SOLAGUM™

New thickeners and emulsifiers for industrial applications

- Liquid form
- Ready to use
- Stir-in for instant thickening
- Emulsifying properties
- Stable viscosity at all pH: 0 to 14
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1 - DESCRIPTION

The SOLAGUM range is a family of multipurpose thickeners and emulsifiers which are extremely easy to use.

They are aqueous solutions of copolymers dispersed in isoparaffin.

The SOLAGUM product range is composed of three grades which are distinguished from each other essentially by flow characteristics, pH stability of their gels, thickening effect on solvents and emulsifying power:

- SOLAGUM SF 306
- SOLAGUM SH 210
- SOLAGUM SJ 108

2 - EASE OF USE

SOLAGUM is unique because of its ease of use:

- it is in liquid form,
- it requires neither neutralisation, heating nor dispersion,
- it has instantaneous thickening and emulsifying effects.

The simple addition of water, appropriate solvent, mixture of solvents or water/solvent blends to SOLAGUM gives instantaneous gels at room temperature.

ADD WATER TO SOLAGUM AND STIR
3 - FLOW CHARACTERISTICS OF AQUEOUS GELS OF SOLAGUM

3.1 - Effect of SOLAGUM concentration on the viscosities of aqueous gels

Figure 1 shows the effect of SOLAGUM concentration on the viscosities of aqueous gels.

**Figure 1**: Viscosity of aqueous gels in relation to SOLAGUM concentration.

3.2 - Pseudoplastic and non-thixotropic flow

Figure 2, where the apparent viscosity is plotted versus the shear rate, shows that a 3 % wt SOLAGUM SH 210 aqueous gel is pseudoplastic: apparent viscosity falls with an increase in speed.

Further studies have demonstrated that all the SOLAGUM gels are pseudoplastic.
Another way of describing the flow behaviour is to study the shear stress at various shear rates. Studies have demonstrated that all the SOLAGUM gels show a non-thixotropic flow: recovery of viscosity when the stress is removed is not time dependant.

4 - HIGHLY ALKALINE AQUEOUS GELS

4.1 - SELECTION OF SOLAGUM THICKENERS

All the SOLAGUM thickeners can be used to prepare stable highly alkaline gels.

However, taking into account the cost/performance ratio, SOLAGUM SF 306 is the best candidate to thicken highly alkaline formulations.

The thickening performance of SOLAGUM SF 306 towards 10% and 25% NaOH solutions are shown in Figure 3, where viscosity is plotted versus thickener concentration after 1 day and 3 months ageing at 20°C.
4.2 - Method for preparing aqueous alkaline gels with SOLAGUM

Two procedures can be used to prepare aqueous alkaline gels with SOLAGUM:

- Direct procedure: Add under stirring SOLAGUM to the alkaline solution to be thickened.

  OR

- Pregel procedure: Add under stirring the alkaline solution to a concentrated aqueous pregel of SOLAGUM.

Both procedures result in the same viscosities. However, the pregel procedure is less time consuming.

For alkaline formulations, maximum thickening is achieved within one day.
4.3 - Example of applications

HIGH CAUSTIC OVEN AND GRILL CLEANER
DTF 105

Formula

- SOLAGUM SF 306 6.0%
- NaOH (100%) 25.0%
- SIMULSOL NW 342 0.5%
- Water qs 100%

MIXING INSTRUCTIONS
Prepare a pregel with Solagum SF306 and one third of water, add under stirring Simulsol NW 342, NaOH in 50% solution and the rest of water.

CHARACTERISTICS
Appearance : opaque gel
Viscosity after 7 days at 25°C : 8500 mPa.s (Brookfield LVT 6rpm)
Viscosity after 3 months at 25°C : 12 000 mPa.s

NOTES
SOLAGUM SF306 (thickener/stabilizer- SEPPIC)
SIMULSOL NW 342 (low foam wetting agent- SEPPIC)
5 - HIGHLY ACIDIC AQUEOUS GELS

5.1 - Selection of SOLAGUM thickeners

SOLAGUM SH 210 is the candidate of choice to thicken highly acidic aqueous solutions. SOLAGUM SH 210 is able to thicken many types of acidic solutions: citric acid, hydrochloric acid, nitric acid, hydrofluoric acid, phosphoric acid, sulfuric acid, ...

