Printers' National Environmental Assistance Center

Printing Environmental Technology
Fact Sheet

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REDUCING INK AND SOLVENT USE IN ENCLOSED FLEXOGRAPHIC INKING SYSTEMS

Introduction

The objective of the flexographic printing process is to transfer solid color, or pigment, while suspended in a volatile liquid carrier, such as water or solvent, to a substrate. The challenge of the flexo process is to do so consistently and efficiently for as long as needed.

The focus of this fact sheet is to explain the coinciding environmental benefits of moving from an open to an enclosed ink delivery and metering system. For most, this move is being done to improve print quality, to lower operating costs and to improve the bottom line. The environmental benefits are an added bonus!

In its simplest form, the flexographic printing system consists of four basic parts: fountain roll, ink metering or anilox roll, plate cylinder and impression cylinder. There are two traditional types of ink feed systems used in flexography, the two-roll systems and the enclosed doctor blade system.

Evolution of Inking Systems

The historical shortcoming of the flexographic printing process has been the ability to reduce and maintain thin ink film. While this was not always recognized as a problem, thick ink films limited flexo print to coarse or heavy coverage printing. Eventually, as demand for finer print increased, the ink film was recognized as being a challenge.

The early, basic two-roll flexographic printing system consists of a smooth rubber fountain roll rotating in ink in an open pan. The partially submerged fountain roll transfers the ink to a mechanically engraved, chrome plated anilox roll (Figure 1). The anilox roll, in turn, transfers the ink to the plate cylinder. The plate cylinder then deposits the ink to the substrate.

The amount of ink transferred to the anilox roll is dependent on the anilox cell volume. The anilox volume is determined by the depth of the individual cells that are engraved in it. An anilox roll with cells that are deep transfers larger volumes of ink than an anilox roll with shallow cells. The anilox roll determines the amount of ink transferred to the plate cylinder and, eventually, the thickness of the ink that is printed on the substrate. Therefor, in the end, amount of ink that is printed on a substrate is dependent on the anilox cell volume. The problem with early methods of ink delivery is the lack of control of the ink film in the transfer process causing the print quality to rapidly deteriorate.

Subsequent transfer methods placed the anilox roll in the pan and employed a rubber roll to wipe excess ink off the anilox in an attempt to reduce the ink film before it moved onto the plate. While this method offered some improvement, it was speed sensitive. Hydraulic forces push the meter roll away form the anilox roll allowing more ink to transfer to the plate.

Variations on the flexographic two-roll inking system are possible. Along with the in-metering action of the nip between the fountain and anilox rolls, it is possible to add a reverse-angle doctor blade to shear the ink from the surface of the anilox roll just beyond the ink metering nip (Figure 2). The doctor blade is usually made of spring steel, plastic or other synthetic material. In this single doctor blade system, the purpose of the blade is to increase the removal of surface ink and ensure a more controlled inking of the printing plates. On a single-blade doctor blade system, the amount of ink transferred to the anilox roll depends only anilox volume. By using less ink to print, emissions are reduced compared to the traditional two-roll system.

The older two-roll systems or the adaptation of the two-roll system to be used with doctor blades had large fountain pans used to hold the inks. These open pans, because of their large surface area, allowed for significant evaporation of solvents into the drying system or surrounding area. Even with the use of fountain covers, considerable amounts of solvent still evaporate in a two-roll ink delivery system.

Enclosed doctor blade systems (sometimes called chambered doctor blade systems) improve print quality and provide environmental benefits. With the use of these systems also is a tremendous economic and environmental compliance advantage. Adding an enclosed doctor blade assembly to an older press or buying new equipment with the systems as standard equipment can reduce emissions of air pollutants. Use of enclosed doctor blades systems has been recognized a pollution prevention technology by the U. S. Environmental Protection Agency (Bahner, et al., 1998).

