# A STUDY OF HEATSET WEB OFFSET HYRDROCARBON EMISSIONS IN METROPOLITAN WASHINGTON, D.C.

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## Introduction

The first federal legisation pertaining to air pollution control was in 1955 which required the Federal government to provide research and technical assistance reserving to the states all of the responsibility for actual pollution control. This was followed by the Clean Air Act of 1963 which formed regional commissions and provided a mechanism to mediate among the states. The Air Quality Act of 1967, among other things, established criteria for health protection and recommended control techniques; it required the states to adopt ambient air standards subject to federal review and approval. Except for California, there was negligible action at the state level, so in 1970, Congress amended the act establishing the Environmental Protection Agency (EPA). It set national primary and secondary air quality standards and required the states to design State Implementation plans (SIP) to achieve the standards. Because the standards were not met, in 1977, the Clean Air Amendments were passed which classified air quality control regions as attainment or non-attainment and the SIPs for non-attainment areas had to be modified in order to avoid major sanctions. A stringent deadline of 1982 was set to meet the National Ambient Air Quality Standards (NAAQS). If the states could not meet this deadline they could request an extension. About half of the states requested extension and were then faced with modifying their implementation plans to include regulations which would meet the standards by 1987.(1)

1 See "Cleaning the Air: Reforming the Clean Air Act" The Brookings Institution, Washington, D.C. Sept. 1981 for a review of the legislative listing of Federal Clean Air laws.

It was very difficult for the states, with their limited resources, to decide which rules were best for each industry and for each of the federally identified pollutants. Consequently, the EPA was charged with the preparation of Control Technology Guidelines (CTG), by industry category, as to what is "reasonably available control technology"(RACT) which states could require the existing installations to adopt in order to meet the ambient air standards. They were also required to develop New Source Performance Standards (NSPS). The Clean Air Act authorization expired Sept. 30, 1982. There are several reauthorization bills and amendments currently before the Congress, all of them bottled up in committee with little chance that anything substantial can be passed before the elections. Failure of the Congress to pass such legislation will keep the present law in effect.

## Clean Air Act and the Printing Industry

The EPA makes a distinction between "mobile" sources such as trucks and automobiles and "stationary" sources which include printing plants. These latter are further classified as "point" sources, i.e. those with potential emissions of more than 100 tons per year as determined by inventory of purchased materials and "area" sources, those with less than 100 tons per year, in practice many states will identify as point sources those which emit 25 tons per year or more.

The printing industry is concerned primarily with hydrocarbons, one of the seven criteria pollutants for which national ambient air quality standards have been set, mainly because they combine with nitrogen oxide in the presence of sunlight to form ozone, a principal component of "smog". This is the standard most widely violated in non-attainment states.

Among hydrocarbons those which are most photochemically reactive are the volatile organic compounds (VOCs), the definition for which is: "a compound having a vapor pressure greater than 0.1 mm of mercury at standard conditions". The EPA reiterated this definition in December 1981.(2)

As part of its mission. the EPA is required to identify major sources of the various pollutants and set priorities for the development of control documents. The graphic arts

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2 61270 Federal Register, Vol. 46. No. 241, Dec. 16, 1981.

industries are always ranked high as major sources of hydrocarbon emissions. As late as August 1979, when setting priorities for the development of New Source Performance Standards (NSPS), the EPA ranked our industry sixth. (3)

In 1978, an EPA contractor produced a draft CTG for the printing industry which was submitted to the Graphic Arts Technical Foundation and others for an industry review. In 1972, the industry had established, for this purpose, the Environmental Control Board of the Graphic Communications Industries (ECB). It was to furnish assistance to members when interacting with the government on regulatory matters affecting the environment, health and safety; it also served as the medium through which cooperative efforts could be developed and information distributed. The GATF serves as its secretariat. The industry found the contractor-generated draft CTG unacceptable.

After numerous meetings with an ECB Air Committee and the contractor, the EPA announced that since the proposed guideline was for control of volatile organic compounds, it would cover only rotogravure and flexography. The printing processes utilizing heatset inks would not be included in the document because oils used in their inks did not meet the definition of VOCs. A committee from these two segments of the industry under the chairmanship of Harvey George of Gravure Research Institute was organized to work with the contractor and EPA, eventually a CTG for these two segments of the industry was published. (4) A New Source Performance Standard for them is in preparation.

This is where the situation stood until late July 1980 when Engineering Science, an EPA contractor, contacted the industry and informed it that they had a contract to develop a CTG for heatset web-offset lithography and for heatset web-letterpress. The stated prurpose was the control of volatile organic compounds. The fact that solvents in the inks for these two processes did not meet the existing definition of VOC did not matter. Consequently, the ECB Air Committee, under the chairmanship of Dr. William D. Schaeffer, Research Director of GATF, was reestablished. Its mission was to convince EPA that no control document for the industry was required since it was not a major source

3 49222 Federal Register, Vol. 44, No. 163, August 21, 1979

4 Control of Volatile Organic Emissions From Existing Stattionary Sources, Vol. VIII, Graphic Arts-Rotogravure and Flexography, EPA 450/2-78-033, U.S. EPA, Research Triangle Park, NC, Dec. 1978.

of photochemically reactive VOCs as we understand the definition and failing that to insure that if a CTG were developed it would be something with which the industry could live.

