PROPERTIES

OF EXPANDABLE MICROSPHERES

Discover the properties and benefits of using ultra-lightweight expandable microspheres

OVERVIEW

Product Type
Expanded microspheres
Unexpanded microspheres

Main Benefits
Controlled foaming
Improved product properties
Lower volume unit cost
Reduced weight
Sound/vibration damping
Uniform cell structure

Applications
See 'Further Reading' section, too many applications to mention here!

What are they?

Expandable microspheres are small thermoplastic spheres, consisting of a polymer shell encapsulating a gas.

When **heated,** the internal pressure from the gas increases and the thermoplastic shell softens, resulting in a **dramatic increase** of the **volume** of the microspheres. The microspheres **expand** up to **60 times** their original volume, imagine a tennis ball increasing to the size of a football! The gas remains inside the spheres.

Expandable microspheres can be used as a physical **blowing agent** or a **lightweight filler**. Their expansion power, ultra-low density and elasticity gives a wide variety of **benefits** in a diverse range of **applications**.

Expanded Microspheres

Unexpanded Microspheres

Unexpanded microspheres are used as **blowing agents**, where their controlled foaming gives a **closed cell** and **uniform** foam structure.

Additional benefits include **shorter cycle times**, **stability** during processing and attractive **surface finishes**.

The unexpanded spheres can also be used to **create internal pressure** by post expansion, and **reduce shrinkage**.

Available with **different thermomechanical behaviours** makes it possible to select a grade to work with your application and process.

Unexpanded microspheres can be used in many different **binders**, **polymers** and **substrates**. If required, they can be used with chemical blowing agents.

Unexpanded microspheres are also available in **masterbatch** form for use with thermoplastics in granular form.

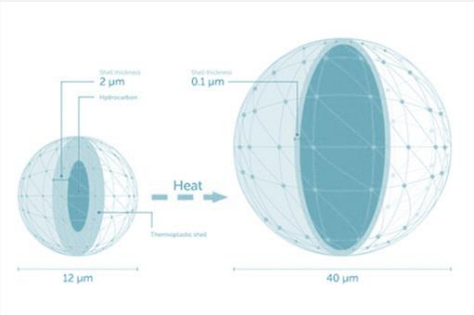
Expanded microspheres, with **densities** as **low** as **0.025 g/cm³**, are used as **lightweight fillers** to reduce **weight**, increase **volume**, lower **costs**, improve **product properties** or create desirable **aesthetic finishes**.

They are used in processes where there is **insufficient heat** for expansion of the microspheres during a process, or when the **matrix crosslinks** at temperatures **lower than** the expansion temperature of the microspheres.

With a **lower density** than **ceramic** or **glass** microspheres, a small addition of expanded microspheres can significantly **reduce** the **density** of a product.

It is also possible to **reduce binder content** without losing desired product properties, reducing formulation costs further.

Boud Minerals produce **dry expanded microspheres** in the **United Kingdom** to bring down costs, make production more environmentally friendly and improve product availability. This gives our **customers** more freedom in the choice of densities and packaging.



Weight & Water

Expanded microspheres

Size Matters

When expandable microspheres start to **expand** their **diameter** will increase and the **shell thickness** will decrease.

The **specific area** will decrease when measured as m^2/dm^3 and increase when measured as m^2/kg.

Expanded microspheres are available in different particle sizes. **Smaller particle sizes** are used to achieve smooth finishes in applications such as bodyfillers, paint, etc.

Larger spheres have thicker shells and therefore better chemical, mechanical and temperature resistance compared to small spheres. Larger particle sizes are also used where a more noticeable tactile finish is required.

Expanded microspheres have a **particle size** in the range 20 to 80 microns, and a **shell thickness** of approximately 0.1 to 0.2 µm.

To **reduce weight**, expanded microspheres can be added to a matrix in different amounts, but the most common is 0.5 to 4.0% w/w.

The low addition is due to extremely low density. With expanded microspheres, less spheres are required in order to achieve a **low density**.

This means the density of a binder, or resin, can be reduced without a dramatic increase of viscosity.

Expanded microspheres can be added in much **lower quantities** by weight **than glass microspheres** to give the same volume.

Expandable microspheres are closed cells which makes them suitable for applications where **reduced water absorption** is needed.