In an enclosed system, two doctor blades are used (Figure 3). The reverse-angle blade is typically made of steel and the trailing blade is made of plastic. The blades are set about two inches apart, but this may vary with different manufacturers. The reverse angle blade acts as the true doctor blade and wipes excess ink from the anilox roll. The trailing blade acts as a capture or containment blade and holds the ink within the confines of the chamber. The blade orientation varies from one side of the press to the other. On a central impression press, the metering blade is located on the bottom portion of the anilox roll on the front of the press and is on the top portion of the anilox roll for the back side of the press. The blades are connected in a box-like enclosure with flexible material at both ends. With an enclosed doctor blade system that seals at both ends of the roll, ink is delivered from the ink pump to the doctor blade system and then back to the pump – essentially, a closed loop. Ink is usually pumped into the system at the middle of the chamber, but can be pumped at several locations on wide presses. A pan is generally placed beneath the anilox roll for cleanup purposes.

Enclosed doctor blade chambers provide better control of ink usage, more consistent color and improved performance of the inks on press. The enclosed system also may reduce the amount of diluent or solvent that will evaporate during operation. As a result of the more stable ink viscosity during a press run, the press operator has better control of the ink being transferred. During idle, emission reductions comparing a traditional two-roll ink feed system to an enclosed doctor blade system can reach 50%. During press operation, this difference is somewhat less at nearly 20%, but still significant. The enclosed system also minimizes VOC emissions and worker exposure to VOCs.

Enclosed doctor blade systems reduce leftover inks at the end of a press run because the doctor blade chamber is small; the system holds less ink than a two-roll system or a two-roll system with a reverse angle doctor blade system. At the end of the print job, the small amount of surplus ink can be removed and stored to possibly be reused.

Flow through doctor blade systems provide few of the environmental benefits of an enclosed doctor blade system. In a flow through system, the ink is pumped into the chamber, however, without end caps, the ink flows through the ends onto an open ink pan (Figure 4). Much like the two-roll system at this point, there is increased exposure of the ink to air promoting evaporation. The ink then drains back into the ink bucket.

In terms of emissions, the flow-through system may approximate the emissions of single blade doctor blade and two-roll systems since, in each of these systems, ink is spread over the ink pan.

On Press Clean-up

The largest amount of solvent used normally incurs during cleanup of the print stations. With the chambered doctor blade systems, cleaning waste is drastically reduced. Enclosed doctor blade chambers allow for reduced usage of cleaning solvents. When two-roll or single doctor blade systems are used, the entire ink pan must be cleaned by hand wiping with solvent.

For enclosed doctor blade chambers, less solvent can be used to wash down the ink fountains and rolls. Only the chamber must be hand wiped, but this part is much smaller than the ink pan and requires very little solvent to be completely cleaned. Only the anilox roll needs to be cleaned on-press. The remaining parts, including the chamber system can be placed in an appropriate wash tub. It is a more efficient cleaning system and uses considerably less cleaning solvents or caustic water solutions. This results in a reduction of hazardous waste from cleaning operations and reduced emissions from cleaning solvents. For the press operator, this also allows for faster and less difficult cleanings between print jobs.

Some doctor blade systems are automated for wash-up while the doctor blade remains in the printing position. Automated cleaning systems can further reduce waste in several ways. Most systems utilize a first stage recirculation wash mode where used dirty water/solvent is used to do the initial cleaning. This dirty water/solvent is returned to a common tank after each wash and can be reused many times. If done properly, this first stage wash actually can do most of the cleaning. Clean water/solvent is used for a final rinse only. It is almost impossible to manage these waste streams manually; so wash ups are typically done with clean water or a reclaimed solvent, all of which goes into waste. When chambers and anilox rolls are cleaned manually, not only is more water/solvent used, but hand cleaning using shop towels is required. These towels must be sent out for cleaning or disposed. Automated cleaning chambers can increase press utilization rates by 25%. This allows more product to be printed in the same time period. When the press is idling for manual cleaning time, power is used for the dryers, drive systems, pumps, etc.

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ADDITIONAL SOURCES OF INFORMATION

For additional information on ink delivery systems and environmental issues impacting flexographic printers, contact the Flexographic Technical Association at www.flexography.org or call (631) 737-6020.

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