for these solvents is crude oil and increasing pressure on supplies of oil will lead to greater interest.

SCREEN PROCESS AND LETTERSET PRINTING

All the important drying methods have been discussed and described and it remains now to look at the way they can be applied and adapted to the last of the major print processes, screen and letterset. Both processes rely very heavily on evaporation drying whether it be for printing on paper board or plastic although chemical reaction and the use of electromagnetic radiation are important.

The nature of both processes requires that the inks are far less volatile than flexo or gravure inks. Letterset is a relief process derived from conventional letterpress principles and, as such requires a set of inking rollers to achieve satisfactory distribution. Although the number of rollers is limited to about half-a-dozen the problem of roller stability is still significant and hence the need for solvents with slow evaporation rates. Considerable energy is therefore needed to remove solvent from the ink film. This can be achieved by using hot air ovens or infra-red heaters. One benefit of letterset is that the filmweight of ink is very low and drying speeds are relatively fast.

There is one exception where letterset does not rely on evaporation and this is in the decoration of collapsible metal tubes. High temperature stoving enamels and inks are used which employ the same basic chemical principles of polymerisation as are used for other metal coatings applications. The end use requirements are generally quite different as adhesion and, particularly, flexibility are critical.

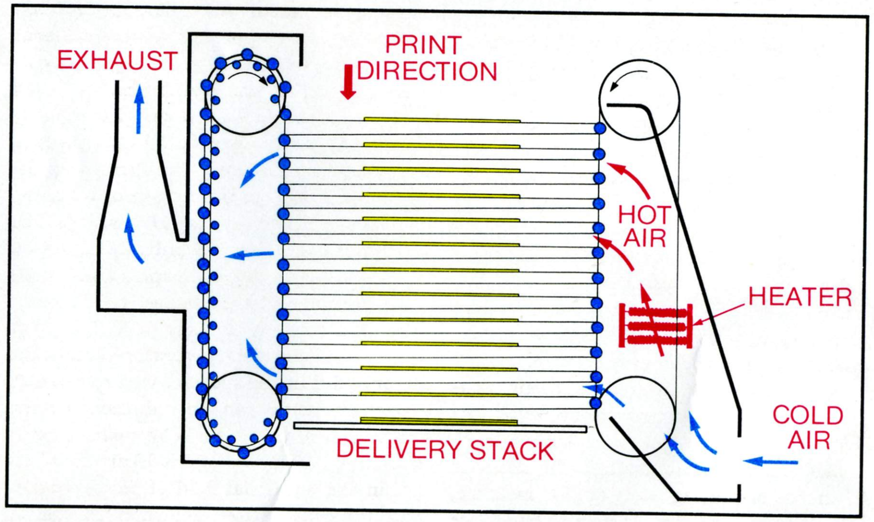
The screen process deposits a very high filmweight of ink and the problems of drying such a thick film are significant. In addition, screen stability of evaporation drying inks is important and solvents which have a much lower volatility than those used in gravure and flexo are needed. The majority of evaporation drying screen inks therefore take a long time to dry even with the help of hot air ovens, infra-red or jet dryers. The use of jet dryers in paper and board printing has largely eliminated the need for racking (air drying) of prints although the physical size of some jet dryers does not always provide any space saving.

The cascade dryer is one method by which the problems of floor space can be overcome. In this type of dryer, the principles of the jet dryer are still used but the sheet to be dried travels in a vertical rather than the more familiar horizontal direction. Hot air is blown over the print throughout most of its travel down the conveyor belt (see diagram), thus maintaining the 'effective length' of a conventional oven at only a fraction of the floor space. The major disadvantage of the cascade dryer is that its overall height is limited by the take-off level of screen printing presses and this, in turn, limits the stack height at the delivery.

The one area where UV has become firmly established in the screen printing market is in the production of printed circuits. UV curing has been adapted to suit all the requirements of the printed circuit board manufacturer and a full range of inks is available eg solder, plating and acid resists, plus board marking inks and insulative and protective coverlays. Not only does UV curing provide all the normal benefits of savings in space, energy and time but there is one other very important advantage. By their very nature, circuit inks require only limited aesthetic properties and their pigmentation levels are accordingly low. This eliminates the problems that can arise through the effect of pigments on curing rates of, for instance, UV display colours. Curing rates are extremely fast.

The use of plastic for the packaging of corrosive or reactive substances imposes severe demands on the resistance properties of inks. For this reason, many screen or letterset inks use chemical action as part of their drying mechanism. Three types are available, the first of which is similar in characteristics to the oxidation drying ink of letterpress and lithography. Drying is slow, taking several hours at room temperature, but can be accelerated by stoving for a few minutes. The second type is directly related to the two-pack inks used in gravure and necessitates the mixing of two portions. Drying is initially by evaporation and the same disadvantages apply as in gravure. Finally, single pack curing systems have been developed which eliminate the need for mixing but satisfy the requirements of stability in the can. Such inks contain a solvent which inhibits the chemical reaction but which will evaporate in the drying oven, allowing the reaction to proceed normally.

With so many problems in achieving a dry print rapidly and efficiently, the application of UV curing has been one of the most important developments in display printing in recent years. All the familiar advantages are apparent – instantaneous drying with excellent stability, good resistance properties and non-pollution – and inks are available for use on virtually any substrate (paper, board, PVC, polyester etc.). One of the early problems was the presence of a large proportion of infra-red radiation emitted by the UV lamps. The heat generated by the infra-red portion could cause scorching of papers and boards and distortion of thermoplastic substrates. The introduction of 'cold' UV units has greatly reduced the temperature within the dryer and thus the speed at which the sheet passes the lamp can be reduced allowing longer exposure times. The next stage in the development of UV is likely to be its use in the industrial field of plastic bottles and tubs. But, the demands for faster drying are not so acute here and the mechanical problems of curing ink on a non-planar surface will be difficult to overcome.



The Cascade dryer adapts the principle of jet drying to produce a more compact unit. Printed sheets are dropped at the top level and travel down a vertical conveyor belt to a small stack at the base.