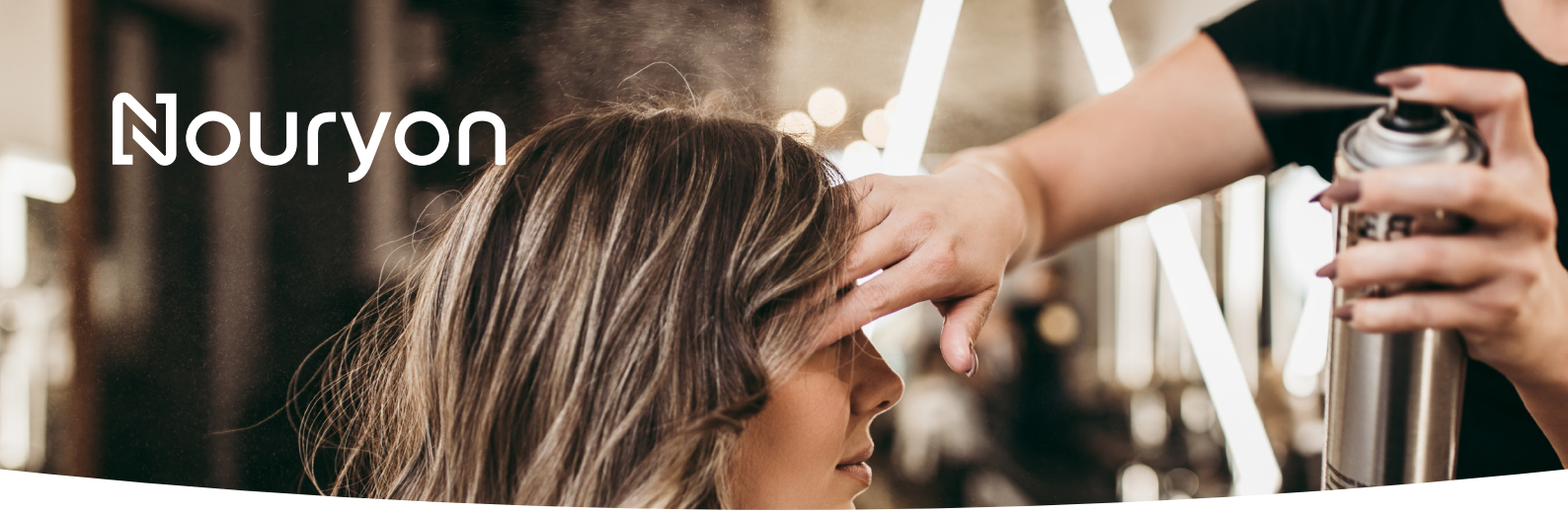
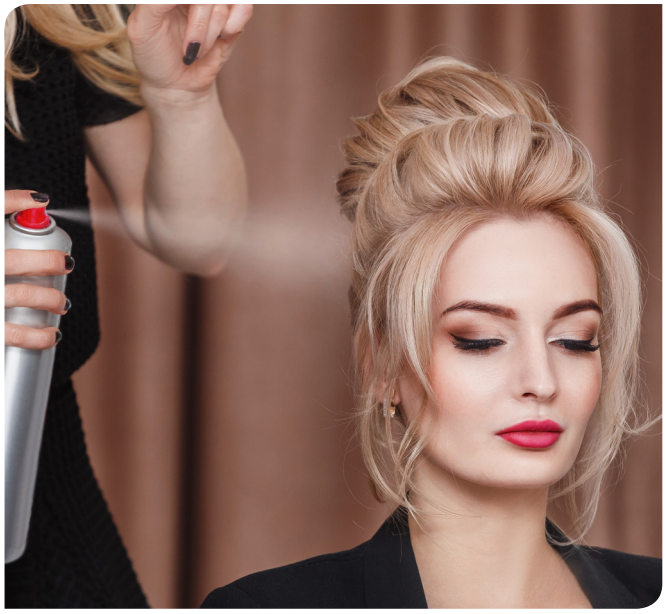


Balance® 47 polymer

Low VOC hair fixative

INCI: Octylacrylamide/Acrylates/Butylaminoethyl Methacrylate Copolymer

Balance 47 polymer, a unique, hydrophobically modified acrylic resin, has been specially designed to produce superior performance in low volatile organic compound (VOC) aerosol and pump hair sprays that contain water. In such systems, the negative effects of water are well known. Water contributes to both increased viscosity and increased surface tension resulting in wetter sprays with a larger particle size. These sprays are inefficient in coating the hair. Water also affects initial curl droop, drying time, polymer holding properties, and stiffness of the hair. Furthermore, the increased viscosity due to the water can limit the polymer solids of the spray and can result in actuator blockage. Due to its unique composition and molecular weight distribution, Balance 47 polymer hair fixative overcomes the effects of water over abroad range of hair spray VOC content.



