Neuburg Siliceous Earth

in CR (polychloroprene) and

UP (un-saturated polyester resin)

based Adhesives

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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, cryptocrystalline and amorphous silica and lamellar kaolinite: a loose mixture impossible to separate by physical methods.

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 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. **The possibilities of treated Neuburg Siliceous Earth and 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, and also different Aktifit products, which are the activated versions of Silfit Z 91.

Aktifit is produced by modifying the surface with functional silanes. The by-products split off during the treatment reaction are largely removed during the production process which firmly attaches the silane to the filler surface. This helps minimize undesirable side effects, as they are potentially encountered with in-situ mixing (direct addition of silane to the compound).

Our puriss products are a natural combination of corpuscular, crypto-crystalline and amorphous silica with lamellar kaolinite. These two elements together form a loose structure which offers particular advantages in terms of application possibilities when puriss is used as a functional filler.
4. **Puriss technology**

The puriss grades of Neuburg Siliceous Earth are significantly finer than classic Sillitin. The extremely low portion of oversize particles is further reduced in comparison with standard Sillitin. The dispersion properties in low-viscosity systems are also greatly improved.

The calcined line is very similar to the puriss products in terms of oversized particles and dispersion.

5. **Results in different adhesive applications**

Using activated fillers it has to be born in mind that together with the functionality of the mineral itself, also chemical bonds can be established from the side of the silane used for coating the filler. The right activation is a key factor for ensuring the most suitable incorporation of the filler in the polymer matrix.

5.1 **Polychloroprene Adhesive**

Starting formulation (% w/w):
- 17.0 % Polychloroprene
- 0.7 % MgO
- 0.6 % ZnO
- 9.0 % Alkylphenolic resin
- 72.7 % Solvents mix

<table>
<thead>
<tr>
<th>Test</th>
<th>Adhesive base</th>
<th>+ Filler</th>
<th>Adhesion strength N/mm</th>
<th>Enhancement</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>100</td>
<td>no filler</td>
<td>8.9</td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>100</td>
<td>10 Sillitin Z 86</td>
<td>8.7</td>
<td>-2.2 %</td>
</tr>
<tr>
<td>3</td>
<td>100</td>
<td>10 Aktisil PF 216</td>
<td>10.2</td>
<td>+14.6 %</td>
</tr>
<tr>
<td>4</td>
<td>100</td>
<td>10 predecessor of Aktisil PF 777</td>
<td>10.4</td>
<td>+16.9 %</td>
</tr>
</tbody>
</table>

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

5.2 **Assembly 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 shear tensile strength.

<table>
<thead>
<tr>
<th>Raw Material</th>
<th>Compound 1 % w/w</th>
<th>Compound 2 % w/w</th>
<th>Enhancement</th>
</tr>
</thead>
<tbody>
<tr>
<td>UP / Acrylic resin</td>
<td>50</td>
<td>50</td>
<td></td>
</tr>
<tr>
<td>Filler</td>
<td>45</td>
<td>35</td>
<td></td>
</tr>
<tr>
<td>Aktisil VM 56</td>
<td>-</td>
<td>10</td>
<td></td>
</tr>
<tr>
<td>Peroxide</td>
<td>5</td>
<td>5</td>
<td></td>
</tr>
<tr>
<td>Tensile shear strength N/mm²</td>
<td>14-15</td>
<td>18-20</td>
<td>+31%</td>
</tr>
</tbody>
</table>

Tested on bonding steel to ceramics.
Not tested herein however recommended as well: Aktifit VM, Aktisil MAM
6. Neuburg Siliceous Earth grade recommendations

For solvent based and solvent-free (100%) systems:

Easy to disperse grades:

- Sillitin V 88
- Sillitin N 85 puriss
- Sillitin Z 86 puriss
- Sillitin Z 89 puriss
- Sillikolloid P 87 puriss
- Silfit Z 91
- Aktisil MAM (methacrylic silane treated)
- Aktifit AM (amino silane treated)
- Aktifit VM (vinyl silane treated, hydrophobic)
- Aktifit PF 111 (alkyl silane treated, hydrophobic) for thixotropic effect. Dosage up to 10 times the usual additive, e.g. synthetic silica.

More dispersion effort requiring grades:

- Aktisil VM 56 (vinyl silane treated)
- Aktisil MM (mercapto silane treated)
- Aktisil EM (epoxy silane treated)
- Aktisil AM (amino silane treated)
- Aktisil PF 216 (teta sulfane silane treated, hydrophobic)
- Aktisil PF 777 (alkyl silane treated) for thixotropic effect. Dosage up to 10 times the usual additive, e.g. synthetic silica.

For water based systems:

- All grades, except the hydrophobic grades:
  - Aktisil PF 216
  - Aktisil PF 777
  - Aktifit VM
  - Aktifit PF 111

These grades can be used if wetting agents or glycol ethers are present.

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

7. Conclusions

These first tests have shown that the right filler choice can be crucial for achieving better results, and especially, that surface treated fillers can enhance even more the mechanical properties of adhesives. In this last case the right choice is even more important to ensure a proper interaction between filler and polymeric matrix.

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