Dampening Systems

COMMONLY OBSERVED PRACTICES

Many operating variables, including ink, plates and press speed, influence the selection of the proper dampening solution. Because operating variables differ from facility to facility, so do press chemistries.

Most commonly, presses are equipped with automatic dampening systems of some type. Different types of dampening systems are available because there are many different inks and presses. Fountain solutions vary to optimize the effectiveness of each different system. Often, printers use alcohol in the dampening solution to enable easier press control. Dampening system automation can noticeably decrease makeready time and materials.

Alcohol, because it evaporates quickly, is considered a volatile organic compound or VOC. Once volatilized, it will react with nitrogen oxides in sunlight to form atmospheric ozone. Reducing and eliminating alcohol may also provide a healthier work environment for employees. For these reasons, it is regulated. Many state and municipal regulations will not permit alcohol usage exceeding 3 - 8.5 percent, depending on location. Printers in geographic areas that exceed federal ambient air standards are required to operate alcohol free.

POLLUTION PREVENTION OPTIONS

The most practical options for preventing pollution and reducing fugitive emissions from the dampening system are presented in this section.

Extending the Useful Life of the Dampening Solution

When determining how to manipulate press factors, it is imperative to create conductivity and pH curves for the fountain solution to estimate solution concentration. Conductivity will increase as the fountain solution picks up ink, lint, dust and, with nonalcoholic substitutes, as water evaporates during use.

By monitoring pH, printers can observe press chemistry changes which will indicate when the pH has shifted from the best range for printing.

Extending product life is an excellent way to prevent pollution and decrease raw material costs. The most common methods of extending product life are:

1. Using a filtration system on recirculating units to remove contaminants such as paper-dust and lint. Filter systems can be used for just one fountain pan or for a recirculating system serving multiple presses. Filter media can be as simple as a charcoal or polypropylene filter, or may be a mixed media, free flow design. The filter media should remove ink residue as well, eliminating the need to dump fountain solution after color changes.
2. Using a refrigeration unit to reduce evaporative losses. Sources indicate that the optimum fountain solution temperature is 50˚F - 55˚F. Reducing temperature from 80˚F to 60˚F can reduce alcohol consumption by 44 percent. If an alcohol substitute is used, cooling will increase viscosity, or the ability of the fountain solution to flow. Be careful not to overcool the fountain solution because ink will become tacky and cause picking or piling problems. Clean condenser coils regularly.

3. Using an automatic mixing system to accurately mix fountain solution to the proper concentration. Controlling the alcohol substitute concentration in the fountain solution is not easy because water evaporates more readily than the substitute. Automatic mixing systems relieve the burden of monitoring conductivity, though it is impossible to determine the actual concentration of alcohol substitute in fountain solution.

Organic growth in recirculating systems can require stringent cleaning. In some geographic areas, this can be a significant problem. Ultra violet light reduces algae, waterborne fungi, and bacterial growth. The traditional method of preventing organic growth in the recirculating unit is to clean the unit with a 10 percent bleach wash followed by numerous rinses.

Foaming can be a specific concern when using alcohol substitutes or nonalcoholic fountain solutions. Foam-free recirculating systems, if compatible with the press, eliminate foaming and the need for anti-foam agents. For recommendations, contact press equipment manufacturers, fountain solution vendors, or printing society associations.

All these controls extend the useful life of the dampening solution and offer print quality benefits by keeping press operating factors from varying.

Eliminating Alcohol from the Fountain

Studies indicate that an effective dampening system can achieve quality printing using 5 percent or less of alcohol or alcohol substitute. When selecting an alcohol substitute consider the type of ink, press and printing constraints. To achieve the best print quality without relying on alcohol, several factors must be monitored and adjusted to accommodate different fountain solution properties.

