PRINTING INK

WITH EXPANDABLE MICROSPHERES

Create 3D, anti-slip, embroidery and smooth velvet effects on a wide range of materials

OVERVIEW

Product Type
Unexpanded microspheres

Main Benefits
3D effects
Anti-slip
Embroidery effect
Increased bulk
Matt surface finish
Peached surface finish
Puff effect
Soft velvet finish
Suede-look finish

Applications
Aluminium
Fabrics
Plastic
Textiles
Wallpaper
Related – Printing blankets

Expandable Microspheres

On heating expandable microspheres **increase** up to **60 times** their **original volume**. When used In a printing ink, the expansion process creates a 3D print, anti-slip or smooth velvet finish and other **surface effects** on **materials** such as textiles, paper, plastics or aluminium.

3D and **anti-slip** effects can be used on beverage cans to give **improved grip**. **Anti-slip dots** and **patterns** can be made on the soles of socks to **increase slip resistance**. **Relief prints** created on garments and wallpaper, and **embroidery effects** replicated on fabric. **Coating**, **gravure**, **multiple layer** and **screen** printing can be used.

The **look** and **feel** of a printed surface can be **changed** by using **microspheres** with different expanded particle sizes, from 20 to 120 µm. The 3D effect created depends on the grade and how much is added.

Surface Effects

Creating colour and texture

Formulating

When adding microspheres to a basic printing ink formulation, a little adjustment may be needed to **create 3D prints** on **various substrates**. A basic formulation may contain **0** to **20%** unexpanded microspheres, **40** to **60%** polymer binder and **2** to **35%** thickener, plus pigments and additives.

The **microsphere grade** used depends on the temperature at which the polymer **binder** cross-links and the type of surface effect to be created.

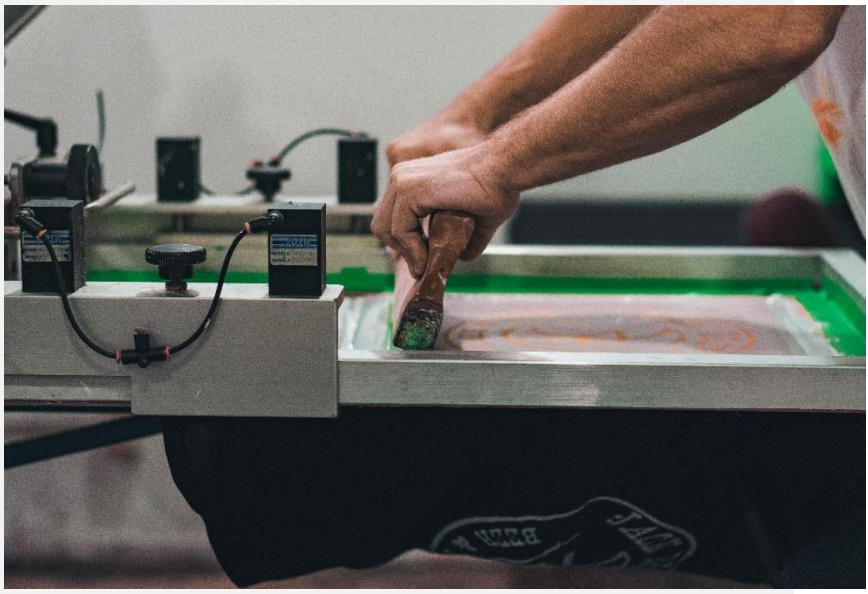
There are microsphere **grades** which give **good expansion** at low, medium and high temperatures, with versions suitable for water-based inks which offer **rheological stability**, and for inks which do not contain water. All grades are **inert** and **white** in colour.

The mechanical properties of the binder and the expansion capacity of the selected microsphere grade influence **abrasion resistance**.

Using three times the quantity of binder to unexpanded microspheres, dry weight, typically gives good abrasion resistance.

If the addition of microspheres is too much, the print will have very poor **adhesion** to the substrate and poor abrasion resistance.

The microspheres are **easily dispersed** with a homogeniser, for example a Silverson mixer.



Without pigment, inks containing microspheres have a semi-opaque finish. For an **opaque white print** add up to 10% w/w titanium dioxide, and for a **coloured print** add up to 8% w/w non-ionic pigment dispersion.

Different expanded microsphere **particle sizes**, from 20 to 120 µm are used to **modify** the **look** and **feel** of the printed surface.

If only a **matt printed surface** is needed, rather than a 3D effect, add **0.5** to **1%** microspheres, based on solid content.

Expanding a print immediately after heating will give a **rough finish** due to water vapour.

Drying the print at a temperature below the microspheres' expansion temperature will give an expanded print with a **smoother surface** finish.

Textiles

Mixing, fixation and printing

Formulating for Textiles

In a printing ink for textiles, unexpanded microspheres can help you achieve effects such as a **velvety** look, **puff** effect and the resemblance of **embroidery**.

A typical **water-based formulation** contains binder, microspheres, thickener, glycerine, ammonia and a defoamer.

The **binder** should be highly elastic, give a good adhesion to the fabric and have good wet tensile strength. The exact type of binder depends on the intended application. If cross-linking of the binder is too strong this may cause a loss of expansion.

