Roller Compounds for UV/EB Inks

By Böttcher Systems

Compound basics
Rubber for printing press roller coverings are blends of polymers, plasticizers, vulcanizing agents, fillers and additives. For each of these major ingredient classes, there are many choices. Two of the most important selection criteria in choosing specific ingredients are their effects on the roller compound's chemical resistance and the compound's dynamic qualities.

Chemical resistance: Good vs. poor resistance
When evaluating a compound's chemical resistance, it is important to look at the entire chemical environment to which the compound will be exposed. The roller supplier must test the roller compound not only with the inks but also with the required wash-up solutions and maintenance products. Typically, wash-up solutions are more damaging to press rollers than are inks.

Chemical resistance is measured by immersion testing. A rubber sample is immersed in the test media for a specified period of time. Upon removal, the test sample is measured for volume and Shore hardness change. Based on test results, the roller supplier can make recommendations about relative compatibility of different roller compounds to different inks and roller washes.

It is important to check with the roller manufacturer when matching a roller compound to the inks that will be used. The roller manufacturer also can be helpful when selecting wash-up solutions and other roller maintenance products. The manufacturer will have data on the compatibility of their compounds with a wide range of inks and washes.

Compound dynamics: Good vs. poor dynamics
If you imagine the polymer as the "springs" of the compound, then the plasticizer is the "shock absorber." The plasticizer is also what makes rubber soft. Together the polymer and plasticizer help determine the dynamic properties of the compound. When speaking of dynamics, we are referring to a compound's ability to release the energy it gains from work that is done to it. As it is compressed and released, a compound with "poor dynamics" retains energy in the form of heat. The generation of excess heat can lead to a multitude of problems, such as difficult ink/water balance, toning and ink misting. Dynamics should not be confused with static hardness. Roller compounds with "poor dynamics" have a higher dynamic hardness. There are many relatively soft rubber compounds with poor dynamics.

Quick summary

EPDM is the compound of choice for dedicated, full-time UV/EB printing.

NBR can be used for limited dual-purpose use if the proper precautions are taken. Some reduction of roller service life is to be expected.

For extensive dual-purpose use, the new non-PVC-based compounds are much preferred due to their superior dynamic qualities.

In all cases the printer should work closely with roller, ink and wash suppliers. This is the only way of selecting the roller compound that is most compatible with any given ink system.

It is important to test all materials that come into contact with the roller: inks, washes and maintenance products.

Dynamic properties can be measured experimentally using a variety of different devices. One such instrument is the roller dynamics test stand. This device uses a small test roller under various running conditions. It can be used to determine dynamic hardness, as well as other physical properties of the compound.

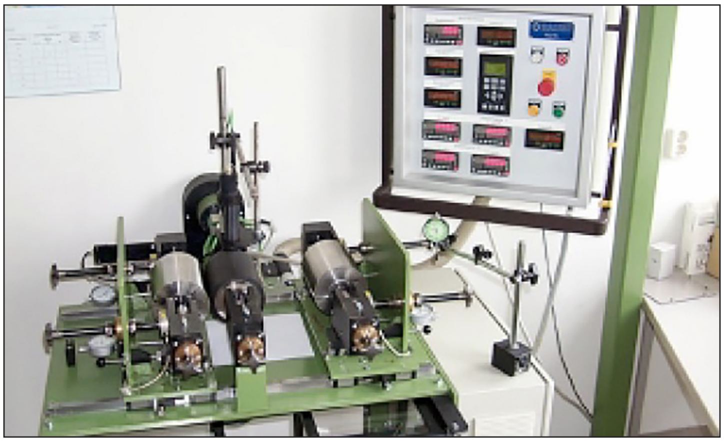

PHOTO 1. Roller dynamics test stand

Table 1 shows results from data collected using the roller dynamics test stand. It compares two compounds with identical static hardness of 25 Shore A. Note the difference in measured dynamic hardness. Also note the difference in temperature change the two test compounds exhibited during this test. Compound B has the superior dynamic properties.

