**KELCOGEL® Gellan Gum User’s Guide**

**Introduction**

Gellan gum is a multipurpose stabilizer for the food industry. Gelation, of course, is one of its well-known functionalities, but the gum is also used commercially for texturizing, heat stability, syneresis control, binding, film forming, and suspending.

Gellan gum is currently available in two forms—high acyl and low acyl gellan gum. While typical food applications for the two types of gellan gum have some overlap, the two products have different properties and some distinct differences in terms of processing requirements. This user’s guide provides helpful background information about how to use the low acyl form of gellan gum, which is sold under the trade names KELCOGEL® and KELCOGEL® F.

The information in this user’s guide should help formulators through the various steps needed to properly use gellan gum:

1) Dispersion and hydration
2) Forming a gel
3) Forming a fluid gel

This guide also has a brief list of commercial applications. Contact CP Kelco for more detailed application guidance.

**Dispersion and Hydration**

KELCOGEL® gellan gum hydration is inhibited by ions (salts). Since the gum itself is a mixed salt, KELCOGEL® gellan gum doesn’t swell significantly when it comes into contact with water. Therefore, even in deionized water, the gum can be readily dispersed when it is added with moderate stirring.

Dispersion can be an issue when KELCOGEL® gellan gum is added to hot water. When adding the gum to hot water, use the following techniques to insure a good dispersion:

1) Dry blend the gum with other dry ingredients or combine it with a liquid dispersant such as oil, glycerin, or corn syrup.
2) Gently add the gum blend to the vortex of the stirring solution.
3) Use high shear mixing capable of breaking up gum lumps.

The hydration of KELCOGEL® gellan gum depends on both temperature and ionic conditions. As ions in the water increase, the hydration temperature increases. In deionized water, KELCOGEL® gellan gum will typically hydrate at ~63°C (146°F). The hydration temperature in tap water, however, will depend on the water hardness.
KELCOGEL® gellan gum hydration is sensitive to all salts, but it is particularly sensitive to divalent ions of calcium and magnesium. Sequestrants aid KELCOGEL® gellan gum hydration by binding divalent ions in the water and reducing the hydration temperature. Using sequestrants, the hydration temperature of KELCOGEL® gellan gum can often be reduced to room temperature—making the gum soluble in cold water.

Common food sequestrants are sodium citrate and sodium hexametaphosphate. Use the following table to guide your use of sequestrants:

Sequestrant Guide for KELCOGEL® gellan gum
KELCOGEL® F gellan gum at 0.3% Use Level*

<table>
<thead>
<tr>
<th>Water Quality</th>
<th>Maximum CaCO3 Level (ppm)</th>
<th>Recommended Level for Sodium Citrate Dihydrate**</th>
<th>Minimum Hydration Temperature (°C)</th>
<th>Minimum Hydration Temperature (°F)</th>
<th>Notes:</th>
</tr>
</thead>
<tbody>
<tr>
<td>Deionized</td>
<td>0</td>
<td>0.07%</td>
<td>22</td>
<td>72</td>
<td>With good stirring (800 rpm), hydrates very quickly (&gt;2 min.).</td>
</tr>
<tr>
<td>Soft</td>
<td>Up to 160</td>
<td>0.12%</td>
<td>22</td>
<td>72</td>
<td>With good stirring (800 rpm), hydrates very quickly (~2 min.).</td>
</tr>
<tr>
<td>Slight Hard</td>
<td>161 to 320</td>
<td>0.16%</td>
<td>22</td>
<td>72</td>
<td>High shear mixing recommended to reduce hydration time.</td>
</tr>
<tr>
<td>Hard</td>
<td>321 to 460</td>
<td>0.20%</td>
<td>28</td>
<td>82</td>
<td>At room temperature, ~95% hydration is possible. High shear mixing recommended to reduce hydration time.</td>
</tr>
<tr>
<td>Very Hard</td>
<td>460 to 920</td>
<td>0.34%</td>
<td>58</td>
<td>136</td>
<td>Heat required for hydration. Gels when cooled without added ions.</td>
</tr>
</tbody>
</table>

* Add 0.004% Sodium Citrate Dihydrate for every additional 0.1% of KELCOGEL® F gellan gum when use level exceeds 0.3%

** If sodium hexametaphosphate is used, the recommended sequestrant level can be reduced by 1/3.

Additional Note: Fine mesh (KELCOGEL® F gellan gum) is recommended for cold water hydration.