Figure 4 shows viscosity after 1 day of 10%HCl, 10% H2SO4, 10% HNO3 and 50% H3PO4 versus SOLAGUM SH 210 concentration.

Figure 4: Thickening of strong acid solutions with SOLAGUM SH 210.

Depending on the concentration of SOLAGUM SH 210 used, the acidic gels are stable upon ageing. As an illustration, Figure 5 shows viscosity after 1 day and one month storage at 20°C of various gels of strong acids obtained with 12 wt% of SOLAGUM SH 210.
Figure 5: Stability upon ageing at 20°C of strong acid gels prepared with 12 wt% SOLAGUM SH 210.

5.2 - Method for preparing aqueous acidic gels with SOLAGUM SH 210

The pregel procedure, which consists of adding under stirring the acidic solution to a concentrated aqueous pregel of SOLAGUM SH 210 is the most efficient. For acidic formulations, maximum thickening might require several days.
5.3 - Examples of applications

TOILET BOWL CLEANER
DTF 101

Formula

- **SIMULSOL SL 10** 5.0%
- **SOLAGUM SH 210** 1.5%
- Citric acid 3.0%
- Water qs 100%

MIXING INSTRUCTIONS

Prepare the gel by adding water to the Solagum SH 210, then stir and add Simulsol SL 10 and citric acid.

CHARACTERISTICS

Appearance : Opaque gel
Initial viscosity : 575 mPa.s (Brookfield LVF1 6 rpm)
Stability : > 1 year at 20°C
> 6 months at 40°C

NOTES

SIMULSOL SL 10 (decyl glucoside- SEPPIC)
SOLAGUM SH 210 (thickener/stabilizer- SEPPIC)
Figure 6: Viscosity stability upon ageing at 20°C of toilet bowl cleaner formula (DTF 101)
Formula

- **SOLAGUM SH 210** | 15.0%
- HNO₃ | 20.0%
- HF | 10.0%
- Water | qs 100%

MIXING INSTRUCTIONS

Prepare a pregel with Solagum SH210 and one third of water, add dropwise under stirring HNO₃ diluted in one third of water, and HF diluted in the last third of water.

CHARACTERISTICS

Appearance : opaque gel
Initial Viscosity : 75 000 mPa.s (Brookfield LVT 6rpm)
Stability : > 2 months at 25°C.

NOTES

SOLAGUM SH 210 (thickener, stabilizer - SEPPIC)
6 - COMPATIBILITY WITH SURFACTANTS

SOLAGUM thickeners are compatible with non-ionic, anionic and amphoteric surfactants but they cannot thicken solutions containing cationic surfactants.

Figure 7 shows the effect of SOLAGUM SH 210 concentration on the viscosity of aqueous solutions of 5% SIMULSOL SL 10 (decalglucoside, 55% dry extract), 5% AMONYL 380 BA (cocoamidopropylbetaine, 30% dry extract) and 5% sodium laurylethersulfate (28% dry extract).

Figure 7 : Viscosity after 1 month storage at 20°C of 5% surfactant solutions in relation to SOLAGUM SH 210 concentration.

7 - EFFECT OF ELECTROLYTES ON VISCOSITY

Electrolytes decrease the thickening effect of SOLAGUM gels. Hence, electrolytes can be added at the end of the process to adjust the viscosity as desired.

To formulate gels with large quantities of electrolytes the concentration of SOLAGUM has to be increased.

