The Soy Ink Industry

Introduction

Petroleum shortages in the 1970s stimulated research into the identification of alternative and renewable materials for formulating printing ink. Vegetable oils were an obvious choice because they are nonvolatile and biodegradable (Erhan and Bagby). Soy ink emerged as a result of this research. The soy ink industry’s potential, growth, threats, marketing efforts and other topics are discussed below. These topics also will be assessed as to how the soy ink industry compares with the petroleum ink industry and how they compete.

The Emergence of Soy Ink

The American Newspaper Publishers Association (ANPA), now known as the Newspaper Association of America, was the developer of soy ink. In 1979, ANPA asked its technical staff to develop an alternative to the petroleum-based ink. During this period of time, petroleum prices were volatile and the ink industry was especially susceptible to price fluctuations. This susceptibility comes from the industry being subject to early cutbacks in times of short supply. After testing some 2,000 vegetable oil formulations, soy ink emerged as the best option. In 1987, it was introduced to the newspaper industry (http://www.soyink.com/inkhistory.html).

Soy Ink Production

Processor

The production of soy ink starts when a processor such as Cargill, ADM or a number of others, purchase soybeans from farmers. These companies process the soybeans into meal and food-grade oil. This food-grade oil is what is used to make soy ink. This step
is clearly different from petroleum ink because of the difference in raw materials between soy ink and petroleum ink.

Manufacturing

The next step in the process is the manufacturer, who buys soybean oil by the tanker load. The manufacturing process for soy ink uses the same equipment as petroleum ink (Patterson). There are three general processes that occur during ink manufacturing. The first step is to cook the vehicle (the liquid that carries the pigment – in this case, soybean oil) in a large kettle, and to add dyes using a dough mixer or agitated tank. The vehicle is cooked at a temperature between 200 and 600 degrees Fahrenheit for 8 to 12 hours. The second step is to grind the pigment into the vehicle using a roller mill. The two most common types of roller mills are 3-roller and 5-roller horizontal or vertical mills. Finally, water needs to be removed from the wet pigment pulp by the ink vehicle, which displaces the water because pigments have a greater affinity for the oil-based material (http://www.epa.gov/ttn/chief/ap42/ch06-final/c06s07.pdf).

Formulation

The only difference in the manufacturing process for soy ink is the ink formulation. (Patterson). Ink manufacturers mix the soybean oil with the same pigments, resins, waxes and other ingredients used in petroleum ink to make soy ink. However, the proportions of these ingredients and the percentage of soybean oil in the ink vary with each individual manufacturer. The proportions also depend on what type of substrate is being printed (http://www.soyink.com/inkenviro.html). Ink manufacturers have a choice of tens of thousands of raw materials to consider when they are formulating ink (http://www.flintinkweb.nsf/PrintWeb-Our Products/A4). Industry-set standards, shown
in Table 1, state that in order to use the SoySeal trademark – used on printed materials to indicate soy ink is used – the ink must contain a minimum percentage of soybean oil as a percentage of the total formula weight.

**Table 1: Industry-Set Standards for Minimum Percentage of Soybean Oil in an Ink in Order to Use the SoySeal trademark**

<table>
<thead>
<tr>
<th>Ink Type</th>
<th>Minimum Percentage of Soybean Oil</th>
</tr>
</thead>
<tbody>
<tr>
<td>Black News Ink</td>
<td>40%</td>
</tr>
<tr>
<td>Color News Ink</td>
<td>30%</td>
</tr>
<tr>
<td>Sheet-fed Ink</td>
<td>20%</td>
</tr>
<tr>
<td>Heat-set Ink</td>
<td>7%</td>
</tr>
<tr>
<td>Cold-set Ink</td>
<td>30%</td>
</tr>
<tr>
<td>Business Forms Ink</td>
<td>20%</td>
</tr>
</tbody>
</table>

(http://www.soyink.com/sstm.html)

*Printers and Publishers*

The next step in soy ink production is when printers and publishers purchase the ink from the manufacturers to print their materials. Thus, soy ink production essentially follows the same channels as petroleum ink once it reaches the manufacturing stage (Patterson).

**Making Headway**

*In the Beginning*

Soy ink’s initial consumers were newspapers. In order to facilitate the adoption of soy ink, the Newspaper Association of America, upon development of soy ink, licensed its formulation to ink manufacturers for $10 to encourage widespread adoption (Patterson). In 1987, after the first year of marketing soy ink, just six newspapers used it (http://www.soyink.com/inkhistory.html).
Promotion

The American Soybean Association and state soybean associations became major advocates for the usage of soy ink in 1993. Spearheaded by the Iowa Soybean Association, promotional efforts increased significantly (Patterson). The National Soy Ink Informational Center, established in 1993 by the Iowa Soybean Association, is strongly identified as the information clearinghouse and resource for soy ink manufacturers and users (http://www.soyink.com/whoweare3.html). Newspaper trials, seminars, a website, trade shows, newsletters, magazine advertisements, partnerships with printers and graphic designers are all tools used to extol the benefits of soy ink. Also, early on when soy ink was priced higher than petroleum ink, the Iowa Soybean Association paid the difference between the two inks for the printer/publisher. This was extensively publicized nationally in order to get more printers to try and, hopefully, switch to soy ink (Patterson).

