PERMIT PROCEDURES FOR MINOR PRINTING FACILITIES AND MINOR MODIFICATIONS AT MAJOR FACILITIES

1. PURPOSE

To specify requirements for permit approval for printing facilities. This applies to minor new sources or to major sources seeking a minor modification. The boilerplate is not intended to cover facilities subject to Prevention of Significant Deterioration (PSD) or nonattainment permit review.

2. REFERENCES

Commonwealth of Virginia Regulations for the Control and Abatement of Air Pollution: Part I, 9 VAC 5-20-121; Part IV, Article 4-24 (9 VAC 5-40-3260 et seq.), Article 4-31 (9 VAC 5-40-4310), Article 4-36 (9 VAC 5-40-5060 et seq.), Article 4-45 (9 VAC 5-40-7800); Part V, Articles 5-1 (9 VAC 5-50-60 et seq.) through 5-5 (9 VAC 5-50-400 et seq.); Part VIII, 9 VAC 5-80-10 and 9 VAC 5-80-11.

40 CFR 60.430 through 60.435 (NSPS Subpart QQ, "Standards of Performance for the Graphic Arts Industry: Publication Rotogravure Printing")

40 CFR 63.829 - 63.830 (MACT subpart KK National Emissions Standards for the Printing and Publishing Industry)

EPA Document 453/R-94-054 dated June, 1994, Alternative control Techniques Document for Offset Lithographic Printing

EPA Document 450/3-91-008 dated February, 1991, Best Demonstrated Control Technology for Graphic Arts

3. DEFINITIONS

The following definitions are for use in this guideline and do not necessarily have the same meaning in other portions of the regulations:

AAlcohol≅ means any of the following compounds when used as a fountain solution additive: ethanol, n-propanol, and isopropanol.

AAlcohol Substitute≅ means any non-alcohol additive that contains volatile organic compounds and is used in the fountain solution.

AArea Source (MACT)≅ means any stationary source of hazardous air pollutants that is not major as defined in 40 CFR 63.2.

ACarbon Adsorption System≅ means a device containing activated carbon as the adsorbent material, an inlet and outlet for exhaust gases, and a system to regenerate the saturated adsorbent. The carbon adsorption system must provide for the proper disposal or reuse of all volatile organic compounds captured in the adsorbent.

ACompliant Ink≅ means low-solvent ink, high solids ink, or waterborne ink.

ACoating Operation≅ (from the MACT) means the application of a uniform layer of material across the entire width of a substrate.

AFabric Coating≅ means the coating of a textile substrate by knife, roll or rotogravure coating to impart properties that are not initially present, such as strength, stability, water or acid repellency, or appearance.

AFlexographic Printing≅ means the application of words, designs and pictures to a substrate by means of a roll printing technique in which the pattern to be applied is raised above the printing roll and the image carrier is made of rubber or other elastomeric materials.

AFountain Solution≅ means any mixture of water, volatile and non-volatile chemicals, and additives applied to a lithographic plate to repel ink from the non-image area on the plate.

AFume Incinerator≅ means a thermal oxidizing device designed to reduce hydrocarbon compounds in an exhaust gas to water and carbon dioxide. Fume incinerators used in the printing industry include direct flame and catalytic.

AHeatset≅ means a lithographic printing process in which heat from a dryer is used to evaporate ink oils from the substrate.

AHigh Solids Ink≅ means an ink which contains 60 percent or more of non-volatile compounds by volume.

ALetterpress≅ refers to a printing process using movable type in which the image area is raised, and the ink is transferred directly from the image surface to the paper.

"Lithographic Printing≅ means a planographic printing process in which the image and nonimage areas are chemically differentiated with the image area being oil-receptive and the nonimage area being water-receptive.

ALow Solvent Ink≅ means an ink which contains not more than 0.5 pounds of volatile organic compounds per pound of non-volatile compounds.

AMajor Source (MACT)≅ means any stationary source or group of stationary sources located within a contiguous area and under common ownership or control that emits or has the potential to emit after controls, in aggregate, 10 ton/yr or more of any hazardous air pollutant or 25 tons per year or more of any combination of hazardous air pollutants, unless the Administrator establishes a lesser quantity, or in the case of radio nuclides, different criteria from those specified in this sentence.

ANoncompliant Ink≅ or ASurface Coating≅ means an ink which does not conform to the definition of a high-solids, low volatile organic compound or waterborne ink or surface coating.

ANonheatset≅ means a lithographic printing process in which the printing inks are set and dried by absorption or oxidation rather than heat. For the purpose of these procedures, UV-cured and electron beam-cured inks are considered nonheatset.

AOffset Lithography≅ refers to a printing process in which the image and non-image areas are on the same plane. The image area is ink wettable and water repellent, and the non-image area is repellent to ink.

APackaging Rotogravure Printing≅ means rotogravure printing upon paper, paper board, metal foil, plastic film, and other substrates which are, in subsequent operations, formed into containers and labels for articles to be sold.

APaper Coating≅ means the coating of paper and pressure sensitive tapes regardless of substrate by knife, roll or rotogravure coating. Related wet coating process on plastic films and decorative coatings on metal foil are included in this definition.

APress≅ means a printing production assembly composed of one or more units to produce a printed substrate (sheet or web).

APrinting≅ means the formation of words, designs, and pictures, usually by a series of application units each with partial coverage.

APrinting Operation (MACT)≅ means the formation of words, designs, and pictures on a substrate other than fabric through the application of material to that substrate.

APrinting Process≅ means any operation or system wherein printing ink or a combination of printing ink and surface coating is applied, dried or cured and which is subject to the same emission standard. May include any equipment which applies, conveys, dries or cures inks or surface coatings, including, but not limited to, flow coaters, flashoff areas, air dryers, drying areas and ovens. It is not necessary for a printing process to have an oven, flashoff area or drying area to be included in this definition.

APublication Rotogravure Printing≅ means rotogravure printing upon paper which is subsequently formed into books, magazines, catalogues, brochures, directories, newspaper supplements or any other types of printed materials not included under the definition of packaging rotogravure printing.

ARotogravure Printing≅ refers to a printing process in which the image area is engraved onto a plated steel cylinder. Ink is applied to the cylinder with excess removed by a doctor blade. The image is then transferred directly to the web when the web is pressed against the cylinder by an impression roll.

ASurface Coating≅ means all nonink liquids and liquid solids mixtures containing volatile organic compounds which are applied to the substrate by printing units.

AWaterborne Ink≅ means an ink whose volatile portion consists of 75 percent or more by volume of water and 25 percent or less by volume volatile organic compounds.

AWide Web Flexographic Press (MACT)≅ means a flexographic press capable of printing substrates greater than 18 inches in width.