	Compound A	Compound B
Static hardness (Shore A)	25	25
Hysteresis	0.17	0.05
Setting (depth in mm)	0.30	0.30
Static pressure (N/mm^2)*	0.15	0.15
Dynamic pressure (N/mm^2)*	0.68	0.40
Dynamic hardness (Shore A)	43	31
Max. pressure in nip (Mpa)	0.06	0.036
Torque (Nm)*	0.68	0.40
Temp increase (K)	43	31
Running speed (m/s)	0.06	0.036

* For 1 mm/1 m covering thickness

TABLE 1. Compound dynamics comparison

Conventional vs. UV printing

Conventional usually uses NBR

Nitrile-Butadiene-Rubber (NBR) is the most common rubber used as a roller covering for conventional printing. NBR has excellent resistance to the hydrocarbon oils and solvents used as a vehicle for coldset, heatset and conventional sheetfed inks. NBR can be easily manufactured in a wide variety of Shore hardness. NBR compounds have good dynamic qualities. NBR compounds are also stable in volume and Shore hardness when exposed to the aliphatic hydrocarbon oils and solvents found in conventional inks and washes.

NBR compounds have some resistance to the monomers, oligomers and photoinitiators found in UV/EB inks. NBR can be attacked by esters, ketones and other solvents found in many UV/EB wash-up solutions. NBR is not recommended for full-time use with UV/EB inks and washes.

UV/EB usually uses EPDM

Ethylene-propylene-diene-terpolymer (EPDM) has excellent resistance to the monomers, oligomers and photoinitiators common to UV/EB inks. EPDM is resistant to attack by ketones, esters and other solvents found in UV/EB washes. It is the polymer of choice for use with UV/EB inks. Though EPDM can be used to produce very durable rollers for the UV/EB ink environment, there are some compromises.

EPDM is very hard. EPDM compounds require the addition of large amounts of plasticizer to produce a soft compound. There are limits to the maximum amount of plasticizer a compound can hold. For this reason, the softest EPDM compounds are usually harder than the softest NBR compounds. Much progress has been made in locking plasticizers into EPDM compounds. Today, EPDM compounds are available as soft as 25 Shore A. Because EPDM compounds push the limit of plasticizer content they are subject to plasticizer loss. It is difficult to keep all of that plasticizer oil in the compound. Press wash solutions and heat will slowly extract some of the plasticizer from the compound, causing the roller to shrink and to harden. This is especially true if the rollers are not properly adjusted or if they are subjected to aggressive wash-up solutions.

EPDM has little or no resistance to the hydrocarbon oils and solvents found in conventional inks and washes. See Photo 2. EPDM must be used only as a roller covering on presses that are dedicated 100% to printing with UV/EB inks. One application of conventional inks or wash can irreversibly damage EPDM rollers.

PHOTO 2. EPDM sample immersed in conventional ink for seven days. Lower button is test sample. Upper button is an original-size control sample for comparison.

Dual-purpose printing

Today, many printers would like to be able to use inks with different curing processes on the same press. They would like to move freely from conventional inks to UV inks or hybrid inks using a single roller compound. This often is referred to as dual-purpose or cross-platform printing. This presents a challenge when selecting a roller compound.

NBR rollers

Since it has excellent resistance to conventional inks and also some resistance to UV/EB inks, NBR can be used for limited dual purpose printing. It is important that all inks and washes be tested before they are run on press. Special care is required in selection of a roller wash. Photo 3 shows 24-hour immersion test results for an NBR roller compound that was exposed to an aggressive, EPDM-friendly UV/EB wash. Even in the best case use of NBR for dual purpose use will reduce the service life of the NBR rollers. Depending on frequency of exposure and severity of the UV/EB environment, service life can be reduced by 50% or more.

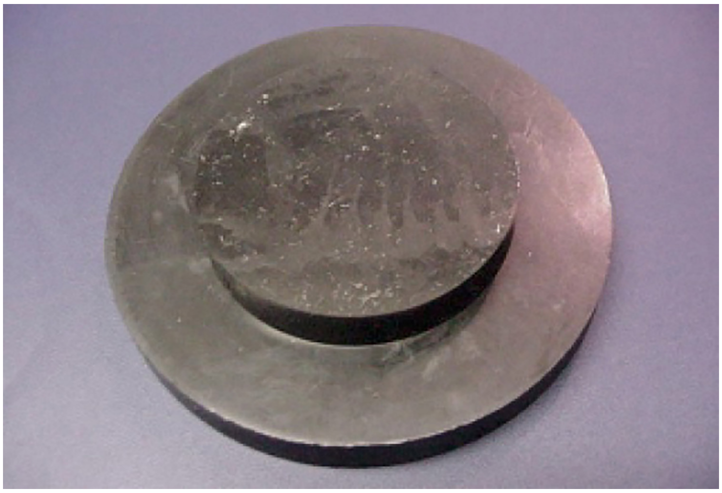

PHOTO 3. 24-hour immersion test results for NBR in aggressive UV/EB roller wash. Lower button is test sample. Upper button is an original-size control sample for comparison.

