

Soy Ink and Recyclability

Conducted:

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SOY INK RECYCLABILITY

INTRODUCTION:

The printing industry is vastly affected by environmental concerns. Specifically, air quality and solid waste have had the greatest impact on the printer. Leading these topics of concern is the problem of post consumer printed waste. As much as 45 percent of all landfill waste is paper and paper products. Many of these products are in the form of printed matter such as newspapers, magazines, and phone books. The challenge for the printer of the 90's, and beyond, is how to improve the printing manufacturing process to help lessen its product impact on the environment.

At the same time, the U.S. and Canada expect to have a recycle newsprint capacity of 4.6 million tons by 1992, double the current rate. The demand for total recycled fiber is expected to exceed 300 million tons within the next ten years. Many paper grades currently produced in the U.S. have as a specification of 5 to 45 percent recycled content. This number is expected to grow substantially within the next few years. Many government agencies that purchase \$10,000 or more of printing or paper are requested to have it's content be at least 50% recycled material.

Many new technologies are being developed to improve the recyclability of papers. For example, soy oil based printing inks are becoming an accepted way of engineering in an environmentally safe printed product.

INKS & PAPER RECYCLING:

Recycling has proven an effective tool in the reduction of paper waste, however, this does not come without cost. The waste bi-products from the recycling process have to be considered. This bi-product waste consists of removed ink particles, paper fibers and other foreign matter such as plastics, glues and metal. Much of this "effluent" waste has to be disposed of, most by conventional methods such as land-filling and waste water treatment.

One major constituent in the printing process is the ink. Unfortunately it's the ink that poses the greatest threat environmentally and reduces the recyclability of the paper products. Printing inks contain many components, three of which are pigments, binders and vehicles. Pigments are very small particles that give the ink its color characteristics. The binders are that which holds the ink to the sheet after it's printed. Vehicles allow the ink to flow from press to paper. It is vital to remove as much of these components as possible from the paper during recycling. Any color pigment that remains will lower the quality of the finished paper by reducing it's brightness potential. Physical properties, such as strength, are effected when the binder and vehicles are not removed. The recyclability of the printed product is therefore directly affected by the components of the ink and the ability to remove them from the paper.

Newspapers represent the largest area of concern in recycling post consumer waste. There are several ways in which inks dry on newsprint. During this process the printing ink does not dry, or cure, it simply soaks into the paper. Currently many methods of removing ink vehicles exist due to the large number of ink formulas available. Emulsification or mechanical de-inking methods are used to remove the oils in newspapers.

In mechanical and emulsification de-inking the chemical compositions of the oils are not altered. High volumes of water are used in treatment equipment to wash and remove the oils from the fibers. Once removed the oils and water are collected for waste treatment and discharge.

WASTE WATER TREATMENT

Before the waste water from a recycling facility can be restored to the fresh water stream it must be analyzed and treated. All toxic and hazardous substances must be removed. One area of analysis is concentration of BOD (Biochemical Oxygen Demand) and COD (Chemical Oxygen Demand). High levels of BOD and COD are detrimental to fresh water as they interfere with the oxygen consumption of plant and animal life in streams and lakes.

Oils such as petroleum and vegetable produce BOD and COD. Printing inks contain such oils. The process by which the BOD's and COD's are removed from the waste water is ingestion by micro-organisms. The water to be treated is stored in very large holding tanks and micro-organisms are released to consume the oils.

Therefore, the higher level of BOD and COD the higher the cost for treatment. This overall cost is effected in two ways; one, the amount of micro-organisms needed and the length of time for treatment.

METHODOLOGY

The purpose of the following study was to systematically study the printing ink vehicle as a waste product for recycling or disposal. Newsprint was selected as an area of special concern as it is a problem post consumer waste product. Two printing ink formulas were

established for the study, (see table 1). One formula was an ink made with soy oil and the other an ink made with conventional petroleum oils. The inks were printed with a conventional offset printing press on a standard news grade paper, (see table 4).

Once printed the test newspapers were collected and stored under controlled temperature and humidity for four weeks to represent typical aging conditions. After this period the papers were recycled using conventional methods.

During recycling the fibers were collected and hand sheets were made for analysis. The hand sheet paper was studied for optical and physical properties, (see table 2), for results. Wet pulp and white waste water were also collected for study. This water and pulp was sent to an analytical lab for study of BOD and COD content, (see table 3) for results.

RESULTS AND CONCLUSIONS

The soy oil seems to release from the fiber better which may result in higher fiber strength and bonding, (see graph 1). The data indicates a higher level of BOD and COD in the waste water studied, which supports the theory of more oils released from the fibers.

The oils which are removed may require a different method of ingestion by the micro-organisms in the BOD and COD reduction process. Soy oils can be ingested quicker and easier than the petroleum during the water treatment process. This may lend to lower costs during treatment.

In addition, further studies will be needed to systematically investigate the influence of soy oils on the environment. Since soy oils are biodegradable they should pose no threat to ground disposal. This is a major concern as inks are currently listed as hazardous waste. This

classification is partly due to the ink pigments used. However, there is new pigment research being conducted to provide safe biodegradable pigments as well. These new pigments along with soy oils will truly provide a safer disposable product.

TABLE 1
News Ink Formulas (Black)
Soy -vs- Petroleum

SOY Black Ink

Total Oils by content:	79.0%
Total pigment by content:	18.5%

Petroleum Black Ink

Total Oils by content:	80.2%
Total pigment by content:	18.0%

TABLE 2
Recycled Fiber Physical Properties

<u>Property</u>	<u>Petroleum</u>	<u>Soy</u>
Basis Weight (g/m ²)	61.6	59.4
Tensile Index	39.1	37.7
Burst Index	1.8	1.67
Tearing Index	6.82	6.98
Brightness (top)	52.3	52.8
Brightness (bottom)	48.4	49.1

TABLE 3
Wastewater Analytical Results

<u>SAMPLE</u>	<u>BOD</u>	<u>COD</u>
Soy (whitewater)	26 mg/L	196 mg/L
Soy (pulp)	1170 mg/L	125,000 mg/L
Petroleum (whitewater)	18 mg/L	122 mg/L
Petroleum (pulp)	1210 mg/L	77,500 mg/L

BOD (biochemical oxygen demand)

COD (chemical oxygen demand)

TABLE 4
Testing Parameters
PRINTING

<u>Substrate:</u>	St. Regis offset news 30#
<u>Fountain Solution:</u>	Varn Lithoetch; 147 pH 4.8 @ 1800 micromos relative conductivity
<u>Printing Conditions:</u>	Printed via a Rockwell Goss Community offset newspaper press. One 32" web printed both sides, converted by way of a conventional tucker blade & pin folder was utilized. Press speed was 13,000 impressions per hour. The test image was designed to mimic a standard news form comprised of tones, line & type and solid densities.

Densities were monitored and maintained at the standards which are representative of those used in the industry.

GRAPH 1

Paper Properties (Soy vs Oil)