4. APPLICABILITY

1. Boilerplate Applicability

This boilerplate is applicable to the construction, reconstruction, relocation or modification at printing facilities classified as minor new sources or existing major sources seeking minor modification. The following types of printing processes are covered under this boilerplate: flexographic printing, packaging rotogravure, publication rotogravure, offset lithography, and letterpress. This boilerplate does

not cover permit applications for major **new** sources under 9 VAC 5-80-10, or sources subject to PSD regulations (9 VAC 5-80-20) or subject to nonattainment regulations (9 VAC 5-80-30).

2. Permitting Applicability (9 VAC 5-80-10)

Permit applicability for graphic arts is determined in 9 VAC 5-80-11 (new source exemption level by size). This exemption applies to presses meeting the definition of flexographic, packaging rotogravure, publication rotogravure, and lithographic printing processes. The permit exemption level is stated as follows:

1. Any printing process if it is within a plant that has an uncontrolled emission rate of not more than 7 tons/yr, 40 lbs/day, and 8 lbs/hr. This applies to construction, reconstruction, or relocation.

2. The 7 ton/yr of VOC includes emissions from associated washup and cleanup operations. Please note, that the exemption is based on plant wide emissions and not on the emission from the new press. As an example: A printing press which has uncontrolled emissions less than 7 tons/yr is subject to new source review if it is installed at a facility which has an uncontrolled emissions rate greater than 7 tons/yr, 40 lbs/day, and 8 lbs/hr.

3. Regulatory Applicability - Article 36 (9 VAC 5-40-5060 et seq.), Emission Standards for Graphic Arts Printing Processes

Article 4-36 applies to the construction, reconstruction, relocation, or modification of each graphic arts printing process (see definition, Section III) located in a VOC Emission Control Area (see 9 VAC 5-20-206) at facilities having a potential to emit 100 tons per year or greater of VOC.

4. Regulatory Applicability - Article 45 (9 VAC 5-40-7800 et seq.) Emission Standards for Lithographic Print Processing

Article 4-45 applies to the construction, reconstruction, relocation or modification of each lithographic printing process (see definition section III) located in a VOC Emissions Control Areas (see 9 VAC 5-20-206) at facilities having a potential to emit

10 tons per year or greater of VOC in the Northern Virginia VOC Emissions Control Area and at facilities having a potential to emit 100 tons per year or greater of VOC in the Richmond Virginia VOC Emissions Control Area. In all cases, areas that were previously nonattainment for ozone that have been redesignated as attainment for ozone are still listed in 9 VAC 5-20-206 as VOC Emissions Control Areas.

5. Coating versus Printing: Article 31 (Emission Standards for Paper and Fabric Coating Application) versus Article 36 (Emission Standards for Flexographic, Packaging Rotogravure and Publication Rotogravure Printing lines)

    1. The difference between coating and printing is found in Article 31 under 9 VAC 5-40-4330:

        AFor the purposes of the applicability of the above emissions standard, coating is the application of a layer of material across any portion of the web and printing is the formation of words, designs and pictures, usually by a series of application rolls each with only partial coverage.≅

    2. Both Articles 4-31 and 4-36 state that a press which both coats and prints will be subject to Article 4-36.

6. Regulatory Applicability - (NSPS) 40 CFR 60, Subpart QQ, Standards of Performance for the Graphic Arts Industry: Publication Rotogravure Printing

    1. NSPS Subpart QQ applies to the construction, reconstruction, relocation, or modification of each publication rotogravure printing press (see definition, Section III).

    2. Emission requirements in this boilerplate for publication rotogravure printing presses are at least as stringent as NSPS Subpart QQ.

7. Regulatory Applicability - (MACT) 40 CFR 63, Subpart KK, National Emission Standards for Printing and Publishing Industry

    1. 40 CFR 63, Subpart KK applies to each new and existing major source of hazardous air pollutants (HAP) at which publication rotogravure, product rotogravure, packaging rotogravure, or wide-web flexographic printing presses are operated. A

facility can choose to commit to emit less than 10 tons/yr (12 months rolling total) of any one HAP and less than 25 tons/yr (12 months rolling total) of a combination of HAP which changes the facility from a major source to an area source.

2. 40 CFR 63, Subpart KK does not apply to coating facilities, provided the facility adheres to the limits in Paragraph 3 below.

3. A facility may designate an individual emission unit as an area source by limiting HAP emissions to five percent of the total mass of all inks, coatings, varnishes, adhesives, primers, solvents, thinners, reducers, and other materials applied by presses using product rotogravure, packaging rotogravure, and wide-web flexographic print stations in each month. This limit is never to be exceeded. The designated units will be subject to recordkeeping requirements.

4. MACT Applicability Examples

    1. Example 1: An area source installs a new press. The HAP emissions from the new press added to the equipment on site exceed either the 10 ton/yr for any one HAP or 25 ton/yr for a combination of HAP.

        The new press would be subject to MACT standards upon startup because the press is being installed at a major facility. The facility would be subject to MACT standards by May 30, 1999.

    2. Example 2: A major source modifies a previously permitted or an existing press.

        The modified press would have to meet MACT standards upon completion of the modification. This is based on the modification taking place at a major facility after the MACT date of promulgation of May 30, 1996. The remaining facility would have to meet the MACT standards by May 30, 1999.

    3. Example 3: An area source modifies a previously permitted or an existing press. The increase results in emissions of 10 tons/yr of any one HAP or 25 ton/yr of a combination of HAP.

The modified press would have to meet MACT standards upon completion of the modification. This is based on the modification taking place at a facility which now meets the definition of a major MACT facility and the modification taking place after May 30, 1996. The remaining facility would have to meet the MACT standards by May 30, 1999.

5. VOC EMISSION REGULATIONS

1. Minor new sources or minor modifications at existing major sources submitting applications subject only to 9 VAC 5-80-10 may not be required to install add-on controls or use compliant VOC inks; however, the source should be encouraged to use compliant inks and implement pollution prevention practices. The exception to the above sentence would be those sources which are synthetic minor sources because of add-on controls. If the source is unwilling to use compliant inks or implement pollution prevention practices, it may be appropriate to require a BACT analysis to determine if a technically feasible, cost effective add-on control technology is available. This is particularly true for minor sources or minor modifications in nonattainment areas and VOC emissions control areas. These facilities need hourly and annual emission limitations and monthly recordkeeping requirements.

2. Standards in Articles 4-24, 4-36, and 4-45 of the Regulations are reasonably available control technology (RACT) determinations as stated in 9 VAC 5-40-300. The control requirements listed in the regulations should be considered as a minimum BACT in most cases. Infrequently a facility may be able to show a technical or economic reason why the control requirements listed in the regulations are not BACT. A permit writer should be careful to review the emissions applicability for specific articles before determining that the RACT/BACT determination contained in the article applies to a specific source.