After about six months of effort and meetings, the EPA agreed to drop heatset web-letterpress but continued for lithography. Despite the best efforts of the committee, which included among its membership, the industry's most knowledgeable people, EPA continued its efforts and produced several draft CTGs. In the interest of time suffice it to say that, much to its surprise, the committee was informed in October 1981, that EPA had abandoned the project ostensibly because costs would be excessive for the emmissions reduction it would provide. Since then, in a letter to Margaret Rogers, Director of Regulatory Affairs for PIA, John W. Hernandez, Jr., the Deputy EPA Administator, stated that the decision to "terminate development of the CTG document for "heat-set web-offset lithographic printing" was based on our inability to identify a level of emission control that could be achieved by all types of printing processes".

However, draft copies of the proposed CTG had been distributed to the various states and the information they contain, much of which is disputed by the industry, is being used by non-attainment areas in the preparation of their State Implementation Plans (thus far, we are aware that Illinois and D.C. are doing so). In addition, the industry has been notified that a NSPS will be developed for the entire offset printing industry -- sheet-fed, non-heat-set web and heat-set web.

During the course of its studies, the Air Committee felt that it would be useful to know what the hydrocarbon emissions for the industry were and how they ranked numerically with other industries. Such information should be available in the inventory of pollutants which states are required to produce as part of their State Implementation Plans (SIP). The plans for Maryland and Illinois were inspected at the EPA offices in Durham, N.C., but they were so poorly organized that no meaningful data could be obtained from them. Besides, the data were several years old. New inventories were required by December 1981 and in July, a Washington Post article reported on the inventory generated by the Metropolitan Washington, D.C. Council of Governments.

We were able to obtain copies of it, plus excellent cooperation from the officials involved. The author has extensive knowledge and contacts in the local industry. Preliminary data indicated that a thorough study would be helpful, first in assessing the industry contribution to the total hydrocarbon emissions in the region, and secondly, to test the model press factors developed jointly by the EPA and the ECB Air Committee. The study reported here is the result of four months' investigation. As expected, excellent cooperation was furnished by area printers and rather extensive data were developed.

## The Council of Governments (COG) Area

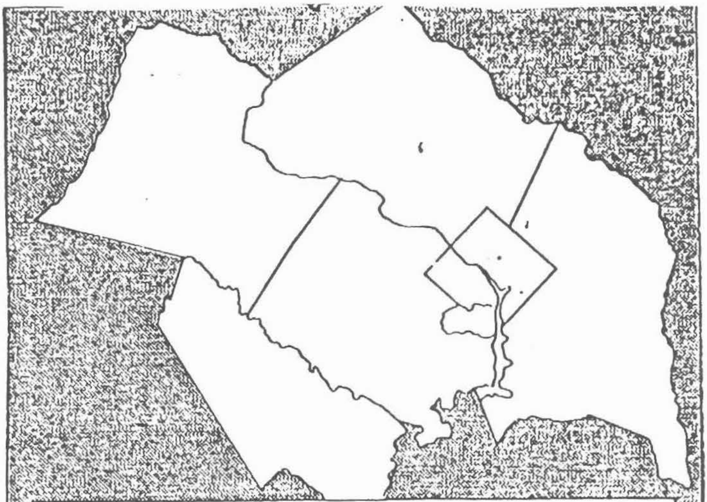
The jurisdiction of the Council of Governments (COG) includes the cities of Washington, D.C. and Alexandria, VA, plus six adjacent counties, 2 in Maryland and 4 in Virginia. Figure 1 (following page) shows a map of the area plus the COG estimate of the amount of pollutants generated in each jurisdiction in pounds per capita per day. The population for the area is 3,175,000.

The total hydrocarbon load for the area is 383 tons per day. Mobile sources such as automobiles and trucks account for 57 percent of the total. The balance is generated by stationary sources. The printing industry contribution to 1980 hydrocarbon emissions in the COG region for area sources was 3.96 metric tons per day, and it ranks eighth among the 18 sources listed. The highest is architectural surface coatings at 27.97 tons per day. The point source contribution is 2.05 tons per day and ranks third among fourteen sources listed. The highest is gasoline and crude oil storage at 3.94 tons per day. Overall, the graphic arts share is 6.01 tons per day (TPD) and represents 1.57 percent of the total.

