Ink for High Speed Printing

Ink should never be a limiting factor for a flexographic press achieving speeds that surpass as much as 2,000 fpm. In fact, most printers want high speed inks that will minimize downtime for print defects. They also want a stable print process over a prolonged run, where there are minimal defects through material fatigue to plates, stickyback, blades and other press consumables.

Converters who have invested millions of dollars in high speed presses as a way to improve efficiencies want to make sure they maximize that spending by using the right ink for high speed presses. By doing so and by avoiding downtime and wasted print, converters will maximize efficiencies in the workplace and stretch their dollars even further.

There are three basic formulary principles to making an ink perform well at higher speeds-slower drying, excellent resolubility and strong colors/opaque whites.

SLOWER DRYING

As press speeds increase, the ink drying speed needs to be slower. Historically, inks that are based on ethanol tend to dry too fast, so as press speeds increase, a different combination of raw materials should be considered for high speed presses. Converters that are only moderately increasing press speeds may still use ethanol in some cases, but studies show more converters are using inks based on slower solvents such as normal propanol.

Diacetone alcohol and a variety of glycol ethers are solvents that would help slow down the drying of ink on press even further. As more converters have invested in high speed presses, there has been a significant shift in the solvents used for the flexo printing process.

The key challenge is to develop an ink solvent blend that both meets the needs of high speed presses and maintains stability. Inks are typically not mono solvent, but contain a mix of solvents that can include a percentage of alcohol, acetates and glycols. The speed range for a variety of solvents that can be used for high speed inks.

High speed presses shear the inks more severely by exacerbating the volatility of the solvents, and it is critical the ratio of these ink blends stays the same during the pressrun. If the solvency changes over time

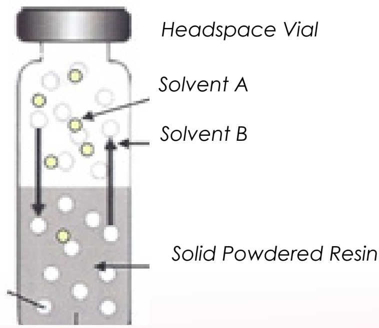
The speed range for a variety of solvents that can be used for high speed inks - photo courtesy of Sun Chemical.

during the run, then the inks are not stable and equally capable of causing defects even with a slower, dry ink blend.

EXCELLENT RESOLUBILITY

Resolubility refers to the balance required between the ink resins and the solvent blend of the formulation. If the ink has poor resolubility, the resin cannot redissolve the partially dry ink on the anilox roller/ plate, so that it is transferred cleanly for the next impression. In the microseconds where the ink comes in contact with the anilox in the doctor blade chamber and the plate comes in contact with the ink in the cells of the anilox, the ink has to resolubilize. Resins will tend to retain or hold onto the solvents they are more soluble in. Figure 2 shows a headspace vial with an evaporated solvent blend (Solvent A + B) above a high speed ink with a general resin chemistry of rosin ester vs. polyamide.

There is a different ratio of solvents (a blend of alcohol and acetate) in the headspace composition above the ink than the solvent ratio in the ink. Polyamide selectively absorbs alcohol and releases more acetate into the headspace, and is less tolerant of acetate compared to rosin ester. Polyamide should be more readily resolubilized in a blend



Solvent/resin interactions

containing a higher level of alcohol, while a higher proportion of acetate should favor resolubility of rosin ester. Dynamic resolubilization of ink resins on the anilox depends upon print speed and solubility parameters of polymer and solvent. Poor matchups will contribute to dirty printing due to excessive drying in the anilox or poor bond strength for lamination to undesired retention of solvents.

STRONG COLORS/OPAQUE WHITES

As press speeds increase, typically the anilox volumes must decrease. This is due to the defect of misting. Misting typically occurs when too much ink is applied, yielding a fine dust that settles on the press equipment. Misting is seen when the deeper aniloxes are used (above ˜6.0 - 7.0 bcm), so the best solution is to move to shallower aniloxes which minimize the defect. However, even with a shallower anilox, the expectation is that the same color strength will need to be delivered. This forces the ink strength to be higher. In summary, using finer aniloxes to get the same color strength requires a stronger ink.

PREDICTIVE MEASUREMENTS FOR HIGH SPEED INKS

The message from flexographic printers is that they want high speed inks delivered to them which require minimal time for testing and trial. That means ink manufacturers need to do the testing in house to accurately predict good performance on press. Testing can start by picking and choosing solvents that dry at the speed desired. Solvents can be measured through gas chromatographs to make sure the right amount and type of solvent are used. A variety of lab methods, such as tap out tests and transfer tests, are then used to validate ink consistency. These tests allow the ink manufacturer to look for any changes in the consistency of the various solvents over long printruns. Solvents which showed significant changes in balance can be noted for what would perform best when it comes to the ideal ink drying speed. Resolubility is then tested by measuring the ability for the resins and pigment dispersions to be rewetted from the dry ink form back to the wet ink form.

Based on the solubility parameters of the resins and solvents, inks and resins are chosen for solubility parameter testing, wet ink dispersion tests in cut solvent, and dry ink resolubility tests in cut solvent, to validate good resolubility. The easiest parameter to check is color strength. The ink can be applied at the right film thickness and measured to the standard. Opacity can be checked with either an opacity meter or a spectrophotometer to confirm the ink film thickness and opacity specification.

The challenge is that after all this testing and finding the "ideal" variables, it is still difficult to get an ink that works to a manufacturer's satisfaction. Although all predictive tests passed successfully, some inks had a wider operating window for long term, high speed success. Using proprietary techniques, there became a way to measure key differences in the ink performance based on a variety of key attributes. These predictive tests can help printers obtain measurements that will correlate with the press speeds that inks can achieve and decrease amount of waste due to the generation of substandard product and lost press time.

Current predictive tests have to date been 85 percent accurate with every ink that is formulated being run, analyzed and entered into the database. As the database gets larger and larger, tests will be refined to predict on press results. This affects the full gamut of the project design, from raw material selection and product-design to manufacturing techniques.

Jim Felsberg
Marketing Chemical