3. New or modified publication rotogravure presses are subject to VOC requirements in Subpart QQ. VOC emissions must be less than or equal to 16 percent of the total mass of VOC solvent and water used at the facility (see 40 CFR 60.430). These facilities need hourly and annual emissions limits and monthly recordkeeping.

4. Applications for minor modifications at existing graphic arts facilities subject to Article 4-36

requirements. Therefore, a minor modification requires use of compliant ink or installation of an emission control system having a minimum overall control efficiency as specified in 9 VAC 5-40-5080 A.4. or as determined by a BACT analysis. These facilities need hourly, daily and annual emission limits, and daily line-by-line recordkeeping to be consistent with AQP-4.

5. Parts and cylinder cleaning operations located at facilities located in ozone nonattainment areas or VOC Control Areas may be subject to Article 4-24. These operations need hourly and annual emissions limits and monthly recordkeeping of VOC used.

6. Lithographic Printing Processes

    1. Lithographic printing facilities and units which are subject to Article 45 (VOC Control Areas) and use heatset web offset printing inks are required to reduce emissions by 90 percent OR have a maximum exhaust concentration of 50 ppm by volume dried as, nonmethane and ethane carbon.

    2. An alternative RACT/BACT has been established for lithographic printing presses which are not subject to Article 45. The alternative BACT for heat set web inks is to require an afterburner. This lowers VOC emissions and prevents opacity problems. The amount of VOC reduction has not been established.

    3. Article 45 contains VOC content limits for fountain solution, for heatset web presses, nonheatset web presses, and sheet fed presses. The regulation limits the amount of alcohol, amount of VOC, and the fountain solution temperature. The amount of VOC and alcohol varies from 1.5 percent to 8.5 percent depending the type of fountain solution and printing press. The fountain solution with higher VOC content requires that the solution temperature be maintained at or below 60E F.

    4. The VOC content of cleaning solution used is limited to no more than 30 percent by weight averaged on a daily basis OR the daily average composite VOC portion is limited to a partial vapor pressure of 10 mm Hg at 68E F as applied.

    5. Article 45 requires waste VOC liquids containing more than 25 percent VOC to be disposed of by

either reclamation (on or off site) or incineration.

6. Article 45 also requires that all cleaning solutions and applicators (rags) shall be stored in covered containers or machines with remote reservoirs when not in use.

7. Sources with control equipment may need to have alternate operating scenarios to address lower control efficiencies resulting from low pollutant inlet concentrations. See the discussion on Aturndown≅ in the Emission Controls section of this procedure.

8. The MACT contains many control technique options and should be reviewed for BACT determinations.

6. CRITERIA POLLUTANT EMISSIONS

1. Volatile Organic Compound Emissions

A printing facility can be a significant source of volatile organic compound (VOC) emissions. Printing inks consist of three major components: pigment, binders, and solvents. VOC emissions are generated as the solvents evaporate during ink application and drying processes. When calculating VOC emissions from inks, assume all solvents volatilize (please note exception for lithographic printing) unless the applicant can document the amount which remains in the product and is sent off site. Additional VOC emissions are generated by solvents used in parts and press cleaning operations and from solvent storage tanks.

VOC emissions can typically be calculated using information found on ink and/or solvent Material Safety Data Sheets (MSDS). Parameters such as specific gravity, VOC content, and percent weight solids are normally provided. VOC emissions should be calculated from VOC content less any water content.

Uncontrolled hourly emissions from printing ink usage and cleaning operations are calculated using the reported maximum hourly VOC throughput, assuming no VOC controls. Reported maximum VOC throughput should be based on printing the largest sheet or web width possible on the press, while using the highest percentage ink coverage the source expects would ever be used. The annual uncontrolled emissions should be calculated from the uncontrolled hourly emissions, assuming 8,760 hours/year operation. Expected hourly emissions are calculated by reducing uncontrolled emissions based on the VOC control efficiency. Annual

expected emissions are determined using the permitted operating schedule or permitted annual consumption of ink and, if applicable, capture and control efficiencies (see Appendix A for sample emission calculations).

2. Lithographic Printing Calculations:

Lithographic printing emissions are calculated based on MSDS, rated capacities, and assumptions contained in the Alternative Control Techniques Document; Offset Lithographic Printing, EPA 453/R94-054.

1. Ink Assumptions

1. The Alternative Control Techniques (ACT) document states that 20 percent of the VOC from heat set inks are retained in the substrate. Heat set inks are heavy molecular weight oil base inks which require drying.

2. The ACT document states that 95 percent of the VOC (by weight) from nonheatset inks are retained in the substrate. Nonheatset inks are designed to dry by absorption.

3. The ACT document states that 95 percent of the VOC (by weight) from the newspaper printing ink is retained in the substrate.

2. Fountain Solution Assumptions

1. One hundred percent of the alcohol is evaporated from the fountain solution.

2. Low or non-alcohol fountain solutions are estimated to contain 10 percent VOC by weight. Verification is required with current MSDS.

3. Blanket Wash Assumptions

1. One hundred percent of VOC is evaporated from the blanket wash applied by automatic systems.

2. Many times blanket wash is applied by rags or towels. The ACT states that the towels contain 50 percent of the VOC applied. Article 45 requires that rags be stored in sealed containers the emissions from blanket wash could be reduced by 50 percent. The towels would have to be either incinerated or

recycled and the VOC recovered. This requirement was stated in the ACT and Article 45.

4. Carryover of Fountain Solution and Blanket Wash

Some of the VOC from blanket wash and fountain solution applied to the cylinders of heat set presses wind up on the web. The web then carries the VOC to the dryer. The carryover is directly captured by the dryer.

Carryover is important when determining the amount of emissions which are uncontrolled and which are exhausted to a stack. The VOC which are exhausted to a stack can be controlled by an add-on control device.
For automatic blanket wash systems on presses which have heat set dryers testing has demonstrated that a reasonable general assumption for carryover is 40 percent of the VOC.

The ACT states that VOC captured from alcohol substituted blanket wash is 70 percent. The ACT states that 70 percent is a reasonable general assumption.

5. Indirect capture

Indirect capture ranges from 70 percent to 40 percent as stated in the ACT. Indirect capture used in calculations may need to be documented and confirmed by testing. Future BACT could require total enclosure.

6. Lithographic Dryers

Many heatset lithographic presses have flame dryers. The dryers speed the setting of the inks. The ACT document does not state that the dryer controls VOC emissions. All testing done for the ACT was done to address capture efficiency.

