Antimicrobial Formulating Guidelines

We always recommend that every formula undergo stability and microbial testing to ensure adequate preservation.
This document was created to address the challenges and concerns regarding our antimicrobials in the formulating process.

Formulators are often challenged with natural antimicrobials, as they are newer and do not necessarily behave like synthetic preservatives. Likewise, incorporating a natural antimicrobial into a formulation is not a matter of simply removing the synthetic preservative and adding the natural antimicrobial – formulation techniques need to be tailored to each natural antimicrobial to ensure the product is properly preserved.
Preservatives may have a broader effect on the finished product, altering aesthetics such as color, odor, and viscosity. When formulating with new antimicrobials, it is important to monitor the antimicrobial closely to control undesired aesthetic changes in the finished product. An important factor to consider when formulating using most natural antimicrobials is broad-spectrum protection. It is not likely that a natural antimicrobial will exhibit the same level of broad-spectrum protection as a synthetic preservative. For this reason, natural antimicrobials often need to be used in conjunction with one another to synergistically produce a broad-spectrum self-preserving system.

This document outlines several properties of each antimicrobial as a means to ensure compatibility during formulation to allow our customers to continue leading the market with impressive formulations and innovative applications.
Leucidal Liquid

Leucidal® Liquid has been in use for almost a decade now and has been proven to be a very compatible ingredient for formulating.

1. We recommend starting with 4.0% Leucidal® Liquid.

2. Monitor the interaction of Leucidal® Liquid with other ingredients for compatibility.

3. Incorporate Leucidal® Liquid into formulations at a pH between 3 and 8, during the cooling phase of the process at temperatures lower than 70°C.

We always recommend that every formula undergo stability and microbial testing to ensure adequate preservation.
Leucidal Liquid

Recommended Techniques
Incorporating Leucidal® Liquid towards the end of the formulating process: A successful recommendation is adding Leucidal® Liquid near the end of the formulating process and after the formulation has cooled to below 70°C. Reference FAQs for recommended techniques regarding specific anionic thickeners.

Heat Stability
Results from testing has shown that Leucidal® Liquid can tolerate temperatures of up to 70°C for a period of 8 hours without having any impact on MIC performance.

Compatibility
The cationic nature of Leucidal® Liquid makes the main formulating concern potential incompatibility with highly anionic ingredients, such as thickeners. Reference FAQs for more information regarding specific anionic thickeners. The use of solubilizing agents may help improve clarity in cases where haziness is observed.

We always recommend that every formula undergo stability and microbial testing to ensure adequate preservation.
1. We recommend starting with 4.0% Leucidal® Liquid Complete.

2. Monitor the interaction of Leucidal® Liquid Complete with other ingredients.

3. Incorporate Leucidal® Liquid Complete into formulations at a pH between 3 and 8, during the cooling phase of the process at temperatures lower than 70°C.

We always recommend that every formula undergo stability and microbial testing to ensure adequate preservation.
Heat Stability
Results from testing has shown that Leucidal® Liquid Complete can tolerate temperatures of up to 70°C for a period of 8 hours without having any impact on MIC performance.

Compatibility
The cationic nature of Leucidal® Liquid Complete makes the main formulating concern potential incompatibility with highly anionic ingredients, such as thickeners. Reference FAQs for more information regarding specific anionic thickeners.

The use of solubilizing agents may help improve clarity in cases where haziness is observed.

Recommended Techniques
Incorporating Leucidal® Liquid Complete towards the end of the formulating process:
A successful recommendation is adding Leucidal® Liquid Complete near the end of the formulating process and after the formulation has cooled to below 70°C. Reference FAQs for recommended techniques regarding specific anionic thickeners.
Additional Information

As with all biological materials, attention must be paid to the conditions under which Leucidal® Liquid Complete is used. Based on bench-scale evaluations, as well as actual product applications, Leucidal® Liquid Complete has been found to be effective over a wide range of typical cosmetic and personal care product manufacturing conditions.

Leucidal® Liquid Complete can be hazy at cooler temperatures, therefore it is recommended to warm the full container of product to 35-40°C and mix until clear prior to use.
Leucidal Liquid SF

1. We recommend starting with 4.0% Leucidal® Liquid SF.

2. Monitor the interaction of Leucidal® Liquid SF with other ingredients for compatibility.

3. Incorporate Leucidal® Liquid SF into formulations at a pH between 3 and 8, during the cooling phase of the process at temperatures lower than 70°C.

