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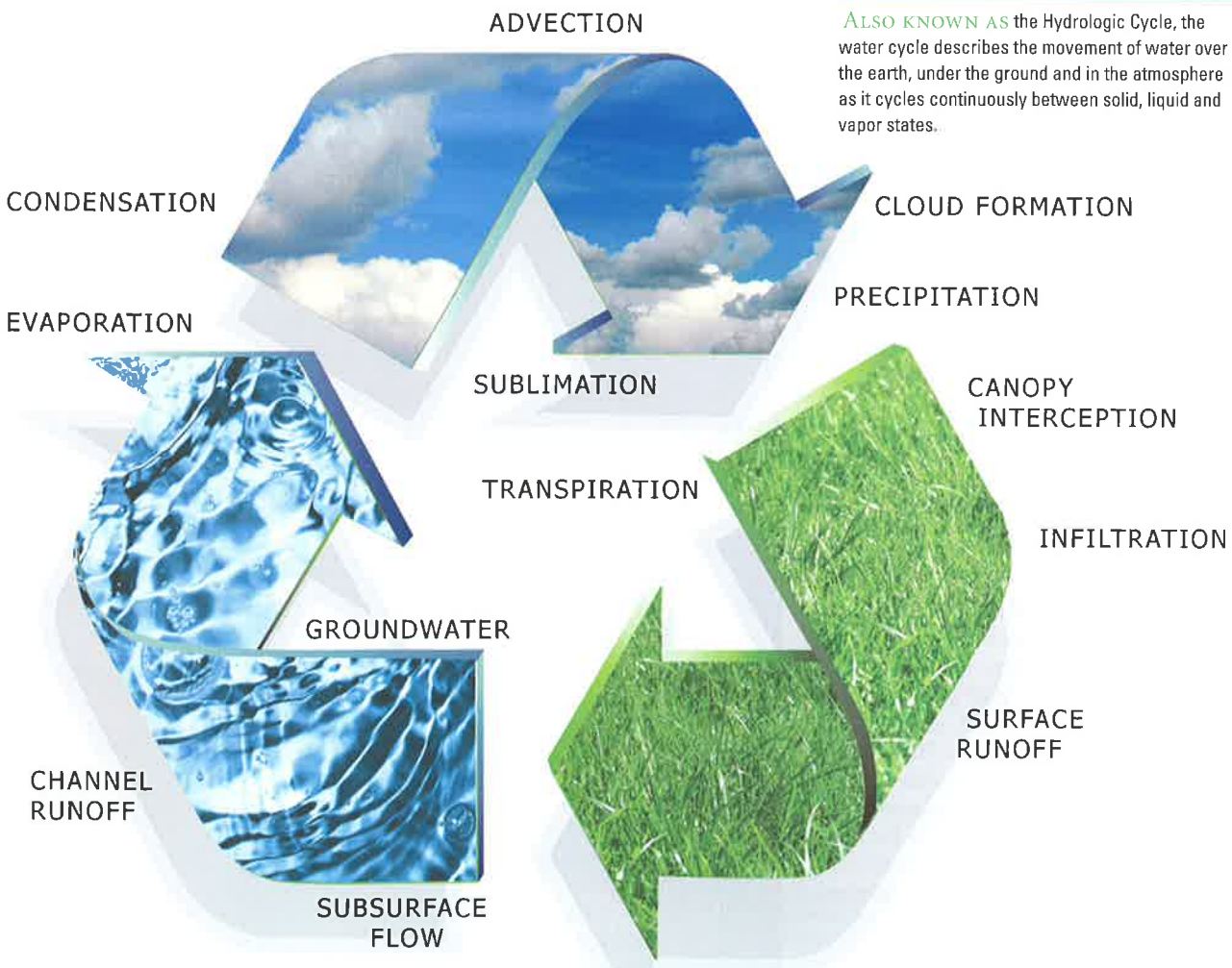
Water-Based Ink and the Environment

Understand how to handle and dispose of these inks to lessen the environmental impact.

The movement toward more widespread acceptability of using environmentally friendlier screen printing inks and supplies continues to be an important change in the way this industry does business. As more textile screen printers become educated in what's available in the marketplace to help their shops become more sustainable, it's important to know what you're buying and how these goods really do affect the surrounding environment. Water-based inks are no exception.