## Area Sources

The contribution of "area" sources is calculated by multiplying the population by a per capita factor of 0.4 mg. annually from which point source contributions are subtracted. The factor was developed by Mr. William Lamason of the EPA Research Triangle Park facility in Durham, NC.(5)

5 Lamason, William H. III, "Technical Discussion of Per Capita Emission Factors For Several Area Sources of Volatile Organic Compounds", presented at 74th Annual Meeting, Air Pollution Control Association, Philadelphia, PA, June 1981



**METRO AREA POLLUTION**

| Metropolitan Area | Hydrocarbons | Nitrogen Oxide |
|---|---|---|
| | lbs. per day, per capita | |
| District of Columbia | .20 | .14 |
| Arlington County | .26 | .15 |
| Alexandria | .25 | .58 |
| Fairfax County | .25 | .22 |
| Loudoun County | .29 | .26 |
| Prince William County | .24 | .49 |
| Montgomery County | .24 | .29 |
| Prince George's County | .25 | .29 |

SOURCE: Metropolitan Washington Council of Governments

The Washington Post

Figure 1-Emissions in the Metropolitan Washington, DC Area

The per capita factor in kg/yr is calculated from one or the other of the below listed equations:

$$PF = \frac{E}{P} \times EAF$$
(Equation 1)

$$PF = \frac{SC}{NP} \times AF \times RF \times EAF$$
(Equation 2)

Where: PF = Per capita factor, kg/cap-yr.
E = Emissions in kg/yr.
P = Population for area where emission estimates are applicable.
SC = National solvent consumption, kg/yr.
NP = National population, x $10^6$ people.

AF = Adjustment factor which allocates unknown consumption into identified solvent end use categories as previously discussed. For industrial categories AF = 1.13 and for consumer/commercial categories AF = 1.17.

RF = Release factor to convert consumption data into emission data.

EAF - Exempt compound adjustment fraction.

Equation 1 employs emissions data to compute a per capita factor while Equation 2 uses national solvent consumption data.

Table 1 lists the exempt solvents:

Table 1. List of Compounds Exempt From EPA's VOC Policy

| | |
|---|---|
| Methane | Ethane |
| Trichlorothifluoroethane | Methylene chloride |
| Trichlorofluoromethane | Dichlorodifluoromethane |
| Chlorodifluoromethane | Trifluoremothane |
| Dichlorotetrafluoroethane | Chloropentafluoroethane |
| 1,1,1-Trichloroethane (methyl chloroform) | |

It should be noted that both Methylene Chloride and 1, 1,1-Trichloroethane are used in blanket and roller washes.

When Mr. Lamason applied Equation 1 to the graphic arts he used a national emissions value (E in equation 1) of 75,000,000 kg. Despite repeated requests, I have not yet been furnished the reports from which he developed this number. He lists his references but at least four of the six references cited apply only to flexo and gravure. Only the Bureau of Engraving and Printing (a point source), has gravure presses in the COG area and I have not been able to find any flexo in this area. The national emissions number was divided by the 1980 population of 215 million, this calculates to 0.3488 kg/cap/yr but he rounds it off upward to 0.4 kg. For the COG area, this results in the area source emissions being overstated by 0.63 metric tons daily. Mr. Lamason compared his 0.4 kg value with data from state plans, only two values were recorded and these were in the 0.3 to 0.4 kg range. However, when he applied the second equation he obtained a negative result. How poor the information on which he relied is contained in his statement "Speciation data in Appendix A of the report (i.e. End use of solvents containing VOC (6)) indicated that special napthas represent 98 percent of solvent used in the Graphic Arts. Another 1 percent consists of glycol esters." Obviously, Mr. Lamason could have used some industry help.

## Point Sources

There are five point sources for the area listed in the COG files. Three of these show less than 100 tons per year (TPY). Of these three, one source with 53 TPY is now out of business and a second, the Bureau of Engraving and Printing, with 92 TPY has no heatset web-offset equipment. Thus, there remain three point sources of which two are located in Maryland and other in the District of Columbia.

The regional SIP is now in preparation. A list of "candidates for feasibility review is reasonable measures for incorporation in 1982 SIP revision for the National Capital Air Quality Planning Region" has been prepared. Only three short-term measures for stationary sources are listed. One applies only to service stations. The other two would:

1. Require RACT on sources with less than 100 TPY hydrocarbon emissions; and
2. Require controls in excess of RACT on stationary sources with greater than 100 TPY hydrocarbon emissions.

The D.C. Government has retained the firm Environmental Sciences as a consultant to develop control technology for offset lithography.

At this point, we must stress that EPA has not published a CTG for heatset web-offset lithography. Thus, the only data on which to gain RACT available to the states is what is contained in the draft CTG. In this, the EPA acknowledges that emissions can be controlled by reducing alcohol consumption and the solvent in the ink. However, it limits RACT to two types of add on controls - incinerators and electrostatic precipitators. The data in the CTG would indicate that only incineration will give satisfactory results. Since there are many ESPs in the industry already installed to meet local regulations on smoke and odor, these would be allowed by EPA if they are substantially upgraded and alcohol is eliminated.

6 "End Use of Solvents Containing Volatile Organic Compounds" EPA-450/3-79-032, U.S. EPA, Research Triangle Park, NC, May 1979.