4. With viscosity modifiers, it is best to add Leucidal® Liquid SF prior to the thickener.

We always recommend that every formula undergo stability and microbial testing to ensure adequate preservation.
Leucidal Liquid SF

Heat Stability
Results from testing has shown that Leucidal® Liquid SF can tolerate temperatures of up to 85°C for a period of 8 hours without having any impact on MIC performance.

Compatibility Anionic Ingredients: The cationic nature of Leucidal® Liquid SF makes the main formulating concern potential incompatibility with highly anionic ingredients like Carbopol®, Xanthan gums, Carrageenan, and Hyaluronic Acid. The haze and the presence of white particles suspended along with bubbles through the thickener solutions in Figure 1 illustrate this incompatibility. The use of solubilizing agents, such as polysorbate 20, may help improve clarity when haziness is observed. The addition of sodium chloride or sodium citrate may help prevent a loss of viscosity when formulating with anionic ingredients. For compatibility issues regarding specific anionic thickeners, reference FAQs.

Figure 1: From left to right Keltrol® CGSFT, Carbopol® Ultrez 10 and Carbopol® 940 with Leucidal® Liquid SF
Compatibility (continued)

**High salt concentration:** We have had customers report that Leucidal® Liquid SF did not perform well in a formulation containing 10% magnesium chloride. This is an unusually high concentration of this salt for a typical cosmetic formulation. We believe the excessive amount of electrolytes in the formulation due to the 10% concentration of magnesium chloride causes saturation of the cationic antimicrobial peptides, essentially neutralizing their efficacy.

**High alcohol content:** Incorporating Leucidal® Liquid SF in a formulation with high alcohol content can cause haziness. Results from testing has shown Leucidal® Liquid SF to be stable and compatible in up to 20% ethanol.
Leucidal Liquid SF

Recommended Techniques

Adding Leucidal® Liquid SF towards the end of the formulating process: A successful recommendation is adding Leucidal® Liquid SF near the end of the formulating process and after the formulation has cooled to below 70°C. Reference FAQs for recommended techniques regarding specific anionic thickeners.

Additional Information
We have had customers report that the addition of Leucidal® Liquid SF before neutralizing the anionic polymers (NovethixTM L-10 Polymer and Carbopol® Aqua SF-1 OS Polymer) resulted in the formation of precipitates. These precipitates were avoided by adding Leucidal® Liquid SF after the neutralization of the anionic polymers.

We always recommend that every formula undergo stability and microbial testing to ensure adequate preservation.
1. We recommend starting with 4.0% Leucidal® SF Complete.

2. Monitor the interaction of Leucidal® SF Complete with other ingredients.

3. Incorporate Leucidal® SF Complete into formulations at a pH between 3 and 8, during the cooling phase of the process at temperatures lower than 70°C.
Leucidal SF Complete

Heat Stability

Results from testing has shown that Leucidal® SF Complete can tolerate temperatures of up to 70°C for a period of 8 hours without having any impact on MIC performance.

Compatibility

The cationic nature of Leucidal® SF Complete makes the main formulating concern potential incompatibility with highly anionic ingredients, such as thickeners. Reference FAQs for more information regarding specific anionic thickeners.

The use of solubilizing agents may help improve clarity in cases where haziness is observed.
Recommended Techniques

Incorporating Leucidal® SF Complete towards the end of the formulating process:
A successful recommendation is adding Leucidal® SF Complete near the end of the formulating process and after the formulation has cooled to below 70°C. Reference FAQs for recommended techniques regarding specific anionic thickeners.

