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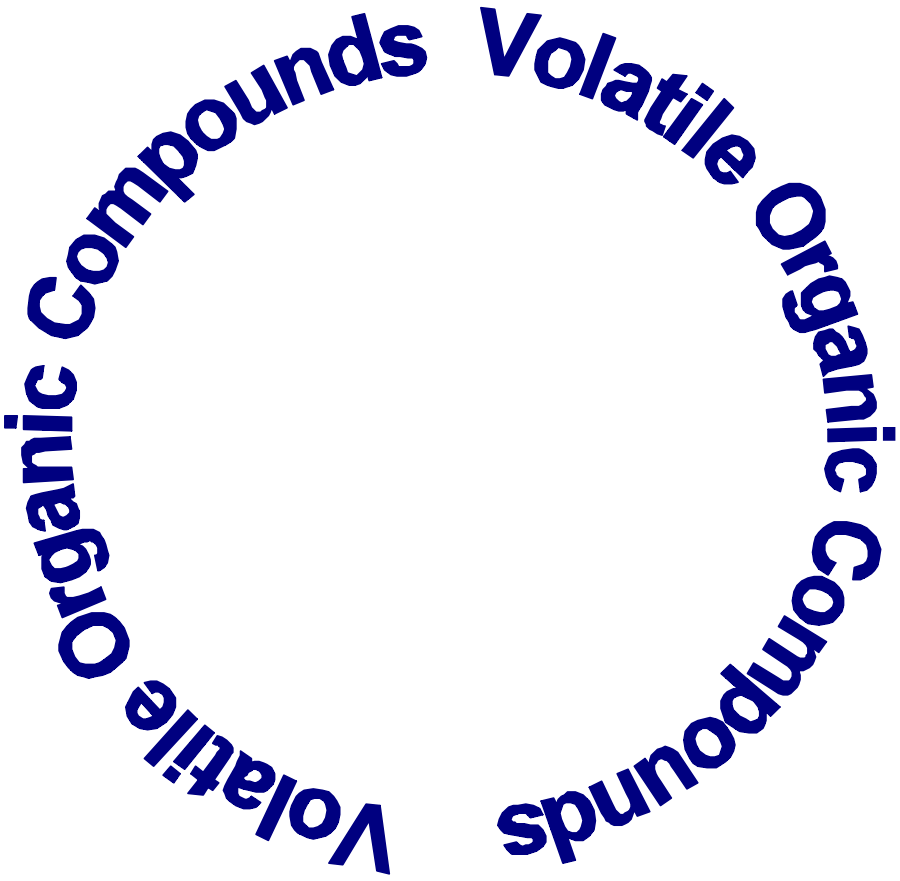

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Volume III

VOC - Volatile Organic Compounds

The Clean Air Act Amendments (CAAA) of 1990 required each state to develop and submit to the EPA, State Implementation Plans (SIP) by November 13, 1993. These plans were to describe how the state would meet the clean air requirements. The plans will include requirements for obtaining "Title V" permits for "major sources."

The EPA must approve or deny the SIP within one year of submittal. Major sources must submit Permit applications within one year after EPA approval. This would be November 15, 1995 at the latest. However, some states are requiring earlier submission of Permit applications or related information.

Because the state submittal of SIPs and the EPA's view of them is behind schedule, as of September 1994, only five states have received approval of their SIPs. These states are Louisiana, New Mexico, Nevada, Washington, and Hawaii.

The principle regulated air pollutant affecting the printing ink industry is Volatile Organic Compounds (VOCs). The amount of VOC emitted determines whether or not a facility is a major source. This amount varies from ten tons per year to one hundred tons per year depending on the particular Air Control District or state in which the facility is located. All major sources will eventually require a Title V permit.

What are VOCs? Where do they come from in ink? What replaces the VOC? These are all questions that are raised today.

VOCs, or Volatile Organic Compounds, as defined by EPA, are any volatile organic compounds which participate in atmospheric photochemical reaction. For the newspaper industry, the EPA has determined that Test Method 24 (D2369) be used to assess the volatility of inks. The conditions for inks under this test are as follows (Figure 1): three-tenths of a gram of sample is weighed and then dispersed in toluene. The use of toluene is needed to assure a uniform distribution of an ink in the testing dish. The sample is then placed in a forced draft air oven for one hour at 110EC or 230EF. At the end of one hour, the sample is then reweighed to determine the percent loss, or VOC. This procedure was originally developed for the paint industry and does not have the greatest of precision to it, especially when applied to printing inks.