In the draft CTG, the EPA Contractor developed several model presses some of the parameters for which are:

Table 2

| | | |
|---|---|---|
| Press width | | 38" |
| Press speed | | 800 ft/min |
| Number perfecting units | | 4 |
| Ink consumption | | 52.2 lbs/hr |
| Ink solvent content | | 40 % |
| Isopropyl alcohol consumption | | 26.0 lbs/hr |
| Annual hours of operation | Model A | 2,000 hrs |
| | Model B | 4,000 hrs |

They assumed that 20 percent of the ink solvent would remain on the sheet and the other 80 percent would go up the stack. They also assumed that 50 percent of the isopropanol was fugitive and would be emitted into the pressroom - the other 50 percent would go up the stack.

## The Printing Industry in the COG Area

The printing industry is the third largest in the capital area ranking behind tourism and construction. It is the largest manufacturing industry and employs over 22,000 employees. Probably another 5,000 are employed in government facilities primarily at the Government Printing Office and the Bureau of Engraving and Printing. Additionally, the various government mapping agencies have substantial printing plants in the area. (7)

Ten commercial plants and one government plant operate heatset web-offset equipment. Currently, there are 27 presses in the area. of which 20 fulfill the description of the EPA Model Press, i.e., four perfecting units 38" wide. Fourteen of these 20 presses are located in the three point sources; all but three of these are equipped with pollution control equipment. Five employ incinerators and six use electrostatic precipitators. Only one press among the area sources is equipped with an incinerator.

About one third of the presses use conventional or brush dampeners although two or three of these employ isopropanol in the fountain at sometime or other. All of the other presses employ continuous dampening systems.

7 "The Printing and Publishing Industry" prepared for the D.C. Government Office of Business and Economic Development.

Appendix I is a listing of presses in the area and was developed in conjunction with George Mattson, of PIA's Web Offset Section.

A wide range of products is printed on this equipment which mirrors to a large extent those printed nationally. On the high-quality end of the spectrum are such monthly publications as Antiques, National Wildlife, Smithsonian, National Geographic, all printed on heavy coated stocks and profusely illustrated in color. Also of high quality are illustrated books for customers like the National Geographic Society, Time-Life Books, and CBS. In the middle quality range are monthly and weekly publications such Time and Newsweek, Chemical Engineering, Changing Times, Science, etc. The area sources print black and white texts in the form of pamphlets and books, with limited illustrations, on uncoated stocks, primarily for the Government Printing Office. In summary, the range is from spartan black and white printing to the highest quality color printing which can be achieved by heatset web-offset lithography.

## Ink Consumption

Appendix II lists heatset ink consumption for the area. The figures are for 1981 extracted from various sources. For the three point sources, actual numbers were obtained from purchase records for the first eleven months and extended for the twelfth. Ink consumption in plants among area sources was obtained from sales figures from the two principal ink suppliers. A few of these were spot-checked by comparing with purchasing records of the plants involved If nothing else, they are valid as rates of ink consumption

According to the ink suppliers, the ink solvent content is in the 33 to 38 percent range, with 35 percent representing a good average. These numbers include the solvents contained in the resins used in the inks.

Total ink consumption is slightly over 2,400,000 pounds, of which almost 85 percent or 2,000,000 pounds are consumed by the three point sources.

The total ink consumption listed in Appendix II is believed to be accurate, certainly within plus or minus 50,000 pounds. The numbers listed as being used on controlled presses are estimates made by plant managers although in one case actual numbers from ink pump meters on the press were furnished. As shown, 71.5 percent of the ink is used on presses equipped with either an incinerator or an electrostatic precipitator.

## Isopropanol Consumption

Consumption of isopropanol in the region was much more difficult to obtain. It is listed in Appendix III and is very probably not as accurate as the ink consumption figures. The three point sources furnished numbers (in gallons) from their purchasing records. This was converted to pounds by multiplying by 6.5. Only one area source was able to furnish consumption figures and that was a government plant. However, all but one or two presses in area plants use no isopropanol. As can be seen, the estimated consumption is just under 1,400,000 pounds. From this, one can calculate an overall alcohol to ink consumption ratio of 0.58 pounds of isopropanol per pound of ink consumed. This is pretty close to the EPA model estimate of 0.5. The ratio for each of the point sources will be discussed later.

All plants in the area have tried alcohol substitutes at one time or another. No press equipped with a continuous flow dampening system was able to completely replace isopropanol. Plant managers and pressmen agree that without the alcohol they lose flexibility and the plate is much harder to keep clean and printing sharply. This leads to loss of quality which is unacceptable. Additionally, paper waste is increased. Two of the three point sources tried very hard within the last six months to convert but have been unable to do so. Attempts continue using mixed dampening aids which include some isopropanol.

Four plants which furnished isopropanol information said that they use from 15 to 25 percent by volume in the water fountain (12 to 20 percent by weight). In one plant, they have had successful runs with 12 percent by volume, but this is a short-run, strictly black-and-white plant.

