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Advanced Electronic Materials

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Brief Guide to Inks and Printing Processes

Lithography or Offset Inks

The process of lithography is better known as offset, due to the use of offset blankets to transfer inks from the litho plate to the substrate. Offset inks dominate the U.S. market, accounting for approximately half of the annual \$4.3 billion in U.S. sales of printing inks.

Generally speaking, offset inks are oil-based paste inks, are highly viscous, and use varnish systems consisting of resins that dry either by oxidation or heat evaporation. Pigment concentration is relatively high, as the ink is applied in a very thin film of approximately three microns. The ink must have some compatibility with water, since water is used to keep the non-image areas of the plate clean.

There are a number of offset variations:

- Web offset printing is done at speeds of up to 3,000 feet per minute. In order to accommodate the higher speeds, the inks must have lower viscosity and tack, while maintaining a high resistance to water. Heatset inks dry through heat, running through ovens on the press. Non-heatset inks dry by penetration, with the oils being absorbed into the non-coated substrate.
- Sheetfed offset inks dry via oxidation. Since oxidation causes the resins to crosslink, they have better resistance properties than many other types of offset inks.
- Direct lithography, used in areas such as business forms, does not use the offset blanket, instead transferring the image to the substrate.
- Coldset inks are solid at room temperature, with melting points ranging from 150°F to 200°F. They are melted and impressed on cold paper, when they revert back to their solid state.
- News inks consist of pigment dispersed in mineral or soya oil, rather than more expensive vehicles. The oil is absorbed into the substrate, rather than dried by heat.
- Metal deco inks are used on beverage cans; these are cured by high temperature, which requires synthetic resin varnishes. They are highly pigmented and very viscous.

Flexographic Inks

Flexography is a rapidly growing process, with ink sales approaching \$850 million, and nearly double-digit growth is forecast. In flexo, ink is dispensed by anilox cells onto a plate, then transferred to the substrate. Flexo inks are liquid inks, utilizing solvent or water. Water-based flexo is mainly used on kraft, corrugated, lightweight news-type paper or polyolefin film, while solvent-based inks are used on films and some paper surfaces.

Energy-Curing Inks

Energy-curable technology is growing at a rate of 10 percent, and is primarily found in flexo, though there is growth in offset. The inks consist of monomers and oligomers and are fluid, but are more viscous than flexo inks. They offer excellent gloss and resistance properties. There are two types of energy-curable inks:

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- Ultraviolet (UV) inks incorporate photoinitiators, and use UV lamps for curing. UV inks are used in a number of processes, including packaging, screen printing, and compact discs.
- Electron beam (EB) inks are cured by electrons. They are found in flexible packaging and folding cartons, particularly in food packaging, where the minimal odors and extractables are advantageous.

Gravure Inks

Gravure inks account for approximately \$700 million in U.S. sales. They are low viscosity liquid inks, and engraved cylinders impart the ink onto the substrate. Gravure inks are mainly solvent-based, drying through evaporation. Gravure inks are found in longer-run applications.

Letterpress Inks

Letterpress inks are viscous, and exhibit high tack. They are oil-based, and use resins that oxidize. In terms of U.S. market share, letterpress inks have been declining in recent years.

Specialty Inks

There are many other types of inks that are gaining in usage. Among these are:

- Screen inks are a growing niche market with various end-use applications, from billboard advertising to labeling. The U.S. screen printing ink industry is valued at \$250 million.
- Ink jet inks are a direct-to-substrate technology, consisting primarily of either pigment-based or dye-based systems that are channeled through a printer head.
- Thermochromic and photochromic inks are heat- or light-sensitive respectively, and will change color when exposed to heat or light. These are particularly useful for packaging or for sensitive documents.
- Metallic inks, incorporating aluminum, bronze or copper flakes, are primarily found in packaging applications, where catching the customer's eye is critical.
- Magnetic and electronic inks react to impulses and form new images.
- Intaglio is used for currency and stamps, with the inks being compressed into the substrate. Currency inks are very viscous and highly pigmented.

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