3. Particulate Emissions

Particulate emissions in the form of oil mist may be generated when heavy molecular weight ink solvent (e.g. kerosene, No. 2 fuel oil) is used in printing. The actual emission rate may be difficult to determine since a portion of the oil may remain in the product and another portion of the oil may be emitted as a gas. In addition, emissions may be double counted as both VOC and particulate emissions. For example, kerosene

and No. 2 fuel oil mist should be counted as a VOC. It is therefore recommended that a particulate emission limit not be calculated; particulate emissions should be limited by opacity only. If the source is unable to meet the opacity limit, add-on controls may be necessary.

7. TOXIC POLLUTANT EMISSIONS

The state toxic regulation will not apply to any new source review permit which is subject to any applicable MACT standard. This is stated in 9 VAC 5-50-160 E.1.a. Currently 40 CFR 63 Subpart KK, National Emissions Standards for Printing and Publishing will apply to newly constructed major Product and Packaging rotogravure and wide web flexographic printing as defined in the MACT. The MACT is applicable to sources constructed after May 30, 1996. The MACT standard does not apply to paper coating, fabric coating, and lithographic printing.

Toxic emissions are usually calculated from Material Safety Data Sheets (MSDS). Some MSDS list only SARA 313 toxics. The following is a list of Clean Air Act HAP which are NOT currently included on the SARA 313 list:

68-12-2 N,N'-dimethyleformamide
822-06-0 hexamethylene-1,6-diisocyanate
110-54-3 hexane
78-59-1 isophorone
7803-01-6 phosphine
1746-01-6 2,3,7,8-tetrachlorodibenzo-p-dioxin
121-44-8 triethylamine
540-84-1 2,2,3-trimethylpentane
coke oven emissions
fine mineral fibers
POM
radionuclides

For printing facilities not subject to the MACT compliance must be determined in accordance with 9 VAC 5 CHAPTER 50 and current agency policy listed in AQP-5.

8. PERMIT LIMITS

1. Hourly and annual emission limits are necessary for each criteria pollutant having controlled emissions of greater than 0.5 tons/yr. Permit emission limits are also necessary for each non-exempt toxic pollutant according to current department policy. In addition, facilities subject to Article 4-36 need daily VOC emission limits.

2. Annual VOC throughput limits are necessary for all VOC containing products including inks, additives, varnishes, and cleaning solvents. Facilities subject to Article 4-36 need daily VOC throughput limits. Materials which cause toxic pollutant emissions greater than the exemption levels in 9 VAC 5-80-11 may need hourly throughput limits based on Department policy.

3. MACT (if applicable)

    1. The compliance date for an owner and operator of a new affected source subject to the provisions of this subpart is upon Astart-up≅ of the affected source, or May 30, 1996, which ever is later.

    2. Annual emissions at minor printing facilities will need to be limited to 10 tons/yr of a single HAP and 25 tons/yr of a combination of HAP. This will insure that minor sources are considered area sources under the MACT.

4. Publication Rotogravure

    Each affected publication rotogravure source shall limit emissions of organic HAP to no more than 8 percent of the total volatile matter used each month. The emission limitation may be achieved by overall control of at least 92 percent of organic HAP used, by substitution of non-HAP materials for organic HAP, or by a combination of capture and control technology and material substitution.

5. Product Rotogravure, Packaging Rotogravure, and Wide Web Flexographic Printing

    1. Each affected product rotogravure, packaging rotogravure, or wide web flexographic printing source that is subject to the requirements of subpart KK shall limit emissions to no more than five percent of the organic HAP applied for the month; or to no more than four percent of the mass of inks, coatings, varnishes, adhesives, primers, solvents, reducers, thinners, and other material applied, for the month; or to no more than 20 percent of the mass of solids applied for the month; or to calculated equivalents of allowable mass based on organic HAP and solids content of the inks, coatings, varnishes, adhesives, primers, solvents, reducers, thinners, and other materials applied for the month.

    2. Facilities are allowed to change products without a permit modification provided the new product

does not cause an increase in VOC emissions, and toxic emissions are less than the limits specified in the permit or below 9 VAC 5-80-11 exemption levels. The facility should notify the regional office if a product change would result in the emission of a different HAP or increase the emission of HAP which are currently used at the facility.

3. Facilities which consistently use a limited number of products may choose a throughput limit on individual products to simplify recordkeeping requirements. In this case, a change in products would require a permit modification.

9. EMISSION CONTROLS

1. Minor permits or minor modification permits at facilities unable to use compliant inks may elect or be required to install add-on VOC controls for a variety of reasons such as selling offsets, internal netting, avoidance of PSD or nonattainment review, or complying with Article 4-36, Article 45, toxics, NSPS Subpart QQ, BACT or MACT requirements. Add-on control at printing facilities consists of a VOC capture system and a control device. Possible control devices include direct flame, regenerative, and catalytic incineration; carbon bed adsorption; flame scrubbers; condensers; and demisters.

According to EPA's "Best Demonstrated Control Technology for Graphic Arts" (EPA -450/3-91-008, February 1991), recent BACT determinations indicate capture efficiencies of 100 percent using permanent total enclosure (PTE) with destruction efficiencies between 97 and 99.5 percent using direct flame, regeneration or catalytic incineration. The destruction efficiency of fume incinerators can vary depending on the type of VOC and age of the unit. Therefore, BACT for minor modifications (for example, the addition of a press) at major nonattainment sources or at facilities subject to Article 4-36 should be PTE with a removal efficiency of 95 percent unless an economic justification can be demonstrated to require less stringent controls. BACT for minor sources and minor modifications can be less stringent due to economic considerations. Control efficiencies of other types of control technologies which may be considered are as follows:

Control Technology	Efficiency

Control Technology	Efficiency
Non-PTE capture system	Greater than 80% capture
Activated carbon bed adsorption systems	90 to 95% adsorption
Incineration	95 to 97% destruction
Condenser system	Case-by-case determination, varies with temperature and type of VOC
Demister	Case-by-case determination, varies with type of VOC and mist size
Fountain solution chillers	One option for meeting requirements of Article 45. May be required as BACT on a case-by-case basis.

2. Turndown Ratio - The turndown ratio is a comparison showing the flexibility of a control device. For example, a particular incinerator may be guaranteed to provide a 95 percent control efficiency. The control efficiency is based on operating at 1,450E F and at a maximum air flow of 20,000 ACFM. If the incinerator has a 4:1 turndown ratio, it is guaranteed to provide a 95 percent control efficiency while operating between 5,000 ACFM and 20,000 ACFM. If a facility regularly operates below the 5,000 ACFM, an alternate operating scenario may be required.

