PNEAC Factsheet

Pollution Prevention: Fountain Solution Solutions

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Commercial Printing

Isopropyl alcohol (IPA), the additive of choice in certain dampening systems, is a target of increasingly stringent environmental regulations because it is a volatile organic compound (VOC). The EPA is currently working on standards that may set national limits on the permissible amount of IPA in dampening solutions. In addition, there are safety and health concerns. IPA can be an irritant when present in the form of vapors in the air. The Occupational Safety and Health Administration (OSHA) has set maximum exposure limits of 400 parts per million (ppm) over an eight-hour time-weighted average. IPA also has a low flash point of 53F, and therefore must be handled with extreme caution. (The flammability of IPA is greatly reduced when it is mixed in the dampening solution.)

Existing alternatives to IPA can reduce VOC emissions in two main ways: (1) substitutes are used in lower volumes than IPA; and (2) due to their lower volatility, less substitute evaporates, decreasing the need to replenish this portion of the dampenin g solution over the course of a day. This fact sheet is designed to help you ease the transition to

Some Disadvantages of Using Isopropyl Alcohol (IPA)

- IPA is often more expensive than most alcohol substitutes on a total use basis.
- PA use may trigger regulatory obligations, since the amount of VOC emissions from a printing facility will dictate air pollution control permit and other regulatory requirements.
- PA is flammable and must be stored and dispensed in accordance with OSHA requirements, which include the use of approved fireproof containers.
- IPA is a volatile organic compound (VOC) that contributes to the formation of ozone by reacting with nitrogen oxides in sunlight.
- The fumes from IPA can be irritating without proper ventilation.

OVERVIEW

The dampening system on a lithographic press applies a water-based dampening (fountain) solution to the printing plate before it is inked. In an acid-based dampening solution it is usually a mixture of phosphoric acid, gums, buffering agents, water and alcohol or an alcohol substitute. It desensitizes water-receptive non-image areas of the plate to prevent ink from adhering to them.

IPA in dampening solutions:

- Reduces the surface tension of water, allowing water to wet the dampener form roller more evenly. The result is that less dampening solution is used and the water is spread more evenly to the plate from the rollers.
- Increases viscosity to provide a thicker layer of dampening solution to be applied across the rollers, thereby improving the performance of the ink, paper and printing plates. Better, faster ink/water balance reduces waste from start-up.
- Allows for less moisture to be carried to the paper, thereby causing less ink drying problems.

Effective substitutes should, to the greatest degree possible, mirror these functions. In many respects they do, but there are significant differences that warrant serious consideration.

Tips For Switching to Alcohol Substitutes

1. **Understand your dampening systems.** Trouble shooting with substitutes will be much easier if you understand the chemistry and the function of the system components.
2. **Dampening system pH.** The relative pH of the dampening solution must be controlled throughout both the mixing and printing processes. The pH indicates the negative log of the hydrogen ion concentration in water. A pH of 7 is neutral; greater than 7 is basic, or alkaline; and less than 7 is acidic. Each whole number increase or decrease in pH represents a 10-fold change in alkalinity or acidity respectively. Printing is more effective when acidity or alkalinity are controlled.

   Most dampening systems use acid compounds to enable the gum arabic to stay in solution so that it can adhere to the non-image areas of the plate. Ideal pH for most acid dampening solutions is between 4.0-5.0. When the solution becomes more alkaline, the gumming agent loses its ability to desensitize the non-image areas, resulting in "scumming," in which the ink replaces the gum on the plate. Scumming may also occur if the solution becomes too acidic because it can affect the protective layer of the plate. The latter type of scumming generally appears darker and is not as evenly distributed as scumming resulting from excessive alkalinity.

   Increased acidity also slows or inhibits ink drying, and can cause plate "blinding," where the image area becomes less receptive to ink, thereby causing a "ghost-like" image. Decreased acidity can prevent the ink from adhering to the inking rollers, resulting in "stripping." If stripping occurs at the beginning of the press run, it is generally a result of glazed roller surfaces; stripping during the press run is often the result of declining pH (DeJidas, Jr., 1990).

3. **Conductivity.** Conductivity refers to the ability of a material to conduct electricity. Pure water does not conduct electricity well. But as more ionic compounds (such as salt or calcium) are dissolved in water, conductivity increases.

   Measuring conductivity is one way to help determine the optimum fountain solution concentrations, including alcohol substitutes, in dampening systems. Measure the conductivity of incoming water first. Then add one ounce of dampening solution and remeasure. Add another ounce and measure again, each time plotting marks on a graph (Figure 1). The graph should provide a visual means to estimate fountain solution concentration based on conductivity because the two are directly proportional. The alcohol substitutes affect conductivity, so when the optimum mix is determined, measure conductivity again. If the conductivity of the dampening solution is known, the amount of concentrate to be added can be read directly from the graph. You will want to create a new graph each time you change the brand of dampening solution, or if you add a water purification system. Also, because water quality will fluctuate on a daily and a seasonal basis, this calibration chart will need to be revised frequently.

