
Offset Inks - Basics

Lithographic inks are paste inks, The press works the ink , thereby heating it and reducing its viscosity or body , making it flow readily to provide a uniform ink film to the image areas of the plate . Litho inks must be heavily pigmented

Formulation of the litho inks

Sheeted lithographic ink contains the following materials .

- Pigment: carbon black, phthalo blue rubine or others
- Varnish: long oil alkyd , phenolic or urethane litho varnish
- Drier: cobalt and manganese salts
- Solvent: heat-set oil
- Modifier: wax compound for rub resistance

Additive and subtractive colour

White is defined as the presence of all colours and black as their absence . When red , green and blue are blended white is the resulting color . When red, green and blue are masked out the resulting color is black . Ink subtracts color and acts as a color filter . Black filters out all colors, yellow filters out blue , magenta filters out green and cyan filters out red.

Pigments

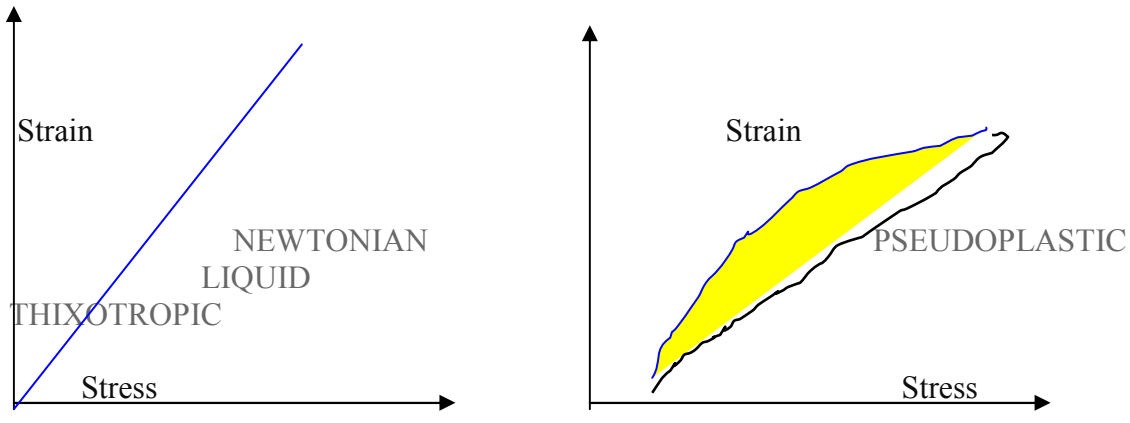
Among the most important properties of printing ink are its color, its flow , and its drying ;that is , the color and behaviour of the ink on the press and on the print . Color is determined principally by the pigment , flow by both the pigment and the varnish, and drying principally by the varnish or vehicle .

Pigment characteristics of importance in ink formulation include tinctorial strength, opacity , shade , gloss , durability, particle size, specific gravity , refractive index, hardness or texture , wettability, dispersibility ,light-fastness and chemical resistance .

Flow

The study of the flow of fluids is known as rheology . The printer is interested mostly in the flow of liquids and the control of viscosity , body and tack . The word viscosity refers to the resistance to flow; the greater the resistance to flow , with a given applied force , the greater the viscosity .

In shear independent or Newtonian liquids the velocity of flow is directly related to the force applied. Lithographic inks are shear dependent or Non Newtonian .



Thixotropy

Paste inks lose viscosity or body when they are stirred or otherwise worked . This characteristic is called thixotropy .Thus thixotropy contributes to the setting of paste ink after they have been printed.

Tack

Tack is a sticky or adhesive quality that can be observed when a printer taps out thin film of ink on the slab . Offset inks should be as tacky or viscous as possible without damaging the paper when it is being printed. The tackier the ink the sharper and clearer it will print lines and halftones and the less tendency it will have to waterlog or breakdown and emulsify in the dampening solution. The tack of offset inks is always changed by emulsification with water or moisture picked up during printing . If the inks are too tacky they damage the paper and print poor solids; if the ink is too soft it prints poor halftones and lines.

Wet trapping

Wet trapping is the ability of a printed ink film to accept a succeeding ink film applied on the press . If increasing the ink film thickness improves release (decreases the force required to split the film) , one might expect that increasing the film thickness on the press especially the blanket, would improve trapping .

Vehicles

All printing inks consist of a colorant and a vehicle . The vehicle carries the pigment , controls the flow of the ink or varnish on the press , and , after drying , binds the pigment to the substrate . Vehicles control the film properties of the dried ink, such as gloss and rub resistance . The word varnish is used to describe an unpigmented coating or film , but varnish also means the major component of the vehicle , consisting of solvent plus resin or drying oil . Thus vehicles are composed of a varnish , waxes , driers , and other additives .

Vehicles for lithographic inks commonly contain low-molecular-weight resins and/or drying oils and non polar hydrocarbon solvents .The vehicles have a high viscosity, so the inks are referred to as paste inks .

Setting and drying of litho inks

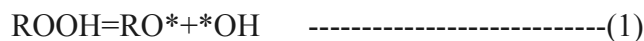
Setting is the increase in viscosity or body (resistance to flow) that occurs immediately after the ink is printed and it is followed by drying . Setting occurs as a result of absorption of solvent or low viscosity components by the printed paper and of the thixotropic nature of paste inks . Thixotropy is caused by the formation of very weak chemical bonds within the ink , bonds so weak that they are broken by simply stirring the ink . The inks mainly dry by oxidative polymerization and by quickset mechanism .