3. Alternate Operating Scenarios - An alternate operating scenario is required for a control system attached to printing presses which occasionally operate below the control systems turndown ratio. Permitting the alternate operating scenario would require a statement in the permit that the efficiency limit does not apply when the presses are operating below the turndown ratio. When the presses are operating below the turndown ratio, only the hourly emissions limit would apply. Hourly compliance should not be a problem even though the control equipment is operating below its guaranteed efficiency. The control equipment should destruct or remove a significant amount of the VOC. In

addition, the input VOC should be much lower than the maximum allowable hourly throughput.

An incinerator=s flexibility can be enhanced by the installation of a variable speed fan, however, the use of variable speed fans may affect collection efficiencies and total enclosure performance.

10. OPACITY

1. Visible emissions from printing facilities shall not exceed 10 percent opacity.

2. Visible emissions at lithographic printing facilities using heavy molecular weight ink solvents which require drying to set shall be limited to 10 percent opacity. (Some facilities may have a problem meeting this standard without installing an afterburner.)

3. Opacity standards apply at all times, except in the case of malfunctions.

11. EMISSION MONITORING (CEMS)

1. Continuous Emission Monitoring Systems (CEMS) may be considered on a case-by-case basis if the permittee is using the monitoring system to demonstrate daily line-by-line compliance or if the facility=s permitted emissions are close to triggering PSD or Nonattainment review. EPA Performance Specification No. 8 and 9 apply to VOC CEMS. In order to insure accuracy and precision of the CEMS, a facility using such systems should be required to meet one of the performance specifications.

2. CEMS are required for some facilities which are subject to 40 CFR 63, Subpart KK (MACT). These CEMS are required to be certified by either EPA Performance Specification No. 8 or 9.

3. Facilities using a carbon adsorption systems should install VOC monitors to indicate VOC break-through unless an alternative method is approved by the DEQ. These monitors need not be subjected to the same permit conditions as the CEMS used for continuing compliance.

12. EMISSION TESTING

1. Facilities using add-on controls and subject to Article 4-36 **or** facilities with VOC permit emissions limits close to PSD or nonattainment significance levels should be tested in accordance with 9 VAC 5-20-121, or current DEQ policy. Facilities subject to NSPS Subpart

QQ must test in accordance with 40 CFR 60.433. VOC testing of other minor facilities using add-on controls should be done on a case-by-case determination. In addition, testing for a specific criteria or toxic pollutant may be necessary.

2. NSPS Subpart QQ testing is a 30-day enhanced mass balance. The mass balance requires a non-resetable totalizer, segregated storage tanks or accounting procedures for shared tanks, ink temperature monitoring for density corrections, purchase records and recovered solvent records. In addition Subpart QQ requires EPA Method 24 or 24A testing to determine VOC ink content. Subpart QQ contains four different testing/compliance requirements; applicability of the testing requirements depends on the facility and ink mixes used.

3. NSPS QQ assumes that all facilities which are subject to Subpart QQ have carbon bed adsorbers. This assumption makes the NSPS testing requirements confusing for facilities which installed incinerators. In most cases this will not be a problem because the BACT or LAER analysis will require a total enclosure. Efficiency testing of the incinerator and total enclosure testing is considered at least as stringent as Subpart QQ material balance testing. Subpart QQ will require a 30-day enhanced mass balance to determine VOC inlet concentration.

4. Article 45 requires testing for any add-on equipment at new facilities. The requirement is listed in 9 VAC 5-40-7890.

5. Compliant Ink Testing - The Department can require facilities using compliant ink to have an independent lab perform a Method 24 or 24A test on any ink to determine compliance with VOC ink content requirements.

   NSPS Subpart QQ requires ink testing during the 30-day enhanced mass balance.

13. <u>TRAINING, OPERATION, AND MAINTENANCE</u>

All operators must receive training in the proper operation of the printing system and the pollution control device(s). Training shall consist of a review and familiarization of the manufacturer's operating instructions, at a minimum. In addition, the permittee must maintain on site operation and maintenance procedures. These procedures shall be based on the manufacturer's recommendations, at a minimum.

14. NOTIFICATION

1. The owner or operator of all facilities must submit notification of the following:

    1. the date of commencement of construction, installation, or reconstruction
    2. the anticipated date of startup
    3. the actual date of startup
    4. the date of reaching maximum production
    5. (if applicable) the anticipated date of performance tests.

2. NSPS Notification: If the permit is subject to NSPS Subpart QQ, copies of written notification referenced in items 1. and 2. above shall be sent to:

    Chief
    Air Enforcement Branch (3AT13)
    U.S. Environmental Protection Agency
    Region III
    1650 Arch Street
    Philadelphia, PA 19103-2099

3. MACT Notification: This will be required until the MACT Program has been delegated to Virginia.

    Director Air Radiation and Toxics
    United Stated Environmental Protection Agency
    Region III
    Mail Code 3AT00
    1650 Arch Street
    Philadelphia, PA 19103-2099

4. The notification on all other permits shall only be submitted to the appropriate regional office of the DEQ.

15. RECORDKEEPING

1. Facilities subject only to the minor source or minor modification requirements in 9 VAC 5-80-10 should maintain a monthly and annual record of all VOC emissions.

2. Facilities subject to Article 4-36 must keep records consistent with AQP-4. This includes records of daily line-by-line compliance. Facilities using compliant ink must maintain records which demonstrate that each ink meets the definition of compliant ink. The source should also maintain a 12-month running total of VOC emissions.

3. Facilities subject to NSPS Subpart QQ must maintain records consistent with 40 CFR 60.434. Otherwise, records of monthly and annual VOC emissions should be required. Monthly and annual records of any other pollutant which has a permit limit should also be required.

4. Facilities subject to Article 4-45 are required to keep records of specific parameters listed in 9 VAC 5-40-7910.

16. REPORTING

Requirements for reports submitted by the permittee may vary depending upon the pollutants being emitted and the compliance history of the company. If a particularly hazardous compound is emitted in significant quantities, or if one of the NAAQS or a SAAC is approached, the region may wish to track certain emissions more closely by requiring periodic reports. Reporting of annual emissions of VOC or any pollutant which has a permit limit may be required.

17. MODELING

There are currently no screening models in use at the DEQ regional offices which are appropriate for modeling VOC emissions as ozone. Toxics modeling should be conducted according to current modeling policy guidelines.

18. PERMIT APPROVAL

Approval authority is given to the Regional Permit Manager who may sign the permit for the Executive Director.

APPENDIX A
SAMPLE EMISSION CALCULATIONS

Compliant Coating Determination

Example 1:

A printing ink with the following composition is applied on a packaging rotogravure printing line:

Ink Component	Volume Percent
Non-volatile	10
VOC	20
Water	70

The volume percent of non-volatile material less water is

$$\frac{\text{10\% non-volatiles}}{\text{100\% ink - 70\% water}} \times 100 = 33.3\%$$

The printing ink is therefore **not** a *high-solids ink* since its non-volatile portion is less than 60 percent by volume.