Use of alcohol substitutes appears to be more successful in the winter months. One problem with them is that during makeready there is a relatively high volume of liquid on the blanket which leads to web breaks on light weight stocks. Another is an increase of paper and ink debris on the blanket, leading to print defects or hickeys.

## Calculation of Hydrocarbon Emissions From Heatset Web-Offset in COG Area

In Appendix IV the estimated actual emissions are calculated from the ink consumption figures in Appendix II and alcohol consumption figures in Appendix III. In the calculations, the solvent content of the ink was 35 weight percent, the number furnished by the manufacturer. The EPA factor of 20 percent retained on the paper and 80 percent emitted into the stack was used. Incinerator efficiency was calculated at 90 percnet, the ESP efficiency at 50 percent. In the calculations, it was assumed that half of the isopropanol consumed is fugitive and the other half goes into the stack; this is the percentage used by EPA.

The calculations show that 1,229,180 pounds of hydrocarbons or 558.7 metric tons are emitted annually by point sources; using the divisor furnished by COG (365), the quotient becomes 1.5 metric tons per day or 0.39 percent of the total estimated by COG of 383 TPD.

The area source contribution is calculated in Appendix IVB and increases the annual emissions in the area to 1,402,430 pounds. However, in calculating the daily emissions for area sources, the local authorities use the divisor 250 days per year. Thus, the daily emissions rate for the entire industry becomes 1.82 metric tons, or 0.48 percent ofthe daily area total.

The EPA Draft CTG dated August 1981 proposes that 0.3 pounds of emissions per pound of ink consumed is Reasonable Available Control Technology (RACT). Using this factor, the emissions in the area would be reduced by an estimated 46 percent and would be just about one metric ton daily. In a letter to Don Goodwin, the ECB Air Committee proposed that RACT be considered 0.38 pounds of emissions per pound of ink consumed for publication work, and 0.5 for book work. There was no way to divide the work performed in this area into these two categories; both types are done in just about all of the plants, particularly those in the point source category. Using the 0.38 factor for publication work, emissions would be reduced by 34 percent to 1.20 metric tons daily; and using the factor for book work, they would be reduced by 15 percent to 1.5 tons daily. The detailed calculations are shown in Appendix V and are tabulated on Table 3:

Table 3

| | M.T. Daily | % Reduction |
|---|---|---|
| Present emissions without RACT | 1.82 | -- |
| Emissions applying 0.3 factor | 0.98 | 46 |
| Emissions applying 0.38 factor | 1.20 | 34 |
| Emissions applying 0.50 factor | 1.54 | 15 |

It is not possible to scientifically determine what it would cost the industry to achieve these reductions; each press would have to be considered on an individual basis. It is probable that the reductions shown could be achieved by the reduction or elimination of isopropanol. Despite strong efforts to do so based on economics, compliance with OSHA regulations, and the potential of tightened environmental regulations, no plant has succeeded in completely eliminating isopropanol. Some important reductions have already taken place but all plant managers and pressmen contacted agreed that replacement with existing alcohol substitutes is not possible on their equipment without modification of the dampening system, or the acceptance of reduced flexibility, reduced quality, reduced productivity, and increased spoilage.

The other option to achieve RACT as proposed would be capital investment in pollution control equipment and upgrading existing controls. As many as seven presses might have to install incinerators and five ESP-equipped presses would have to be upgraded.

## Some Data From Individual Plants

All three point sources were contacted several times in order to obtain data which could be compared with the EPA model and to assess the impact of the proposed RACTs. In addition, representatives from one government plant and four commercial plants from the area sources were interviewed. Some of the data obtained are given below.

**Plant #1.** A very large modern plant producing the highest quality color work, particularly monthly publications, books and catalogs. All of its presses are equipped with pollution controls. About half of the perfecting units on these presses discharge into incinerators and the other half to electrostatic precipitators. The plant also operates some sheetfed presses. The plant operates three full shifts a day including most Saturdays. It is estimated that the plant operates three hundred days a year.

Plant #1 was unable to furnish running hours (from readily available data) as defined in the proposed EPA CTG; however, its productivity is very high and the running hours per press are probably very close to the 4,000 hours annually in the EPA model. If one uses this figure, the ink consumed per hour of running time would be 33.3 pounds or about 64 percent of the 52.2 pounds per hour in the model. If the EPA model hourly ink consumption rates were applied, the ink consumption would be 56.6 percent more than that actually used.

The isopropanol to ink ratio is 0.6 based on purchase records. The present emission of hydrocarbons based on these records and solvent content in the inks obtained from their supplier is 0.56 pounds per pound of ink consumed. They are using 20 percent isopropanol by weight in the water fountain. If they were to reduce this to 10 percent, their emissions per pound of ink would drop to 0.33 pounds per pound of ink consumed. The plant manager does not believe that this would be possible and still maintain their quality, productivity, and present waste allowances.