The compatibility of SOLAGUM with electrolytes decreases in the following order: SOLAGUM SF 306 > SOLAGUM SH 210 >> SOLAGUM SJ 108.
8 - THICKENING OF SOLVENTS

SOLAGUM can efficiently thicken many solvents and solvent blends. They offer the possibility to prepare non-aqueous formulations.

8.1 - Thickening of solvents

SOLAGUM can be used to prepare anhydrous gels of solvent (a non-exhaustive list is given in table 1).

**Table 1 : list of some solvents which can give anhydrous gels**

<table>
<thead>
<tr>
<th>SOLAGUM SH 210</th>
<th>SOLAGUM SF 306</th>
<th>SOLAGUM SJ 108</th>
</tr>
</thead>
<tbody>
<tr>
<td>Monoethyleneglycol</td>
<td>YES</td>
<td>YES</td>
</tr>
<tr>
<td>Monopropyleneglycol</td>
<td>YES</td>
<td>YES</td>
</tr>
<tr>
<td>Diethyleneglycol</td>
<td>YES</td>
<td>YES</td>
</tr>
<tr>
<td>Triethyleneglycol</td>
<td>YES</td>
<td>NO</td>
</tr>
<tr>
<td>DMSO</td>
<td>YES</td>
<td>NO</td>
</tr>
<tr>
<td>Glycerol</td>
<td>YES</td>
<td>YES</td>
</tr>
<tr>
<td>Methyl lactate</td>
<td>YES</td>
<td>not studied</td>
</tr>
</tbody>
</table>

* Thickening appears only if stirring is applied.

Figure 8, where viscosity of gels of monopropyleneglycol and DMSO are plotted versus SOLAGUM SH 210 concentration, is given as an illustration.

**Figure 8 : Viscosity of solvent gels in relation to SOLAGUM SH 210 concentration.**
8.2 - Thickening of solvent blends

Some solvents cannot be thickened by SOLAGUM. However, it is possible to obtain anhydrous gels containing these solvents by using an auxilliary solvent.

For instance, N-methyl-pyrolidone (NMP), Ethylacetate (AcOEt), Tetrahydrofuran (THF) or MethylEthylKetone (MEK) cannot be thickened by SOLAGUM SH 210 but anhydous gels containing high amount of these solvents can be formed by adding, for instance into a gel of dimethylsulfoxide (DMSO).

Some examples are summarized in Table 2.

**Table 2 : Compositions and viscosity of gels of five anhydrous solvent blends**

<table>
<thead>
<tr>
<th></th>
<th>Studied formulations</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>SOLAGUM® SH 210</strong></td>
<td>3.0%</td>
</tr>
<tr>
<td><strong>DMSO</strong></td>
<td>48.5%</td>
</tr>
<tr>
<td><strong>NMP</strong></td>
<td>48.5%</td>
</tr>
<tr>
<td><strong>AcOEt</strong></td>
<td>-</td>
</tr>
<tr>
<td><strong>THF</strong></td>
<td>-</td>
</tr>
<tr>
<td><strong>MEK</strong></td>
<td>-</td>
</tr>
<tr>
<td><strong>Viscosity after 1 day</strong></td>
<td>88 000</td>
</tr>
<tr>
<td><strong>Viscosity after 1 month at 20°C</strong></td>
<td>130 000</td>
</tr>
<tr>
<td><strong>Viscosity after 1 year at 20°C</strong></td>
<td>143 000</td>
</tr>
</tbody>
</table>

Brookfield LVT 0.6 rpm, 20°C, mPa.s.
8.3 - Example of applications

**PAINT STRIPER**
**DTF 128**

**Formula**

- **SOLAGUM SH 210**
- **SIMULSOL NW 342**
- **DMSO**

<table>
<thead>
<tr>
<th></th>
<th>2.0%</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>0.5%</td>
</tr>
<tr>
<td></td>
<td><strong>qs 100%</strong></td>
</tr>
</tbody>
</table>

