Böttcher Stabilis 257 30

New Inking Roller Compound for Vegetable Oil-Based Inks

In recent years, there have been significant changes in the formulation of inks for sheetfed offset printing. While traditionally mineral oils formed the main base for sheetfed inks, recently the use of vegetable oils, such as linseed or soy oil, has dramatically increased. While the press operator may not notice any significant differences in the printability of these inks, chemically this development means a significant shift in the polarity of the inks and – with that – in their effects on rubber roller coverings. In contrast to mineral oil-based inks, inks incorporating significant quantities of vegetable oils can often cause considerable shrinkage when used with standard roller coverings.

Why is this?

In order to understand the differences in the inks and the resulting differences in their behaviour, it is worthwhile taking a closer look at the chemistry involved and in particular at the whole question of polarity.

Polar/Non-Polar – What Does it Mean?

Larger particles – so-called molecules – are built up from a number of much smaller particles – so-called atoms. When two atoms bond, they do so via the electrons situated on their perimeter. In a simple bond, each atom supplies one electron. This bonding pair of electrons can either be situated in the centre between the two atoms, or can have a bias towards one or the other atom. A bias occurs when one atom exerts a higher degree of attraction or “pull” on the electrons than the other.

One example for this is the methanol molecule (CH_3OH).

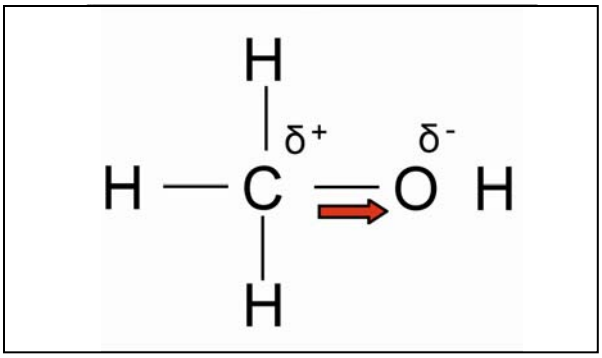

Fig. 1: Charge distribution in the molecule

The oxygen atom (O) exerts a stronger pull on the electrons, giving it a slightly negative electrical charge (δ^-). The carbon atom (C) loses electrons and becomes electrically positive (δ^+). In this way, a dipole is formed or – in other words – the molecule becomes **polar**.

Why is this Important for Roller Manufacturers?

The more chemically similar two substances are, the easier it is for them to react to each other. For example, when oil (non-polar) is added to water (polar), the two substances will not mix, no matter how hard and long you shake them. Isopropyl alcohol (better known in the printing trade as IPA), however, will dissolve completely in water, as both substances are polar.
The same applies to rubber rollers and printing inks. The more chemically similar the ink and the rubber are, the easier it is for them to enter into a chemical reaction.

A standard rubber roller covering for conventional sheetfed offset inks contains the elastomer NBR (acrylonitrile-butadiene-rubber). On account of the acrylonitrile group, this rubber is polar. A roller covered in this material will normally react to other polar substances, such as vegetable oils (on account of their polar alkyd resins).

To understand what happens when the roller and the inks come into contact, we have to take a closer look at the molecular structure of rubber rollers. Simply expressed, rubber consists of long chains (polymer chains), which are normally held together (cross-linked) by sulphur. Plasticisers – the substances which are used to make rubber compounds soft – are distributed in this network of polymer chains. The plasticisers are not bonded to the chains, but held in place by chemical interactions. In a rubber compound with 25 Shore A durometer, approximately 20 – 40 % of the total volume consists of plasticisers.

When vegetable oil-based offset inks come into contact with an NBR-based rubber roller, it is easy to imagine that polar components of the ink will leach into the polymer matrix.

Conversely, the polar plasticisers can be extracted from the rubber by the polar oils in the ink. As a result, the roller will become harder and shrink (Fig 2). In the case of vegetable oils, the extraction of plasticisers outweighs any ingress of ink components into the roller.

