New multifunctional base for domestic fabric softeners

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Fabric softeners are liquid compositions added to washing machines during the rinse cycle to make clothes acquire a soft touch. These products work by depositing lubricating chemicals on fabrics treated to make them feel soft, reduce static cling, and impart a fresh fragrance. The first fabric softeners were developed by the textile industry during the early twentieth century. At that time the process used for dyeing cotton fibres granted a harsh feel to fabrics. In the early 1900s, preparations known as cotton softeners were developed to improve the feel of fibres after dyeing. Product development chemists created fabric softeners designed to meet specific marketing requirements, above all to grant attributes desired by consumers such as superior softness, aesthetically pleasing, safe to use, and cost effective. Chemists used technical evaluations based on consumer test marketing and created formulations that are both effective and affordable.

Early fabric softener formulas were relatively simple dispersions of fatty materials that would deposit on fibres after washing. One of the most common ingredients used was dihydrogenated tallow dimethyl ammonium chloride (DHTDMAC), which belongs to a class of materials known as quaternary ammonium compounds, or quats. This kind of ingredient is useful because part of the molecule has a positive charge that attracts and binds it to negatively charged fibres. This charge interaction also helps disperse the electrical forces that are responsible for static cling. The other part of the molecule is fatty in nature and it provides the slip and lubricity that makes the fabric feel soft.

While these quats do in fact soften fabrics effectively, they also make them less absorbent. This is a problem for certain laundry items such as towels and diapers. To overcome this problem, modern formulations use quats in combination with other more effective ingredients. The most popular Esterquat used in fabric softeners production is:

Methyl Bis[Ethyl (Tallowate)]-2- Hydroxyethyl Ammonium Methyl Sulfate = Esterquat

Esterquat products are available in solvent media (alcohols) at concentrations up to 90 percent. The presence of alcohol, as solvent, creates some problems in handling, stacking and production. Commercial Esterquats are flammable (ADR product), and the presence of alcohol imparts a typical smell composed of a mix of tallow and alcohol odour, obliging the formulator to exceed in the intensity and stability of perfume in terms of dosage and quality. Perfumes must cover the typical Esterquat smell and must have cationic media stability. A new class of fabric softeners has been developed with the aim to solve actual problems and offer additional performance advantages to classical fabric softeners. The new fabric softener studied has good softening performance, excellent stability, no odour, solvent free, and imparts at the same time considerable easy ironing effect.

In this article we will evaluate this new raw material for domestic fabric softening, list the advantages in comparison with classical Esterquats and examin the results of the performance tests (softening effect and easy ironing effect).

**Eterol 100**

**Aspect**
flaks / powder

**Active content**
min. 99%

**Odour**
absent

**Solvents**
absent

**Chemical description**
blend of quaternized long chained alcohols

**Polarity**
cationic

**Viscosity (2% sol.) 25°C**
1200 mPas

**Brook. sp3 rpm 6**

**EVALUATION OF SOFTENING EFFECT**

Test of softening effectiveness is based on a panel test involving 50 subjects that judged the “softness” of towels, cotton clothes, and mixed cotton-synthetic cloths (50/50) after a normal washing cycle and rinse treatment with a fabric softener based on Esterquats as well as Eterol 100.

**Washing Conditions**

- **Hardness of water** 25 °F
- **Temperature** 40°C
FORMULATION

Wash cycle: normal for cotton
Wash Machine: Miele W 3205
Detergent: Powder (market leader)
Softener quantity: 90 ml

<table>
<thead>
<tr>
<th>Reference</th>
<th>95g detergent</th>
<th>90 ml softener solution</th>
</tr>
</thead>
<tbody>
<tr>
<td>B</td>
<td>Powder detergent</td>
<td>6% Conc. Esterquat 90</td>
</tr>
<tr>
<td>C</td>
<td>Powder detergent</td>
<td>2% Conc. Eterol 100</td>
</tr>
<tr>
<td>D</td>
<td>Powder detergent</td>
<td>9% Conc. Esterquat 90</td>
</tr>
<tr>
<td>E</td>
<td>Powder detergent</td>
<td>3% Conc. Eterol 100</td>
</tr>
</tbody>
</table>

Fabrics have been dried at room temperature overnight.

SOFTNESS EVALUATION TEST

Due to the absence of an “official method” to evaluate softness of fabrics, we decided to evaluate it by means of a panel test involving 50 frequent users of fabric softeners equally distributed between men and women in the age range of 25-55 years old.

3 types of fabrics (cotton, towels and cotton/synthetic 50/50) were washed and treated with 90ml of 4 different softeners at 1, 5, and 10 treatment cycles.

Fabrics were cut in 50 equal pieces of 20 x 20 cm and marked B, C, D & E as above to identify the softening base and concentration used. Each piece was also marked with the numbers 1, 5, 10 to identify the treating cycle to help identify eventual cumulative effect.

Each evaluator was asked to give a comparative score between B1, C1, D1 & E1 granting the score 4 for the softest and score 1 for the least soft as well as for B5, C5, D5 & E5 And also for B10, C10, D10 & E10.

The softening performance of Eterol 100 at a concentration of 2 percent is slightly higher than the performance of an Esterquat at 6 percent concentration.

The softening performance on towels of Eterol 100 at a concentration of 2 percent is slightly higher than the performance of an Esterquat at 6 percent concentration.