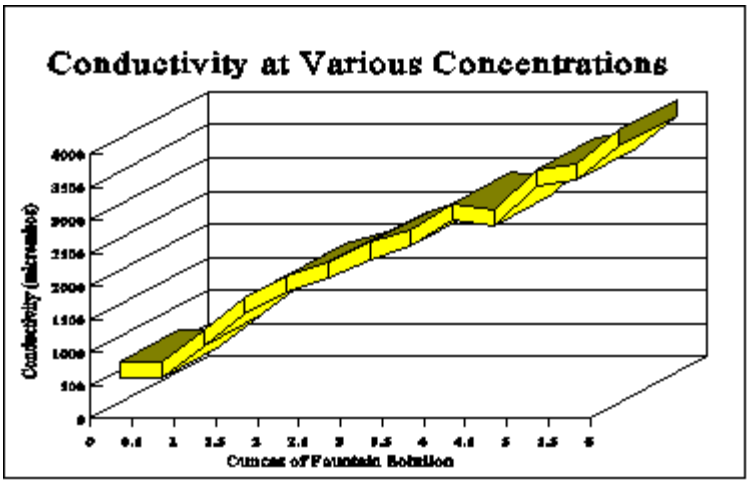

Figure 1. Measuring Conductivity. A sample of fountain solution. (Source: Iowa Waste Reduction Center, 1994).

Because most alcohol substitutes contain buffering agents, the pH can remain the same while the conductivity of a solution increases proportionately to the concentration of fountain solution additives and contaminants. This is because any materials that dissolve into the solution will increase its conductivity. Thus the conductivity of the solution may be more important than the pH in determining the amount of alcohol substitute in the fountain solution (DeJidas, Jr., 1992).

4. **Monitor incoming water quality.** "Hard" (high mineral content) water contains many dissolved minerals, which can increase conductivity. In some areas of Montana, water quality can change hourly! Water softeners or filtration systems may be useful in controlling mineral content, which may help ensure consistent water quality. Reverse osmosis and deionization units can be used to remove salts, minerals, and some organic material from the water.
5. **Clean the presses thoroughly.** Find cleaners that are effective for both the inks and fountain solutions used. Stripping may occur if rollers are not effectively cleaned, leading to inconsistent ink thickness across the roller.
6. **Control water feed carefully.** Too much water can cause emulsification. Reducing the nip between the chrome roller and form roller to run alcohol substitutes may aggravate this problem.
7. **Carefully monitor the pressure settings of the rollers.** Experiment until you find optimum settings for the dampening rollers and the plate-to-blanket pressure settings, then record in a press log.
8. **Monitor metering roller.** Some alcohol substitutes can affect water receptivity of the chrome and metering rollers, so it is important to monitor the metering roller for salt deposits or sensitivity to ink. Salt can be etched from the roller with a solution of 1 ounce phosphoric acid to 32 ounces gum. Water softeners may help prevent salt build-up on rollers.
9. **Consider roller hardness.** Hard rollers can perform poorly and may cause banding (lines occurring in the direction of paper travel). Rollers should be replaced when their durometer increases ten points beyond the recommended value. Keep a record of when rollers were replaced and take readings once a month Softer rollers or rollers with a sl ightly rough surface may solve this problem.
10. **Refrigeration.** Refrigeration units can help reduce evaporation. In addition, refrigeration can help control viscosity. IPA makes dampening solutions thicker (more viscous). But in contrast to alcohol, many substitutes have little or no effect on dampening system viscosity. One way to offset the loss in viscosity as a result of substitutes is to use refrigeration. Be careful not to overcool because fountain solutions that are too viscous may cause tacking, picking and piling problems. Optimum temperatures are around 50Âº - 55Âº F. Estimated costs for installing refrigeration are $2400 - $3500 for a 5-gallon unit, plus $1000 for plumbing.
11. **Consider using filters.** Filters can extend the life of a fountain solution by filtering out paper dust and lint as well as ink residue. Some printers have employed filters that serve large central units supplying fountain solution to multiple presses.
12. **Automatic mixing systems.** Automatic mixing systems and foam-free recirculating systems may help prevent some other problems associated with alcohol substitutes. Make sure automatic mixing systems are properly set and periodically checked to ensure they are functioning properly.
13. **Work with suppliers.** It is important to work with ink, plate and to some extent paper vendors before an alcohol substitution program is undertaken. It is important that these materials be compatible with the new fountain solution chemistry.

Vendors and Suppliers

Indication herein of specific vendors and suppliers does not imply endorsement, nor does omission imply a refutation by the Montana State University Extension Service Pollution Prevention Program.

Low- or No-Alcohol Dampening Systems

Resourcenet/Dixon Paper Co.
1495 Monad Road
Billings, MT 59102

(406) 252-2103

Accel Graphics Systems
2478 Southwell
Dallas, TX 75229
(214) 484-6808

Epic Products International
2801 East Randol Mill Road
Arlington, TX 76011
(800) 527-9529

Thistle Boyd USA
P.O. Box 581117
Tulsa, OK 74158
(918) 836-4016

Sources:

DeJidas, L. P. "Alcohol Substitutes: Making Them Work For You" *GAFTWorld*, Volume 4, # 1, 1992, p. 21-28.

DeJidas, L. P., "Dampening Solution Primer" *GAFTWorld*, Volume 2, #5, 1990, p. 27-33.

MacPhee, J. "Tips on How to Maximize the Performance of Dampening Systems" *GAFTWorld*, Volume 2, #5, 1990, p. 35-36.

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