Oxidative Polymerization

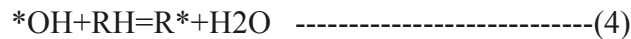
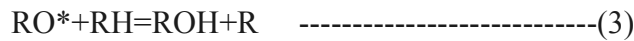
Those varnishes that are derived from drying oils , such as linseed oil , react with oxygen in the air to form a chemical called hydroperoxide . In the presence of a cobalt or a manganese salt , called an initiator or a catalyst , the hydroperoxide forms a free radical , which reacts with another oil molecule forming a molecular chain that continues to grow . As the chain gets longer and longer , it flows less and less readily until after sometime enough chains have been formed so that the ink will no longer flow .It will not smear when it is rubbed , it is dry .The main stages are

- Peroxide/hydroperoxide formation
- Decomposition to form free radicals, which initiate ;
- Polymerization
- Termination

The first stage involves the attack by atmospheric oxygen at activated sites on the drying oil fatty acid chains. Once hydroperoxides or cyclic peroxides have been formed they can decompose into free radicals as follows:

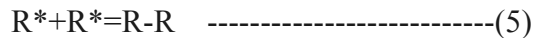


The following reactions are then possible :

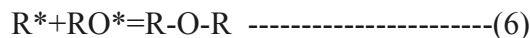


The R* radicals formed in reactions (3)&(4) can react with atmospheric oxygen to form peroxides and hydroperoxides thus propagating the chain reaction .

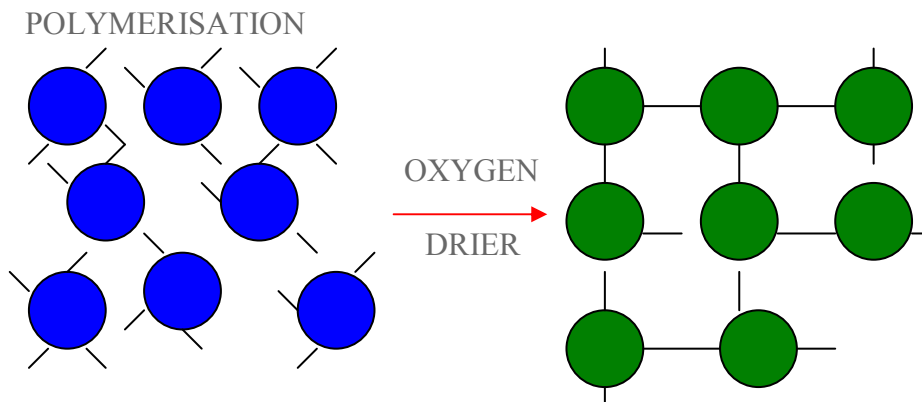
The radicals formed in the above reactions can add on to another molecule of drying oil , and these addition reactions can continue increasing the molecular weight termination occurs . There is also more than one site for the growing radicals to attack and this produces cross-linked molecules . The increasing molecular weight and the cross-linking reactions cause the ink vehicle to become a solid material , encapsulating the pigment .The R* radicals formed in reactions (3)&(4) can also react with each other leading to the termination reaction:



Other , minor reactions involving the other free radicals formed include:



And



Quickset mechanism

The quickset vehicle is composed of two phases, which are of limited compatibility . One phase is a highly viscous solution of hard resin in drying oil , and the other phase is very low viscosity petroleum distillate . The resin/drying oil and distillate must be sufficiently compatible for the vehicle to remain as a stable , homogenous fluid throughout ink distribution and transfer to the substrate on the press.

However, once deposited as a thin film on an absorbent paperboard, a capillary-draw mechanism pulls the highly mobile distillate away from the rest of the ink. If the two phases are too compatible, the affinity of the resin/oil for the distillate will inhibit this penetration. However if only limited compatibility exists the distillate will be separated from the ink and will be drawn into the interstices of the substrate coating or the fiber network leaving the hard resin in the drying phase binding the pigment on the print surface. While not fully dry, the ink film reaches such a high viscosity that it loses mobility and ceases to transfer readily.

At this stage the ink is said to be set and will not mark the reverse of the subsequent sheet in a stack of sheet-fed work unless the stack is subjected to hard lateral scuffing. After the print is set, oxidation drying within the drying oil or alkyd, and possibly the resin, leads to polymerization and the formation of a three-dimensional cross-linked network of chemical bonds. Depending on formulation and ambient conditions in the stack, such as temperature, humidity and acidity, the chemical reaction is usually well advanced in 8-16 hours although it may take a matter of days to reach completion. The result is the conversion of the set film into a hard, dry solid exhibiting the maximum potential rub, scratch and scuff resistance for the particular ink formulation and substrate combination.

OXYGEN

INK FILM
PAPER

| | | |
|---|---|---|
| FRESHLY PRINTED THIN OIL IN INK WITH TWO PART VARNISH | VARNISH ABSORBED LEAVING THICK OIL ON SURFACE - SET FILM | REMAINING OIL OXIDISED IN AIR TO LEAVE DRY FILM |
|---|---|---|

