Nouryon

Amphomer® polymer

Hard holding hair fixative

INCI: Octylacrylamide/Acrylates/Butylaminoethyl Methacrylate Copolymer

Amphomer polymer is an exceptionally hard holding acrylic polymer that is widely used in a variety of hair styling aids. When used in hair sprays at "typical" solids levels, Amphomer polymer produces a very hard hold and unsurpassed style retention. Alternatively, Amphomer polymer can be used at reduced solids to give a soft, natural hold while maintaining good setting properties. Amphomer polymer has both carboxylate and amine functionality along the polymer backbone. After neutralization, the carboxylate groups become highly anionic.

During dry down, these anionic groups may associate with the amine groups in Amphomer polymer through ionic association and hydrogen bonding mechanisms to give a three-dimensional resin matrix. This polymer matrix performs like a polymer of much greater molecular weight than Amphomer polymer and contributes to its excellent humidity resistance, solubility, and adhesion. However, Amphomer polymer still retains the desired properties of a low molecular weight polymer: fine spray pattern, easy dry comb, good solubility, and shampoo removability.

Recommended applications

Traditional and low VOC aerosol and pump hair sprays, and styling aids such as mousses, gels, creams, pomades, and glues.

Features and benefits

- High hydrocarbon propellant tolerance
- Holds styles under humid conditions
- Gives very firm hold sprays
- High performance acrylate polymer
- Very resistant to humidity
- Forms strong films
- Provides additional hold and humidity resistance in styling aids

Suggested use levels, as supplied

Hair sprays	2-7%, may be used in higher concentrations in non-aerosolhair spray formulations

Amphomer polymer is a humidity resistant, extra hard holding hair spray resin. The exact amount to use depends on the hold level desired, amount of propellant in the system, and the types and levels of other additives that may affect the hold properties of the final formulation.

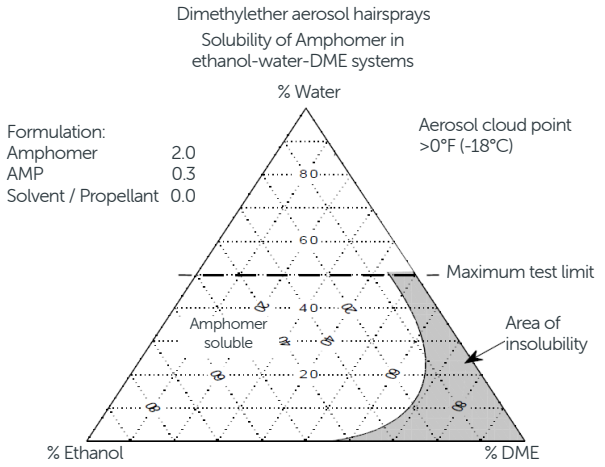
Suggested pH range of final formulation: 8.0-9.0

Propellant systems

Amphomer polymer is highly compatible with hydrocarbon, dimethylether, and hydrofluorocarbonpropellants. In fact, Amphomer polymer is widely used throughout the world in aerosol hair sprays using combinations of these types of propellants. Amphomer polymer and other carboxylated polymers can be made more compatible with hydrocarbon propellants by adding small quantities (1-5%) of water. For optimum hydrocarbon tolerance and resin stiffness, it is recommended that the formulator evaluate partial neutralization with a long chain amine. The balance should then be made up of a primary neutralizer such as AMP (aminomethyl propanol). This may eliminate the need for additional plasticizers in the formulation. For VOC compliant hair spray formulas, Amphomer polymer may also be used with Hydrofluorocarbon 152A (1,1 difluoroethane) propellant.

Alcoholic solutions of Amphomer polymer are compatible with carbon dioxide. This solubilized, compressed gas has been used as a propellant with Amphomer-based concentrates.

Figure 1: Solubility of Amphomer in ethanol-water-dme systems

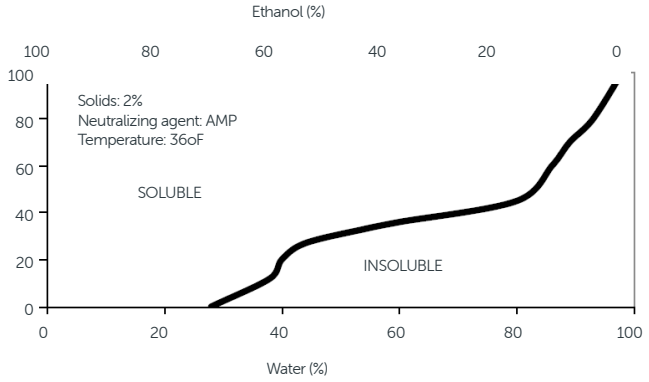


Formulation guidelines

Solubility

Amphomer polymer is soluble in ethanol and isopropanol. As supplied, it is insoluble in water, but can be made water soluble by complete neutralization of the carboxyl groups with a strong base. Suggested neutralizers include AMP (2-amino-2-methyl-1-propanol), ammonium hydroxide, sodium hydroxide, and potassium hydroxide. When partially neutralized, Amphomer polymer is soluble in a wide range of water-alcohol blends. Depending on the type of neutralizer used, propellant tolerance needs to be re-checked.