PVC-filled dual-purpose rollers

One approach to improving the chemical resistance of a dual-purpose compound is the addition of polyvinyl chloride (PVC) to the polymer blend. PVC can provide the compound with additional chemical resistance to UV/EB inks and washes. However, PVC has relatively poor dynamic properties. Rollers containing PVC will tend to run hot. This will contribute to such press problems as toning, dot gain and the need to run excess dampening solution. Ink misting, due to viscosity break down, is another common heat-related ink problem. Using the roller dynamics test stand, heat buildup was measured for three test roller compounds. Running conditions were: stripe of 4 mm, speed at 1500 rpm and run duration of 30 minutes. Chart 1 shows the test results. The PVC-filled compound runs hotter than a traditional NBR or the new dual purpose compound.

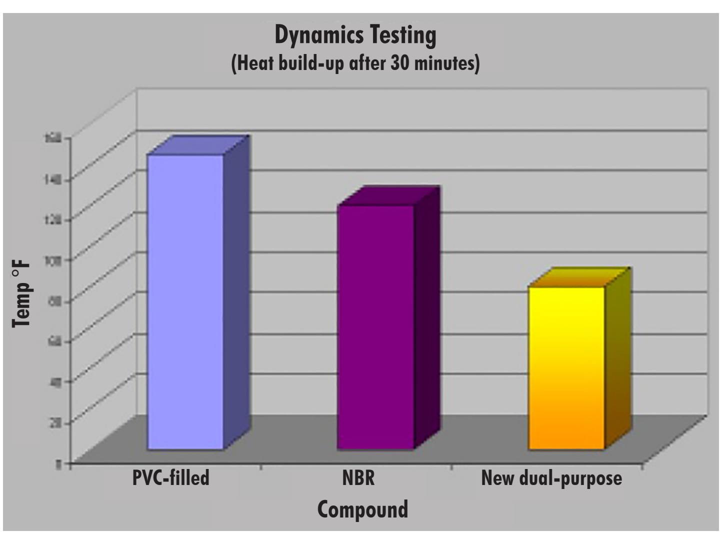

CHART 1

New dual-purpose compound rollers

The newest technology uses proprietary polymer blends with much better dynamics than PVC. In addition, these new polymer blends have improved chemical resistance compared to both NBR and PVC-filled compounds. These new compounds have chemical resistance as good as EPDM with many UV/EB inks. These compounds are also ideal for use with hybrid inks. See Chart 2.

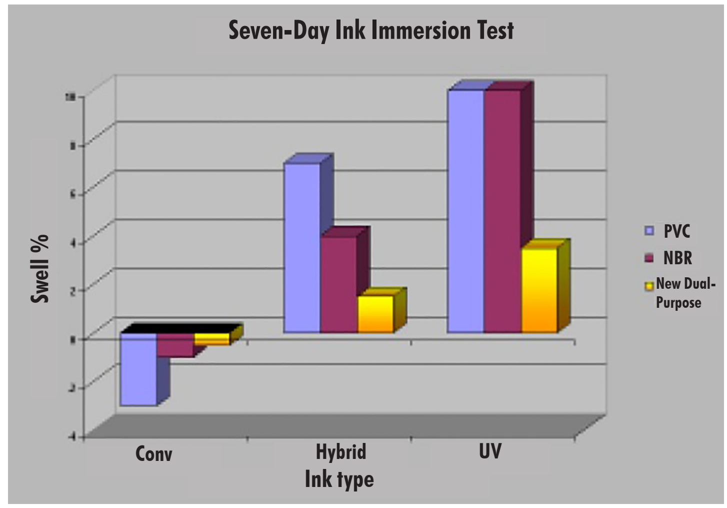

CHART 2

The improved dynamics of these compounds allow rollers to run cooler than PVC-filled compounds. Less heat build-up will decrease ink misting, extend roller life and reduce heat-related print quality issues. ■