Recommended applications

Balance 47 polymer can be used in a wide variety of hair fixative formulations, and is particularly suited to low VOC (80% VOC to alcohol-free) hair spray formulations.

Features and benefits

- Low solution viscosity
- Excellent film former
- High Tg acrylic polymer
- Hydrophobically modified
- Hydrolytically stable
- Fine atomization in low VOC hair sprays with water
- Rapid drying
- Use in high solids formulas
- Propellant compatible
- Non-tacky
- Good holding – even in soft, natural hair sprays
- Excellent aerosol stability
- Easy shampoo removability
- Innovative product capabilities
- Useful in a wide range of styling aids such as mousses, styling creams, and setting lotions

Suggested use levels, as supplied

Application	% active
Aerosol hair spray	2-8%, depending on hold level
Non-aerosol hair spray	2-10%, depending on hold level

Formulation guidelines

Solubility

As supplied, Balance 47 polymer is soluble in ethanol and isopropanol but insoluble in water. The polymer becomes water soluble when neutralized 80%-100% with suitable bases such as AMP (2-amino-2-methyl-1-propanol). When neutralized, Balance 47 polymer is also soluble in alcohol-water blends and can be easily washed off the hair with shampoo. Typical usage levels are 2-10%.

Neutralization

Balance 47 polymer is carboxylated and must be neutralized with a suitable alkaline material in the formulation. AMP is recommended, although other neutralizers can be used. For example, neutralization the inorganic neutralizers such as potassium hydroxide or sodium hydroxide, can produce a stiffer film on the hair, while still making the polymer easily shampoo removable.

For those low VOC hair sprays containing water, the recommended neutralization level will depend on the water content of the formula. In both 80% VOC and 55% VOC hair sprays containing water, it is recommended that Balance 47 polymer be neutralized 80% with AMP; aqueous, alcohol-free systems require 95% to 100% neutralization to achieve suitable water solubility. The final formulation pH of a Balance 47 polymer containing hair spray should fall within a pH range of 8.0-9.0.

To neutralize the carboxyl groups in Balance 47 polymer, the amount of base required can be determined by the following relationship:

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

Where:
B = weight of base needed (grams)
W = weight of Balance 47 polymer used
A = acidity of polymer taken from the certificate of analysis or (use average acidity of 2.5)
N = % neutralization required (decimal)
E = equivalent weight of base

Example: To neutralize 25 grams of Balance 47 polymer, 80% with AMP

$$B = \frac{25 \times 2.5 \times 0.80 \times 89.14}{1000} = 4.457 \text{ grams}$$

W = 25 grams
A = 2.5 (average acidity)
N = 0.90
E = 89.14 g/mol

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. Contact us for further information and procedures.

Compatibility

Additives

The formulator may wish to use various additives to either enhance on-hair properties or for marketing claims. Balance 47 polymer is compatible with a wide variety of anionic and nonionic additives such as silicones, proteins, esters, and other commonly used additives. Due to its amphoteric character, the compatibility of Balance 47 polymer with cationic additives will depend on quantity, type, pH, and charge density.

To further reduce particle size and minimize the foaming tendency of low VOC hair sprays containing Balance 47 polymer, the formulator may wish to evaluate use of the following additives (the use of these additives is described in U.S. Patent 5,599,524): Hexamethyl disiloxane, Bisphenyl hexamethicone, Isocetyl alcohol.