Additional Information

As with all biological materials, attention must be paid to the conditions under which Leucidal® SF Complete is used. Based on bench-scale evaluations, as well as actual product applications, Leucidal® SF Complete has been found to be effective over a wide range of typical cosmetic and personal care product manufacturing conditions.
Leucidal Liquid PT is perfect option for Powdered or Spray Treatments

1. We recommend starting with 2.0% Leucidal® Liquid PT.

2. Monitor the interaction of Leucidal® Liquid PT with other ingredients for compatibility.

3. We recommend incorporating Leucidal® Liquid PT at temperatures lower than 70°C and a pH between 3 and 8.

We always recommend that every formula undergo stability and microbial testing to ensure adequate preservation.
Leucidal Liquid PT

Heat Stability

With regard to the potential negative effects of high temperatures, we have done testing to show that Leucidal® Liquid PT can tolerate temperatures of up to 70°C.

Compatibility

We are unaware of any adverse reactions between Leucidal® Liquid PT and any thickeners.

Recommended Techniques

Add Leucidal® Liquid PT to the water phase: Leucidal® Liquid PT is water soluble and may therefore be added to aqueous systems, as well as the aqueous phase of emulsions.

Leucidal®Liquid PT can also be easily incorporated into emulsion systems and water based applications. For color applications, we recommend spraying the product on the pigments along with other ingredients such as binders.

We always recommend that every formula undergo stability and microbial testing to ensure adequate preservation.
1. We recommend starting with 5.0% **PhytoCide Elderberry OS**.

2. Monitor the interaction of **PhytoCide Elderberry OS** with other ingredients.

3. We recommend incorporating **PhytoCide Elderberry OS** at temperatures lower than 75°C and a pH between 3 and 8.

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*We always recommend that every formula undergo stability and microbial testing to ensure adequate preservation.*
Heat Stability
With regard to the potential negative effects of high temperatures, we have done testing to show that **PhytoCide Elderberry OS** can tolerate temperatures of up to 75°C for a period of 8 hours without having any impact on the MIC performance.

Compatibility
**PhytoCide Elderberry OS** does not interact with anionic materials and, because of this, we are not aware of any adverse reactions between **PhytoCide Elderberry OS** and thickeners.

Recommended Techniques
Add **PhytoCide Elderberry OS** to the oil phase: **PhytoCide Elderberry OS** is oil soluble and may therefore be added to the oil phase of emulsions.

Additional Information
**PhytoCide Elderberry OS** is temperature stable up to 75°C and its antimicrobial properties are most effective between a pH of 3 and 8

We always recommend that every formula undergo stability and microbial testing to ensure adequate preservation.
1. We recommend coupling AMTicide® Coconut with one of our broad-spectrum antimicrobials, such as Leucidal® Liquid, at 4.0% each.

2. Monitor the interaction of AMTicide® Coconut with other ingredients for compatibility.

3. Incorporate AMTicide® Coconut into formulations at a pH between 3 and 8, during the cooling phase of the process at temperatures lower than 70°C.
Heat Stability
Results from testing has shown that AMTicide® Coconut can tolerate temperatures of up to 70°C for a period of 8 hours without having any impact on MIC performance.

Compatibility
The cationic nature of AMTicide® Coconut makes the main formulating concern potential incompatibility with highly anionic ingredients, such as thickeners. Reference FAQs for more information regarding specific anionic thickeners.

The use of solubilizing agents may help improve clarity in cases where haziness is observed.

Recommended Techniques

Add AMTicide® Coconut to the water phase: A successful recommendation is incorporating AMTicide® Coconut into the water phase of an emulsion or during cooling phase once the emulsion has been formed. Reference FAQs for techniques with anionic thickeners.

Additional Information
AMTicide® Coconut typically works well when added toward the end of the manufacturing process when the formulation temperature is below 70°C.
PhytoCide Aspen Bark Extract Powder

1. We recommend starting with 3.0% PhytoCide Aspen Bark Extract Powder.

2. Monitor the interaction of PhytoCide Aspen Bark Extract Powder with other ingredients.

3. We recommend incorporating PhytoCide Aspen Bark Extract Powder at temperatures lower than 70°C and a pH between 3 and 8.
Heat Stability
With regard to the potential negative effects of high temperatures, we have done testing to show that **PhytoCide Aspen Bark Extract Powder** can tolerate temperatures of up to 70°C.

Compatibility
**PhytoCide Aspen Bark Extract Powder** does not interact with anionic materials and, because of this, we are not aware of any incompatibility between the product and thickeners.