Before making any changes to the printing process, review how the affected dampening system works. Consult chemical suppliers regarding available options specific to the press model, dampening system, ink roller wash, blanket wash and papers used. Provide a sample of makeup water to the fountain solution vender to determine which products (fountain solution, alcohol substitutes, anti-foaming agents, etc.) are compatible. Discuss the change in fountain solution with the ink supplier to prevent an incompatible selection and record and recommendations provided.

Adjust the dampening roller pressure setting and plate to blanket pressure to accommodate the alcohol substitute's different surface tension and viscosity. Check durometer readings for the inking and dampening form rollers. The press manufacturer can help in determining proper settings, though it is recommended that the durometer of the metering roller be reduced to 18-22.

When first using an alcohol substitute, follow the manufacturer's mixing instructions. Use the smallest amount of fountain substitute indicated in the instructions and measure the pH and conductivity of the mixture. Record the mixture and measurements in a log. This becomes the reference point. Print with this mixture, recording observations about its performance. Note how the plate rolls up, how the press starts after feed trips, if excess fountain solution is used to keep the plate clean, and if the metering roller is picking up ink. Discuss this information with the vendor for further suggestions and clarification.

Adjust concentration and print again until the optimum mix is achieved. When optimum performance is achieved, note the concentrations of fountain solution, water and alcohol substitute. Use this information as a reference for standard press operation. Start experimenting with alcohol substitutes on one press at a time, phasing in additional presses when the previous one is running smoothly. Keep a press log current, noting maintenance schedules, problems and solutions.

Conductivity and pH can predict fountain solution quality. Conductivity measures the ability to transmit an electrical charge and is proportional to the concentration of ions in solution. Measure conductivity of the water and fountain solution mixture, increasing the fountain solution concentration incrementally and graph the values. The graph provides a visual means to estimate fountain solution concentration based on conductivity.

Conductivity increases during press runs because impurities, such as ink and paper, are picked up by the dampening system. Measure conductivity on a daily basis. When problems with print quality arise, re-measure fountain solution conductivity. This measurement can help predict print problems that result from fountain solution quality.

Alcohol and alcohol substitutes affect conductivity, so when the optimum mix is determined, take conductivity measurements again. If using alcohol, remember that alcohol will evaporate during press runs. Alcohol substitutes evaporate slower than water, so during press runs, water may need to be added.

The pH, acidity (0-7) or alkalinity (7-14), of the fountain solution affects the print quality. As the pH of the fountain solution becomes more alkaline, the ability of the gum to desensitize the non-image areas decreases, causing "scumming" where the ink replaces the gum on the plate. When the pH of the fountain solution drops, the acid reacts with the drier, making it useless as a drying stimulator.

Measure and record the pH of the fountain solution to determine the optimum range for printing.

Although the paper's pH minimally affects the fountain solution's pH, it is beneficial to know if the paper used for each job is alkaline or acid in case of a problem. Alkaline paper is produced using a process that includes calcium carbonate. During printing, the calcium can accumulate in the fountain solution, raising the conductivity without affecting pH. Calcium buildup can create print problems including scumming.

The incoming water's conductivity affects the performance of alcohol substitutes. In areas with hard water (water with high mineral content), water purification systems; such as water softeners, reverse osmosis or deionization systems; are recommended to eliminate problems that alcohol addition formerly masked.

Water softening systems exchange magnesium and calcium carbonate with sodium carbonate. This form of treatment is effective in eliminating calcium or magnesium salt deposits from spray bar dampening systems or nozzle tips.

Deionizing units remove minerals and salts from the water, reducing conductivity to less than 50 micromhos. This type of treatment can change pH depending on the type of deionizing unit used. These units are recommended if the water supply quality is highly variable.

Reverse osmosis units remove salts, minerals and organic matter from the water. The conductivity of the treated water is reduced to 50 micromhos or less and the pH should be neutral. These units are recommended for water supplies of variable quality, as well.

Reverse osmosis units include a water softening unit, carbon filters to remove organic matter, and a micro-membrane to remove sodium carbonate. Reverse osmosis units tend to cost more than deionizing units but have less operating costs.

