

GroutAid®

Microsilica Additive Essential for Improving Cement Injection Grouts

Introduction

GroutAid®, a silica fume (microsilica) -based additive for use in combination with microcement and other cement-based grouts, has been developed by Elkem Materials of Norway during the last decade.

The use of GroutAid will increase the efficiency of injection grouting by improving both the plastic and hardened properties of the grout, enabling injection into soils and cracks in rock and concrete.

This improved permeation capability of cement-based grouts further reduces the need to use chemical grouts with the subsequent advantages of cost reduction and environmental safety.

The advantages of using microsilica in cement-based systems are well known from concrete technology. The microscopic particle size and pozzolanic reactivity of microsilica act to reduce bleeding and segregation, develop stronger and less permeable concrete, and increase durability and resistance to chemical attack. These same properties are also important for injection grouts.



GroutAid - ready for action !

GroutAid® improves the properties of the injection grout and the injected formation :

- ✓ **Stability**
- ✓ **Penetration**
- ✓ **Strength**
- ✓ **Permeability**
- ✓ **Durability**
- ✓ **Environment**
- ✓ **Economy**

GroutAid® properties

GroutAid is an aqueous suspension of microsilica.

Chemical composition

SiO ₂	86% min.
Carbon	2.5% max.
LOI (Loss on Ignition)	3.0% max.
Alkali oxides	2.0% max.

Physical properties

Bulk density	1350-1410 kg/m ³
Solids content	50% ± 2%
Surface area dry (BET)	15 m ² /g min.
Viscosity	100 cP max.
Coarse particles (+45µm)	1.0% max.
pH	4.5 – 6.5
Color	gray

Packaging

GroutAid is packaged in 1000 liter containers or bulk.

Particle Size

The microsilica used in GroutAid production has been carefully selected and quality-controlled so that the coarse particles content is extremely low, ensuring complete compatibility with the finest of microcements. GroutAid particles are extremely fine (Fig.1) having more than 90% less than 1µm.

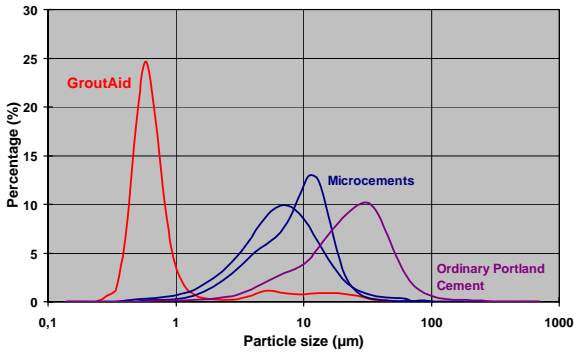


Figure 1. Particle size distribution of GroutAid compared to typical microcements and ordinary Portland cement.

Stability

A stable, non-segregating grout is extremely beneficial for successful injection. Stable grouts will ensure that cracks and voids will be more thoroughly filled, which can lead to reduced need for injection. The important parameters to determine the stability of an injection grout are bleeding and fluid loss.

The addition of GroutAid means the addition of a great number of extremely fine particles of very high specific surface area. This very high surface area and corresponding internal attraction forces, keep the cement and microsilica particles suspended without settling within the water, even at high water/powder ratios.

Pure cement grouts are stable only up to water/powder ratios of approximately 1.0. However, stable grouts with water/powder ratios as high as 6.0 can be made by replacing a proportion of the cement with GroutAid (Fig. 2).

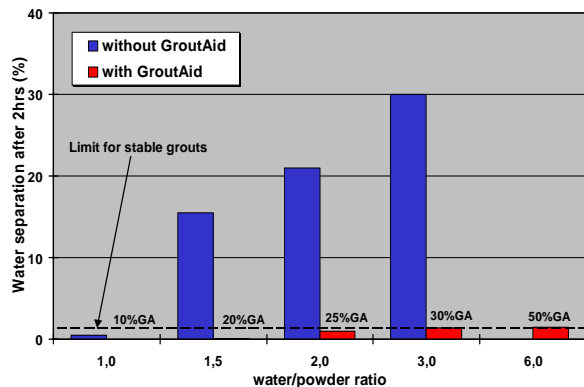


Figure 2. Stabilizing effect of GroutAid

Penetration

The extremely fine particles of GroutAid fill the voids between the cement particles (Fig.3) and produce an injection grout with minimal bleeding and segregation.