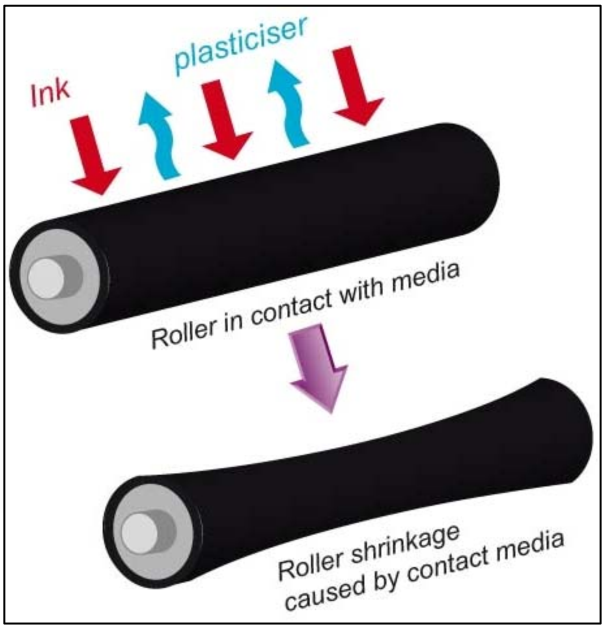

Fig. 2: Influence of ink on rubber rollers

In practice, the extraction process will not take place evenly along the length of the roller covering, but will tend to be stronger towards the centre of the roller. The roller stripe is no longer parallel, but typically broader at the ends of the roller than in the middle (see Fig. 3). At the same time, the hardness of the rubber will increase measurably. As a roller in this condition will inevitably cause problems with uneven ink transfer and detract from the controllability of the printing process, sooner or later it has to be replaced.

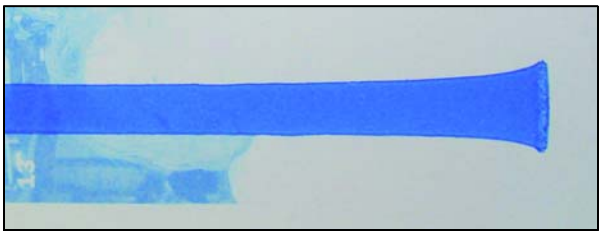

Fig 3: Roller stripes affected by shrinkage

The New Sheetfed Roller Compound for Vegetable Oil-Based Inks – Böttcher Stabilis 257 30

As part of our ongoing Quality Assurance and Market Observation programme, we conduct approximately 30,000 swell tests each year. This means that we immerse rubber samples in different media (such as printing inks or washes) under standardised conditions for a defined period of time. Before and after the immersion phase, both the volume and the hardness of the rubber sample are recorded and compared.

The development of the new sheetfed inking roller compound Böttcher Stabilis 257 30 is a direct result of this programme of continual market observation. This material is ideally adapted to the latest generation of sheetfed inks and offers a high degree of dimensional stability in contact with both mineral and vegetable oil-based inks.

How is this Stability Achieved?

The main chemical properties of a compound are determined by the base polymers used in its formulation (NBR, EPDM, etc.). Besides this, a large number of further components can be used to influence the compound's physical and chemical characteristics. Plasticisers, fillers, cross-linking agents and many others can be integrated into the formulation of the rubber to give the compound specific properties. By skilfully combining individual substances, Böttcher chemists were able to achieve an optimum balance in terms of resistance to both mineral and vegetable oils in offset inks. Fig. 4 shows very clearly that normal rubber compounds designed for conventional sheetfed can shrink quite significantly, while Stabilis 257 30 displays very balanced results, ranging from slight shrinkage in some inks and a small, but uncritical degree of swell in others.

In today's printing environment, this balanced behaviour is a must, as very few printers switch entirely to the so-called "biological" inks – in most cases, the rollers are subjected to a mix of conventional, mineral oil-based inks and their newer, biological counterparts.

