polymeric thickener, emulsifier and stabilizer for the cosmetic industry

<table>
<thead>
<tr>
<th>Chemical Name</th>
<th>Hydrophobically modified sulfonic acid copolymer, partially neutralized</th>
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<tbody>
<tr>
<td>INCI Designation:</td>
<td>Ammonium Acryloyldimethyltaurate/ Beheneth-25 Methacrylate Crosspolymer</td>
</tr>
</tbody>
</table>

**General formula**

![Chemical structure of Aristoflex® HMB](image)

**Product properties**

<table>
<thead>
<tr>
<th>Property</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Appearance (20°C)</td>
<td>White powder</td>
</tr>
<tr>
<td>Solid content</td>
<td>Min. 92.00%</td>
</tr>
<tr>
<td>Water content (Karl Fischer)</td>
<td>Max. 5.00%</td>
</tr>
<tr>
<td>Viscosity 20°C (1% in dist. water)</td>
<td>35000 - 70000 mPas</td>
</tr>
<tr>
<td>pH-value (1% in dist. water)</td>
<td>4.0 - 6.0</td>
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**Emulsifying and Stabilizing with Aristoflex® HMB**

Aristoflex® HMB represents a high molecular weight acrylamidomethylpropane sulfonic acid (AMPS) polymer, partially neutralized with ammonia. However, in addition to having a large, water loving (hydrophilic) portion, Aristoflex® HMB also contains a smaller oil-loving (hydrophobic) portion. This chemical structure allows this copolymer to function as primary emulsifier and stabilizer in oil-in-water emulsions. This is done as the hydrophobic portion adsorbs at the oil-water interface, and the hydrophilic portion swells in the water phase to provide exceptional emulsion stability to a broad range of oils.

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1 These characteristics are for guidance only and not to be taken as product specifications. The tolerances are given in the product specification sheet. For further product properties, specifications, safety and ecological data, please refer to the MSDS.
How Aristoflex®HMB emulsifies

Traditional ionic or non-ionic surfactants stabilize oil-in-water emulsions principally by forming liquid crystals at the emulsion interface; typically usage levels are 3 – 7%. The hydrophilic-lipophilic balance (HLB) of the oil and surfactant phase must be carefully controlled to ensure good emulsion stability. Often polymeric hydrocolloids, such as Aristoflex®HMB, are added to increase the stability of the oil-in-water emulsion by thickening and adding yield value to the water phase. Emulsions created with very low levels of Aristoflex®HMB polymer are extremely stable. The mechanism is believed to be electro steric stabilization, in which oil droplets are entrapped and held in place as a result of the very high yield value typical of Aristoflex®HMB. At equilibrium, adsorbed homopolymer molecules form an adsorbed layer comprised of loops and tails extending into the solution phase. Thus, when two oil droplets approach each other, a repulsive force is generated owing to the presence of these adsorbed layers. Both mechanisms are represented in Figure 1.

Application

Aristoflex®HMB is a hydrophobically modified synthetic polymer used as gelling agent for aqueous systems and as texturizer or thickener for oil-in-water emulsions. The polymer is pre-neutralized, easy to use and provides formulations with excellent yield value, corresponding to superior stability even in the absence of additional emulsifier. Due to the hydrophobic modification, even low concentrations of Aristoflex®HMB stabilize high amounts of oil. Emulsions formulated with Aristoflex®HMB provide favorable shear thinning effects and viscoelastic properties. Besides the rheological aspects, excellent sensory properties (good skin feel, low degree of stickiness and/or tackiness), excellent transparency of aqueous gels as well as perfect compatibility with organic solvents characterize formulations comprising Aristoflex®HMB. Based on a polymer backbone derived from sulfonic acid, O/W emulsions can be formulated even at low pH, enabling easy incorporation of e.g. AHA’s.
High Efficiency
The amount of Aristoflex ®HMB used in personal care formulations is typically in the range of 0.3 – 1.2 %. Typically only 0.5 % of Aristoflex ®HMB is required to provide a stable emulsion for up to 30 % oil phase in oil-in-water (O/W) emulsions.

