Understanding Conductivity

In addition to the importance of measuring pH and its effect on the printing process, another valuable tool in monitoring fountain solution performance is that of measuring conductivity.

Conductivity is one of the least understood terms in lithographic printing but can be most helpful in determining proper fountain solution concentration or contamination. Since the advent of buffered fountain solutions, using a pH reading as a means of fountain solution control was no longer a reliable method. Proper operating pH was achieved with considerably less fountain concentrate per gallon of water than was necessary. Conversely, adding too much concentrate would only result in a minimal change in pH at best. Finding the correct strength is important since having the wrong mixture can lead to a host of production problems such as ink emulsification, tinting, scumming, slow ink drying, etc. An alternate method of determining a fountain solution's strength was needed to ensure proper press performance and to use as a quality control tool.

Conductivity is such a tool and is defined as the ability of a substance or a solution to conduct an electric current. The lower the resistance of a material to conduct current, the higher its conductivity. Resistance to current flow is measured in ohms. Since conductivity is the inverse of resistance, we use a unit of measure called the mho (ohm spelled backwards). However, to measure the conductivity of water or a fountain solution, we use a much smaller unit as the base measure of conductivity called the micromho or mmho (one millionth of a mho). The level of conductivity of a solution is measured using an electrically operated conductivity meter (TK083200), which gives readings in micromhos per centimeter. Internationally, the unit of measure is stated as microSiemens (mS), and is directly interchangeable with mmhos.

Pure, distilled water does not conduct electricity; it is an insulator and has a conductivity of zero. It is only when impurities are added that current is allowed to flow. As minerals and metals are dissolved in water, ions are formed and can be measured as a conductivity reading. Unlike pH, conductivity is measured on a linear scale whereas the more additives or impurities a water sample contains, the greater its measured conductivity will be. This gives an indication of nearly every ingredient in a solution and helps monitor a solution's relative strength. Generally speaking, hard water (>450 mmho/cm) will render a higher conductivity reading than soft water (<225 mmho/cm) and is undesirable for lithographic use. In such situations, it may be necessary to use distilled water or a water treatment system to ensure a consistent fountain solution.

Establishing what the proper conductivity reading should be will be dependent on factors such as the type of water and fountain concentrate being used. Determining the ideal conductivity must begin by mixing the fountain concentrate according to the manufacturer's recommendations and making trial press runs until optimum performance is achieved. Once you find that mixture, it should become your standard. From that point on you can monitor conductivity to ensure that it remains at or near the desired level. Remember that using tap water can greatly influence your readings from day to day depending on the chemical composition of the water coming into the plant. Still, it is up to printers to determine whether their tap water used in conjunction with their fountain solution will produce acceptable results. That is why many manufacturers recommend achieving a certain conductivity reading above that over the water reading since water varies greatly in different parts of the country.

Other factors that can seriously affect conductivity are paper lint, ink or wash-up chemicals. Usually, such contamination registers as an increase in conductivity and becomes an effective way of determining if the fountain solution balance is getting out of control. These contaminants can affect the surface tension and viscosity of a fountain solution, both of which are critical factors in effective dampening. Therefore, it is important to check pH and conductivity at the beginning of a shift, at least once during the day and whenever experiencing printing problems. A change in conductivity of 100 umhos or more probably indicates fountain solution contamination.

Alcohol, which does not conduct an electrical charge, has a conductivity of zero. Since conductivity readings represent micromhos per centimeter, alcohol will dilute the solution and lower the conductivity reading. And since alcohol is very volatile, conductivity will change drastically with changes in alcohol concentration due to evaporation. For this reason, it is suggested that you take conductivity readings before and after adding alcohol. If using the latter as a benchmark, be sure that the solution being measured contains the same amount of alcohol as was initially added. This can be done by using a hydrometer. Furthermore, automatic alcohol replenishers and temperature controllers may be necessary if using conductivity as an effective quality control tool when running alcohol-based fountain solutions.

Understanding conductivity and pH can be instrumental in monitoring proper fountain solution performance and are often used in Total Quality Management (TQM) programs by many print shops. Once quality press performance has been established, you can be sure to keep at least one variable from getting out of hand and disrupting production.