The softening performance on mixed cotton/polyester 50/50 fabrics of Eterol 100 at a concentration of 2 percent is slightly higher than the performance of an Esterquat at 6 percent concentration.

Figure 1. Shows that on cotton fabrics there is no increased performance upon increasing the concentration of the Esterquat base (from 6 to 9 percent). Similar attitude is observed when the concentration of Eterol 100 is increased (from 2 to 3 percent).

Figure 2. Shows that on towels there is no increased performance upon increasing the concentration of the Esterquat base (from 6 to 9 percent). Similar attitude is observed when the concentration of Eterol 100 is increased (from 2 to 3 percent).

Figure 3. Shows that on mixed cotton/polyester 50/50 fabrics there is no increased performance upon increasing the concentration of the Esterquat base (from 6 to 9 percent). Similar attitude is observed when the concentration of Eterol 100 is increased (from 2 to 3 percent).
FORMULATION

SOFTENER RESIDUES ON FABRICS

Organic and inorganic residues have been detected on fabrics washed and treated 5 times. Organic residues have been determined by solvent extraction. Inorganic residues have been determined by means of gravimetric determination of ash at 550°C (mg/kg fabric treated).

<table>
<thead>
<tr>
<th>Fabrics treated 5 cycles</th>
<th>Organic Residue mg/Kg</th>
<th>Inorganic Residue mg/Kg</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Towels</td>
<td>Cotton-synthetic</td>
</tr>
<tr>
<td>Without softener</td>
<td>1</td>
<td>0.6</td>
</tr>
<tr>
<td>+90ml Eterol 100 (2%)</td>
<td>1.5</td>
<td>0.8</td>
</tr>
<tr>
<td>+90ml Esterquat 90 (6%)</td>
<td>1.35</td>
<td>0.8</td>
</tr>
</tbody>
</table>

Presence of higher residues detected on fabrics treated with 2 percent Eterol 100 as well as fabrics treated with 6 percent Esterquat 90 justifies the increased performance in terms of “softening effectiveness”.

EVALUATION OF EASY IRONING

The method used for the evaluation of the “easy ironing effects” of softener consists of a panel test involving the same group of people that tested the softness of fabrics. Each subject was asked to iron the fabrics B5, C5, D5 & E5 dried in standard conditions in addition to fabric A washed but not treated with any softener.

A) Not treated with any softener (blank)
B) Washed & Treated 5 times with fabric softener (6 percent Esterquat 90)
C) Washed & Treated 5 times with fabric softener (2 percent Eterol 100)
D) Washed & Treated 5 times with fabric softener (9 percent Esterquat 90)
E) Washed & Treated 5 times with fabric softener (3 percent Eterol 100)

Washing conditions
Hardness of water 25 °F
Temperature 40°C
Washing cycle normal for cotton
Washing Machine Miele W 3205
Detergent Powder market leader

Treatment conditions
Eterol 100 (2% conc) 90 ml
Esterquat 90 (6% conc) 90 ml
Eterol 100 (3% conc) 90 ml
Esterquat 90 (9% conc) 90 ml
Blank Without softener

Ironing Condition
Iron Jura K30
Temperature Cotton, Cotton – synthetic (as indicate in the iron)
Each evaluator was asked to give a comparative score between A, B5, C5, D5 & E5 granting the score 4 for the easiest to iron and score 0 to the most difficult to iron.

CONCLUSION

Panel test shows that the softening performance of Eterol 100 at 2 percent concentration is similar to that obtained with 6 or even 9 percent concentration of a classical Esterquat 90. Softeners based on special blends of long chained quaternized alcohols such as Eterol 100 perform at low concentrations better than classical softeners based on Esterquats in terms of fabric softening, easy ironing, and fragrance stability.

The suggested dosage of Eterol 100 being 3 times lower than classical Esterquats imparts a reduced environmental impact. The absence of solvents and fatty odour further reduces the quantity of fragrance and the formula cost. The functional attributes and advantages with respect to classical Esterquats can be summarized in terms of:
- Better softening performance at lower dosage.
- Easy ironing effect free of silicone based additives.
- Stable fragrance carrier free of fatty odour.
- Free of solvents and easily biodegradable.
- Good fabric re-wetting properties.
- Easy to dissolve in water.
- Flexible viscosity control.
- No negative effect on fabrics colour.

The rheology of softeners based on Eterol 100 can be adjusted in function of the temperature of dissolution, this makes their preparation particularly flexible and provides considerable savings on thickening additives.

**In cold process preparations**

2 percent of ETEROL 100 is dissolved in water at ambient temp. under constant stirring till a medium viscosity liquid is obtained; 1200 mPas (Brookfield at 25°C, rpm 6 sp.3).

**In hot process preparations**

2 percent of ETEROL 100 is dissolved in water at 60-65°C under constant stirring until complete dissolution, after slow cooling under constant stirring a much higher viscous solution is obtained that can reach up to 6000 mPas (Brookfield at 25°C, rpm 6 sp.3). Intermediate viscosities can be obtained with faster cooling. Both dissolution processes do not require any special equipment due to the absence of solvents.

**REFERENCES AND NOTES**

1. H.G.Hauthal, Household cleaning, care and maintenance product, Wagner Editor, Germany.
2. SSOG, fabric softener performance test, Milano, Italy.