The volume percent of VOC in the volatile fraction of the ink is

$$\frac{\text{20\% VOC}}{\text{20\% VOC + 70\% water}} \times 100 = 22.2\%$$

The volume percent of water in the volatile fraction of the ink can be calculated by either of the following two methods:

$$\frac{\text{70\% Water}}{\text{20\% VOC + 70\% water}} \times 100 = 77.8\%$$

or

$$100\% - 22.2\% = 77.8\%$$

The printing ink does meet the definition of a *waterborne ink* since its volatile portion consists of more than 75 percent by volume of water and less than 25 percent by volume of VOC.
Example 2:

A printing ink with the following composition is applied on a flexographic printing process:

Ink Component	Weight Percent
Non-volatiles	79.3
VOC	20.7

Ink density = 11.0 pounds/gallon
VOC density = 6.0 pounds/gallon

The volume of VOC in one gallon of ink is

$$\frac{11.0 \text{ lb ink}}{1 \text{ gal ink}} \times \frac{0.207 \text{ lb VOC}}{1 \text{ lb ink}} \times \frac{1 \text{ gal VOC}}{6.0 \text{ lb VOC}} = \frac{0.38 \text{ gal VOC}}{1 \text{ gal ink}}$$

The volume percent of non-volatile material in one gallon of ink is

$$(1 - 0.38) \times 100 = 62\%$$

The ink is therefore a *high-solids ink* since it contains more than 60 percent of non-volatile compounds by volume.

Example 3:

A printing ink with the following composition is applied on a flexographic printing process:

Ink Component	Weight Percent
Non-volatiles	68.7
VOC	31.3

The weight of VOC per pound of non-volatiles is

$$\frac{0.313 \text{ lb VOC}}{} \times \frac{1 \text{ lb ink}}{} = \frac{0.46 \text{ lb VOC}}{}$$

1 lb ink	0.687 lb non-volatiles	1 lb non-volatiles

The ink is therefore a *low-solvent ink* since it contains less than 0.5 pounds of VOC per pound of non-volatile compounds.

Determination of Overall VOC Control Efficiency

Example:

A printing facility has multiple printing lines. Each line has a VOC emission capture efficiency of 75 percent. All lines are vented to a common control device which has a VOC destruction efficiency of 90 percent.

The overall efficiency for each line is

$$(0.75 \times 0.90) \times 100 = 67.5\%$$

Calculation of VOC Emissions from Printing Facilities

Non-Compliant Coatings (high-VOC inks, low-solids inks)

Example:

A plant uses a flexographic printing ink that is 80 percent by weight VOC and 20 percent by weight pigments and other non-volatiles as applied. The ink density is 7.44 pounds per gallon. The reported hourly, daily, and annual usage of ink is 2.5, 100, and 5,000 5-gallon drums, respectively.

The VOC content of each drum is

$$\frac{5 \text{ gal ink}}{\text{drum}} \times \frac{7.44 \text{ lb ink}}{\text{gal ink}} \times \frac{0.80 \text{ lb VOC}}{\text{lb ink}} = \frac{29.8 \text{ lb VOC}}{\text{drum}}$$

Potential emissions are

$$\frac{29.8 \text{ lb VOC}}{\text{drum}} \times \frac{2.5 \text{ drums}}{\text{hour}} = \frac{74.4 \text{ lbs VOC}}{\text{hr}}$$

$$\frac{29.8 \text{ lb VOC}}{\text{drum}} \times \frac{100 \text{ drums}}{\text{day}} = 2{,}976 \text{ lbs VOC} = \frac{1.5 \text{ tons VOC}}{\text{day}}$$

$$\frac{29.8 \text{ lb VOC}}{\text{drum}} \times \frac{5{,}000 \text{ drums}}{\text{year}} = 148{,}800 \text{ lbs VOC} = \frac{74.4 \text{ tons VOC}}{\text{yr}}$$

Waterborne Inks

Example:

A plant uses a flexographic printing ink that is 10 percent by volume non-volatiles, 20 percent by volume VOC, and 70 percent by volume water as applied. The density of the VOC solvent is 6.0 pounds per gallon, and the ink density is 7.44 pounds per gallon. The reported hourly, daily, and annual usage of ink is 2.5, 100, and 5,000 5-gallon drums, respectively.

The VOC content of each drum is

$$\frac{5 \text{ gal ink}}{\text{drum}} \times \frac{0.20 \text{ gal VOC}}{\text{gal ink}} \times \frac{6.0 \text{ lb VOC}}{\text{gal VOC}} = \frac{6.0 \text{ lb VOC}}{\text{drum}}$$

Potential emissions are

$$\frac{6.0 \text{ lb VOC}}{\text{drum}} \times \frac{2.5 \text{ drums}}{\text{hour}} = \frac{15 \text{ lbs VOC}}{\text{hr}}$$

$$\frac{6.0 \text{ lb VOC}}{\text{drum}} \times \frac{100 \text{ drums}}{\text{day}} = \frac{600 \text{ lbs VOC}}{\text{day}}$$

$$\frac{6.0 \text{ lb VOC}}{\text{drum}} \times \frac{5{,}000 \text{ drums}}{\text{year}} = 30{,}000 \text{ lbs VOC} = \frac{15 \text{ tons VOC}}{\text{yr}}$$

High-Solids Inks

Example:

A plant uses a flexographic printing ink that is 79.3 percent by volume non-volatiles and 20.7 percent by volume VOC as applied. The density of the VOC solvent is 6.0 pounds per gallon, and the ink density is 7.44 pounds per gallon. The reported hourly, daily, and annual usage of ink is 2.5, 100, and 5,000 5-gallon drums, respectively.

The VOC content of each drum is

$$\frac{5 \text{ gal ink}}{\text{drum}} \times \frac{0.207 \text{ gal VOC}}{\text{gal ink}} \times \frac{6.0 \text{ lb VOC}}{\text{gal VOC}} = \frac{6.2 \text{ lb VOC}}{\text{drum}}$$

Potential emissions are

$$\frac{6.2 \text{ lb VOC}}{\text{drum}} \times \frac{2.5 \text{ drums}}{\text{hour}} = \frac{15.5 \text{ lbs VOC}}{\text{hr}}$$

$$\frac{6.2\ \text{lb VOC}}{\text{drum}} \times \frac{100\ \text{drums}}{\text{day}} = \frac{621.0\ \text{lbs VOC}}{\text{day}}$$

$$\frac{6.2\ \text{lb VOC}}{\text{drum}} \times \frac{5{,}000\ \text{drums}}{\text{year}} = 31{,}050\ \text{lbs VOC} = \frac{15.5\ \text{tons VOC}}{\text{yr}}$$

Low-Solvent Inks

Example:

A plant uses a flexographic printing ink that is 31.3 percent by weight VOC and 68.7 percent by weight pigments and other non-volatiles as applied. The ink density is 7.44 pounds per gallon. The reported hourly, daily, and annual usage of ink is 2.5, 100, and 5,000 5-gallon drums, respectively.

