HOFFMANN MINERAL
Unternehmensgruppe Hoffmann

Neuburg Siliceous Earth in adhesives based on CR (polychloroprene) and UP (unsaturated polyester resin)

Authorship: Félix Vicente Mondéjar
Hubert Oggermüller

VM-2/0416/03.2025

HOFFMANN MINERAL GmbH • Muenchener Strasse 75 • D-86633 Neuburg (Donau) • Phone +49 (0) 8431 53-0
www.hoffmann-mineral.com • e-mail: info@hoffmann-mineral.com

1. What are mineral fillers?

Mineral fillers are solid ingredients used as additives in adhesives, coatings, rubber, polishing agents and other applications. Normally they are inorganic in nature, and they can be segregated into two categories, treated and untreated fillers or, active and inactive fillers. With active fillers better and specific mechanical properties can be targeted and this is the reason why active fillers are also called reinforcing fillers.

Reinforcing fillers until now were not very present in the production of adhesives, glues, putties, sealing compounds etc, if we do not consider carbon black and fumed silica. Increasing costs and market availability can be critical and therefore mineral fillers should be considered as potential alternatives.

Classic Neuburg Siliceous Earth is a natural combination of corpuscular Neuburg Silica and lamellar kaolinite: a loose mixture impossible to separate by physical methods.
As a result of natural aging, the silica portion exhibits a round grain shape and consists of aggregated primary particles of about 200 nm diameter.

Often fillers have to meet very special requirements. In many cases not only good dispersion characteristics are of importance, but also mechanical and dynamic properties of the final products. Improved tensile- and lap shear strength, electrical insulation resistance, better aging and fluid resistance as well as improved anticorrosion properties have a crucial role to play in many areas. At Hoffmann Mineral, we developed Aktisil to meet such customer requirements.

2. What are CR Adhesives?

Contact adhesives based on Polychloroprene exhibit performance advantages in a wide variety of related applications where quick, high strength and permanent bonds are needed.

About one third of CR production is used as a raw material for adhesives, both solvent and water based.

Typical applications for CR adhesives are bonding of high pressure laminates, automotive trim, roofing membrane attachments, furniture, kitchen cabinets, shoes, etc…

3. Surface-treated Neuburg Siliceous Earth and surface-treated Calcined Neuburg Siliceous Earth

These special fillers are produced by treating the surface of Neuburg Siliceous Earth with chemical agents, especially silanes. The reaction by-products (e.g. alcohol) formed during the manufacture of the different types of Aktisil are largely removed right away during the process. The coupling reaction fixes the silane to the surface of the filler. Any undesirable side-effects that can occur during mixing by direct addition of the silane are virtually eliminated. The customer can choose today from a complete product range of many different types of Aktisil. This is the result of many years of in-house experience and of close cooperation with customers. Know-how for the users' benefit.

Apart of Aktisil we have also developed a calcined range of products, including Silfit Z 91, which is the calcined version of Sillitin Z 86, and also different Aktifit grades, which are the activated versions of Silfit Z 91.

Aktifit grades are produced by modifying the surface with functional silanes similar to the Aktisil grades based on the traditional Neuburg Siliceous Earth.

4. Puriss technology

The Sillitin puriss grades of Neuburg Siliceous Earth are created by a downstream process. The puriss grades are characterized by significantly improved dispersing behavior in critical systems. These include all non-aqueous formulations, in particular solvent-free polyester, epoxy, polyurethane and acrylate systems in which the fillers and pigments are dispersed with dissolvers or similar equipment. The already low proportion of oversized particles, represented by the screen residue > 40 µm, is further reduced compared to standard Sillitin.
Both effects, improved dispersing behavior and lower oversize particle content, result in a reduction of the abrasive effect and thus reduce wear on processing equipment.
The calcined Silfit and Aktifit grades are very similar to puriss products in terms of oversize particles content and dispersion properties.

5. Results in different adhesive applications

When selecting surface-treated fillers, it is important to bear in mind that, in addition to the functionality of the mineral base, silane functionality must also match the system.

5.1 Polychloroprene Adhesive

Formulation (% w/w):

17.0 %	Polychloroprene (CR)
0.7 %	MgO
0.6 %	ZnO
9.0 %	Alkylphenolic resin
72.7 %	Solvents mix

On this basis, 10 parts by weight each of Neuburg Siliceous Earth products were added.

Test	Adhesive base	+ Filler	Adhesion strength N/mm	Enhancement
1	100	no filler	8.9	
2	100	10 Sillitin Z 86 (puriss)	8.7	-2.2 %
3	100	10 Aktisil PF 216	10.2	**+14.6 %**
4	100	10 Aktisil PF 777	10.4	**+16.9 %**

Tested on rubber shoe soles.
Not tested herein, however recommended as well: Aktifit PF 111 and Aktifit AM.

This example clearly shows the positive effect of Aktisil as a surface-treated product with increased strength at relatively low concentration.

5.2 Mounting Adhesive Polyester-Acrylic Based

The partial substitution of the traditional filler by Aktisil VM 56, considering an unsaturated polyester resin with acrylic monomers, showed the following results in lap shear strength.

Formulation	**Compound 1 % w/w**	**Compound 2 % w/w**	
UP / Acrylic resin	50	50	
Filler	45	35	
Aktisil VM 56	-	10	
Peroxide	5	5	
Result			**Enhancement**
Lap shear strength N/mm^2	14-15	18-20	**+31 %**

Tested on bonding steel to ceramics.
Not tested herein, however recommended as well: Aktifit VM, Aktifit Q and Aktisil MAM

This example clearly shows the positive effect of Aktisil VM 56 as a surface-treated product with increased strength by partial replacement of the standard filler.

6. Neuburg Siliceous Earth grade recommendations

Recommended dosage depending on desired effect, around 10 %, up to 50 % possible.

- **For solvent based and solvent-free systems :**
  - Easy to disperse grades:
    - Sillitin V 88
    - Sillitin V 85
    - Sillitin N 85 puriss
    - Sillitin Z 86 puriss
    - Sillitin Z 89 puriss
    - Sillitin P 87 puriss
    - Silfit Z 91
    - Aktisil MAM (methacrylic silane treated)
    - Aktifit AM (amino silane treated)
    - Aktifit PF 115 (special amino silane treated, hydrophobic)
    - Aktifit VM (vinyl silane treated, hydrophobic)
    - Aktifit Q (methacrylic silane treated, hydrophobic)
    - Aktifit PF 111 (alkyl silane treated, hydrophobic) for thixotropic effect. Dosage up to 10 times of the usual rheology additive, e. g. synthetic silica.
  - More dispersion effort requiring grades:
    - Aktisil VM 56 (vinyl silane treated)
    - Aktisil MM (mercapto silane trated)
    - Aktisil AM (amino silane treated)
    - Aktisil PF 216 (tetrasulfane silane treated, hydrophobic)
    - Aktisil PF 777 (alkyl silane treated, hydrophobic) for thixotropic effect. Dosage up to 10 times of the usual rheology additive, e. g. synthetic silica.

- **For water based systems:**

  - All grades, depending on formulation also hydrophobic products.
    Hydrophobic products can be used case-by-case without additional measures. If necessary, the addition of wetting agent or glycol ether in the formulation helps.

7. Conclusions

These investigations have shown how much the selection of the right filler can contribute to better properties and, above all, in which surface-treated fillers can also improve the mechanical properties of adhesives. In such cases, the correct choice of the product used is particularly important to ensure optimum interaction between filler and polymer matrix.