It is recommended that KELCOGEL® gellan gum be hydrated in the cleanest environment possible. If possible, hydrate the gum in the water before adding other ingredients. Do not try to hydrate the gum below a pH of 4. When the pH is less than 4, use buffers to raise the pH above 4 and add back acid to reduce the pH after the gum is hydrated.

Soluble solids will also increase the hydration temperature. However, with the right level of sequestrant, KELCOGEL® gellan gum will fully hydrate in 80°BRIX corn syrups. (Do not use more than 0.2% sodium citrate hydrate.)

**Forming a Gel with KELCOGEL® gellan gum**

There are three ways to form a gel using KELCOGEL® gellan gum:
1) Ion diffusion
2) Internal set
3) Heating and cooling
The first two methods are cold-set processes, meaning that the gel is formed from a solution below the gel set temperature. Typically, these processes are run at room temperature. There are two ways to make gellan gum solutions that are liquid at room temperature—the gum can be hydrated in the cold or the gum solution can be heated and cooled without adding back sufficient salts or acids to form a gel.

The ion diffusion method requires that the gellan solution be dropped or extruded into an ion or acid bath—typically a calcium bath. A gel skin forms instantly when the ions diffuse into the solution and the gel continues to set more fully as the ions diffuse into the gel piece. Because diffusion throughout the gel piece takes time, this method is used most often when gelling small shapes—like gel beads or small bits of restructured fruit.

The internal diffusion method uses slowly dissolving acids or salts to form a gel. (Calcium sulfate and calcium phosphates are used most often.) When acids or salts dissolve slowly enough, they can be stirred into a gellan gum solution. As the salts or acids dissolve, the ions are released into solution forming a gel. The recommended procedure is to slurry the salts in water just before adding them to the KELCOGEL® gellan gum solution. The salts need to be dispersed quickly and evenly using good mixing, then the stirring must be turned off (immediately after a good dispersion is attained) to avoid shearing through the setting gel.

If readily soluble acids or salts—or other ingredients containing salts or acids—are added to a cold KELCOGEL® gellan gum solution, the gum will gel instantly and uncontrollably. This phenomenon is commonly referred to as pre-gelling. The resulting texture will be mushy, grainy and prone to syneresis.

It is not uncommon for other ingredients in the formulation to bring in enough ions to create problems with pre-gelling. In these cases, the best results are obtained by adding sodium citrate to a solution of these other food ingredients, combining the ingredient solution with the cold gellan gum solution, and then adding a slowly soluble acid to provide a controlled calcium ion release. (As a side note, sodium citrate loses its sequestering abilities as the pH falls.)

Cold-set gels are very prone to syneresis. The KELCOGEL® gellan gum sets with added calcium, but the molecules rearrange with time and start to squeeze out water. (Adding a second hydrocolloid, such as xanthan gum, guar or locust bean gum, can help slow the development of syneresis.)

Because of the syneresis issues, it is more common to use the heating and cooling method of forming a gel. If the gum solution is above the setting temperature, acids and salts can be added without fear of pre-gelling. The solution can then be cooled and the gel will form once the temperature falls below the gel setting temperature. Because the gelation is more controlled during the cooling, the gum molecules are more optimally aligned and syneresis will not be an issue.

If syneresis can be avoided by heating the gellan gum solution above the setting temperature, then the critical question becomes, “How high must the temperature be prior to adding salts or acids?” or, alternatively, “What is the setting temperature of KELCOGEL® gellan gum solutions?” The setting temperature depends on a combination of factors including gum concentration, ionic environment, and soluble solids levels. Use the following guide to determine the heating requirements:
Once the heating requirement is met, ions and acids (or ion containing ingredients) can be added back to the KELCOGEL® gellan gum solutions without pre-gelation. The next obvious questions are, “Do I need to add ions or acid?” and “How much ions or acid should be added?” The answer depends on the pH and soluble solids of the final application. It also depends on the ionic contribution of the other ingredients in the formulation.