The VOC content of each drum is

$$\frac{5\ \text{gal ink}}{\text{drum}} \times \frac{7.44\ \text{lb ink}}{\text{gal ink}} \times \frac{0.313\ \text{lb VOC}}{\text{lb ink}} = \frac{11.6\ \text{lb VOC}}{\text{drum}}$$

Potential emissions are

$$\frac{11.6\ \text{lb VOC}}{\text{drum}} \times \frac{2.5\ \text{drums}}{\text{hour}} = \frac{29.1\ \text{lbs VOC}}{\text{hr}}$$

$$\frac{11.6\ \text{lb VOC}}{\text{drum}} \times \frac{100\ \text{drums}}{\text{day}} = \frac{1{,}164.4\ \text{lbs VOC}}{\text{day}}$$

$$\frac{11.6\ \text{lb VOC}}{\text{drum}} \times \frac{5{,}000\ \text{drums}}{\text{year}} = 58{,}218\ \text{lbs VOC} = \frac{29.1\ \text{tons VOC}}{\text{yr}}$$

Printing Process with Emission Control System

Example:

A rotogravure printing process uses an ink that is 80 percent by weight VOC and 20 percent by weight pigments and other non-volatiles as applied. The ink density is 7.44 pounds per gallon. The reported hourly, daily, and annual usage of ink is 2.5, 100, and 5,000 5-gallon drums, respectively. The plant elects to install an emission control system (carbon adsorption system, incineration, or equivalent) having a destruction/collection efficiency of 95 percent. The process is hooded and has a capture efficiency of 80 percent.

The VOC content of each drum is

$$\frac{5\ \text{gal ink}}{\text{drum}} \times \frac{7.44\ \text{lb ink}}{\text{gal ink}} \times \frac{0.80\ \text{lb VOC}}{\text{lb ink}} = \frac{29.8\ \text{lb VOC}}{\text{drum}}$$

Potential (uncontrolled) emissions are

$$\frac{29.8\ \text{lb VOC}}{\text{drum}} \times \frac{2.5\ \text{drums}}{\text{hour}} = \frac{74.4\ \text{lbs VOC}}{\text{hr}}$$

$$\frac{29.8\ \text{lb VOC}}{\text{drum}} \times \frac{100\ \text{drums}}{\text{day}} = 2{,}980\ \text{lbs VOC} = \frac{1.5\ \text{tons VOC}}{\text{yr}}$$

$$\frac{29.8\ \text{lb VOC}}{\text{drum}} \times \frac{5{,}000\ \text{drums}}{\text{year}} = 148{,}800\ \text{lbs VOC} = \frac{74.4\ \text{tons VOC}}{\text{yr}}$$

Overall VOC control efficiency is

$$(0.80 \times 0.95) \times 100 = 76.0\%$$

Expected (controlled) emissions are

$$(74.4\ \text{lbs VOC/hr}) \times (1 - 0.76) = 17.9\ \text{lbs VOC/hr}$$

$$(2{,}980\ \text{lbs VOC/day}) \times (1 - 0.76) = 715.2\ \text{lbs VOC/day}$$

$$(74.4\ \text{tons VOC/yr}) \times (1 - 0.76) = 17.9\ \text{tons VOC/yr}$$

Emissions can also be calculated by totaling the fugitive and stack emissions from the process. Accordingly, expected fugitive emissions are

$$(74.4\ \text{lbs VOC/hr}) \times (1 - 0.80) = 14.9\ \text{lbs VOC/hr}$$

$$(2{,}980\ \text{lbs VOC/day}) \times (1 - 0.80) = 596.0\ \text{lbs VOC/day}$$

$$(74.4\ \text{tons VOC/yr}) \times (1 - 0.80) = 14.9\ \text{tons VOC/yr}$$

Expected stack emissions are

$$(74.4\ \text{lbs VOC/hr}) \times (0.80) \times (1 - 0.95) = 3.0\ \text{lbs VOC/hr}$$

$$(2{,}980\ \text{lbs VOC/day}) \times (0.80) \times (1 - 0.95) = 119.2\ \text{lbs VOC/day}$$

(74.4 tons VOC/yr) x (0.80) x (1 - 0.95) = 3.0 tons VOC/yr

Total expected emissions are

14.9 + 3.0 = 17.9 lbs VOC/hr

596.0 + 119.2 = 715.2 lbs VOC/day

14.9 + 3.0 = 17.9 tons VOC/yr

Summary of VOC Emissions from Printing Facilities

The following table illustrates the results of the above emissions calculations. Note the effects of varying the coating type and control requirements in various printing processes utilizing similar throughputs and coating densities.

Coating Type or Process Type w/Control	Annual Thruput	Coating and VOC Density	VOC	Non-VOC	Water	VOC Emissions (tons/yr)
Non-Compliant Coatings (high-VOC/low-solids inks)	5,000 5-gallon drums	7.44 lb/gal ink 6.0 lb/gal VOC	80% by weight	20% by weight	-	74.4
Waterborne Inks			20% by volume	10% by volume	70% by volume	15.0
High-Solids Inks			20.7% by volume	79.3% by volume	-	15.5
Low-Solvent Inks			31.3% by weight	68.7% by weight	-	29.1
Printing Press w/Emission Controls			80% by weight	20% by weight	-	17.9

Calculation of VOC Emissions from Publication Rotogravure Printing Facilities

Publication rotogravure printing facilities must meet the minimum requirements listed in 40 CFR Part 60, Subpart QQ. This standard states that facilities may not emit VOC into the atmosphere in excess of 16 percent of the total mass of VOC solvent and water used at the facility during any 30 consecutive calendar days. Reviewer should check for compliance with this standard.

Non-Compliant Coatings (high-VOC inks, low-solids inks)

Example:

A publication rotogravure facility uses a printing ink that is 80 percent by weight VOC and 20 percent by weight pigments and other non-volatiles as applied. The ink density is 7.44 pounds per gallon. The reported hourly, daily, and annual usage of ink is 2.5, 100, and 5,000 5-gallon drums, respectively.

