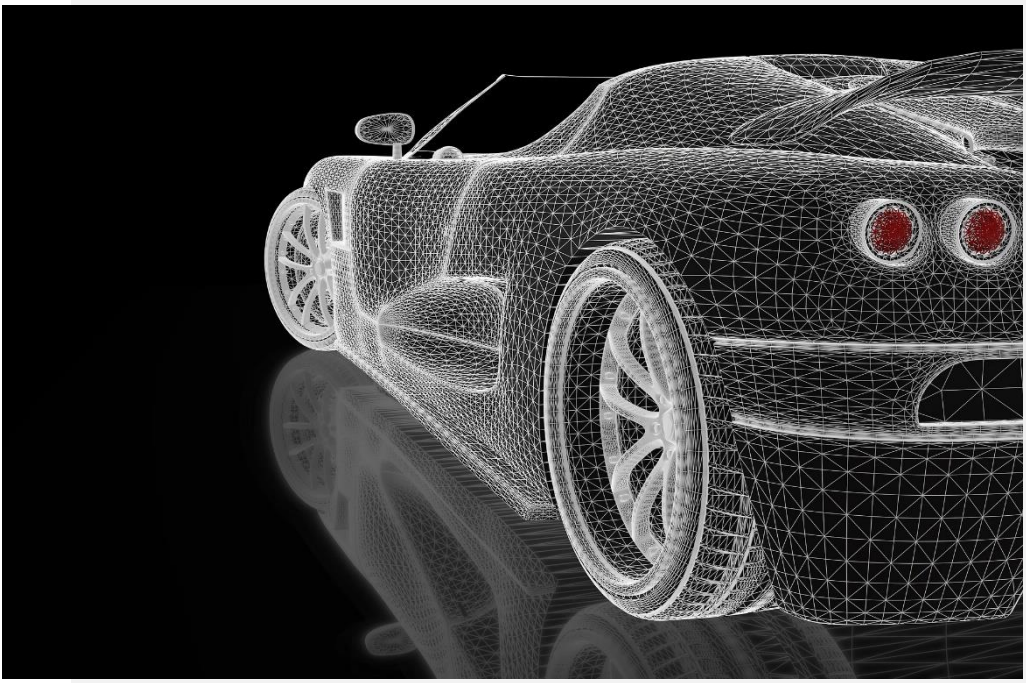
TECHNICAL TEXTILES

WITH EXPANDABLE MICROSPHERES

Enhance the properties of substrates and gain exciting advantages



OVERVIEW

Product Type
Expanded microspheres
Unexpanded microspheres

Main Benefits
Anti-slip
Improved compressibility
Improved hand-feel
Increased bulk, dimensional stability & thickness
Reduced weight & vibration

Applications
Composites
Fabrics
Paper
Structures
Webs

Expandable Microspheres

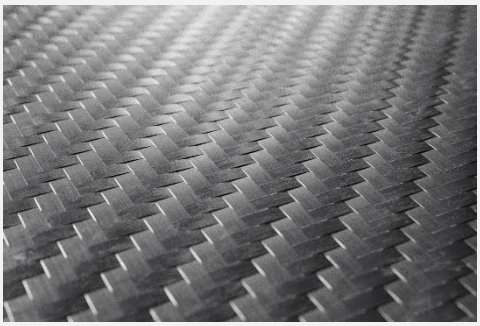
Expandable microspheres can be used to **improve** the **properties** of **substrates**, by exchanging some of the binder and/or filler with the spheres.

Different **application techniques** can be used, such as coating, impregnation, laminating or spraying.

The spheres can be expanded to **very low densities**; spherical, elastic and compressible they give the **final product** good insulation, improved compressibility and elasticity, increased bulk and increased thickness, increased dimensional stability and reduced weight.

The microspheres can also be used for **surface modification**; for anti-slip properties, improving hand and matting.

Extent of effects on final properties and surface modifications are influenced by the amount of microspheres added, formulation and substrate.