First, a bit of background information. In 2007, The Intergovernmental Panel on Climate Change (IPCC) issued its fourth assessment report. The panel was established by the United Nations in 1988 to study the impacts of human-induced climate change and to advise on what could be done to counteract them. In this report, the panel concluded that the negative impacts of climate change on water resources was found in all regions of the world.

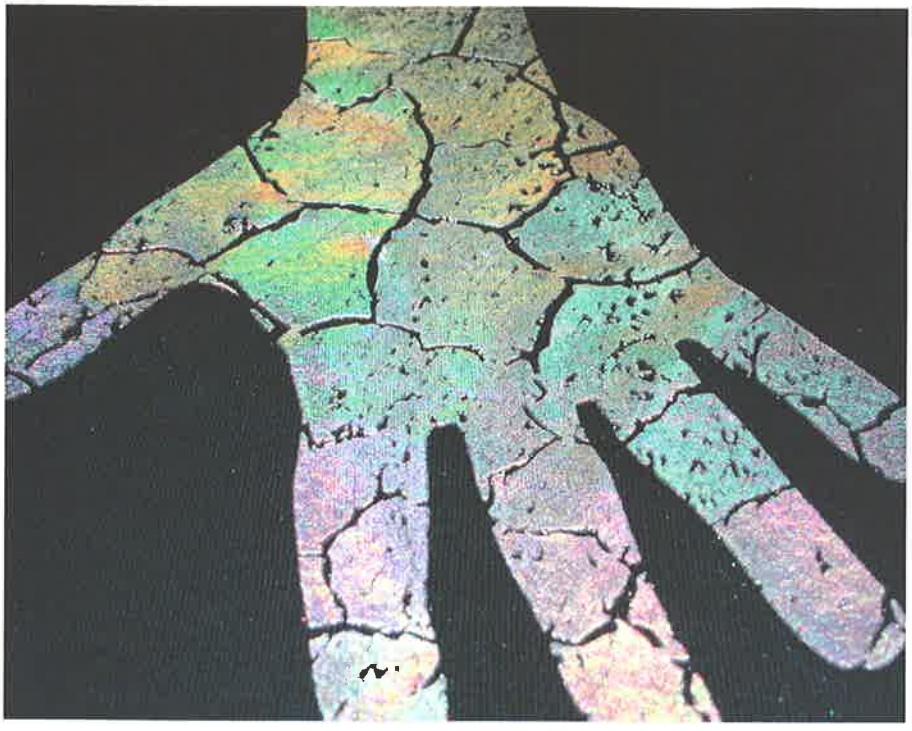
In arid areas, such as the Southwestern U.S., where ground and surface water already is limited, run-off is projected to decline. This is an area that is very densely



ALSO KNOWN AS the Hydrologic Cycle, the water cycle describes the movement of water over the earth, under the ground and in the atmosphere as it cycles continuously between solid, liquid and vapor states.

The Water Cycle

By Ed Branigan,
Contributing Writer



WATER-BASED AND safer inks also can have a specialty touch, such as this hand print that used a foil adhesive and foil application to give it an iridescent look. *All ink images in this article were printed using Intl. Coatings Co.'s Gen IV inks.*

populated and is experiencing drought conditions with water rationing. The Los Angeles basin alone is home to about 17 million people. It also is home to a large apparel printing and manufacturing business community.

Many questions have been asked by the textile printing community in recent years regarding the "greening" of the industry and what types of inks would be best at promoting and embracing this new ideology. Restrictions placed on phthalates both by the U.S. and the European Union (EU) and the recurring question of PVC have put plastisol inks under the spotlight in terms of environmental friendliness. Manufacturers are responding to these questions by developing PVC-free and phthalate-free plastisol screen printing products, but so far many remain pricier and not as versatile as standard inks.

This has brought water-based inks back into the picture as a viable alternative. Before the choice is made, however, the same questions need to be asked: Can water-based inks be considered environmentally friendly? Can they be used in a sustainable manner?

SUSTAINABILITY

According to Miriam-Webster's online dictionary, the definition of sustainability is "a method of harvesting or using a resource so that the resource is not depleted or permanently damaged." The definition most widely used internationally is taken from the 1987 Report of the World Commission on Environment and Development — sustainability means "meeting the needs of the present without compromising the ability of future generations to meet their own needs."