Recommended Techniques
Add **PhytoCide Aspen Bark Extract Powder** to the water phase: **PhytoCide Aspen Bark Extract Powder** is water soluble and may therefore be added to aqueous systems, as well as the aqueous phase of emulsions.

Additional Information
When using **PhytoCide Aspen Bark Extract Powder** it is recommended to maintain the formulation pH between 3 and 8 and incorporate the product at temperatures below 60°C.
1. We recommend starting with 3.0% PhytoCide Black Currant Powder.

2. Monitor the interaction of PhytoCide Black Currant Powder with other ingredients.

3. We recommend incorporating PhytoCide Black Currant Powder at temperatures lower than 75°C and a pH between 3 and 8.
Heat Stability
With regard to the potential negative effects of high temperatures, we have done testing to show that PhytoCide Black Currant Powder can tolerate temperatures of up to 75°C.

Compatibility
PhytoCide Black Currant Powder does not interact with anionic materials and, because of this, we are not aware of any adverse reactions between anionic thickeners.

Recommended Techniques

Adding PhytoCide Black Currant Powder to the water phase: PhytoCide Black Currant Powder may be added to aqueous systems, as well as the aqueous phase of emulsions.

Additional Information
When using PhytoCide Black Currant Powder it is recommended to maintain the formulation pH between 3 and 8 and incorporating the product at temperatures below 75°C

We always recommend that every formula undergo stability and microbial testing to ensure adequate preservation.
1. We recommend starting with 2.0% **SynerCide Asian Fusion**.

2. Monitor the interaction of **SynerCide Asian Fusion** with other ingredients.

3. We recommend incorporating **SynerCide Asian Fusion** at temperatures lower than 70°C and a pH between 3 and 8.

We always recommend that every formula undergo stability and microbial testing to ensure adequate preservation.
Heat Stability
We have done testing to show that **SynerCide Asian Fusion** can tolerate temperatures of up to 70°C for a period of 8 hours without having any impact on MIC performance.

Compatibility
**SynerCide Asian Fusion** does not interact with anionic materials and, because of this, we are not aware of any adverse reactions between **SynerCide Asian Fusion** and thickeners.

Recommended Techniques
**Add SynerCide Asian Fusion to the water phase:** **SynerCide Asian Fusion** is water soluble and may therefore be added to aqueous systems, as well as the aqueous phase of emulsions.

Additional Information
Optimal conditions for formulating with **SynerCide Asian Fusion** include maintaining a pH between 3 and 8 and temperatures below 70°C. If formulating at temperatures higher than 70°C it is recommended to add the ingredient on cooling after an emulsion has formed.
1. We recommend starting with 2.0% SynerCide Herbal Fusion.

2. Monitor the interaction of SynerCide Herbal Fusion with other ingredients.

3. We recommend incorporating SynerCide Herbal Fusion at temperatures lower than 70°C and a pH between 3 and 8.

We always recommend that every formula undergo stability and microbial testing to ensure adequate preservation.
Heat Stability
We have done testing to show that **SynerCide Herbal Fusion** can tolerate temperatures of up to 70°C for a period of 8 hours without having any impact on MIC performance.

Compatibility
**SynerCide Herbal Fusion** does not interact with anionic materials and, because of this, we are not aware of any adverse reactions between **SynerCide Herbal Fusion** and thickeners.

Recommended Techniques
**Add SynerCide Herbal Fusion to the water phase:** **SynerCide Herbal Fusion** is water soluble and may therefore be added to aqueous systems, as well as the aqueous phase of emulsions.

Additional Information
Optimal conditions for formulating with **SynerCide Herbal Fusion** include maintaining a pH between 3 and 8 and temperatures below 70°C. If formulating at temperatures higher than 70°C, it is recommended to add the ingredient on cooling after an emulsion has formed.
1. We recommend starting with 4.0% Arborcide® OC.

2. Monitor the interaction of Arborcide® OC with other ingredients for compatibility.

3. Incorporate Arborcide® OC into formulations at a pH between 3 and 8, during the cooling phase of the process at temperatures lower than 70°C.

Arborcide®OC is not Certified Organic by the USDA National Organic Program. However, it is allowed for use in Certified Organic products according to section 205.605 of the Code of Federal Regulations.

Arborcide®OC must be reviewed and approved for use by each customer’s individual certifying agency if it is to be used in an organic finished formula.

