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TO: Company Representatives – Members and TAM's

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A Realistic Appraisal of Soy Oil Printing Inks - 2007

An updated version of the NAPIM document, "A Realistic Appraisal of Soya Inks" issued in 1991

Executive Summary

Printing with inks formulated with soybean oils as a replacement for petroleum based oils is one of a number of approaches aimed at reducing the environmental impact of printed products. Generally, this objective can be accomplished by reducing air pollutant emissions (volatile organic compounds or VOC's), using raw materials based on renewable resources and minimizing the impact of the entire life cycle of the ink from the production of the raw materials through the disposal or recycling of the finished printed product. This report details how the choice of oils, whether it be petroleum or naturally sourced, will address each of these factors.

Introduction

The current attention in the public media of being environmentally friendly has triggered renewed interest in using printing inks that have the least impact on the environment. To many people, this means replacing petroleum oil with soybean oil, largely due to the marketing effort of the American Soybean Association. Another reason for the emphasis on soybean oil is that it is largely domestically produced, although it can be sourced in other parts of the world. There are a number of alternatives to soy with a variety of plant derived or vegetable-type, "renewable" oils suitable for use in printing inks. Linseed, tung (chinawood), oiticica, safflower and sunflower in addition to soy oil have been utilized by the printing ink industry for decades. These oils are differentiated by drying rate, film forming properties, cost and availability. The oil of choice is highly dependent on the printing process, ink drying mechanism, end use requirements and pricing structure of that particular type of ink.

The entire life cycle of the production of the oil must also be taken into consideration. This would include CO_2, NO_x, SO_x and particulate emissions from the agricultural equipment used to plant, maintain and harvest the crops as well as the emissions from the processing and refining of the oil.

Technical Background

It is important to recognize that soy and other naturally derived oils cannot be used in all types of inks. Use of these oils is limited to oil based inks, which are primarily news inks and other lithographic offset inks. There are limiting factors due to performance issues for various types of offset ink that will be discussed later. Flexographic and gravure inks generally are not formulated with oils, and have turned to water-based technology as a means of reducing the environmental impact for these print processes.

Many of today's lithographic offset inks are a combination of both vegetable oil and petroleum oil. The petroleum oils used in printing inks consists of two main types: 1) Refined napthenic or paraffinic oils with a typical volatile content of 1 to 15%, with the main use in news ink and cold set web; 2) Aliphatic hydrocarbon oils are lower in viscosity with a typical volatile content of 80 to 100% used in all types of oil based inks.

Use of Soy Oil

All oil based inks contain pigments, resins, oils, waxes and small amounts of other ingredients. News inks are somewhat less complex formulations, also containing pigments and oils, but typically a smaller proportion of resin. The amount of soy oil that can be used in lithographic inks is restricted to a large degree by the drying mechanism. News inks dry by penetration into the paper and therefore have the potential for a higher content than commercial sheetfed and heatset publication printing inks.

A summary of the limitations for each type of ink are discussed below:

- Heatset web inks dry by evaporation of volatile aliphatic hydrocarbon oils, where the printed paper is passed through an inline oven providing the heat to drive off the volatiles, most of which are captured by a recovery unit where the volatiles are burned with the aid of a catalytic converter, so that there are almost no emissions being released into the atmosphere. The use of vegetable oils in this type of ink are minimal (5-7%) as the soy oil is not heat reactive and can be detrimental to drying of the printed ink film.

- Sheetfed inks which dry by oxidation and absorption into the paper, contain a much lower amount of aliphatic hydrocarbon oils (typically from 0 to 15%) and more vegetable oils. The most widely used vegetable oils include linseed, soy bean and tung (Chinawood), while there are some other oils used much less frequently such as oticicia, cottonseed, peanut, coconut, palm, canola (rapeseed) safflower, cashew, walnut and host of others. Due to the chemical structure some of these oils will oxidize (dry) more readily than others, a parameter that is very important in today's market of quick turn around. Linseed and tung will dry more quickly than soy. Drying oil content of sheetfed inks is typically up to 20%.

- Newspaper inks dry by absorption into the paper and historically have been composed of petroleum oils. Today's color news inks have largely shifted to soy oil at levels of up to 30%. The use of soy is not as effective in black news inks, mainly due to economic factors.

The American Soybean Association has established a set of guidelines in order to carry the ASA SoySeal as shown on the table below.