**MIXING INSTRUCTIONS**
Prepare the gel by adding DMSO to the Solagum SH210, then stir and add Simulsol NW342

**CHARACTERISTICS**
Appearance : opaque gel
Initial Viscosity : 121 000 mPa.s (Brookfield LVT 0.6rpm)
Viscosity after 1 year storage at 40°C : 85 000 mPa.s

**NOTES**
SOLAGUM SH 210 (thickener/stabilizer- SEPPIC)
SIMULSOL NW 342 (low foam wetting agent- SEPPIC)
9.1 - Preparation of emulsions

SOLAGUM is able to emulsify various oils at room temperature with a minimum energy.

Two procedures can be used to prepare an emulsion:

1) **ADD THE OIL INTO THE AQUEOUS SOLAGUM GEL AND STIR**
2) **ADD THE OIL TO SOLAGUM, STIR, ADD WATER AND STIR**
Various oils can be emulsified and stabilised via the use of SOLAGUM.

Some examples are given in Figure 9 and 10.

**Figure 9**: Stability upon ageing of paraffin oil in water emulsion prepared with 4 wt% SOLAGUM SF 306.

**Figure 10**: Stability upon ageing of silicon oil in water emulsion prepared with 4 wt% SOLAGUM SF 306.
9.2 - EXAMPLES OF APPLICATIONS

D-LIMONENE EMULSION DEGREASER
DTF 103

**Formula**

<table>
<thead>
<tr>
<th>Ingredient</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>SOLAGUM SH 210</td>
<td>2.0%</td>
</tr>
<tr>
<td>SIMULSOL OX 1006 L</td>
<td>1.0%</td>
</tr>
<tr>
<td>D Limonene</td>
<td>10.0%</td>
</tr>
<tr>
<td>Water</td>
<td>qs 100%</td>
</tr>
</tbody>
</table>

**MIXING INSTRUCTIONS**
Prepare the emulsion containing D-Limonene, water and SIMULSOL OX 1006 L, then add under stirring onto Solagum SH 210.

**CHARACTERISTICS**
Initial viscosity: 27 200 mPa.s (Brookfield LVT 6rpm)
Viscosity after 1 month storage at 25°C: 25 000 mPa.s

**NOTES**
SIMULSOL OX 1006 (Degreasing surfactant – SEPPIC)
MINERAL SPIRIT EMULSION DEGREASER
DTF 121

Formula

- **SIMULSOL SL 10** (55%)
- **SOLAGUM SJ 108**
- Mineral spirit
- Water

<table>
<thead>
<tr>
<th>Component</th>
<th>Quantity</th>
</tr>
</thead>
<tbody>
<tr>
<td>SIMULSOL SL 10</td>
<td>2.0%</td>
</tr>
<tr>
<td>SOLAGUM SJ 108</td>
<td>1.0%</td>
</tr>
<tr>
<td>Mineral spirit</td>
<td>10.0%</td>
</tr>
<tr>
<td>Water</td>
<td>qs 100%</td>
</tr>
</tbody>
</table>

MIXING INSTRUCTIONS
Prepare the gel by adding water to the Solagum SJ 108, then stir and add Simulsol SL 10 and White Spirit.

CHARACTERISTICS
Appearance : Viscous emulsion
Viscosity : 1100 mPa.s (Brookfield LVF2 6 rpm)
Stability : Excellent

NOTES
SIMULSOL SL 10 (decyl glucoside- SEPPIC)

Specific formulations of polishes prepared with **SOLAGUM** are also available (do not hesitate to contact SEPPIC).
10 - ANALYTICAL AND SAFETY DATA

<table>
<thead>
<tr>
<th>ANALYSIS</th>
<th>SOLAGUM SJ 108</th>
<th>SOLAGUM SH 210</th>
<th>SOLAGUM SF 306</th>
<th>METHODS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Appearance</td>
<td>Fluid emulsion</td>
<td>Fluid emulsion</td>
<td>Fluid emulsion</td>
<td>Visual</td>
</tr>
<tr>
<td>Viscosity (25°C, mPa.s)</td>
<td>≥ 40 000 at 3%</td>
<td>≥ 40 000 at 3%</td>
<td>≥ 10 000 at 3%</td>
<td>Brookfield LVT, M4V6</td>
</tr>
</tbody>
</table>

All the components of SOLAGUM products are listed as safe in use, in at least one part of CFR 21, Food and Drugs parts 170 - 199.