**Plant #2.** A medium-size plant engaged in a variety of commercial work, including publications, high quality newspaper inserts on coated ground wood papers, catalogs, etc. One-third of their perfecting units are equipped with an incinerator; the other two-thirds use electrostatic precipitators. The plant also operates a few medium sized sheetfed presses. It operates three full shifts including Saturdays; they probably operate 300 days a year. The running hours for the first eleven months of 1981 were furnished and extrapolated by the plant manager to cover December. Only actual running hours were furnished, i.e., exclusive of makeready. These averaged 3,150 hours per press.

The plant manager felt that if "makeready 2" figures were added (running for color OK), the total hours running with ink on paper would be increased by 18 percent. Exclusive of all makeready, this plant averages 42 pounds of ink per running hour, despite heavy ink coverages on some jobs. If "makeready 2" hours were included, the average would be about 36 pounds per hour.

Based on actual purchase figures for 1981, the alcohol-ink ratio in this plant is 0.96 pounds of alcohol per pound of ink. These figures were checked several times.

Even when isopropanol used in the plateroom and elsewhere was subtracted, the total was still high. The plant has made a very serious effort to replace isopropanol in the fountain with some limited success. However, when they run into a problem the pressman invariably will add alcohol. Major problems with isopropanol substitutes are increased ink emulsification, excessive web breaks during makeready on light weight papers (both coated and uncoated), increased plate sensitivity leading to remakes, increased spoilage, and general loss of flexibility in controlling the press. At present, they claim to use 25 percent isopropanol in the fountain by volume as determined by a hydrometer.

**Plant #3.** A medium-sized plant doing a variety of commercial work, primarily monthly publications ranging from very high quality color work to simple black and white or two color publications. About 40 percent of their ink consumption is on a press equipped with an incinerator. The balance of their equipment has no pollution control. Almost half of their perfecting units use no alcohol.

Two presses are equipped with conventional dampening systems. Based on purchasing records for the last 12-month period, the isopropanol-ink ratio in the plant is 0.52 overall, but since almost half of the units use no isopropanol at all, the ratio for those presses which do, becomes 0.76. This despite the fact that management makes a serious effort to keep the isopropanol in the fountain to 15 percent by volume (12 percent by weight). It is expected that isopropanol consumption in the future will show further reduction since they were able to eliminate it from half their units and reduce it in the others. The limited success obtained on presses with Dahlgren systems on them did not come without some additional costs; they did experience loss of productivity and increased spoilage. Problems encountered were very much like those found in Plant #2, i.e., tendency of halftone and reverses to fill in, web breaks. ink emulsification, etc. They did report that they had better success in winter months than in the summer.

Actual running hours plus "makeready 2" hours were furnished. They averaged 3.800 hours per press. The ink consumption divided by the total running hours resulted in 33.8 pounds of ink consumed per hour per press. If their eight-unit press is counted as two fours then ink consumption per hour per press becomes 26.7 pounds.

Using ink solvent content furnished by their principal supplier, which averages 35 percent, their emissions per pound of ink consumed are calculated at 0.6 pounds. It would be very idfficult for this plant to achieve any of the proposed RACTs without some capital investment.

**Plant #4.** This is a government plant and was not included in the point sources in the area although it probably will in the future. Most all of their work is single color on medium weight (50 lb) uncoated offset stocks and light weight (28 lb) newsprint. It is included in the report because it is representative of other area source plants. There are not emission controls on their presses.

This plant operates about 2.5 shifts per day on a five-day schedule. It does not keep records on running hours but they are low because average runs on their web offset equipment are under 5,000.

By chemical analysis of resins employed and formula control of the ink which they make themselves, the solvent content of the ink used is 34.7 percent. Based on this value and the ink actually consumed over a twelve-month period, their hydrocarbon emissions (including alcohol) are 0.42 pounds per pound of ink consumed. This number is for the web offsent equipment only. This meets the "book" RACT proposed by the ECB.

They try to keep the isopropanol in the fountain to 15 percent by volume but have had some success with 12 percent (by weight the range is 9 to 12 percent). None of the isopropanol substitutes worked well enough to replace it, despite the short runs and spartan quality of their work. Based on careful records the alcohol-ink ratio is 0.5.

One other plant outside the COG area was interviewed, primarily to obtain information on running hours. They operate two four-color presses, one on a two-shift basis, the other on a three-shift basis, both for six days a week. The two-shift press operated 2,460 running hours in 1980 and 2,900 hours in 1981. The three-shift press operated 4,224 hours in 1979 and 4,300 hours in 1981. They also have a single-color press operating three shifts, six days a weekand it operated 3,890 hours in 1980 and 3,600 hours in 1981. All these values are running hours only; no makeready time is included.