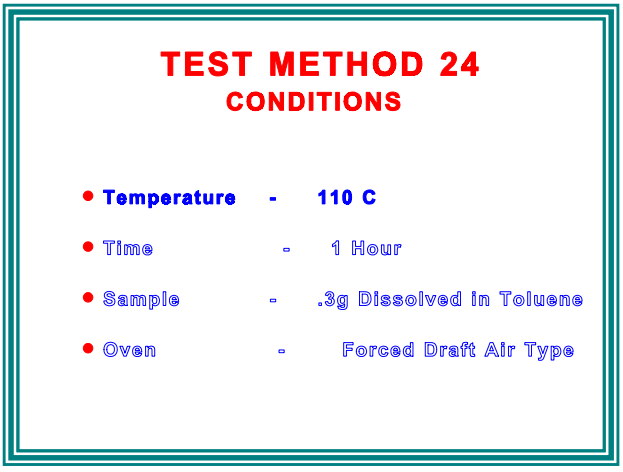

Figure 1

VOC ANALYSIS OF NON-HEATSET INKS

USING ASTM D2369

Sample	A	B	C	D
Average % VOC	5.2	15.48	30.73	31.62
Reproducibility as % of the Average	52.3%	46.2%	31.4%	12.9%

Table I

A round robin study conducted by an ASTM subcommittee, which included eleven laboratories, showed a test reproducibility level as high as 52% in a series of tests they have performed. The results of the test reproducibility values with this study are shown in Table 1. As you can see from the table the test precision was better at the higher levels of VOC, however there still was a 13% relative difference.

In looking at the black inks commercially available in today's market, they generally fall into three categories. Standard blacks typically have a volatility from 5 to 10%. Low rub, no rub type inks have 6 to 28%; and low VOC, low rub and soy inks generally have less than 5%. This is a wide range in VOC.

LITHOGRAPHIC INK COMPOSITION

TYPICAL WEB OFFSET BLACK FORMULATIONS

Component	Conventional	Low Rub
Mineral Oil	55 -60%	0 - 20%
Varnish	0 - 15%	25 - 45%
Solvent	0 - 5%	15 - 45%
Pigment	16 - 20%	16 - 20%
Additives	2 - 6%	2 - 9%

To determine what components in an ink cause these VOC, let us examine some typical formulas for a conventional and low rub black ink. In examining these formulas (Table 2), both contain similar type ingredients: mineral oil, carbon black, varnish, solvent or low viscosity mineral oil, and additives. In comparing a conventional type black ink to a low rub ink, you can see that the varnish level has been increased. In doing this, ink makers have typically raised the levels of low viscosity oils to compensate for the tack and viscosity increase that the additional varnish (resin) causes. In general, the resin and pigment portions are solid materials, which result in low VOC emission, so the major volatility of an ink must come from the oil portion. In examining the oils currently utilized by ink manufacturers, they are broken down into different viscosity grades based on fractional distillation of crude products. Low viscosity oils have higher volatility (Table 3). It decreases with the increase in viscosity, however there are exceptions to the rule. If the oil is not properly stripped at the refinery, it would contain higher VOC. So, in creating a low VOC type product, the low viscosity oils must be eliminated from an ink and the oils must be carefully selected from the refinery.

VOC CONTENT
OF NEWS INK OILS

Component	% VOC's Method 24
Heavy Visc. Mineral Oil	.2 to 4%
Medium Visc. Mineral Oil	3 to 12%
Low Visc. Mineral Oil	50 to 70%
Soy Bean Oil	.2 to 2%

As you can see if you change a formula, for any reason, you can potentially affect the VOC of that ink. In the standard production of a given formulation, adjustments are made to each batch for tack, viscosity, water pick up, and other various physical properties. These adjustments can affect the VOCs of any given formula. So it is important to note that the reported values on a given type of formula are generally the average values and thus different batches of the same formula will not be identical in VOC..

One issue, which potentially could reduce the concerns for VOC in newspaper inks, is a study which was done for the Control Techniques Guidelines (CTG) (Figure 2). This report summarizes the emissions in the offset lithographic process. The information contained in this report shows that for no-heat web offset newspaper applications, 95% of the volatiles produced by Test Method 24 are retained in the web.

RETENTION FACTOR

EPA is investigating a retention factor in which 95% of the volatiles generated by test method 24 for No Heat Printing are retained in the web.

For example, an ink with 20% VOC, 95% of these volatiles would be retained in the web, or 5% of the total VOC would be emitted to the atmosphere - for a resulting 1% VOC emission from this ink.

The EPA has announced that they will not be able to issue these guidelines as specified in the Clean Air Act Amendments of 1990, due to budget cut backs and other restraints. Contact your local Air Protection agency to see if these guidelines can be applied.

The VOC's of an ink, as shown above, can vary not only from batch to batch but also greatly with the established test procedure. It is critical when applying for air permits that these factors be taken into effect.

The above is brief summary of the CAAA regulations as US Ink understands them, but this should not be considered legal advice. US Ink recommends that any legal questions be directed to a competent attorney.

Further information about the Clean Air Act can be obtained from:

EPA Small Business Ombudsman
U.S. Environmental Protection Agency
Office of Small and disadvantaged Business Utilization (123OC)
401 M Street S.W.
Washington D.C. 20460

Toll Free "Hotline" 800-368-5888
Fax number 703-305-6462
Or the EPA Technical Control Agency (919) 541-0800

Or your State Air Pollution Control Agency