Flexibility

The thermoplastic shell of expandable microspheres softens when heated and when the temperature returns to normal the shell stiffens again. The thin walls that enclose a gas make it possible for the shell to **compress**.

Particle size and shell thickness influence this compressibility, which allows the microspheres to have an **elastic behaviour**, which contributes to a **lower compression set**.

Unlike ceramic and glass microspheres, **expandable microspheres** are **resilient**, and used to keep or improve resilience in different products.

Another important feature for expanded microspheres is their **flexibility**. The microspheres will be compressed under pressure but as soon as the pressure is released they regain their **original shape.**

There will be differences in behaviour between grades; how easy they are to compress and how fast they recover.

Thanks to this extremely **high resilience**, expandable microspheres can withstand several cycles of loading/unloading without breaking.

This characteristic is frequently used to make products **withstand higher mechanical stresses** without being destroyed, also reducing their weight.

This also means the microspheres can withstand **hard mechanical mixing** and be passed through **spray guns**.

Final Finish

With expandable microspheres

Expanded microspheres in a paint or coating application will lower the gloss, producing an **aesthetically pleasing** suede / matting effect on the surface.

By adding expanded microspheres to a putty, the creamy butter-like consistency will make **application easier** and **sandability** will be significantly improved, in comparison to glass microspheres, with **less wear on tools**.

The **dust** from sanding contains broken microspheres **without sharp edges**. Broken inorganic microspheres, such as ceramic or glass,, may cause eye and skin irritation.

By choosing a smaller particle size you will get a **smoother surface finish**, with no pinholes.

Shrinkage will also be reduced.

Chemical Resistance

Insulation & Heat Resistance

Expanded microspheres have excellent **heat insulation** properties. They are used in different applications and even **electrical insulation** properties can be improved. Insulation improves with an increasing amount of microspheres.

For applications where **heat resistance** is important, the choice of expanded microsphere grade can be important.

In applications where high temperature is needed to dry or cure the system, spheres with polymer shells based on polyacryonitrile (PACN) offer excellent **temperature resistance**.

In comparison to grades based on polyvinylidene dichloride (PVDC), PACN grades withstand a higher temperature or longer exposure time before breaking down.

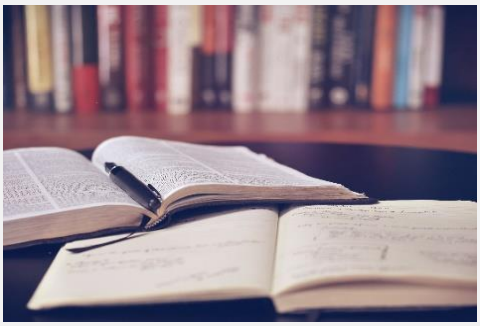
Microspheres with polymer shells based on PACN are chlorine-free products and sometimes preferred for environmental reasons.

For heat resistance, and chemical iresistance, It is recommended you carry out your own tests for your expandable microspheres application.

Expandable microspheres are **resistant** to many **chemical** substances, but **some** chemicals **affect** the elasticity of the **polymer** shell, particularly when stored for a long time, at elevated temperatures or mixed at high shear rates. As guidance:

24 hours at 40°C	**PACN**
10% Hydrochloric acid	●
10% Sodium chloride	●
10% Sodium hydroxide	●
10% Sulphuric acid	●
Acetone	●
Butyl diglycol acetate	●
Butyl glycol	●
Ethanol	●
Ethyl acetate	●
Ethylene glycol	●
Iso-propanol	●
Methanol	●
Methyl ethyl ketone	●
Propylene glycol	●
Styrene	●
Toluene	●
White spirit	●
Xylene	●

- ● No unfavourable effects anticipated
- ● Use with caution
- ● Contact not recommended



Further Reading

Our **Application Guides** and **Case Studies** show the many different ways in which expandable microspheres can be used:

- Adhesives
- Automotive bodyfiller
- Concrete
- Crack filler
- Elastomeric coatings
- Fairing compounds
- Faux leather
- Faux marble
- Filling compounds
- Leather finishing
- Lightweight foam
- Modelling board
- Modelling clay
- Paints & coatings
- Plastisols
- Polyester putty
- Porous ceramics
- Printing ink
- Rubber
- Sealants
- Silicone rubber
- Technical textiles
- Thermoplastics

If your application is not listed, then please get in touch so we can help you.

What's Next?

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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