Nota: SOLAGUM products are reserved for industrial applications and are not permitted in Cosmetics, Pharmaceuticals and Food.

Shelf life: 12 months.
Recommendation: Stir before use.
    Store indoors at room temperature (5°C to 30°C) in well ventilated area.

11 - TOXICOLOGICAL DATA

SOLAGUM SH 210 and SOLAGUM SF 306 were tested on rats. Oral LD50 is greater than 5g/kg.
Because of structural similarity, it can be concluded that SOLAGUM SJ 108 also has no acute toxicity orally in the rat.
12 - SPECIFIC FEATURES OF SOLAGUM

<table>
<thead>
<tr>
<th></th>
<th>SOLAGUM SH 210</th>
<th>SOLAGUM SJ 108</th>
<th>SOLAGUM SF 306</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ease to formulate</td>
<td>+++</td>
<td>+++</td>
<td>+++</td>
</tr>
<tr>
<td>Alkaline pH compatibility</td>
<td>++</td>
<td>++</td>
<td>+++</td>
</tr>
<tr>
<td>Acidic pH compatibility</td>
<td>+++</td>
<td>++</td>
<td>++</td>
</tr>
<tr>
<td>Anionic compatibility</td>
<td>++</td>
<td>++</td>
<td>++</td>
</tr>
<tr>
<td>Non-ionic compatibility</td>
<td>++</td>
<td>++</td>
<td>++</td>
</tr>
<tr>
<td>Cationic compatibility</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Silicone emulsion</td>
<td>+++</td>
<td>+++</td>
<td>+++</td>
</tr>
<tr>
<td>Paraffin emulsion</td>
<td>+++</td>
<td>+++</td>
<td>+++</td>
</tr>
<tr>
<td>White Spirit emulsion</td>
<td>+++</td>
<td>+</td>
<td>+</td>
</tr>
<tr>
<td>Limonene emulsion</td>
<td>++</td>
<td>+</td>
<td>+</td>
</tr>
<tr>
<td>Electrolytes compatibility</td>
<td>+</td>
<td></td>
<td>++</td>
</tr>
<tr>
<td>Solvent thickening</td>
<td>+++</td>
<td>+</td>
<td>++</td>
</tr>
</tbody>
</table>

+++ Excellent    ++ Good    + Fair    No Incompatible
Nota

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* SEPPIC being: and, depending on the country:

**SEPPIC S.A.**
75, quai d’Orsay
75321 Paris cedex 07
FRANCE
Tel.: +33 (0) 1 40 62 55 55
Fax: +33 (0) 1 40 62 52 53

**SEPPIC UK Ltd**
50 Salisbury Road
PO Box 338 · Hounslow
TW4 6SH · ENGLAND
Tel.: +44 208 577 8800
Fax: +44 208 570 2106

**SEPPIC ITALIA Srl**
Via Quarenghi 27
20151 Milano
ITALY
Tel.: +39 02 38009110
Fax: +39 02 38009140

**SEPPIC Inc.**
30, Two Bridges Road, suite 210
Fairfield, New Jersey 07004-1530
USA
Tel.: +1 973 882 5597
Fax: +1 973 882 5178

**SEPPIC China**
Room 510 Jin Tai Building
58 South Mao Ming Road
Shanghai 200020 CHINA
Tel.: +86 (21) 64 66 01 49
Fax: +86 (21) 64 66 11 09

[www.seppic.com](http://www.seppic.com)

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