TYPE OF INK	**SOY OIL CONTENT** (By percent weight)
Black news ink	40
Color news ink	30
Cold-set ink	30
Sheet-fed ink	20
Business forms ink	20
Heat-set ink	7
UV/EB ink	7
Metallic ink	10

No guidelines have been established for the other oils.

What Does Environmentally Friendly Mean?
There is no formal definition for 'environmental friendliness'. In the case of inks, there are at least six possible properties that would serve to characterize it as "environmentally friendly":

- The product is made from a renewable resource
- The product reduces emissions
- The product does not result in any waste that is classified as hazardous
- The product is more readily de-inkable after printing
- The product produces de-inking sludge which is not classified as hazardous
- The product is more biodegradable.

Listed below is a discussion of the properties that define environmental friendliness that might be affected by the use of soy oil.

Renewable Resource
Soybean, linseed, tung, safflower and other vegetable oils are all clearly renewable resources while petroleum oils are not. Therefore, the use of vegetable oils of any type will reduce the demand for petroleum oils in the printing ink industry.

Emissions - **Do Soy Oil Inks Reduce Volatile Organic Compounds (VOC's)?**
Yes, soy or the other vegetable oils are classified as nonvolatile materials with virtually no VOC's as defined by EPA Method 24*. The replacement of volatile petroleum oils with vegetable oils will reduce the VOC content, as will the use of low volatility grades of petroleum oil. In the case of news and other cold set inks much of the volatile material is

retained in the substrate (most, but not all regulatory jurisdictions accept a 95% retention factor), whereas with heat set inks it is emitted during the printing process, but as mentioned above, captured before going into the atmosphere.

Regulatory Classification of Waste Ink?
Waste ink that has not been contaminated with other pressroom materials is not considered a hazardous waste. Hazardous wastes are defined by the EPA under the Resource Conservation & Recovery Act (RCRA) regulations. The petroleum oils used in news and offset lithographic inks are not considered hazardous wastes under the Federal RCRA regulations. Consequently, replacing the petroleum oils with soy or any other vegetable oil would have little or no impact under the Federal hazardous waste regulations.

More readily De-Inkable?
NAPIM has no experimental data on the de-inkable characteristics of soy or vegetable oil ink versus other oil based inks. A review of typical formulations suggests, however, that there would be little or no difference in de-inkable properties between soy or other vegetable oil inks and petroleum based inks.

Regulatory Classification of De-Inking Sludge?
Again, NAPIM has no experimental data on de-inking sludge. However, since the pigments in vegetable oil inks are identical to pigments used in other types of inks and since the vehicle, resins, driers and other additives are either identical to, or similar to petroleum based ink, there is no reason to expect that the ink portion of the sludge resulting from the de-inking of soy inks would be classified any differently than other de-inking sludge. In addition, there are other sources that need to be taken into account such as the chemicals used during the de-inking process as well as any byproducts from the paper.

More Biodegradable?
While there is some evidence that soy and vegetable oils are more biodegradable than petroleum oils, no difference in biodegradability of a printed product would be anticipated. Biodegradability of printed matter is mainly a function of the biodegradability of the substrate, not of the dry ink film.

Does the Use of Soy and Other Vegetable Oil Inks Impact Printing Performance?
Depending on the type of ink, the replacement of petroleum oils with soy and other vegetable oils can alter a variety of parameters including drying, rub resistance, gloss, film integrity and press stability. There are formulation techniques that can result in an ink with a well balanced set of properties using any of these oils.

Other Options
There are other ways of reducing the environmental impact of printing inks, things such as the use of resins from renewable sources, hydrogenation of petroleum oils, inks formulated to reduce pressroom waste and use of energy curable inks. These and other topics will be addressed in a future report.

Conclusion

The reduction of the environmental impact of printing inks can be accomplished in a number of different ways. If the goal is to use renewable resources, the options are not restricted to soybean oil inks, but include a variety of vegetable oil based products.

Additional Information

Please be aware that many websites contain inaccurate information and overstated claims in regard to the use of soybean and vegetable oils in printing inks. When in doubt, contact your ink supplier or the NAPIM office.

* EPA Method 24 is based on heating a small sample at 110 degrees centigrade for 1 hour and measuring the loss in weight to calculate the percentage of volatiles.

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