The resource under consideration here is water. Determining the sustainability and environmental friendliness of water-based ink systems involves looking at their entire life cycle from manufacturing to disposal after print production.

It also requires an understanding of how water, in its various forms, moves through the environment.

THE WATER CYCLE

Also known as the Hydrologic Cycle, the water cycle describes the movement of water over the earth, under the ground and in the atmosphere as it cycles continuously between solid, liquid and vapor states. It is in a state of constant change, from precipitation (which includes not only rain but snow, fog moisture and sleet) to advection, transpiration, condensation and surface runoff. Surface runoff comes from rainfall and melted snow moving over and through the ground, and is one of the ways in which water moves across land. This is of particular concern not only to screen printers, but to the industry in general.

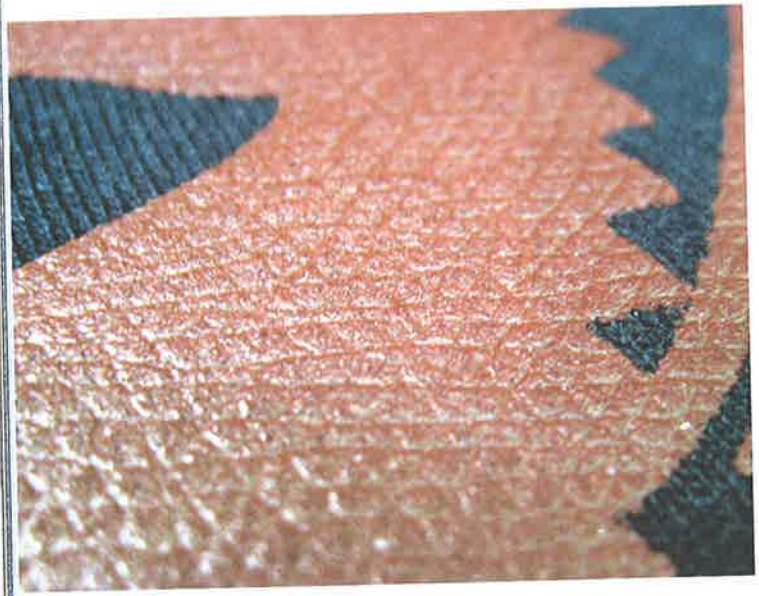
Surface runoff is one of the sources of what is known as Nonpoint Source Pollution (NPS). This type of pollution actually is caused by rainfall and snowmelt moving across the ground picking up many of the man-made and natural pollutants that it encounters along the way. The water in this runoff can end up being absorbed into the ground, thus finding its way into groundwater or it can make its way into lakes and reservoirs. It also can evaporate into the atmosphere as water vapor.

Another pertinent fact — and one that often is a surprise to people — is what are called reservoir times. The average residence time for a water molecule in an ocean is 3,200 years; the average for glaciers 20 to 100 years. A molecule of water can hang out in soil moisture for one to two months, in rivers for two to six months and in shallow groundwater for 100 to 200 years. It can stay put in deep groundwater for up to 10,000 years. The shortest time of residence for a water molecule is in the atmosphere, where it lasts, on average, just nine days.

The main concern here is the particulate content of any water that makes its way down the drain that had been used for clean-up of water-based inks, either during manufacturing or printing.

THE INKS

Traditional textile water-based ink systems for garment printing contain upwards of 80% water. In some cases, it can reach as high as 90%, but mostly stays within the 70% to 80% range. The remaining 20% to 30% is what is known as the ink's solid



ECO-FRIENDLIER INKS can create stunning designs, such as this snakeskin patterned embossed print that shows texture and dimension.

content. The most common components of the solid content are the resin, pigment and binders. These give the ink its body. Acrylic resins are the most commonly used in textile inks, although there are others, such as urethane. The solid content also can contain ingredients like heavy metals or formaldehyde — used as a preservative — and glycols, which are used as coalescing agents. A gallon of ink can contain any or all of these ingredients and still be three-quarters water.

For water-based inks to cure, cross linking of the various ingredients needs to occur just like they do in plastisol inks. The difference is that in order for cross linking to occur during curing in textile water-based ink, all of the water has to be evaporated from the ink first. This requires longer drying times, sometimes up to two to three times longer.