## Conclusions and Recommendations

1. It is obvious from the above that hydrocarbon emissions from the heatset web offset industry in the Metropolitan Washington, D.C. Council of Government area are not very significant, less than one-half of one percent of the total for hydrocarbons are calculated by COG.
2. Application of even the EPA proposed RACT would not substantially alter this situation. The bottom line is that if RACT had been in effect at the time of the COG survey the total area emissions would have been 382 tons per day instead of the 383 estimated. This is about .26 percent less and is probably within the statistical error included in the COG survey.
3. The elimination of isopropanol or substituting it with some other dampening aid is not RACT. In fact, 10 percent by weight in the water fountain may not be RACT, at least not now. In addition, even if substitutes could be used universally there would be additional costs in lost productivity and increased waste. The draft CTG do not reflect this.
4. Actual ink consumption figures per running hour in this geographic area are only 50 to 75 percent of that listed in the EPA model. This despite the fact that the point source plants have as heavy ink coverages on their individual jobs as any publication considered in the development of the model. In fact, some of those are printed here. This has the effect of overstating the dryer exhaust emissions by at least 25 percent.
5. The ink solvent content is only 35 percent instead of the 40 percent in the EPA model; this, too, has the effect of overstating drying emissions.
6. On the other hand, the isopropanol to ink consumed ratio is more than the 0.5 in the model; more realistic would be about 0.6. This despite the fact that the concentration of isopropanol in the plants studied was not more than 20 percent by weight and in most cases less.
7. The running hours should be defined as "makeready 2" (running for color OK) plus actual running hours. We would propose 3,000 hours per press per year for a three-shift operation without overtime, ie., five days a week. The 4,000-hour figure in the model. which would presumably apply to all the point source plants in the area, would also have the effect of overstating uncontrolled emissions and therefore, reductions which could be achieved by installing control equipment. Obviously, this would then affect the cost benefit calculations.

8. The CTG or New Source Performance Standards should clearly state that the model is just that; it is not an average. Local authorities should use actual numbers obtained by inventory and plant records.
9. The emissions calculated in this study are a relatively small percent of the total in the COG inventory of hydrocarbon emissions for the entire printing industry, i.e., 1.82 tons found in this study against 6.01 tons per day estimated by COG. Since there are no flexo or gravure plants in the area and since sheetfed offset (and what letterpress printing is left) have no solvents in their ink, the EPA factors furnished to the local authorities should be questioned.
10. Industry statistics collected in this study support the ECB Air Committee position that a major portion of heatset web offset emissions is already controlled.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## APPENDIX I

Inventory of Heatset Web Offset Presses
In Metropolitan D.C. Area

### Point Sources

| No. Presses | Perfecting Units Per Press | Width | Total Perfecting Units |
|---|---|---|---|
| | Equipped with Incinerators | | |
| 2 | 8 | full | 16 |
| 2 | 6 | full | 12 |
| 1 | 5 | full | 5 |
| 5 | | | 33 |
| | Equipped with ESP | | |
| 1 | 8 | full | 8 |
| 3 | 6 | full | 18 |
| 1 | 4 | full | 4 |
| 1 | 4 | double | 4 |
| 6 | | | 34 |
| | Uncontrolled | | |
| 3 | 6 | full | 18 |

### Area Sources

| No. Presses | Perfecting Units Per Press | Width | Total Perfecting Units |
|---|---|---|---|
| | Equipped with Incinerator | | |
| 1 | 5 | full | 5 |
| | Uncontrolled | | |
| 2 | 4 | full | 8 |
| 1 | 3 | full | 3 |
| 1 | 2 | full | 2 |
| 3 | 1 | full | 3 |
| 2 | 2 | double | 4 |
| 2 | 5 | half | 10 |
| 1 | 4 | half | 4 |
| 12 | | | 34 |
| 27 | Grand Total | | 124 |

## APPENDIX II

1981 Ink Consumption (LBS/Yr) By Heatset Web Offset Presses in COG Area

### Point Sources

| | | |
|---|---|---|
| On presses equipped with incinerators | 910,000 | |
| On presses with ESP | 820,000 | |
| On presses with no controls | 300,000 | |
| Sub-total | | 2,030,000 |

### Area Sources

| | | |
|---|---|---|
| On press equippped with incinerator | 30,000 | |
| On uncontrolled presses EPA model or or better | 135,000 | |
| On uncontrolled presses less than EPA model | 212,000 | |
| Sub-total | | 377,000 |
| Grand Total | | 2,407,000 |

### Summary

| | | |
|---|---|---|
| Ink consumption on incinerator controlled presses | 940,000 | |
| Ink consumption on ESP controlled presses | 820,000 | |
| Ink consumption on uncontrolled presses | 659,000 | |
| Total | | 2,407,000 |

Note: 72% of ink consumed used on presses with controls.