The VOC content of each drum is

$$\frac{5 \text{ gal ink}}{\text{drum}} \times \frac{7.44 \text{ lb ink}}{\text{gal ink}} \times \frac{0.80 \text{ lb VOC}}{\text{lb ink}} = \frac{29.8 \text{ lb VOC}}{\text{drum}}$$

Potential emissions are

$$\frac{29.8 \text{ lb VOC}}{\text{drum}} \times \frac{2.5 \text{ drums}}{\text{hour}} = 74.4 \text{ lbs VOC/hr}$$

$$\frac{29.8 \text{ lb VOC}}{\text{drum}} \times \frac{100 \text{ drums}}{\text{day}} = 2{,}976 \text{ lbs VOC} = 1.5 \text{ tons VOC/day}$$

$$\frac{29.8 \text{ lb VOC}}{\text{drum}} \times \frac{5{,}000 \text{ drums}}{\text{year}} = 148{,}800 \text{ lbs VOC} = 74.4 \text{ tons VOC/yr}$$

In this example, no water exists in the printing ink used, and **all** of the VOC used are emitted into the atmosphere. Non-compliant inks, therefore, cannot be used in new publication rotogravure printing facilities without the use of add-on control.

Waterborne Inks

Example:

A publication rotogravure printing facility uses a printing ink that is 10 percent by volume non-volatiles, 20 percent by volume VOC, and 70 percent by volume water as applied. The density of the VOC solvent is 6.0 pounds per gallon, and the ink density is 7.44 pounds per gallon. The reported hourly, daily, and annual usage of ink is 2.5, 100, and 5,000 5-gallon drums, respectively.

The VOC content of each drum is

$$\frac{5 \text{ gal ink}}{\text{drum}} \times \frac{0.20 \text{ gal VOC}}{\text{gal ink}} \times \frac{6.0 \text{ lb VOC}}{\text{gal VOC}} = \frac{6.0 \text{ lb VOC}}{\text{drum}}$$

The water content of each drum is

$$\frac{5 \text{ gal ink}}{\text{drum}} \times \frac{0.70 \text{ gal water}}{\text{gal ink}} \times \frac{8.3 \text{ lb water}}{\text{gal water}} = \frac{29.1 \text{ lb water}}{\text{drum}}$$

Total weight of VOC and water in each drum is

$$6.0 + 29.1 = 35.1 \text{ lb VOC \& water/drum}$$

Potential emissions are

$$\frac{6.0 \text{ lb VOC}}{\text{drum}} \times \frac{2.5 \text{ drums}}{\text{hour}} = 15 \text{ lbs VOC/hr}$$

$$\frac{6.0 \text{ lb VOC}}{\text{drum}} \times \frac{100 \text{ drums}}{\text{day}} = 600 \text{ lbs VOC/day}$$

$$\frac{6.0 \text{ lb VOC}}{\text{drum}} \times \frac{5{,}000 \text{ drums}}{\text{year}} = 30{,}000 \text{ lbs VOC} = 15 \text{ tons VOC/yr}$$

Percent VOC emitted is

$$(6.0/35.1) \times 100 = 17.1\% > 16\%$$

This particular waterborne ink does not meet the standard for publication rotogravure printing facilities.

Printing Process with Emission Control System

Example:

A publication rotogravure printing process subject to NSPS Subpart QQ uses an ink that is 80 percent by weight VOC and 20 percent by weight pigments and other non-volatiles as applied. The ink density is 7.44 pounds per gallon. The reported hourly, daily, and annual usage of ink is 2.5, 100, and 5,000 5-gallon drums, respectively. The plant elects to install an emission control system (carbon adsorption system, incineration, or equivalent) having a destruction/collection efficiency of 95 percent. The process is hooded and has a capture efficiency of 92 percent.

The VOC content of each drum is

$$\frac{5 \text{ gal ink}}{\text{drum}} \times \frac{7.44 \text{ lb ink}}{\text{gal ink}} \times \frac{0.80 \text{ lb VOC}}{\text{lb ink}} = \frac{29.8 \text{ lb VOC}}{\text{drum}}$$

Potential (uncontrolled) emissions are

$$29.8 \text{ lb VOC} \times 2.5 \text{ drums} = 74.4 \text{ lbs VOC/hr}$$

drum		hour				
29.8 lb VOC / drum	x	100 drums / day	=	2,980 lbs VOC	=	1.5 tons VOC/yr
29.8 lb VOC / drum	x	5,000 drums / year	=	148,800 lbs VOC	=	74.4 tons VOC/yr

Overall VOC control efficiency is

(0.92 x 0.95) x 100 = 87.4%

Expected (controlled) emissions are

(74.4 lbs VOC/hr) x (1 - 0.874) = 9.4 lbs VOC/hr

(2,980 lbs VOC/day) x (1 - 0.874) = 375.5 lbs VOC/day

(74.4 tons VOC/yr) x (1 - 0.874) = 9.4 tons VOC/yr

Emissions can also be calculated by totaling the fugitive and stack emissions from the process. Accordingly, expected fugitive emissions are

(74.4 lbs VOC/hr) x (1 - 0.92) = 6.0 lbs VOC/hr

(2,980 lbs VOC/day) x (1 - 0.92) = 238.4 lbs VOC/day

(74.4 tons VOC/yr) x (1 - 0.92) = 6.0 tons VOC/yr

Expected stack emissions are

(74.4 lbs VOC/hr) x (0.92) x (1 - 0.95) = 3.4 lbs VOC/hr

(2,980 lbs VOC/day) x (0.92) x (1 - 0.95) = 137.1 lbs VOC/day

(74.4 tons VOC/yr) x (0.92) x (1 - 0.95) = 3.4 tons VOC/yr

Total expected emissions are

6.0 + 3.4 = 9.4 lbs VOC/hr

238.4 + 137.1 = 375.5 lbs VOC/day

6.0 + 3.4 = 9.4 tons VOC/yr

Percent VOC emitted is

(9.4/74.4) x 100 = 12.6% < 16%

In this example, the use of add-on controls with a good capture efficiency assured compliance of the emission standard.

Calculation of Toxic Pollutant Emissions from Printing Facilities

The ink/additive/clean-up solvent manufacturer's material safety data sheets (MSDS) usually give the weight percent of each toxic pollutant contained in their products. This information can be used in the following general equation to calculate toxic emissions from printing facilities. For the purposes of this calculation, the term *ink* will be used to represent inks, additives, and clean-up solvents, as applicable.

$$[\text{ink thruput}] \times [\text{ink density}] \times \frac{[\text{wt \%}/100]}{} \times \left[1 - \frac{\text{control eff}}{100}\right] = \text{lb toxic}$$

$$\frac{\text{gal ink used}}{\text{year}} \times \frac{\text{lb}}{\text{gal ink}} \times \frac{\text{lb toxic}}{\text{lb ink}} \times 1 - \frac{\text{control eff}}{100} = \text{lb toxic}$$

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