Structure® 2020 Polymer

Polymer thickener for alcohol-based hand sanitizers

INCI name: Acrylates Crosspolymer-6

Key benefits

- Effective thickening of ethanol and 2-propanol based hand sanitizers
- Structure 2020 is a low viscosity, white liquid emulsion of 30% actives - easily pumpable
- Thickener product is non-hazardous and carries no warning label
- Product mixes easily into the target alcohol
- Liquid emulsion thickener allows quicker formulation than when using solids typically used, avoiding lengthy hydration and high shear preparation methods
- The emulsion viscosifies and clears upon the addition of alkaline neutralizing agents (such as TEA or AMP) - the resulting viscosified alcohol is water white
- Formulated product rheology matches that of market leading technologies
- Formulated systems are both viscous and elastic – air bubbles can be held inside the gel
- Typical dosage 3-5% active in 70% ethanol. Similar dosage also viscosifies 2-propanol solutions
- Formulated gel provides good viscous pump disperser action, spreads easily on hands, providing a luxurious handfeel with rubbing. It dries quickly leaving hands feeling soft
- Patent pending

Clear thickened gels from liquid emulsion polymers

Structure 2020 is a high molecular weight alkali-swellable polyacrylate emulsion polymer product. It is sold as a stable white, milk-like emulsion in water (figure 1). Alkali swellable emulsions are activated upon addition of an alkaline neutralizing agent, which causes the emulsion to break (become clear) and viscosify (figure 2). Structure 2020 acts as an excellent thickener for ethanol and 2-propanol solutions typically used for hand sanitizing applications. Clear solutions are a desirable consumer property.

Figure 3 shows clarity data for Structure 2020 solutions in both ethanol and 2-propanol compared with the market leading clear formula.

Figure 1. Structure 2020 emulsion polymer as sold

Figure 2. Clear hand sanitizer gel formulated with Structure 2020 – 16.6% Structure 2020 (5% total active) in 70% ethanol
Ease of thickener formulation

Most gelled hand sanitizers today use high molecular weight powder polymer thickeners during production. These powders are difficult to disperse and take a long time to hydrate, leading to elongated batch times requiring specialty equipment. Structure 2020 is a 30% active liquid emulsion polymer, meaning it requires no specialty production equipment. It can be easily pumped into mixing tanks and vessels, and quickly disperses into ethanol/2-propanol without the need for extreme shear. Because it is a lower activity liquid, a larger volume is required to provide thickening. Care should be taken to include the 70% water included in the product when calculating the formulation requirements (see below for framework formulations).

Method of alcohol-based hand sanitizer gel preparation

Please follow all appropriate safety measures when dealing with hand sanitizer production. Although Structure 2020 has no hazard label or warnings, the main alcohol component in the hand sanitizer and the finished product formulations are flammable.

- Charge the chosen alcohol and any desired glycerine to the preparation vessel and stir
- Charge the desired amount of Structure 2020 to the dose tank adding any additional make up water to the Structure 2020 emulsion rather than to the alcohol charge
- Note that Structure 2020 contains 70% water, and this water should be used when calculating the desired alcohol concentration of the finished hand sanitizer gel
- Charge the diluted Structure 2020 into the alcohol, mixing well until the solution is homogenous
- Note that the emulsion may appear to flocculate during the initial charge, but this dissipates with stirring
- Add the chosen alkaline neutralizing agent - triethanolamine (TEA) or aminomethyl propanol (AMP) - see below guidance on the amounts to be added
- Formulation pH should be brought above pH 7
- Note that ionic neutralizing agents (i.e. NaOH) are not suitable for this system
- The addition of the neutralizing agent will cause the emulsion to break (removing the milky appearance) and cause the solution to viscosify
- Caution should be taken to minimize air entrainment if bubbles are not desired in the end formulation
- Continue stirring until homogenous
- Dispense and pack

For other components required in the formulation, a best practice guideline is to add more-hydrophobic ingredients into the alcohol charge, and more hydrophilic components in with Structure 2020. It is advised to avoid formulating electrolytes into the system due to impacts on gel rheology, and drying effect on the hands.
Neutralizing agent dosing guidance
To initiate viscosification of Structure 2020, an alkaline neutralizing agent needs to be added to the alcohol solution containing the dilute emulsion. The acid number of the Structure 2020 emulsion is $1.26 \times 10^{-3}$ mol COOH/g.

