KÖSTROSOL® for the investment casting industry

General

KÖSTROSOL is a colloidal solution of dispersed SiO_2 particles in water (colloidal silica). The particles are not visible to the naked eye, but are clearly identifiable under an electron microscope.

The colloidal silica is odourless, non-flammable, miscible with water in any ratio and is opaque to milky white in appearance.

Colloidal silica must be protected from frost since otherwise the silicic acid flocculates irreversibly, thus making the colloidal silica useless.

Frost-protected KÖSTROSOL should also be transported and stored in such a way that it is protected from frost. In contrast to *unprotected* colloidal silica this product can be thawed successfully after being affected briefly by frost.

The first two numbers of the nomenclature of KÖSTROSOL products denote the particle size in *nm* and the last two numbers denote the solid content in percent by mass.

Application

KÖSTROSOL 0830 and KÖSTROSOL 1030 are used as binding agents for various substances such as silicate refractory materials, natural stone and metal pigments.

The main area of application is the precision casting industry where colloidal silica is used with refractory mould materials and additives for the production of immersion compounds, in particular for the primary coating and, if applicable, also for the secondary coating of ceramic moulds and cores.

If colloidal silica is used as a binding agent for immersion compounds, gelling and curing takes place on the mould surfaces. The gelling is caused by the removal of amorphous silicic acid particles from the colloidal colloidal silica solution.

Ceramic moulds are used in precision foundries for the production of precision castings using the dewaxing or Shaw method, using colloidal silica as a binding agent. The dewaxing method is extremely widely used. A wax model is immersed in a suspension consisting of the binding agent solution and fine grain refractory material and coarse fillers are then scattered on to it.
After this first coating, which has a major bearing on the surface properties and dimensional accuracy of the later castings, has dried the second and all other coatings are applied.

Colloidal silica is easily miscible with refractory materials such as zircon oxides, quartz flour, chamotte, sillimanite, molochite, cristobalite or mullite, resulting in suspensions with a long service life and reproducible properties.
The binding agent suspensions can easily be added to anionic or non-ionic wetting agents and froth killers.

Drying the ceramic mould results in the mixture, which consists of refractory material, hardening, with the colloidal silica being responsible for producing the high initial strength of the mould. After this the wax is melted (for example using a steam autoclave) and the ceramic moulds heated to a temperature of 900°C before the molten metal is fed into them.

Excellent durability values and very high strengths of the casting moulds can be achieved if colloidal silica is used as the binding agent. The reject rate of the moulds during the firing process is minimal since colloidal silica offers high heat shock resistance. Its relative insensitivity to molten metal is another prerequisite for achieving a perfect, very smooth surface and high precision of the finished castings.
After the castings have cooled the ceramic mould is removed, for example using a cleaning vibrator and final lye treatment.

Specimen application of a binding agent solution for the primary coating

Production of the immersion compounds

KÖSTROSOL 0830 or KÖSTROSOL 1030
+ 0.1 – 0.5 % anionic or non-ionic tensides
+ 0.1 – 1.2 % froth killer
2.7 – 3.4 kg refractory material/l colloidal silica, ideally zircon silicate with a grain size of around 325 mesh

The quantities of tensides and froth killer relates to the volume of colloidal silica. The substance should be added before the addition of the refractory materials.
A zircon silicate with around 50 – 80 mesh is recommended for sanding. However, other refractory materials, such as quartz, mullite or molodite may also be used. The primary coating must cover the wax model with a complete, relatively dense film.

Pre-treatment of the wax models

Before applying the primary coating the wax models must be washed with a cleaning fluid (isopropyl alcohol or trichloroethylene) and then rinsed with water. The wax model must be dried before the first immersion coating is applied.

Application of the primary coating, sanding and drying

The immersion compound temperature should be 22 – 24°C. Ideally it should be mixed continuously.
A fine-grain refractory solid material (“sanding”) is applied to hold the immersion coating. The primary coating must be allowed to dry for around two hours in a temperature of 23 – 28°C and

relative humidity of 30 – 60°C before the secondary coating is applied with ethyl silicate or colloidal silica.
Application of the secondary coatings, sanding and drying

Colloidal silica or ethyl silicate can be used for the secondary coatings.

Possibilities	Benefits	Drawbacks
Silica sol primary coating Secondary coating ethyl bound with silicate	Used most frequently since flexible High strength of the shells by different air drying times times before ammonia hardening may adjust the shell strength to suit the requirements	Two different binding agents with different properties, alcohol vapour
Primary coating +2nd coating Colloidal silica-bound 3rd and 4th coatings ethyl silicate-bound	Higher shell strength, resistance to deformation even at high temperatures high dimensional accuracy, good drying and production times	Two different binding agents with different properties, alcohol vapour
Silica sol primary coating bound Secondary coating silica sol and ethyl silicate bound	Double immersion procedure for secondary coatings Both binding agents harden each other chemically Low cost production	Two different binding agents with different properties, longer drying times
Primary and secondary coatings silica sol bound	Only 1 binder, simply handling Immersion compound is easy to monitor High strength of mould shells	Removal of moulding shells from casting more difficult, Not ideal with difficult wax models, longer drying times
Primary and secondary coatings ethyl silicate bound	Only 1 binding agent Process acts quickly	Alcohol vapour Immersion compound tends to destabilise as a result of high moisture

Recommended products: KÖSTROSOL 0830.

KÖSTROSOL 1030

Safety data

Proportion of crystalline silica	None
Harmful, toxic, inflammable	No
Other data	See Material Safety Data Sheet

Packaging, transport, storage

KÖSTROSOL is packed in 200 litre plastic barrels and in 1000 litre plastic containers. The product can also be delivered in tanker vehicles if the customer requires large quantities.

The product must be stored and transported in sealed and light-impermeable packaging at temperatures between 5 and 25°C. Colloidal silica products freeze in temperatures below 0°C, flocculate irreversibly when they thaw and are thus rendered useless.

It is possible to protect the colloidal silica products from the effects of frost by using an anti-freeze agent so that they can be thawed successfully after they have frozen. Frost-protected colloidal silica products are only supplied if specially requested by the customer.