Each agency interprets the Code of Federal Regulations in their own way. Because of this, we recommend consulting with the organic certifying agent of choice prior to submitting the finished formula for certification.

We always recommend that every formula undergo stability and microbial testing to ensure adequate preservation.
**Heat Stability**
With regard to the potential negative effects of high temperatures, we have done testing to show that Arborcide® OC can tolerate temperatures of up to 70°C.

**Compatibility**
We have not encountered formulating issues with Arborcide® OC.

**Recommended Techniques**

**Add Arborcide® OC to the water phase:** A successful recommendation is adding Arborcide® OC in the water phase of an emulsion or cooling phase once the emulsion has been formed.

**Additional Information**
As with all biological materials some attention must paid to the conditions under which Arborcide® OC is used. Applications to date have shown that the material is stable up to a temperature of 70°C. Additionally, our testing has shown that Arborcide® OC remains active between a pH of 3 and 8.
FAQ’s

1. What use level is best compatible for my formulation?
When formulating with our products we recommend starting with the highest suggested use level of each AMT product. As formulations are different, the use level can be adjusted down to best fit the specific needs of the formulation.

2. How do I formulate with AMT products and anionic ingredients?
2a. AMTicide® Coconut and Anionic Thickeners
Overall, 4.0% AMTicide® Coconut is compatible with the following thickeners: Carbomers (Carbopol® Ultrez 10; Carbopol® 940), Hyaluronic Acid, Carrageenan, and Xanthan Gum. Compatibility tests with these thickeners and AMTicide® Coconut were performed and the order of addition that provided the best clarity and viscosity are displayed below

<table>
<thead>
<tr>
<th>4.0% AMTicide® Coconut (M14003)</th>
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</thead>
<tbody>
<tr>
<td>Water + Viscarin® SD 389 Carrageenan + M14003</td>
</tr>
<tr>
<td>Water + Keltrol® CG-SFT + M14003</td>
</tr>
<tr>
<td>Water + Sodium Hyaluronate/Hyaluronic Acid + M14003</td>
</tr>
<tr>
<td>Water + M14003 + Carbopol® Ultrez 10</td>
</tr>
<tr>
<td>Water + Carbopol® 940 + M14003</td>
</tr>
</tbody>
</table>

We always recommend that every formula undergo stability and microbial testing to ensure adequate preservation.
2b. Leucidal® Liquid and Anionic Thickeners
Overall, 4.0% Leucidal® Liquid is compatible with the following thickeners: Carbomers (Carbopol® Ultrez 10; Carbopol® 940), Hyaluronic Acid, Carrageenan, and Xanthan Gum.

Compatibility tests with these thickeners and Leucidal® Liquid were performed and the order of addition that provided the best clarity and viscosity are displayed below.

### 4.0% Leucidal® Liquid (M15008)

<table>
<thead>
<tr>
<th>Compatibility Test</th>
<th>Result</th>
</tr>
</thead>
<tbody>
<tr>
<td>Water + M15008 + Viscarin® SD 389 Carrageenan</td>
<td></td>
</tr>
<tr>
<td>Water + M15008 + Keltrol® CG-SFT</td>
<td></td>
</tr>
<tr>
<td>Water + M15008 + Sodium Hyaluronate/Hyaluronic Acid</td>
<td></td>
</tr>
<tr>
<td>Water + M15008 + Carbopol® Ultrez 10</td>
<td></td>
</tr>
<tr>
<td>Water + Carbopol® 940 + M15008</td>
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</tr>
</tbody>
</table>

We always recommend that every formula undergo stability and microbial testing to ensure adequate preservation.
FAQ’s

2. How do I formulate with AMT products and anionic ingredients?
2c. Leucidal® Liquid Complete and Anionic Thickeners
4.0% Leucidal® Liquid Complete has been tested for compatibility with Carbomers (Carbopol® Ultrez 10; Carbopol® 940) and Xanthan Gum. Compatibility tests with various orders of addition deemed Leucidal® Liquid Complete incompatible with Carbomers. The order of addition that provided the best clarity and viscosity for Xanthan Gum is displayed below.