Application & Curing

Impregnation is the traditional way to use expandable microspheres in technical textile applications. The substrate should have a porous texture to allow a mixture of spheres and binders to penetrate the substrate matrix. It is important the fibres of the substrate are not chemically bonded to each other as this would prevent expansion of the spheres during curing.

Spheres in a **coating** form a uniform closed cell structure, adding thickness, improving surface characteristics and reducing weight. Particle size influences the surface characteristics of the coating; the smaller the size, the smoother the finish. Expanded spheres can be used to achieve a smooth surface on a rough texture. Kiss roll or knife coating with a doctor blade or floating knife are commonly used. **Laminating** a core material can improve compressibility, elasticity and insulation properties of laminates with textiles or paper, thickness controlled by the deposit and amount of spheres. The resilience of expandable spheres makes **spray application** possible.

After application, substrate passes through a curing stage where the expansion of the spheres takes place. Direct **heating** in a hot air oven or infra-red can be used, with temperature and time being adjusted to give good expansion. **Before final curing**, some applications require a pre-drying stage at a lower temperature to prevent blisters or voids in the matrix due to boiling effects of water or solvent.

Adding Spheres

How much?

There are **unexpanded** and **expanded** microspheres available, with versions suitable for formulations **with** and **without water**.

The amount of **unexpanded** microspheres added typically varies from **0.5** to **4.0%** w/w dry content, depending on the desired effect.

For **expanded** microspheres, addition usually varies from **0.5** to **30%** w/w dry content.

At the **lowest addition**, the change in hand and matting are the only obvious effects. At **higher additions**, the thickness of the product increases, giving a foamed structure.

As formulations and desired effects differ, the optimal addition of microspheres needs to be determined for each application.

Spheres & Binders

Natural and synthetic lattices

Mixing for Best Results

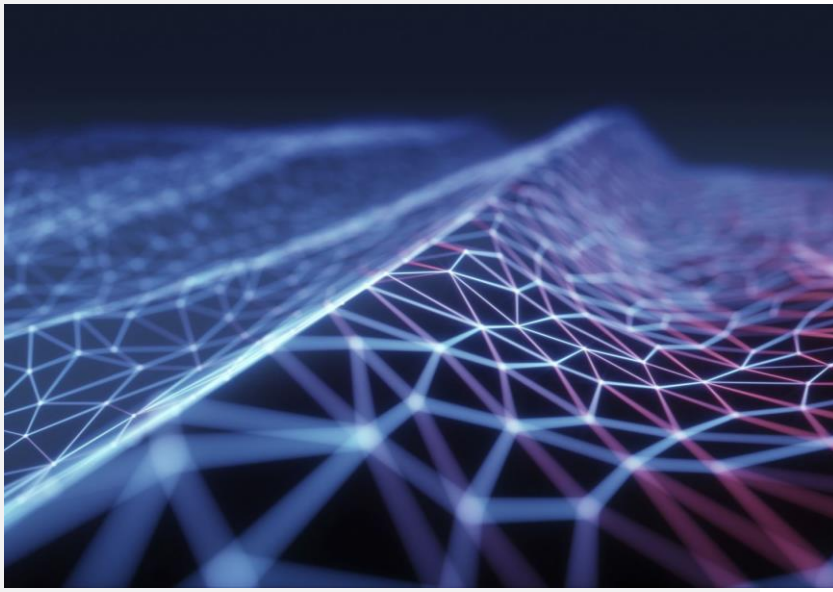
For **best results**, the spheres must be properly dispersed.

Unexpanded microspheres are resilient and, if the binder system allows, can withstand high shear forces when mixed with a homogeniser.

For **binders sensitive** to **shear**, such as natural rubber latex, **wet, unexpanded microspheres** should be added as a **40** to **45%** w/w **slurry**. If using **inorganic fillers**, such as calcium carbonate or clays, they can be pre-mixed with the spheres to form a slurry, with final solid content depending on the ratio of spheres to filler. During **mixing**, temperature of the slurry should be **<50°C** to prevent expansion of the spheres. The sphere slurry, binder, and additives can be mixed with a conventional stirrer.