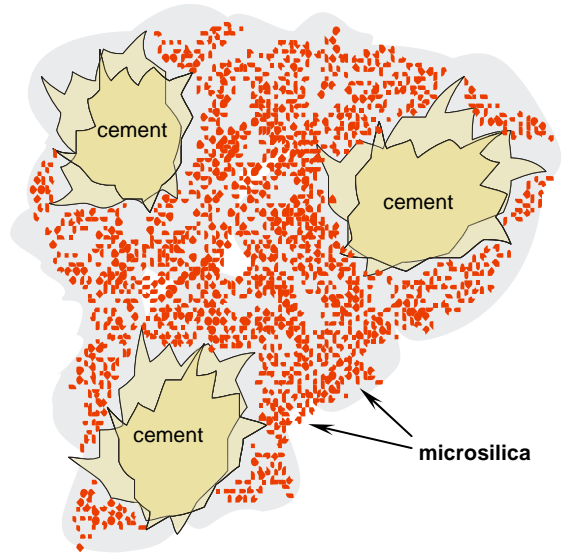


Figure 3 Ultrafine microsilica particles fill the voids between the cement grains.

Since the water is not forced from the grout under the pressure of injection, the solids remain in suspension and are not deposited in cracks or pores close to the borehole. The homogeneous grout flows into the formation.

At the same dry solids content, a grout based on GroutAid and cement will have improved penetrability compared to a pure cement-based grout (Fig. 4).

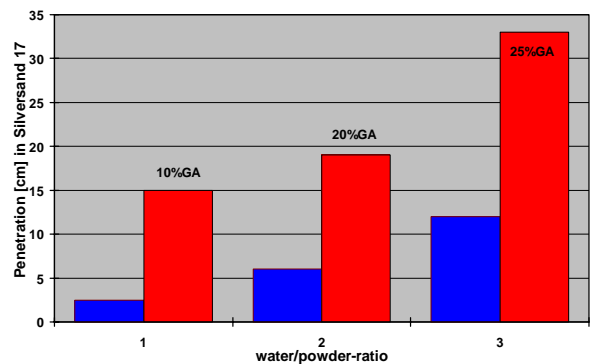


Figure 4. Penetration into Silversand 17 for injection grouts with varying water/powder ratios, with and without GroutAid

Strength

The microsilica particles in GroutAid react with the calcium hydroxide that forms during the hydration of the cement. This creates an increased amount of binder, improving strength and durability. In addition, the ultrafine microsilica particles also provide an increased concentration of particles (Fig. 3) in an injection grout and improve the interface strength between the grout and the sand particles or rock. (Fig.5 and Fig.6). Even at very high water/powder ratios, acceptable strength of the injected formation can be achieved.

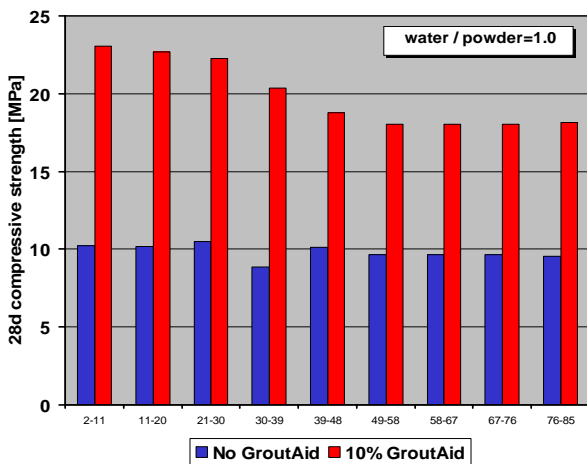


Figure 5. Compressive strength of injected sand at various depths, grouts with water/powder ratio 1.0, with and without GroutAid.