<table>
<thead>
<tr>
<th>4.0% Leucidal® Liquid Complete (M15024)</th>
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</thead>
<tbody>
<tr>
<td>Water + Keltrol® CG-SFT + M15024</td>
</tr>
</tbody>
</table>

2d. Leucidal® Liquid SF and Anionic Thickeners
Overall, 4.0% Leucidal® Liquid SF is compatible with the following thickeners: Carbomers (Carbopol® Ultrez 10; Carbopol® 940), Hyaluronic Acid, Carrageenan, and Xanthan Gum. Compatibility tests with these thickeners and Leucidal® Liquid SF were performed and the order of addition that provided the best clarity and viscosity are displayed below.

<table>
<thead>
<tr>
<th>4.0% Leucidal® Liquid SF (M15019)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Water + M15019 + Viscarin® SD 389 Carrageenan</td>
</tr>
<tr>
<td>Water + M15019 + Keltrol® CG-SFT</td>
</tr>
<tr>
<td>Water + M15019 + Sodium Hyaluronate/Hyaluronic Acid</td>
</tr>
<tr>
<td>Water + M15019 + Carbopol® Ultrez 10</td>
</tr>
<tr>
<td>Water + M15019 + Carbopol® 940</td>
</tr>
</tbody>
</table>

We always recommend that every formula undergo stability and microbial testing to ensure adequate preservation.
2. How do I formulate with antimicrobials and anionic ingredients?

2e. Leucidal® SF Complete and Anionic Thickeners
4.0% Leucidal® SF Complete has been tested for compatibility with Carbomers (Carbopol® Ultrez 10; Carbopol® 940) and Xanthan Gum. The order of addition that provided the best clarity and viscosity for these thickeners is below.

<table>
<thead>
<tr>
<th>4.0% Leucidal® SF Complete (M15025)</th>
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</thead>
<tbody>
<tr>
<td>Water + M15019 + Viscarin® SD 389 Carrageenan</td>
</tr>
<tr>
<td>Water + M15019 + Keltrol® CG-SFT</td>
</tr>
</tbody>
</table>

We always recommend that every formula undergo stability and microbial testing to ensure adequate preservation.
3. What can be used to improve the clarity or viscosity of the solution?

Add a solubilizing agent to improve clarity: When a lipophilic peptide such as AMTicide® Coconut, Leucidal® Liquid, or Leucidal® Liquid SF interacts with an anionic material, haze may be observed. The haze is the result of the lipophilic portion going from fully soluble to partially soluble. A solubilizing agent, such as polysorbate 20, can be used to drag the lipophilic portion back into solution and, consequently, improve clarity. Therefore if it is possible, the addition of polysorbate is recommended at a use level of < 0.5%. If a solubilizing agent is employed, it should be incorporated after the addition of the antimicrobial.

Add salt to improve viscosity: In cases where this recommended procedure does not produce the desired viscosity, such as with xanthan gum, the addition of sodium chloride or sodium citrate has been shown to increase viscosity. After thorough mixing of water, salt, and Leucidal® Liquid SF, the anionic ingredient is then added to the solution and agitation is continued. In the case of xanthan gum, we have found that the salt to xanthan gum ratio should be around four parts salt to each part of xanthan gum (e.g., 2.0% sodium citrate or sodium chloride to 0.5% xanthan gum). Again, care should be taken to determine the amount and duration of agitation required to produce the desired solution.

We always recommend that every formula undergo stability and microbial testing to ensure adequate preservation.
4. How compatible are antimicrobials with anionic ingredients?
Overall, AMTicide® Coconut Leucidal® Liquid or Leucidal® Liquid SF is compatible with the following thickeners: Carbomers (Carbopol® Ultrez 10; Carbopol® 940), Hyaluronic Acid, Carrageenan, and Xanthan Gum. Compatibility testing was performed and viscosity curves were created for each anionic thickener.

4a. Carbomers

![Viscosity Curve for Carbopol® Ultrez 10 and AMT products](image1)

![Viscosity Curve for Carbopol® 940 and AMT products](image2)

Figure 2: Viscosity Curve for Carbopol® Ultrez 10 and AMT products

Figure 3: Viscosity Curve for Carbopol® 940 and AMT products

We always recommend that every formula undergo stability and microbial testing to ensure adequate preservation.
The order of addition for each antimicrobial that proved most compatible with each of the carbomers are outlined in the tables below.