Preparation of emulsions
Aristoflex ®HMB can be used to prepare O/W emulsions in both hot and cold process. Aristoflex ®HMB is typically added to the oil phase (comprising emollient and emulsifier), slight agitation facilitates dispersion. Any small aggregates can be broken up easily with gentle stirring. The mixing reactor should be completely dry of moisture to prevent the polymer from migrating prematurely to any water already present and becoming gummy. Production facility requirements will usually govern the emulsification method applied. Aristoflex ®HMB can be used for both direct emulsification (i.e. adding the oil phase to the water phase) and inverse emulsification (i.e. adding the water phase to the oil phase). As Aristoflex ®HMB is partially pre-neutralized, no neutralization step is required. Finally, the emulsion is homogenized with suitable mixing equipment. Emulsions comprising Aristoflex ®HMB are brilliant and glossy, they provide excellent spreadability and fast absorption. The O/W emulsions are characterized by dry aesthetic skin feel without tackiness and are especially suitable as light, elegant formulations.

Preparation of emulsifier-free cream-gels
Another special feature of Aristoflex ®HMB is the stabilization of water-insoluble liquids (e.g. oil) WITHOUT using additional emulsifiers. The resulting O/W formulations are also known as cream gels. The stabilizing effect of Aristoflex ®HMB is explained by the cross-linked structure of the polymer, providing a yield value and thus ‘trapping’ the oil droplets or solids (e.g. pigments) in the water/polymer matrix. The hydrophobic side chains additionally stabilize nonpolar components. ‘Yield value’ reflects the minimum force that must be applied to the liquid to start disrupting the structure imparted by Aristoflex ®HMB, so flow can occur.

Preparation of aqueous gels
Aqueous gels (e.g. hair gels) can be prepared by adding the water phase to Aristoflex ®HMB. Special care should be taken for good agitation. Aristoflex ®HMB 1% provides transparent, crystal clear gels. The best gel clarity is obtained using water which is relatively free of metal ions (demineralized or deionized). Aristoflex ®HMB has a good compatibility with other polar organic solvents. Hydro-alcoholic, transparent gels can be made comprising more than 50% ethanol. Typically, the water/ethanol mixture is added to Aristoflex ®HMB. Ethanol can be used to dissolve active ingredients while avoiding the use of solubilizes such as PEG-40 Hydrogenated Castor Oil, Polysorbate 20, or similar ingredients. In this way it is easy to prepare hydro-alcoholic gels containing perfume oils, oil-soluble UV-filters, actives (e.g. plant extracts), film formers etc. In case of high ethanol content additional preservation is not required.
To manufacture hydro-alcoholic gels based on Aristoflex® HMB the best option is to first prepare the aqueous gel, and subsequently add to the gel a solution of the active (or film former) dissolved in ethanol. The addition is preferably done by using a slow moving anchor stirrer to minimize trapping of air bubbles.

**Universal Emulsification**
Because Aristoflex® HMB does not depend on building liquid crystalline structure to provide emulsion stability, it can be used with virtually any oil phase, regardless of the required HLB for the oil phase. Oil-in-water emulsions have been made with many oil types, including silicone oils, hydrocarbons/waxes and ester oils. Waxes can be emulsified in their molten state.

**Triggered Water Release**
Emulsions created with low levels of Aristoflex® HMB break quickly upon contact with an electrolyte. This is advantageous in emulsion coatings which are applied over ionic surfaces. In such an environment, the emulsion will quickly collapse, expelling the water and providing much faster drying time than is normally found with conventional emulsion systems.

**Compatibility**
Aristoflex® HMB polymeric emulsifier is compatible with a broad range of nonionic or slightly ionic water soluble materials. High levels of electrolytes will prevent the normal swelling of the hydrophilic portion of the molecules, and emulsion creaming may occur due to the resulting low viscosity. In the absence of higher amounts of salt Aristoflex® HMB can be used as an associative thickener for rinse-off formulations containing anionic surfactants. These formulations also permit the stabilization of organic pigments. Cationic species often complex with Aristoflex® HMB resin.

Aristoflex® HMB can be used in a broad pH range of 2.5 – 9.0. As Aristoflex® HMB is an ammonium salt, higher pH than 9.0 will release ammonia.

**Storage recommendations**
The product is stable when stored in closed original containers. It must be protected from humidity during storage. Further information on handling, storage and dispatch is given in the EC safety data sheet.