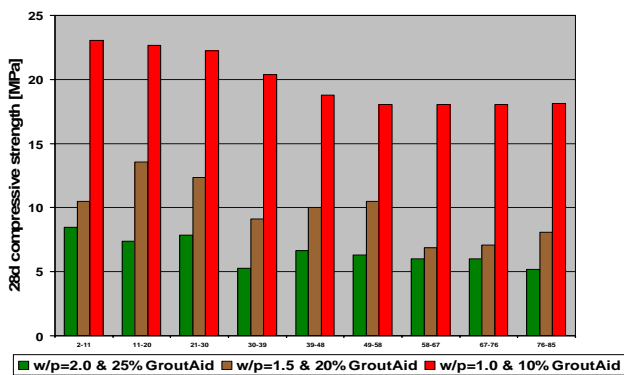


Figure 6. Compressive strength variation of injected sand with injection grouts of various water/powder ratios and varying % of GroutAid

Permeability

The addition of GroutAid to a cement-based injection grout will, at the same water/powder ratio, reduce the permeability of the injected formation. The reasons for this are improved filling of cracks and voids, and the improved interface between grout and sand particles or rock. Also the hardened grout has a lower permeability than the pure cement-based grout due to improved pore structure.

Durability

Most forms of chemical attack on a cement-based injection grout are typified by leaching of calcium hydroxide or by ingress of harmful substances.

Since microsilica reacts with and binds the more easily soluble calcium hydroxide, the use of GroutAid will reduce the permeability and the ingress of harmful substances.

As a consequence, injection work with grouts based on cement and GroutAid will show more resistance to chemical attack and thus have improved durability over work performed with pure cement-based grouts.

Environment

GroutAid is a non-toxic, mineral based product.

Injection grouts based on cement and GroutAid have a positive impact on the environment through:

- ✓ Reducing the need for potentially harmful chemical grouts.
- ✓ Reducing permeability that will contribute to a decreased risk of leaching of harmful substances through soils – such as in landfills.

Economy

GroutAid will provide a more cost-effective injection because:

- ✓ Improved penetration implies that cement-based injection can be performed in finer soils and cracks than was possible before, and may reduce the use of expensive chemical grouts.
- ✓ Improved penetration implies that the number of injection holes drilled can be reduced, or alternatively, that the total requirement for injection can be reduced.
- ✓ Material cost can be reduced since the “dry content” is reduced.



GroutAid at work in the Oslo Metro extension project.

Applications & Dosage

GroutAid® is suited to all applications where cement-based grouts are used currently.

Dosage can vary from 5% upward, depending on application and the nature of the cements. Specific advice may be provided by your MultiGrout® specialist representative or authorized agent.

GroutAid is a key component of the MultiGrout® injection grouting system – a complete suite of products for most injection grouting applications:

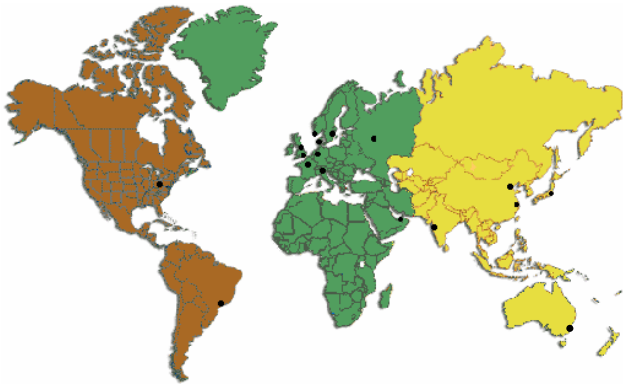
- ✓ Ultrafine & Microfine cements
- ✓ GroutAid®
- ✓ Dispersing Agent
- ✓ “Blocker” cement

The MultiGrout Team

The MultiGrout activities extend well beyond materials supply, and are supported through a world-wide network of representatives.

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



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 specialist representative or the office number given on this datasheet.

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