Promotional Facts

In order to take on the established ink in the industry, petroleum, soy ink had to have a number of advantages over petroleum ink. In actuality, soy ink has a significant number of advantages over petroleum. These advantages, listed below, were the selling points used to promote soy ink’s acceptance.

- Soy ink uses a sustainable resource that is abundant. Also, by using soy ink, the American agricultural industry is supported.

- Soy ink delivers a printed item, which is of the same or generally higher quality than a petroleum ink printed item. Soybean oil’s clarity also allows pigments to reach their full potential.

- Soy ink is also more environmentally friendly than petroleum ink. Soy ink is naturally lower in volatile organic compounds, a major source of air pollution (http://www.soyink.com/inktalking.html). On average, soy-based inks have about
17% of the amount of volatiles as petroleum based inks (http://es.edp.gov/techinfo/specific/proj-sum.html). Also, soy ink is removed more efficiently during the de-inking process, and the resulting waste is not considered hazardous and can be treated easier and at a lower cost.

- Soy ink also maintains lithographic stability better throughout the entire job, resulting in less operator adjustments and fewer rejected copies due to poor quality.

- Soy ink is cost competitive with petroleum ink.
  - The only ink that is higher priced today is black news ink, which can be up to 25 percent higher in cost. That’s because news inks are priced on the cost of the oil rather than the pigment, which is how other lithographic inks are priced. Because news inks contain so much oil (soy or petroleum), the use of soybean oil for this application continues to be more costly. (http://www.soyink.com/inktalking.html)

- Soy ink has less ink ruboff on readers’ hands and clothes than petroleum ink (Erhan and Bagby)

Legislation

Legislation, both state and national, has also had an impact on the acceptance and growth of soy ink. The Vegetable Ink Printing Act, passed by Congress in 1994, requires the federal government and its contractors to use vegetable-based ink when economically feasible (http://www.swmcb.org/EPPG/5_2.asp). Many states have similar legislation in place. The federal Clean Air Act Amendments in 1990 also resulted in increased soy ink usage due to the need to reduce the emissions of volatile organic compounds (http://www.tintas.com/tech_info/vocs.html).

Expanding Into New Markets

Upon finding success in the news ink arena, soy ink began to be considered for other applications. These applications offered increased exposure and increased gains for the soy ink industry. Brief explanations of these products are discussed below. Ink manufacturers played a major role in improving soy ink. As soy news inks became more
and more popular, the manufacturers began developing other soy ink formulations. Thus, there are now a considerable number of soy ink formulations to choose from (Patterson).

*Sheet-Fed Ink*

Sheet-fed ink is used by commercial printers on smaller presses that print one sheet at a time on both coated and uncoated papers. This type of ink contains more resins than news ink and needs to dry quicker than on web presses if coated paper is used. Generally, these types of ink contain 20 to 30 percent soybean oil.

*Heat-Set Ink*

Large web presses using big rolls of paper are used to publish magazines. The paper for this type of printing is generally coated stock, which absorbs less oil from the ink. To solve this problem, the paper is passed through a high-temperature oven in order to set the ink on the paper. Less than 20 percent soybean oil is common for this type of ink.

*Cold-Set Ink*

Newspaper inserts, catalogs and directories are generally printed with this type of ink on web offset presses using absorbent paper. This type of inks contain around 30 percent soybean oil.

*Business Forms Ink*

This type of ink is used on presses that print business forms on lengthy rolls of paper, which is uncoated stock. Generally, this type of ink contains around 40 to 50 percent soybean oil (http://www.soyink.com/inktypes.html).

*Baby Footprints*

When babies are born, their footprints and handprints are stamped onto their birth certificate. This ink plate is a hit amongst nurses because it is easier to clean than
petroleum-based ink. Soy ink cleans up with just soap and water, while petroleum ink requires scrubbing. Also, the formulation used in making this product contains nothing that is harmful to the newborn child (National Soy Ink Informational Center).