Typical addition levels of wet **unexpanded microspheres** in a printing ink for textiles are between **10** to **12%**, dry weight. Some microsphere grades are more **rheologically stable** making them more suitable in formulations where rheological stability is a concern. A higher addition level may be needed for other grades.

The **thickener** should give a short buttery rheology. Glycerine, a **hygroscopic agent**, prevents skinning and clogging of screens. A **defoamer** prevents formation of foam during mixing. Addition of **water** compensates for the varying solid content of different wet unexpanded microsphere grades. **Ammonia** can be used if necessary to adjust pH. The **viscosity** of the printing ink tends to increase when stored.

Using an homogeniser, all **ingredients**, **except thickener** and **ammonia**, are **mixed** until **uniform**, using ammonia to adjust **pH** to **8.5**. **Thickener** is added to the mixture during stirring. Stirring is continued until thickening is complete and a smooth mixture obtained. Screen and gravure printing are suitable **application techniques** for expandable printing inks. The **3D** effects are most obvious with a heavy deposit.

During **fixation**, **drying** of the print, **expansion** of the microspheres and **cross-linking** of the binder takes place, in direct connection with the **printing** during **heating**. Temperature depends on type of microsphere, substrate, type of binder, degree of deposit and curing oven to be used. Fixation takes **1** to **3** minutes, but could be prolonged if a complete drying is not obtained within this time.

For **multi-colour printing**, printed material can be dried intermittently at room temperature or up to 80°C. If the **print** is **overheated** and/or **heating time** is **too long**, the microspheres may collapse and become discoloured. An **infrared dryer** may be used instead of or in combination with a heating oven. This requires a lower temperature and/or a shorter drying time. The microspheres will not expand if the system is cured with **UV light**.

Wallpaper

Mixing, viscosity and screen printing

Inks for Wallpaper

Using unexpanded microspheres to achieve **3D** or **matting** effects, a typical **water-based ink** contains binder, microspheres, thickener, glycerine, ammonia and a defoamer.

It is important the **binder** offers good adhesion and abrasion resistance. While a **soft binder** can improve adhesion, a **hard binder** can give the required resistance to abrasion.

The amount of **microspheres** in the ink should be between **1** to **15%**, dry weight, of the total formulation.

The **thickener** should give a pseudoplastic rheology, to produce a low viscosity at high shear rates and allow printing at high speeds. At the same time, the viscosity will be high at low shear rates, preventing the ink from flowing after printing.

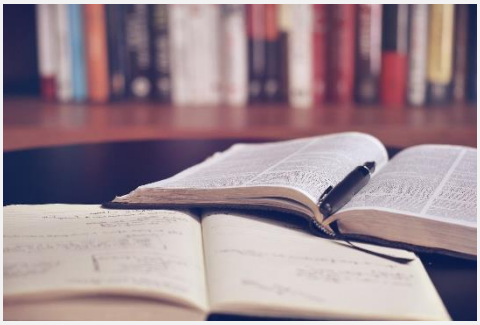
A **hydroscopic agent**, glycerine or propylene glycol, prevents skinning and clogging of screens. **Defoamer** prevents formation of foam during mixing. Addition of **water** compensates for the varying solid content of the different microsphere grades. Water can be added as the last component or in the pre-mix of microspheres, binders, hygroscopic agent and defoamer.

When adding **pigments**, dry powder pigments should be fully dispersed in the binder before adding microspheres, a dispersant additive may be required. A pigment dispersion can be added at any stage of the mixing process.

Microspheres are mixed with **binders**, **hygroscopic agents**, and **defoamer** using a high-speed mixer to give a **homogeneous** mixture **before** adding the **thickener**, continuing to **stir** until a **smooth** mixture is obtained. Mixing must not take too long to **prevent** heat developed at high shear rates from **prematurely expanding** the microspheres.

The formulated printing **ink** exhibits a **pseudoplastic flow**, where its viscosity decreases with increasing shear rates. **Viscosity** can be **regulated** by using more or less thickener in the formulation. A **preservative** can be added to inhibit the growth of bacteria and fungi to improve **shelf life** during storage.

In screen printing**, 3D** effects become most noticeable with a **heavy deposit**. This can be achieved using a **coarse screen**, 60 to 85 mesh (24 to 34 threads per cm). **Finer detailed patterns** and **sharp contours** are realised with a **lower deposit**, using a **finer screen**, 100 to 125 (40 to 50 threads/cm) mesh. The printing ink should be **filtered** before application to prevent clogging of the screen. **Dry**, **expand** and **cure** is preferably carried out immediately after printing for 0.5 to 2 minutes. For **multi-colour printing**, dry the printed material intermittently at 20 to 85°C.



What's Next?

Further Reading

Our **Technical Guide – Properties of Expandable Microspheres** takes an in depth look at the properties of expandable microspheres. A great introduction if you are new to the world of expandable microspheres.

Find out about other applications where expandable microspheres are used, for example, to make uniform foamed plastisols in our **Application Guide – Plastisols with Expandable Microspheres**.

Expanded microspheres are highly effective in paints and coatings. These are just a couple of examples which benefit from the use of pre-expanded microspheres, but they are not the only possibilities. To discover more refer to our **Application Guide – Paints & Coatings with Expandable Microspheres**.

Do you need help **choosing the right grade** for your application, **more information** or a **sample** to try?

We are always happy to help and answer any questions you may have. Please do not hesitate to contact us:

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