Low flow may cause the water temperature to increase from one side of the fountain tray to the other. This will affect the fountain solution's viscosity and its ability to cover non-image areas of

the plate. Low flow may result from clogged lines or improperly routed lines. Measure the temperature of the fountain solution across the pan. If it varies more than two degrees (+/-), check the flow rate into the water pan.

Overcoming Obstacles of Alcohol Substitutes

The following suggestions may help correct problems that can occur when using an alcohol substitute:

1. **Clean presses thoroughly.** Carefully select cleaners that are effective for inks and fountain solution used. If the system is not cleaned sufficiently between uses of different alcohol substitutes, roller stripping can occur. When this occurs certain areas of the roller become more sensitive to ink than others, and apply an inconsistent ink thickness. For older presses, copperizing the rollers may eliminate the problem. To correct this on newer presses with nylon- or teflon-covered oscillator rollers, flush the ink rollers with warm water after removing the ink with cleaner.

   Brush dampener systems need the brushes cleaned frequently to prevent increasing the water feed rate to compensate for the dirt. Keep brush guards in place and use white rollers to easily identify soiling.

2. **Control the water feed carefully.** Excessive water feed will cause emulsification and poor dampening system performance. On some presses, if the dampening system is left on when the paper feed stops, the inking system will flood. The reduced nip between the chrome roller and form roller necessary to run alcohol substitutes intensifies this problem.

3. **Check the pressure settings of all rollers.** Check both the dampening roller pressure setting and the plate to blanket pressure settings. Include the optimum settings in the press log for reference.

4. **Inspect the chrome roller for pitting or ink sensitivity.** Pitting can cause an uneven water feed rate across the press. Pitted chrome rollers should be replaced.

5. **Check the metering roller for ink sensitivity or salt deposits.** Alcohol substitutes can affect the water receptivity of the chrome and metering rollers. When this happens, it is recommended to etch the chrome roller with a 1:32 etch (1 ounce phosphoric acid to 32 ounces gum) to restore water receptiveness. Water receptivity of the metering roller is maintained by applying gum.

   Some fountain solutions encourage salt deposits on the metering roller. The metering roller needs to be backed away from the chrome roller and cleaned. If the conductivity of the water is above 300 micromhos, a water softening unit could eliminate the deposits.

6. **Check the hardness of the metering rollers.** Banding or grind marks, comblike or corduroy-like marks on the substrate in the direction of paper flow, can occur if the metering rollers are too hard. This can occur even when using rollers of normal hardness, 25-30. These effects may also occur if the fountain solution is not mixed correctly.

   Use softer rollers or rollers with a slightly grained surface. Consult press manufacturer and fountain solution manufacturer regarding optimum hardness for metering rollers. Continue monitoring the hardness of the rollers. When the durometer reading varies by 10 points beyond the recommended range, replace or recondition the roller.

   Rollers harden over time and a combination of age and glazing can render the rollers ineffective. Deglazing rollers should reduce roller hardness by five durometer points.

COSTS AND BENEFITS

When making the move to alcohol-free printing, there are unrecoverable costs. Many printe across the United States are going alcohol free because it is required by law. In addition t areas where the federal government has required air emissions reductions, many state and local agencies have also required air emissions reductions from all industries, including printing. Other printers are reducing their alcohol consumption for other environmental compliance reasons, such as reducing air permit requirements.

Financial pay back can be calculated by comparing true costs to traditionally externalized costs such as the costs of environmental compliance (i.e. permitting fees, staff or consultants that prepare the permit applications) and, if the businessperson opts for noncompliance, the fines associated with regulatory violations.

Once the printer has eliminated alcohol, print quality usually improves and is more consistent. This should have direct pay offs in higher productivity from easier press control and higher customer satisfaction. Another externalized benefit is the public relations of being a good neighbor.