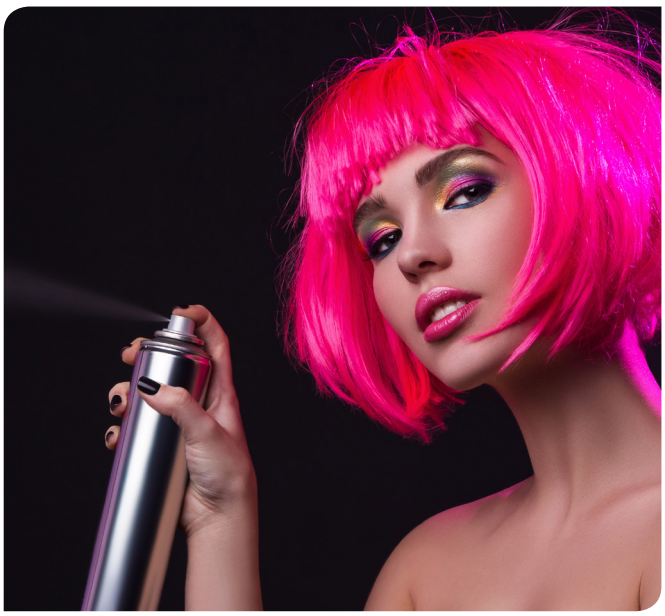
Propellant

As supplied, Balance 47 polymer is soluble in ethanol and isopropanol but insoluble in water. The polymer becomes water soluble when neutralized 80%-100% with suitable bases such as AMP (2-amino-2-methyl-1-propanol). When neutralized, Balance 47 polymer is also soluble in alcohol-water blends and can be easily washed off the hair with shampoo. Typical usage levels are 2-10%.

Important note: Balance 47 polymer is incompatible in some high propellant hair spray systems. Product stability and suitability should be confirmed in all respects by doing appropriate stability and robustness testing. For questions and recommendations, contact one of our regional office.

Other polymers

Balance 47 polymer is compatible with a variety of other polymers. Polymer blends can be usedsuccessfully to modify properties of Balance 47 polymer in hair care products..



Performance properties

Hair sprays

Sprays with Balance 47 polymer, the formulator has a unique tool in creating innovative products in low VOCcompliant hair sprays to reduce overall impact of water on the hair. Due to its exceptionally low viscosity in aqueous and aqueous–alcoholic systems, Balance 47 polymer can be formulated at much higher than typical use levels. A restricted valve orifice can then be used to deliver to the hair what would amount to amore "normal" resin deposition – to produce more "normal" holding properties.

Reduced spray rates resulting from restricted valve orifice deliver less water to the hair and release less VOCs into the atmosphere per actuation interval. Thus, through use of Balance 47 polymer, the formulator can mitigate the impact of water in hair spray through reduction in the "initial curl droop of the hair" produced by water. Since less VOCs are emitted per actuation, lower VOC compliance can be achieved while formulating at higher VOC content.

Viscosity

As supplied, Balance 47 polymer is soluble in ethanol and isopropanol but insoluble in water. The polymer becomes water soluble when neutralized 80%-100% with suitable bases such as AMP (2-amino-2-methyl-1-propanol). When neutralized, Blance 47 polymer is also soluble in alcohol-water blends and can be easily washed off the hair with shampoo. Typical usage levels are 2.0-10.0%.

	Solution viscosity (cps)*
Balance 47 polymer	4
Commercial acrylate	109

* RV Brookfield/spindle 21/50 RPM/10% solution in water

Migration of a resin droplet along the hair shaft is a critical factor in imparting stiffness and set to the hair. It can also impact the feel and gloss of the hair. In low VOC systems, water increases viscosity and restricts droplet flow down the hair shaft. However, use of the low viscosity Balance 47 polymer allows droplets to migrate down the hair shaft more quickly. Using UV pulsing laser microscopy, the following droplet flow rates were determined on hair. Droplet size was fixed at 550 + 30 microns. Sprays were delivered from 80% VOC aerosols containing water.

Resin	Viscosity	% solids	Flow rate (mm/sec)
Commercial A	High	5	3.2
Commercial B	Medium	5	4.0
Balance 47 polymer	Low	5	7.1
Balance 47 polymer	Low	8	3.2

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

* Alcohol temperature dramatically affects solution rate. It is generally suggested that 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 aerosol packing machinery involved.

Hair sprays covering the entire spectrum of VOC levels can be prepared with Balance 47 polymer.

Storage and handling

Balance 47 polymer is supplied as a white powder.
Some settling will occur in the drums duringshipping.
Balance 47 polymer can be stored under normal conditions without undergoing decomposition. When not in use, the drums should be kept covered to prevent dust accumulation and moisture pick-up.

Health and safety

Information on Balance 47 polymer relating to the EU Cosmetics Directive 76/768/EEC is available on request.

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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