by a standard procedure. From this information, the VOC volume fraction is calculated.

2. Procedure

2.1 Weight Fraction VOC.

2.1.1 Apparatus.

2.1.1.1 Weighing Dishes. Aluminum foil, 58 mm in diameter by 18 mm high, with a flat bottom. There must be at least three weighing dishes per sample.

2.1.1.2 Disposable syringe, 5 ml.

2.1.1.3 Analytical Balance. To measure to within 0.1 mg.

2.1.1.4 Oven. Vacuum oven capable of maintaining a temperature of 120 ±2°C and an obsolute pressure of 510 ±51 mm Hg for 4 hours. Alternatively, a forced draft oven capable of maintaining a temperature of 120 ±2°C for 24 hours.

2.1.1.5 Analysis. Shake or mix the sample thoroughly to assure that all the solids are completely suspended. Label and weigh to the nearest 0.1 mg a weighing dish and record this weight (M_{x1}).

Using a 5-ml syringe without a needle remove a sample of the coating. Weigh the syringe and sample to the nearest 0.1 mg and record this weight (M_{cY1}). Transfer 1 to 3 g of the sample to the tared weighing dish. Reweigh the syringe and sample to the nearest 0.1 mg and record this weight (M_{cY2}). Heat the weighing dish and sample in a vacuum oven at an absolute pressure of 510 ±51 mm Hg and a temperature of 120±2°C for 4 hours. Alternatively, heat the weighing dish and sample in a forced draft oven at a temperature of 120 ±2° C for 24 hours. After the weighing dish has cooled, reweigh it to the nearest 0.1 mg and record the weight (M_{x2}). Repeat this procedure for a total of three determinations for each sample.

2.2 Coating Density. Determine the density of the ink or related coating according to the procedure outlined in ASTM D 1475–60. Make a total of three determinations for each coating. Report the density D_c as the arithmetic average of the three determinations.

2.3 Solvent Density. Determine the density of the solvent according to the procedure outlined in ASTM D 1475–60. Make a total of three determinations for each coating. Report the density D_v as the arithmetic average of the three determinations.

3. Calculations

3.1 Weight Fraction VOC. Calculate the weight fraction volatile organic content W_o using the following equation:

$$W_o = \left[\frac{M_{x1} + M_{cY1} - M_{cY2} - M_{x2}}{M_{cY1} - M_{cY2}}\right] \quad \text{Eq. 29-1}$$

Report the weight fraction VOC W_o as the arithmetic average of the three determinations.

3.2 Volume Fraction VOC. Calculate the volume fraction volatile organic content V_o using the following equation:

$$V_o = \frac{\overline{W}_o \, \overline{D}_c}{\overline{D}_v} \quad \text{Eq. 29-2}$$

4. Bibliography

4.1 Standard Method of Test for Density of Paint, Varnish, Lacquer, and Related Products. In: 1974 Book of ASTM Standards. Part 25, Philadelphia, Pennsylvania. ASTM Designation D 1475–60. 1974. p. 231–233.

4.2 Telecon. Wright, Chuck. Inmont Corporation with Reich, R.A., Radian Corporation. September 25, 1979. Gravure Ink Analysis.

4.3 Telecon. Oppenheimer, Robert, Gravure Research Institute with Burt, Rick, Radian Corporation. November 5, 1979. Gravure Ink Analysis.

[FR Doc. 80-33550 Filed 10-27-80; 8:45 am]

BILLING CODE 6560-26-M