The following charts indicate the appropriate data necessary to estimate the costs and benefits of the pollution prevention opportunities discussed. An example is provided for mathematical purposes. Before preparing the "Actual" column of the chart, it is necessary to discuss substitute products with vendors and obtain the cost of the proper product for the substitution.

Table H below compares the costs of using alcohol and using an alcohol substitute in an area allowing alcohol use.

Future analyses should incorporate price changes and increased productivity from better press control. Makeready wastes should also decrease, reducing operating expenses.

In areas where alcohol use is allowed, it may be the most cost beneficial to reduce alcohol consumption by installing water treatment equipment. By ensuring consistent water quality, press factors will not vary dramatically and alcohol usage can be decreased to 5 percent. Other variables affected by maintaining press chemistry are makeready time and paper use. Makeready time can be decreased by 5 percent and paper saving of 1 percent can be achieved just by keeping press chemistry constant.

Table H
Alcohol and Alcohol Substitutes
Cost Caparison Worksheet

ITEM	VARIABLE	EXAMPLE	YOUR FACILITY
A	Cost of alcohol	$2.00/gallon	
B	Volume consumed	2 gallons/mon.	
C	Multiply cost by volume = A x B	$4.00/month	
D	Air permitting fees (if applicable)	$12.50[a]	
E	Permit preparation	$800.00[b]	
F	Total (Cost of alcohol + any permit expenses) = C + D + E	$860.50[c]	
G	Cost of noncompliance	<$10.000/day	
H	Cost of substitute	$2.60/gallon	
I	Volume consumed	1.32 gal/mon.	
J	Substitute cost (Multiply cost by volume) = H x I	$3.43/month	
K	New rollers	$600.00/roller	
L	Water treatment equipment	$2100.00 total	
M	Other equipment necessary	None	
N	Total equipment costs = K + L + M	$2700.00	
O	Operating cost (Cost incurred from downtime for change over, lost time, etc.) = O x C	$460.00[d]	
P	First year expenses = J + N	$3201.18	

[a] Assuming $25/ton emissions fee and actual emission of 0.5 tons.

[b] Assuming application is prepared by a consultant charging $50/hour in 16 hours. This is conservative. Training a staff member to prepare the permit is recommended.

[c] Annual alcohol cost = $4/month x 12 months/year = $48/year
Total cost of alcohol = $48/year for alcohol + $12.50 air emission fee + $800 permit application preparation = $860.50

[d] Assuming 18 hours @ $20/hour and $100 in supplies = $460

The following chart compares the costs and complexity of press accessories.

Table I
Press Accessories Comparison

Equipment	Capital Cost	Process Complexity	Additional Considerations
Filtration system on recirculating units	Low	Low	Requires recirculating unit. Organic growth may be a problem
Foam-free recirculating systems	Low	Low	Must be compatible with press and fountain solution.
Refrigerated unit	Low	Low	Take care not to overcool alcohol substitutes.
Automatic mixing system	Medium	High	Controls conductivity but makes it difficult to determine the concentration of alcohol substitute used. Requires operator training.

Low = Approximately $2,500 or less.
Medium = $2,500 - $5,000
High = Over $5,000

Filtration systems, foam-free recirculating systems and refrigerated units are most effective when operating as a system. Systems should be in the medium price range.

Table J
Water Treatment Unit Comparison

Equipment	Capital Cost	Process Complexity	Additional Considerations
Water softening	Low	Low	Will only reduce salt deposits from spray bar dampening systems or nozzle tips.
Deionizing units	Medium	Medium	Will reduce the conductivity of the water. This is the best choice for high volume water consumption.
Reverse osmosis	Medium	Low	Remove salts, minerals and organic matter.

Low = Approximately $2,500 or less.
Medium = $2,500 - $5,000
High = Over $5,000

For best results, use a combination of the above treatment methods. Water treatment equipment should be sized for pressroom needs and can be sized for fountain solution needs only. When fountain solution requires small quantities of water, a less expensive option may be to purchase distilled water.