Dry, unexpanded microspheres can be dispersed into resin using a conventional mixer.

Expanded microspheres, wet and dry, are more sensitive to shear, should be added directly to the binder and mixed using a conventional low shear mixer. The density of expanded microspheres is extremely low. The rheological properties of the formulation are of crucial importance to prevent floatation of the expanded spheres.



Expandable microspheres are compatible with waterbased binders, such as **natural** rubber, **synthetic** lattices, and mixtures of the two.

Synthetic latex should have a neutral to alkaline pH when blending with **natural** rubber latex. Typically, synthetic lattices are chosen to meet the needs of the application, for example, compressibility, flexibility, hardness, rub resistance, washability, etc.

In general, **synthetic** lattices consisting of self cross-linking or cross-linking acrylic polymers, polyurethane or other acrylate co-polymers give good properties.

Expandable microspheres are also suitable for use in full and low **ammonia** lattices, the latter giving less odour during production.

In many cases, expandable microspheres can be incorporated into an **existing formulation**.

Expanding Horizons

Drying, expansion and curing

Added Ingredients

Wet, unexpanded microspheres can be used with acrylic, cellulose, copolymer, and polyurethane **thickeners**. When using microspheres with an alkaline pH with a pH-sensitive thickener such as cellulose, it should be added as a pre-thickened stock solution, and a **preservative** added to prevent the cellulose thickener from biodegrading during storage. The pH of the formulation can be adjusted to give the correct thickening by adding ammonia. The choice of thickener should be determined by the binder and required rheological properties of the formulation for each specific application.

Expandable spheres can be filled with **inorganic fillers** such as chalk or talc. For each formulation, the maximum filler load should be determined, taking into account the effects on product properties, for example, compressibility, flexibility, formulation costs, and shelf life.

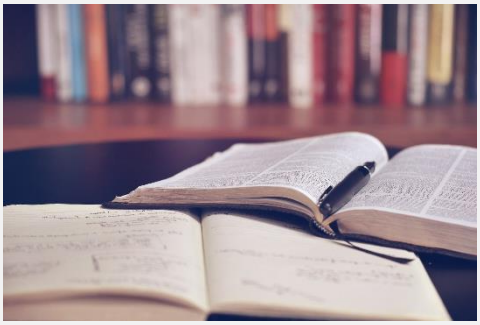
The spheres are normally not affected by conventional **accelerators** and **curing additives** used for rubber curing, such as sulphur, polysulfides, zinc oxides, and zinc organic substances.

For **cross-linking** of synthetic latices, guidance should be sought from the latex supplier. When expanding microspheres in situ, the curing cycle should be optimised — not too rapid to hinder expansion of the spheres and not too slow to minimise the effect of temperature on the spheres.

Immediately after applying the **compound**, while it is still **wet**, the substrate should be **dried**, **expanded**, and **cured**. If the applied compound is **dried before expansion**, it will produce a **controlled, uniform cell structure** created by the expansion of the microspheres. If the compound is **expanded without drying**, it will produce larger **voids** in the matrix due to the boiling of the water in the compound. Voids formed in this way cause a nonuniform appearance of the foamed layer, such as a **rough surface**.

Suitable drying and **curing temperatures** depend on the type of unexpanded microsphere, binder, weight of the deposit, and type of substrate. For drying, typically, the temperature is set between 30 and 100°C. **Expansion** of the microspheres takes place during the curing of the binder by using contact heating, hot air, steam, or IR techniques. For curing, the temperature may be set between 140 and 180°C.

The **temperature** of the drying and curing processes and the heating time must be **adjusted** carefully to achieve **maximum expansion**. If the temperature is too high or the heating time is too long, the microspheres may collapse and become discoloured.



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.

Unexpanded microspheres can be used to formulate debonding adhesives to allow articles made of different materials to be separated and recycled at end of life, for more information refer to our **Application Guide – Expandable Microspheres in Adhesives.**

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 about using expandable microspheres in paints and coatings, refer to our **Application Guide – Paints & Coatings with Expandable Microspheres**.

WoDo 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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