Figure 2:



Plasticization

Amphomer polymer is an exceptionally hard resin which offers the formulator a great deal of freedom in developing hair sprays over a range of tactile properties. In most cases, plasticizers are used in combination with Amphomer polymer to improve feel and to enhance gloss and combing properties.

Polymeric "plasticizers" such as Resyn® 28-2930 polymer can also be used to achieve some very interesting results. These can plasticize Amphomer polymer without producing undesirable softening. Propellant compatibility and low temperature stability of any blend should be thoroughly evaluated.

Neutralization

Amphomer polymer is carboxylated and must be completely or almost completely neutralized for water solubility and shampoo removability. A neutralization range of 80-100% with AMP is recommended. The final formulation pH of an Amphomer-containing hair spray should fall within a pH range of 8.0-9.0.

The level of neutralization can also alter the film properties, where higher neutralization provides a softer, more flexible feel, while lower neutralization imparts a harder, stiffer feel. While AMP is the neutralizing agent of choice, other agents may be used effectively including AMPD (2-amino-2-methyl-1,3-propanediol), monoisopropanolamine, triisopropanolamine, and dimethyl stearamine.

The amount of base needed to neutralize the carboxyl groups in Amphomer polymer can be determined by the following relationships:

$$B = \frac{W * A * N * E}{1000}$$

Where:

B = weight of base needed (grams)
W = weight of Amphomer used
A = acidity in meq/g of Amphomer
N = % neutralization required (decimal)
E = equivalent weight of base

Example:

To neutralize 100 grams of Amphomer polymer 90% with AMP

W = 100 grams
A = 2.40 (average acidity)
N = 0.90
E = 89

$$16.4 = \frac{100 * 2.05 * 0.90 * 89}{1000}$$

Organic amines and amino alcohols, when used as neutralizers for carboxylated polymers, will produce a plasticizing effect on the polymer. The degree of softening will be a function of molecular weight and structure of the neutralizer, as well as degree of neutralization required. Neutralization with inorganics provides an excellent way to bring out the inherent stiffness of Amphomer polymer.

It has been found that certain inorganic neutralizers, such as potassium hydroxide, impart minimal softening while speeding alcohol release from the polymer film. Since inorganic neutralizers are relatively strong bases, the formulator should consider lower percent neutralization of the polymer than would be used with amino alcohol neutralization.

Note: Depending upon the polymer used, it may be necessary in quality control to consider the alkalinity of the polymer in titrations to determine percent neutralization. Call Nouryon Personal Care for further information and procedures.

Preparation of hair spray concentrates

The preparation of the aerosol concentrates should be carried out according to the procedure outlined in the following example:

- Charge the mixing vessel with the required amount of alcohol
- Start agitation
- Add resin slowly – so that no accumulation of resin occurs on the surface
- After all the resin is added, slowly add the neutralizing agent (If KOH, add as 10% solution in alcohol)*
- Continue mixing until all the resin is in solution
- Add the rest of the ingredients in the formulation
- Filter the concentrate down through 5-10 micron cartridge filters before filling the aerosol containers.

***Note:** Alcohol temperature dramatically affects dissolution rate. It is generally suggested that the alcohol temperature be 15-20°C. Concentrates of up to 20% neutralized resin in alcohol may be prepared. Care should be taken that the viscosity of the concentrate is suited to the production equipment involved.

Compatibility

Additives

Amphomer polymer is compatible with a wide variety of additives such as ester type plasticizers,ethoxylates, silicones and a variety of protein derivatives. When formulating Amphomer polymer with high proportions of hydrocarbon or hydrofluorocarbon propellant, it is essential that the hydrocarbon compatibility of the additives themselves be confirmed.

Storage and handling

Amphomer polymer can be stored under ambient conditions without undergoing decomposition or degradation. This product is supplied in fiber containers. When not in use, the container should be kept covered to prevent dirt, dust, and moisture pick-up. Store in a cool, dry area.

Health and safety

Information on Amphomer polymer relating to the EU Cosmetics Directive 76/768/EEC is available onrequest.

Contact us directly for detailed product information and sample request
website | nouryon.com/markets/personal-care
email | PersonalCare.Marketing@nouryon.com

Nouryon

Nouryon is a global, specialty chemicals leader. Markets and consumers worldwide rely on our essential solutions to manufacture everyday products, such as personal care, cleaning goods, paints and coatings, agriculture and food, pharmaceuticals, and building products. Furthermore, the dedication of more than 7,900 employees with a shared commitment to our customers, business growth, safety, sustainability and innovation has resulted in a consistently strong financial performance. We operate in over 80 countries around the world with a portfolio of industry-leading brands. Visit our website and follow us @Nouryon and on LinkedIn.

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