**Carbopol® Ultrez 10**

<table>
<thead>
<tr>
<th>Combination</th>
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<tbody>
<tr>
<td>Water + M14003 + Carbopol® Ultrez 10</td>
</tr>
<tr>
<td>Water + M15008 + Carbopol® Ultrez 10</td>
</tr>
<tr>
<td>Water + M15019 + Carbopol® Ultrez 10</td>
</tr>
<tr>
<td>Water + M15025 + Carbopol® Ultrez 10</td>
</tr>
</tbody>
</table>

**Carbopol® 940**

<table>
<thead>
<tr>
<th>Combination</th>
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</thead>
<tbody>
<tr>
<td>Water + Carbopol® 940 + M14003</td>
</tr>
<tr>
<td>Water + Carbopol® 940 + M15008</td>
</tr>
<tr>
<td>Water + M15019 + Carbopol® 940</td>
</tr>
<tr>
<td>Water + M15025 + Carbopol® 940</td>
</tr>
</tbody>
</table>

We always recommend that every formula undergo stability and microbial testing to ensure adequate preservation.
4. How compatible are the Antimicrobials with anionic ingredients?

**4b. Xanthan Gum**

*Keltrol® CG-SFT*

![Graph showing viscosity curve for Keltrol® CG-SFT and AMT products]

The order of addition for each AMT product that proved most compatible with xanthan gum is outlined in the table below.

<table>
<thead>
<tr>
<th>Keltrol® CG-SFT</th>
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<tbody>
<tr>
<td>Water + Keltrol® CG-SFT + M14003</td>
</tr>
<tr>
<td>Water + M15008 + Keltrol® CG-SFT</td>
</tr>
<tr>
<td>Water + M15019 + Keltrol® CG-SFT*</td>
</tr>
<tr>
<td>Water + Keltrol® CG-SFT + M15024</td>
</tr>
<tr>
<td>Water + M15025 + Polysorbate 20 + Keltrol® CG-SFT</td>
</tr>
</tbody>
</table>

*Continued*
The best way to go about formulating Leucidal® Liquid SF with xanthan gum is to add Leucidal® Liquid SF to the water phase and then add xanthan gum. Haziness is likely to occur, but the addition of polysorbate 20 (<0.5%) will improve clarity. If the formulator would prefer to add Leucidal® Liquid SF into the solution of xanthan gum and water, salt can be used. White flocculation occurs when Leucidal® Liquid SF is added after the xanthan gum. The flocculation forms as Leucidal Liquid SF is being introduced into the xanthan gum and water solution, suggesting that it is a result of the Leucidal® Liquid SF out of solution. The addition of salt (<2.0% sodium chloride or sodium citrate) lowers the charge density, pulling Leucidal® Liquid SF into the solution and ultimately increases the viscosity of the solution.
4. How compatible are the Antimicrobials products with anionic ingredients?

*When formulating AMTicide® Coconut with sodium hyaluronate, the addition of polysorbate 20 (<0.5%) may improve clarity, however the clarity achieved may not be ideal for clear formulations.
4. How compatible are the Antimicrobials products with the following anionic ingredients?

*When formulating AMTicide® Coconut with Viscarin® SD 389, the addition of polysorbate 20 (<0.5%) may improve clarity, however the clarity achieved may not be ideal for clear formulations.

The order of addition for each AMT product that proved most compatible with carrageenan is outlined in the table below.

<table>
<thead>
<tr>
<th>Viscarin® SD 389</th>
<th>Water + Viscarin® SD 389 Carrageenan + M14003*</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Water + M15008 + Viscarin® SD 389 Carrageenan</td>
</tr>
<tr>
<td></td>
<td>Water + M15019 + Viscarin® SD 389 Carrageenan</td>
</tr>
</tbody>
</table>

We always recommend that every formula undergo stability and microbial testing to ensure adequate preservation.
Additional Questions?

Contact us

Formulator Sample Shop
+1.704.276.7099 / +1.704.276.7370
info@FormulatorSampleShop.com

We always recommend that every formula undergo stability and microbial testing to ensure adequate preservation.