In most common food applications, formulations ingredients such as fruits and flavors add enough ions to create a gel. In most cases, it is not necessary to add additional ions. Sometimes, however, adding calcium is useful for firming the texture or raising the heat stability of the gels. (Ion addition is sometimes needed in water jellies when soft water is used or in bake stable fillings to increase the heat stability.) In these cases, trial and error may be required to obtain the right gel properties. Excessive calcium, however, should be avoided. It can lead to softer gel textures, pre-gelation and excessive syneresis. Use the table below to help guide your ion addition:

### Ion Addition Recommendations:

<table>
<thead>
<tr>
<th>pH</th>
<th>BRIX</th>
<th>Calcium Ion Addition:</th>
<th>Maximum Recommended Calcium Chloride Anhydrous Addition (%)</th>
<th>Maximum Recommended Calcium Chloride Dihydrate Addition (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>&gt;4</td>
<td>0-100</td>
<td>Add up to 0.032% calcium ion by weight plus ½ the level of sodium citrate added.</td>
<td>0.09</td>
<td>0.12</td>
</tr>
<tr>
<td>3.5-4.0</td>
<td>&lt;45</td>
<td>Add up to 0.024% calcium ion by weight.</td>
<td>0.07</td>
<td>0.09</td>
</tr>
<tr>
<td>3.5-4.0</td>
<td>45-65</td>
<td>Add up to 0.012% calcium ion by weight.</td>
<td>0.03</td>
<td>0.04</td>
</tr>
<tr>
<td>3.5-4.0</td>
<td>&gt;65</td>
<td>No ions needed.</td>
<td>0</td>
<td>0.00</td>
</tr>
<tr>
<td>&lt;3.5</td>
<td>0-100</td>
<td>Minimize added ions.</td>
<td>0</td>
<td>0.00</td>
</tr>
</tbody>
</table>

*Note: If using a monovalent ion such as sodium, increase the maximum recommended concentration by 10x.*
Fluid Gels with KELCOGEL® gellan gum

KELCOGEL® gellan gum fluid gels are solutions with a weak gel structure. They exhibit an apparent yield stress, i.e., a finite stress that must be exceeded before the system will flow. These systems are very good at suspending particulate matter since (provided the stress exerted by the action of gravity on the particles is less than the yield stress) the suspension will remain stable. Their highly pseudoplastic flow provides extremely efficient suspension combined with low viscosity at higher rates of shear. This results in low viscosity in the mouth, making them particularly useful for suspending fruit pulp or jelly pieces in beverages. Suspension can be achieved without adversely affecting the mouthfeel.

Fluid gels can be made with a hot or cold process. Follow the hydration procedures outlined above to hydrate the gum. The gum use level should be kept very low to avoid a true gel—gum concentrations below 0.3% work best. In cold make-up, the solution is sheared during ion addition. In hot make-up, the solution is sheared while cooling. The ions affect the texture, storage and heat stability of the fluid gel. The guidelines for adding ions to a fluid gels are the same as those presented above for optimizing gel properties.

Two issues are a concern for fluid gels—gelation with time and syneresis. When gum use level is high and ions are not optimized, the fluid gel may re-knit or heal with time. Optimizing ion levels will stabilize the fluid gel texture as well as improve its heat stability. Adding a thickening gum, such as xanthan gum, will also help stabilize the fluid gel texture.

A small amount of syneresis is common in fluid gels. If syneresis is a problem, the addition of a thickening gum is recommended.

Applications of KELCOGEL® Gellan Gum

KELCOGEL® gellan gum is used commercially in water jellies, salad dressing, puddings, bakery fillings, icings, dairy products, bakery dry mixes, and beverages. Some non-food applications are microbiological media, capsules and room deodorant gels.

More Information Is Available To You

This bulletin is intended to be general in nature. We are eager to work with you in the development of new products and processes. For additional information about our products, please contact us at one of our regional offices or visit our web site at www.cpkelco.com.

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