Even without curing in an oven, the water from the older systems eventually will evaporate out of the solid content. Try leaving a water-based ink container open for any length of time and watch it thicken and gradually harden. Once the water evaporates through curing, the thickness of the ink film is greatly reduced and — as is often the case with the older systems — a very transparent print is the result.

There are newer inks on the market today with half the moisture content, resulting in inks that have 70% solids and 30% water. These newer water-based ink systems offer an opacity that rivals plastisol, as well as greater control over the scourge of ink drying in the screen or bucket. This has

been achieved by the development of emulsifying agents that not only encapsulate the water molecules, but keep them there for much longer periods of time. Printed and cured the same way, this new generation not only lives longer, but can be rescued when partially dried and made usable again.

Some of these ink systems also are free of many of the elements associated with traditional water-based systems and now are considered less desirable. These include heavy metals, biphenyls, APEO, pesticides, etc.

Reducing the water content of a gallon of ink from 70% to 30% makes a great stride toward sustainability, as does the moisture retention characteristics of the new breed. Anyone who has printed with water-based ink has added water to their buckets of ink at some point to keep them going a little longer or to try and bring them back to life. Moisture retention means that inks don't dry out in a hurry, so they don't require additional water to keep them hydrated. That means water is conserved for where it's really needed.

SHOWN HERE IS a close-up portion of a lion design, where the PVC- and phthalate-free water-based ink used incorporates a puff additive, making the image raise up off the fabric.

DISPOSAL

When looking at the eco-friendliness of this issue, here's where a challenge lies: What to do with the water that's used to clean up after printing. Most often, this water is poured down the drain. Any particulate matter that is mixed in with the water obviously will go down the drain with it. Most modern municipal codes include restrictions on disposal of industrial waste, including water. Most have wastewater treatment facilities, where such water is diverted for treatment before being pumped into rivers or oceans, or redirected back into drinking water.

This sounds great and makes sense from a public health perspective — and even an environmental one. A major problem is that the last generation has seen large population shifts toward urban centers. More people are moving to cities and, with them, come the attendant industries. Many municipal water treatment systems, including sewage, are antiquated and were built to service a much smaller population. During major storms or heavy rainfall, older city drains become blocked or backed up, causing the waste water to mix with the surface runoff mentioned earlier. This can quite easily contaminate the ground that it crosses and possibly end up in reservoirs or groundwater used for drinking.

In the U.S., the birth of the Environmental Protection Agency (EPA) in the 1970s gave rise to a greater awareness on the environmental impact of industrial processes. Stricter controls on air emissions and industrial waste disposal were implemented. These regulations have evolved over the years with some states, and even individual counties, having tighter controls than at the federal level. A net result of these policies has been a great reduction in VOC emissions from the curing of inks, as well as the development of ink systems that do not contain many of the more harmful elements, such as heavy metals or pesticides mentioned above.

The most preferred solution would be to not pour any of the water used for cleaning screens and inks down the drain at all. There are systems on the market right now that enable this. Closed-filtration systems remove ink and emulsion from screens, recycle liquid and collect solids for disposal. These are expensive and often are out of the reach of many smaller printers. Even so, there are some simple and straightforward measures that can be taken to lessen the environmental impact and increase the sustainability of the water resource that printers can use.

For example, using less water to clean and reclaim screens is a start — and there are automated systems that do just that while limiting employee handling of the used water. Any solid or particulate matter can be removed and disposed of according to local regulations. And even if automation is out of the question, using a gallon bucket of water with protective gloves to clean ink from screens or setting aside a wash-out booth with a good filter can certainly impede any negative environmental impact.

Whatever direction the marketplace takes, water-based ink users need to be aware that the presence of water in the product does not automatically guarantee that its solid content is free of any ingredients that are not environmentally friendly. If a printer is concerned about environmental impact, ask what's in the ink. Check tech sheets and MSDS before deciding which product to use. The sustainable use of any product is the responsibility of the end user, as well as the manufacturer. By asking questions and demanding inks that are greener, consumers are forcing manufacturers to make them. Once the product is in the printer's hands, their handling of the printing and disposal process can make a huge difference to the overall environmental impact. ◢

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