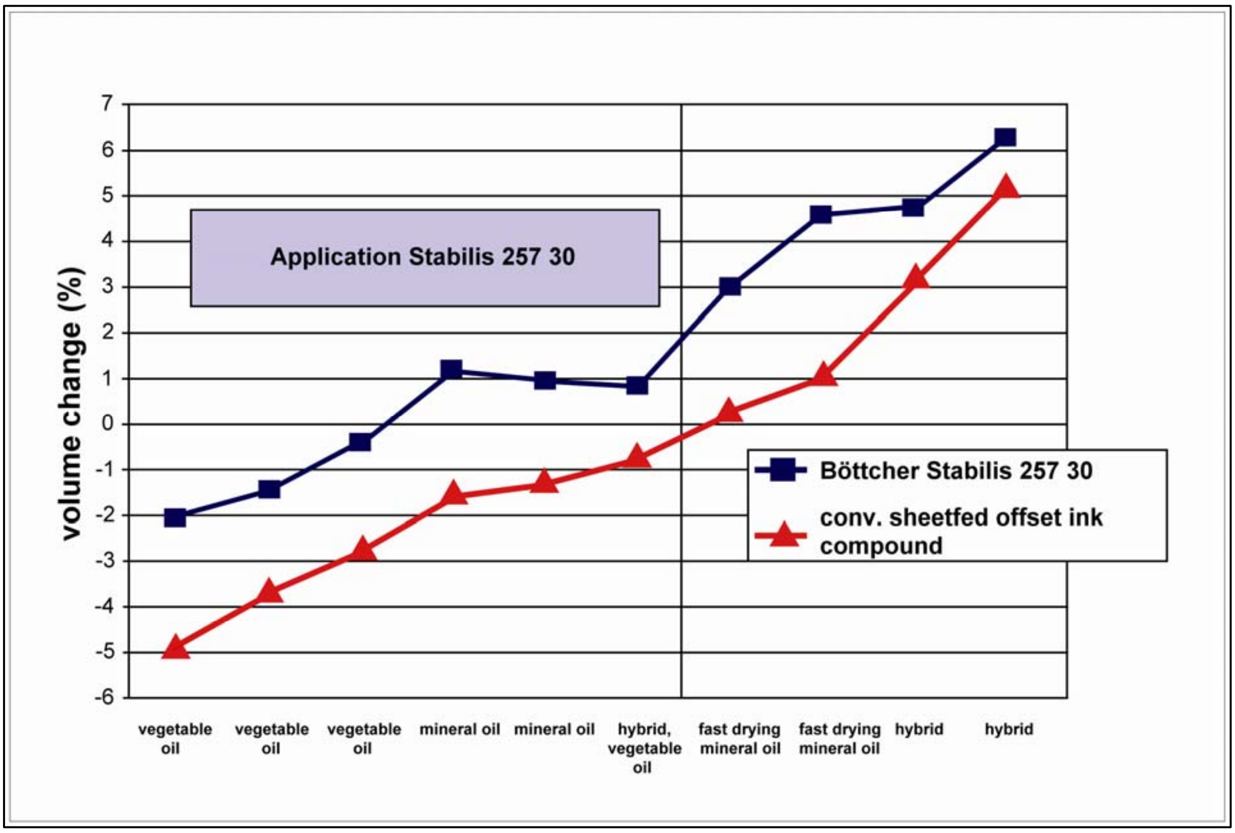

Fig. 4: Comparison of chemical resistance of a conventional rubber compound and Böttcher Stabilis 257 30

Stabilis 257 30, Böttcher's answer to the challenges posed by vegetable oil-based inks, was introduced at Drupa 2008 and has since become a favourite and a problem-solver for many printers. The greatest benefits can be achieved on presses run in the main with mineral oil-free inks. This compound is not intended for use with UV or hybrid inks, which could potentially cause excessive swell (for inks of these types, Böttcher offers the award-winning Chameleon series of compounds).

25 Shore A or 30 Shore A?

Stabilis 257 30 is supplied in 30 Shore A durometer. This is a deviation from the normal hardness of 25 Shore A specified by most sheetfed press manufacturers.

Practical experience has confirmed that this difference in durometer has no detrimental effects on the printing process. There are two main reasons for this:

1. Durometer Increase in Use:

Since Stabilis 257 30 is less susceptible to chemical reactions induced by the vegetable oils in sheetfed inks, significantly less plasticiser is extracted from the rubber. Rollers covered with Stabilis 257 30 will retain their original durometer for a much longer period than other rollers, which often harden by 5 Shore A or even more within the first year of use.

2. Dynamic Hardness:

The dynamic hardness of a rubber compound is determined by its chemical formulation and represents the proportions of its viscous and elastic components (rubber is fundamentally a so-called visco-elastic material). "Dynamic hardness" is theoretically a contradiction in itself, as it is impossible to make a direct measurement of it. The term is used, however, to designate the effective force generated in the nip while the press is running. This force can only be measured on special test apparatus and represents far more realistically than a static measurement the effec-

tive hardness of a roller under production conditions. In Böttcher's R&D laboratories, equipment on which measurements of this nature can be made has been instrumental in developing rubber compounds for modern, high-speed presses.

Stabilis 257 30 incorporates a much higher level of elastic components than typical sheetfed roller compounds, resulting in a dynamic hardness which is very close to the nominal, static durometer.

In practical terms, this means that – although when the press is stationary the force in the roller nips will be slightly higher than with 25 Shore A roller compounds, when the press is running, the dynamic nip forces will be significantly lower, thereby generating less heat and exerting less mechanical pressure on roller journals, bearings, etc.. In other words: when the press is running, Stabilis 257 30 is effectively softer than many rollers with a nominal hardness of 25 Shore A.

New Inking Roller Compound for

Vegetable Oil-Based Inks – Böttcher Stabilis 257 30

Less need to re-set rollers, less roller hardening,

more stable printing conditions and longer roller life.