To achieve pH 7.1-7.5 in the finished gel, the following guideline dosage should be used for two recommended organic neutralizing agents:

- Per gram of Structure 2020 added, 0.38g of 50% aminomethyl propanol (50% AMP) should be added
- Per gram of Structure 2020 added, 0.32g of triethanolamine (TEA) should be added

Framework formulations
To prepare effective hand sanitizers from ethanol or 2-propanol, the following formulations are provided for guidance, giving the viscosity, pH and clear appearance as described below. Modification of some of the ingredient’s concentrations will modify the properties of the gel. So too, addition of other ingredients that might be included in the formulation i.e. perfume, color etc.

Ethanol based hand sanitizer – 5% active Structure 2020

<table>
<thead>
<tr>
<th>Ingredient</th>
<th>Concentration</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ethanol</td>
<td>70%</td>
</tr>
<tr>
<td>Glycerol</td>
<td>0.5%</td>
</tr>
<tr>
<td>Structure 2020</td>
<td>16.6% (5% total active)</td>
</tr>
<tr>
<td>Water</td>
<td>11%</td>
</tr>
<tr>
<td>Aminomethyl propanol</td>
<td>1.9% (50% solution)</td>
</tr>
</tbody>
</table>

Resulting viscosity (Brookfield Sp 5, 20 RPM, 20°C) 6400 cps
Resulting pH 7.5
Resulting appearance clear

2-Propanol based hand sanitizer

<table>
<thead>
<tr>
<th>Ingredient</th>
<th>Concentration</th>
</tr>
</thead>
<tbody>
<tr>
<td>2-Propanol</td>
<td>70%</td>
</tr>
<tr>
<td>Glycerol</td>
<td>0.5%</td>
</tr>
<tr>
<td>Structure 2020</td>
<td>16.6% (5% total active)</td>
</tr>
<tr>
<td>Water</td>
<td>11%</td>
</tr>
<tr>
<td>Aminomethyl propanol</td>
<td>1.9% (50% solution)</td>
</tr>
</tbody>
</table>

Resulting viscosity (Brookfield Sp 5, 20 RPM, 20°C) 5600 cps
Resulting pH 7.4
Resulting appearance clear

The amount of Structure 2020 can be varied to meet desired properties.

Physical properties of Structure 2020
Structure 2020 is an emulsion polymer. It is not stable to freeze/thaw cycles and must be maintained above freezing prior to use. Please consult the material safety data sheet for guidance and handling.

Product specifications

<table>
<thead>
<tr>
<th>Specification</th>
<th>Parameter Limits</th>
</tr>
</thead>
<tbody>
<tr>
<td>Solids</td>
<td>29-31%</td>
</tr>
<tr>
<td>pH</td>
<td>2.2-3</td>
</tr>
<tr>
<td>Viscosity (cP)</td>
<td>10,000-15,000 (pH 9.0, NaOH, 25°C, 10 rpm), 2.5% (dry)</td>
</tr>
</tbody>
</table>

Other typical data (not specifications)

<table>
<thead>
<tr>
<th>Chemical and physical data</th>
<th>Typical Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Appearance</td>
<td>white Emulsion at 20°C</td>
</tr>
<tr>
<td>Density</td>
<td>8.82 lbs/US gal. at 25°C</td>
</tr>
<tr>
<td>Specific Gravity</td>
<td>1.06 g/cc at 25°C</td>
</tr>
<tr>
<td>Viscosity</td>
<td>&lt;200 cps at 25°C</td>
</tr>
</tbody>
</table>
For more information and sample formulations contact us at cleaning@nouryon.com.

USA and Canada
Chicago, USA
T +1 800 906 9977

South America
Itupeva, Brazil
T +55 11 4591 8938

Central America and Caribbean
Mexico City, Mexico
T +52 55 5261 7895

China
Shanghai, China
T +86 21 2220 5000

South East Asia
Singapore
T +65 6635 5183

India
Mumbai, India
T +91 22 6842 6700

Europe
Stenungsund, Sweden
T +46 303 850 00

Middle East
Dubai, United Arab Emirates
T +971 4247 1500

Russia
Moscow, Russia
T +7 495 766 1606

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