

Micro-Cements for Injection Grouting

Introduction

Micro-cements are superfine cements, ground in special mills to a defined particle size. Their use has become widespread in Japan and North America for the grouting of fine to medium grade sands, not groutable with ordinary cement grouts.

In Scandinavia, ultrafine and microfine cements are used extensively in the pre-grouting (and post-grouting) of rock tunnels for consolidation and water tightening of the rock. Rapid hardening cement or OPC might be used in cases of larger fissures.

Micro-cement grout has become an accepted means of overcoming the problems of toxicity, low strength and uncertain permeability associated with the chemical grouts normally used for fine granular soils.

As a consequence of its reduced maximum grain size, the permeation characteristics of the micro-cement grouts are comparable to those of chemical grouts (Figure 1), such as silicates and acrylamides.

The advantages of using micro-cements include:

- ✓ Able to replace chemical fluids and gels (Figure 1)
- ✓ No toxicity or environmental problems
- ✓ Higher strengths and durability than chemical gels
- ✓ More economical compared to chemical injection
- ✓ Better permeation and tightness characteristics than normal cements (Figure 1)

The MultiGrout® System incorporates OPC/Industry/GP, microfine and ultrafine Portland cements to cover the full range of grouting needs:

- ✓ **Ultrafine Cements** – two grades, max. particle size < 16µm and max. particle size < 12µm, for fine penetration injection grouting.
- ✓ **Microfine Cement** - max. particle size < 20µm & max. particle size < 30µm sulphate resistant cement, for less demanding penetration injection grouting.

Applications

As part of the MultiGrout® System, the micro-cements can be used in a variety of grouting applications in underground and civil engineering applications:

- ✓ Rock injection - pre-injection, post-injection, rock stabilization, curtain grouting
- ✓ Soil injection - stabilization, water tightening, control of ground water
- ✓ Grouting of anchors - in rock and soil
- ✓ Injection of cracks in concrete

Injection grouts	Gravel	Sand			Silt	Clay
		coarse	med.	fine		
Cementitious						
Micro-cement	→					
Cement	→					
Bentonite	→	→				
Sodium silicate	→	→	→			
Chemical						
Lignin	→					
Urea resin	→					
Acrylamide	→					
Grain Size (mm)	2	0.5	0.25	0.074	0.005	
Permeability (cm/s)	10 ⁻⁰	10 ⁻¹	10 ⁻²	10 ⁻³	10 ⁻⁴	10 ⁻⁵

Figure 1 Effectiveness of micro-cement grouts

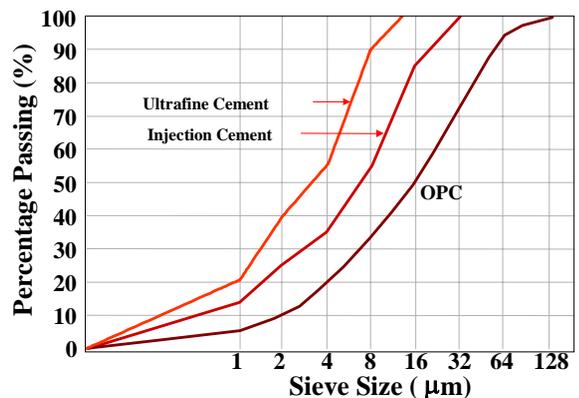


Figure 2 Particle Size Distribution

Particle Size

The particle size distribution of the ultrafine and the microfine cements are shown in Figure 2. The surface area shown below is measured by the BET (nitrogen absorption) method.

Cement	d ₉₅	d ₅₀	Surface Area, m ² /kg (BET)
Ultrafin 12	10µm	3µm	2200
Ultrafin 16	14µm	5µm	1600
Microfine 20	19µm	6µm	2600
Injektering 30	22µm	7µm	1250

Stability

Generally micro-cements improve the stability of injection grouts as compared to grouts with OPC. However, in order to penetrate the finest fissures it is desirable to inject high water/cement-ratio grouts. The use of GroutAid®, a silica fume (microsilica) - based additive developed for use in combination with injection cements, is always recommended. Extremely “thin” grouts can be injected without problems with bleeding and fluid loss.

Setting

As tunnelling often has to stop during grouting, the setting time of the grout is important. The use of the Blocker Cement System in combination with injection cements ensures full control and flexibility during the grouting operation. Nominal setting time of the ultrafine and the microfine cements is 80 and 140 minutes, respectively.

Manufacture

Our micro-cements are manufactured in Sweden, from selected clinker, and ground in a specially designed and patented mill. The cements are also chromate-reduced complying with European Directive 2003/53/EG. The microfine cement complies with Swedish Standard 134201 and CEM I 52.5 LA/SR and ultrafine cements comply with Swedish Standard 134201 and CEM I 52.5 R/LA/SR.

Packaging

Standard packaging is 20 kg, multi-layer paper bags. Forty or twenty bags per pallet, shrink-wrapped.

DISCLAIMER:

The information given on this data sheet is based on many years of research and field experience and is accurate to the best knowledge of MultiGrout personnel. However, due to the numerous factors that can affect the performance of injection grouts, with or without our products, MultiGrout offers this information without guarantee and accepts no liability for any direct or indirect damages from its use. If further information or assistance is required, please contact your local representative or the office number given on this datasheet.

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Storage & Shelf Life

Being finely ground, micro-cements may become more sensitive than ordinary cement to storage conditions. Storage in an environment with damp air, or in direct exposure to moisture, will quickly damage the cement. The cement should not be stored for more than six months, since the chromate reduction gradually loses its effect.

Mixing & Use

When mixing injection cements, it is essential to use a high-speed colloidal mixer (1,500+rpm), that works by recirculating the grout through a centrifugal pump. The pump imparts a shearing force to the grout as it passes through the narrow steel pump casing. The pump discharges the grout tangentially into a vertical cylindrical tank, causing a vortex to form. The centrifugal force created throws the heavier, unmixed fraction of grout against the tank walls, where it runs down the wall and re-enters the pump for further mixing. Colloidal mixing should always be specified in contract documentation.

Handling

The micro-cements, like any cementitious product, should be handled by taking appropriate precautions and using the appropriate safety equipment. Please consult our Material Safety Data Sheet.

The MultiGrout Team

The MultiGrout activities extend well beyond materials supply.

These activities also involve a core group of technical specialists providing four key service elements to MultiGrout clients:

-  Materials supply
-  Application methodology
-  Education / on-the-job training
-  Engineering / design support

MultiGrout® Global Contacts: for all technical & commercial enquiries



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