

White Paper: Environmental Attributes of Lithographic Inks and Coatings

Prepared by: Kate Scholz, Hemlock Printers Ltd. (kscholz@hemlock.com)

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We have attempted to source as much factual information as available and compile it into the following white paper. The information presented here is, to the best of our knowledge, accurate and true. Please see our the referenced sites listed at the end of this paper. We continue to research this subject and will provide updates to the document as we learn more. If you have any comments about this material, please direct your feedback to Kate Scholz, Sustainability Communications Coordinator at Hemlock Printers, kscholz@hemlock.com.

Environmental info beyond vegetable-based ink:

Inks used in lithography are mixtures of powdered pigments, solvent oils, resins and varnishes. Different inks contain different solvents and different amounts of solvent depending on the printing method using them. Sheetfed litho inks contain the highest proportion of pigment, and dry by polymerization, absorption into the paper and a little evaporation. Web-fed litho inks usually dry more by evaporation. UV cured litho inks solidify under UV light banks in the press.

The pigment-metal connection: Pigments are man-made chemical substances that give colour to the ink and are not included in ink's vegetable content as no vegetable-based pigments are commercially available. Natural and man-made pigments often contain a metal atom - even blood gets its colour from the metal iron. Metals in ink are able to escape after printed items are disposed of or in recycling or incineration wastes. Since the mid 1990s the four most toxic heavy metals once used in pigments have been banned by laws affecting all manufacturers in Europe and North America. The US model law is called Coalition of North East Governors' model packaging toxics legislation (CONEG), and the EU law is called the EU Reduction of Hazardous Substances (RoHS) Packaging Directive. Metals cadmium, hexavalent chromium, lead and mercury must not be intentionally added and must be below 100 parts per million as a group under these laws. Suppliers can provide statements of compliance to these standards. Other metals that are much less toxic but still of some concern when concentrated have replaced the CONEG metals: barium, copper, and zinc. Zinc is mostly found in metallic gold inks. Unfortunately, barium, and especially copper, are found in most process color inks.

Vegetable-based Inks today: There may be from 4 to 30% non-vegetable VOC (Volatile Organic Compound) oils in vegetable based ink. Most traditional lithographic inks are at the lower end of the scale, and are based on naturally drying linseed oil, or catalyzed soy oil. In fact, most printers now usually use vegetable based inks. There is no minimum amount of vegetable oil needed to label an ink vegetable based – ask your printer.

Solvents found in ink include some VOC or petroleum oil even in sheetfed vegetable based inks. Only 5% of the VOC in a sheetfed litho ink escape the printed page according to US EPA tests, but almost all the VOC in a web-printed page is evaporated in heated dryers, and then must be recaptured for reuse or burnt. **Varnishes** are like inks without pigment that give a glossy protective coat to a printed item, and can be vegetable based also. **Aqueous Coatings** contain insignificant VOC, instead containing water with coating dissolved in it and salts for even wetting. Some of the chemicals used to promote polymerization in **UV inks and coatings** can evaporate before curing also. **Toner-based printing** inks use less solvent and less evaporable solvents than

conventional litho printing, but also do not use any vegetable oil content. The solvents used in lithographic fountain solutions and press cleaners are likely to outweigh ink solvent impacts in sheetfed and UV pressrooms.

HISTORY OF VOC REDUCTIONS IN SHEETFED LITHO PRESSROOM CHEMISTRY

Total VOC emissions have been increasingly controlled due to concerns about urban air quality – VOCs combine with exhausts from combustion to form smog and ground level ozone which are health hazards. Inks and varnishes in sheetfed litho were typically 34-40% VOC at the time. Beginning in the late 1980's, lower VOC alternatives to isopropyl alcohol fountain solutions and volatile cleaning solvents were developed. While the laws don't prevent the use of flammable carcinogenic isopropyl everywhere, fountain solutions containing 0% isopropyl have been available for decades along with press cleaning solvents much less likely to evaporate than water. Around the same time, vegetable oil based inks made a comeback after falling out of fashion during the petrochemical boom after World War 2.

How does UV printing compare to best practices of sheetfed litho printing? Little information is available comparing the relative atmospheric impacts of sheetfed offset litho and UV presses when both are being run with optimal environmentally minded chemistry and settings. While the VOC advantages of UV versus low VOC sheetfed litho printing are unclear, air quality can be much improved when UV technology replaces high VOC printing processes. For this reason, the US EPA has recommended UV as a Best Available Control Technique for areas having difficulty reaching smog control targets. High VOC printing processes include web-fed litho without efficient emissions control devices, high VOC sheetfed litho on a large scale, and other organic solvent based printing and coating processes.

UV printing is marketed as a VOC free product, but this is not entirely accurate. While the fully cured ink is a solid without volatile fractions, during printing, some of the ingredients of UV inks as well as other press chemicals used in UV printing may evaporate as VOC during printing while under the heat of the UV lamp, during the increased misting that occurs as UV inks transfer between rollers, and any time inks don't cure completely for a variety of reasons. While this amount of VOC escape is a low percent of ingredients, it likely that it is a little above 1% of ink weight.

UV processing is also associated with a small amount of ozone creation a non-VOC pollutant that is the basis of smog related VOC air quality controls. Enough ozone is created by the action of the UV light on the air between the bulb and the ink that constant venting is required for worker safety. Ozone is not a VOC, but it is one of smog's more hazardous ingredients - VOC's are controlled to prevent smog ozone formation. Untreated ozone produced directly by UV printing and vented to the outdoors in smog-forming conditions can linger and have an impact.

Other considerations when evaluating the environmental friendliness of your ink and/or coating choice:

Recyclability: Research centres focused on deinking and recycling have noted that UV, water based and toner printing can be difficult to separate from fibre during the deinking process. Though this is still being studied and technology is improving, these inks and coatings are either too strongly bonded to the fibre to be separated or pass through filters with pulp. With newer technology and additional kneading stages, they can be deinked to improving brightness levels. Conventional vegetable-based web and sheetfed litho inks are the easiest to repulp and deink, resulting in high quality, bright, speck free pulp with minimum effort and energy use.



RESOURCES

Metallic contents of different pantone inks:

- <http://www.pidseattle.com/ECO/toxcol.pdf> by Partners In Design - Seattle, WA.

REFERENCES

Regarding metals:

- http://www.packaginglaw.com/index_mf.cfm?ID=153
- http://pffc-online.com/mag/paper_reduce_comply/
- <http://www.repak.ie/files/Catherine%20Goodall.pdf>

Regarding UV curing:

- http://www.radtech-europe.com/files_content/may%20papers%202005/cocoliospapermay2006.pdf
- <http://www.inkworldmagazine.com/articles/2006/10/uv-ink-sales-continue-to-expand-although-challenge.php>
- <http://www.packaging-online.com/paperboardpackaging/article/articleDetail.jsp?id=282613>
- http://www.andlitho.com/pdf/UV_Coating.pdf
- <http://www.sartomer.com/TechLit/5056.pdf> photo initiators decompose - volatile unpleasant odours
- http://www.flintgrp.com/printers_resource/energycurablebasics.html
- <http://www.nutraingredients.com/news/ng.asp?n=72113-benzophenone-fsa-itx>
- <http://www.praworld.com/publications/samples/radnews-2006-01.pdf>

Regarding exposures compared between UV and litho:

- http://www.radtech-europe.com/files_content/june%20papers%202005/nuijtenpaperjune2006.pdf