## APPENDIX III

### Estimate of 1981 Isopropanol Consumption (in lbs.) On Heatset Web Offset Presses in COG Area

#### Point Sources

| | | |
|---|---|---|
| On presses equipped with incinerators | 574,000 | |
| On presses equippped with ESP | 570,000 | |
| On uncontrolled presses | 156,000 | |
| Sub-Total | | 1,300,000 |

#### Area Sources

| | | |
|---|---|---|
| On presses equipped with incinerators | 15,000 | |
| On uncontrolled presses EPA model size | 37,000 | |
| On less than EPA model size | 40,000 | |
| Sub-Total | | 92,000 |
| Grand Total | | 1,392,000 |

## APPENDIX IV A

### Calculation of Hydrocarbon Emissions (lbs. per year) in COG Area in 1981

#### Point Sources

| | | |
|---|---|---|
| From incinerator equipped presses: | | |
| Pressroom alcohol (0.5 x 574,000) | 287,000 | |
| Dryer exhaust alcohol (574,000 x .5 x .1) | 28,700 | |
| Dryer exhaust ink solvent (910,000 x .8 x .35 x .1) | 25,480 | |
| Sub-Total | | 341,180 |
| From ESP equipped presses: | | |
| Alcohol | 570,000 | |
| Dryer exhaust ink solvent (820,000 x .8 x .35 x .5) | 114,800 | |
| Sub-Total | | 684,800 |

From uncontrolled presses:

| | | |
|---|---|---|
| Alcohol | 156,000 | |
| Dryer exhaust ink solvent (300,000 x .8 x .35) | 84,000 | |
| Sub-Total | | 240,000 |
| | | 1,229,180 |

Total Point Sources

| | |
|---|---|
| As metric tons annually | 558.7 |
| As metric tons daily (divide by 365) | 1.5 |
| As % total COG emissions (divide by 383) | .39% |
| As total of point source emissions in % (divide by 2.05) | 73.0 % |
| As total of total Graphic Arts emissions (divide by 6.01) | 25.0 % |

## APPENDIX IV B

Calculation of Hydrocarbon Emissions (lbs. per year) in COG Area in 1981

Area Sources

From incinerator equipped presses:

| | | |
|---|---|---|
| Pressroom alcohol (15,000 x .5) | 7,500 | |
| Dryer exhaust alcohol (15,000 x .5 x .1) | 750 | |
| Dryer exhaust ink solvent (30,000 x .8 x .35 x .1) | 840 | |
| Sub-Total | | 9,090 |

From uncontrolled presses, EPA model size:

| | | |
|---|---|---|
| Pressroom alcohol | 13,500 | |
| Dryer exhaust alcohol | 13,500 | |
| Dryer exhaustink solvent (135,000 x .8 x .35) | 37,800 | |
| Sub-Total | | 64,800 |

From uncontrolled presses less than model size:

| | | |
|---|---|---|
| From ink (212,000 x .8 x .35) | 59,360 | |
| From alcohol | 40,000 | |
| Sub-Total | | 99,360 |
| Total Area Sources | | 173,250 |

| | |
|---|---|
| Metric tons annually | 78.8 |
| Metric tons daily (divide by 250) | 0.32 |
| As % of COG area total | 0.08% |
| As % of Graphic Arts pt. source total (divide by 3.96) | 8.08% |

Summary

| | |
|---|---|
| Emissions from point sources | 1,229,180 |
| Emissions from area sources | 173,250 |
| Total COG HC emissions | 1,402,430 |

| | |
|---|---|
| Metric tons annually | 637.5 |
| Metric tons daily (pt. + area) (.32 + 1.50) | 1.82 |
| As % of COG total emissions | 0.48% |
| As % of total Graphic Arts emissions | 30.3% |

## APPENDIX V

### Effect of Various Proposed RACT on COG Area Heatset Emissions

#### Applying EPA Proposed 0.3 lbs. Emissions/lb. Ink Consumption

| | Emissions would be (lbs) | Reduction lbs. and % |
|---|---|---|
| Point source emissions (.3 x 2,300,000) | 609,000 | |
| Area source controlled press (.3 x 30,000) | 9,000 | |
| Area source uncontrolled model press or larger (subject to RACT) (.3 x 135,000) | 40,500 | |
| Area source, less than model (not subject to RACT) | 99,360 | |
| Emissions with RACT | 757,860 | 644,570 |
| As % of without RACT | 54% | 46% |

#### Applying ECB Air Committee Proposed Publication Rate of .38 lbs. Emissions/lb. Ink Consumed

| | | |
|---|---|---|
| Point source emissions (.38 x 2,030,000) | 771,400 | |
| Area source controlled press (.38 x 30,000) | 11,400 | |
| Area source uncontrolled model press or larger, subject to RACT (.38 x 135,000) | 51,300 | |
| Area source, less than model (not subject to RACT) | 99,360 | |
| Total emissions with RACT | 933,460 | 468,970 |
| As % of without RACT | 66% | 34% |

Applying ECB Air Committee Proposed Book Rate of .5 lbs. Emissions/lb. of Ink Consumed

| | | |
|---|---|---|
| Point source emissions (.5 x 2,030,000) | 1,015,000 | |
| Area source controlled press (.5 x 30,000) | 15,000 | |
| Area sources uncontrolled model press or larger (subject to RACT)(.5 x 135,000) | 67,500 | |
| Area source, less than model | 99,360 | |
| Total emissions with RACT | 1,196,860 | 205,570 |
| As % of without RACT | 85% | 15% |