**Ballpoint Pens**

The soybean industry is very excited about the possibility of using soy ink in ballpoint pens because of the size of the market. The market worldwide amounts to 10 billion units, pens and refills, a year. Research and testing is currently being undertaken to establish a product and to make comparisons with conventional ballpoint pens (http://www.soyink.com/research.html). In all, this market would consume approximately one million pounds of soybean oil per year (United Soybean Board).

**Soy Toner Cartridges**

Another product that could reach store shelves soon is a soy ink toner cartridge for use in office copiers and printers. Research is geared toward having a product that is de-inked more readily than conventional toners and is of high quality. Preliminary results are coming back positive, and commercialization could be within a couple of years (http://www.soyink.com/research.html).

**Crayons**

Soy crayons are already on the market, being sold under the brand name Prang. These products seem to have similar, if not better, qualities than the industry leader, Crayola. These crayons are also non-toxic, so they’re safer for kids to use (Patterson).

**Soy Ink Today**

Soy ink’s growth has been phenomenal. Currently, more than 3,000 newspapers use soy ink. Of the nation’s daily newspapers, 90 percent use soy ink (primarily color soy
ink). Approximately one-fourth of the United States’ 50,000 commercial printers use soy ink. Major newspapers and companies such as The Los Angeles Times, Boston Globe, The Des Moines Register, The Chicago Board of Trade, Ford Motor Company, the World Wildlife Fund and the Minnesota Timberwolves are all high-profile users of soy ink (http://www/soyink.com/inktalking.html).

Also, there are currently about 100 U.S. ink manufacturers that produce at least one soy ink product (http://www.soyink.com/inkqanda.html). Soy ink’s U.S. market share has increased from less than 5 percent in 1987 to 22.5 percent today. In 2000, 108 million pounds of soybean oil were used to manufacture printing inks, which is the oil from more than 9 million bushels of soybeans (http://www.soyink.com/asia.html).

The potential usage is approximately 457 million pounds of soybean oil if everything was printed with soy ink. Growth is not limited to just the United States, though (http://www.soyink.com/research.html). There are more than 1,000 SoySeal-registered soy ink users in Japan alone, as well as 23 Japanese ink manufacturers that have signed SoySeal user agreements (United Soybean Board).

Figure 1 shows the annual usage of soybean oil in printing inks, and the potential volume use.
Figure 1: Annual Use of Soybean Oil in Printing Inks

(http://www.soyink.com/research.html)

Threats

Demand Slowing

By examining Figure 1, it’s evident that the growth of soy ink has started to plateau significantly below the potential use level. This has lead to a major concern for soy ink advocates. Upon researching the reasons behind this plateau, the potential cause was found to be that the end user, the company that buys printing or the person who buys a magazine, is no longer requesting soy ink. Thus, a new promotional effort is being put forth targeting the end user market. Promotional efforts will continue to target printers and publishers as well, but at a lesser level. Thus, the hope is to launch both a pull-through and push-through strategy in order to accelerate soy ink usage rates (Patterson).
New Products

US Ink, the nation’s largest news ink company, recently announced the introduction of Beacon Black Ink. Beacon Black Ink is a mineral oil-based ink with a VOC (volatile organic compounds) level of less than 2 percent. This new ink is also priced significantly lower than comparable soy inks. Beacon Black Ink’s VOC level is very similar to 100 percent soy-based inks, and thus meets or exceeds the VOC guidelines; it also has similar ruboff properties as soy ink. The lower cost dramatically reduces the cost of environmental compliance for newspapers. This new ink is positioned below 100 percent soy ink and standard ink prices. This new product is a severe blow to the soy ink industry because the VOC reduction was a major promotional aspect for soy ink (http://www.usink.com/press_beaconblack.html).

Barriers to entry

Petroleum Ink Industry

When soy ink started competing in the ink industry, the petroleum ink companies did not put up a fight to keep soy ink out. This can be mainly attributed to the small market share ink plays in the overall petroleum market. Thus, the losses were trivial to most petroleum producers. Soy ink’s low VOC levels actually spearheaded a drive by the manufacturing industry to lower VOC levels in all inks, including petroleum inks, which benefited the petroleum ink industry as well.

Press Operators

One of the biggest struggles for soy ink’s introduction was persuading press operators to make the switch. Many of these people were “old school” printers who treated their printing presses like babies. These people were the most reluctant to change (Patterson).
Conclusion

Soy ink emerged due to petroleum shortages in the 1970s, which stimulated research into the identification of alternative and renewable materials for formulating printing ink (Erhan and Bagby). Soy ink emerged as a result of this research. Soy ink usage has grown significantly during the years, thanks in large part to the American Soybean Association and state soybean associations. The industry is still growing, but there are some new challenges arising. How the industry adapts will determine whether the potential use shown in Figure 1 will be met.
Bibliography


4. Patterson, Jo, Personal Interview, October 5, 2003.


