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Acrylates Copolymer

Very water resistant film-forming polymer

INCI: Acrylates/Octylacrylamide Copolymer

Globally, consumers are becoming increasingly aware of the need to protect their skin from the harmful effects of UV radiation. Demand for these products has driven the sun care market to become the fastest growing personal care sector over the last few years. New trends have emerged as consumers redefine what is important in their sun protection products: higher Sun Protection Factor (SPF) values, broad spectrum protection, enhanced water and rub-off resistance, more aesthetically pleasing products, and convenience.

The advent of newly popular forms such as alcohol-based aerosol and non-aerosol sprays has created a challenge for formulators as they try to achieve water resistance in these non-traditional systems. **Acrylates Copolymer** film-forming polymer is the ideal choice for these systems due to its alcohol solubility.

Acrylates Copolymer polymer is a hydrophobic, high molecular weight, carboxylated acrylic copolymer. Films of **Acrylates Copolymer** are inherently moisture resistant, making it the ideal ingredient for use in water resistant products.

Acrylates Copolymer film-forming polymer can also be used to hold active ingredients on the site of application by imparting resistance to abrasion or rub-off.

Recommended applications

- Recreational sun protection products
- Daily wear moisturizers with SPF
- Tinted sun protection products
- Color cosmetics
- Face, body, hand, and foot creams and lotions

Features and benefits

Features	Benefits
Film-formation	Proven water resistance and SPF retention Resistant to rub-off
Solubility in ethanol	Easy to use No neutralization required in alcoholbased products Excellent performance in alcoholbased properties
Solubility in water, with neutralization	Broad application areas
Broad acceptability	Safety tested for use in spray applications Globally approved

Suggested use levels, as supplied

Application	% active
Sun protection	1.0-5.0
SPF daily wear moisturizer	0.5-3.0
Tinted sunscreens	0.5-5.0
Color cosmetics	1-10
Creams and lotions	0.5-3.0

Formulation guidelines

Solubility

As supplied, **Acrylates Copolymer** film-forming polymer is soluble in ethanol, isopropanol and fatty alcohols, but is insoluble in water. The polymer becomes water soluble/dispersible by neutralizing the carboxyl groups with a suitable water soluble base, such as triethanolamine, 2-amino-2-methyl-1-propanol (AMP), ammonium hydroxide, or potassium hydroxide. For effective solubilization/dispersion, 100% neutralization of the carboxyl groups is generally recommended. Likewise, **Acrylates Copolymer** polymer can be solubilized into an oil system by fully neutralizing the polymer with a long chain amine, such as dimethyl stearamine.

Neutralization

Acrylates Copolymer film-forming polymer is carboxylated and is normally neutralized with a suitable alkaline material in formulation. The formulator can use materials such as triethanolamine, 2-amino-2-methyl-1-propanol, ammonium or potassium hydroxides, or long chain amines. The amount of base required to neutralize the carboxyl groups in **Acrylates Copolymer** 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 **Acrylates Copolymer** used

A = acidity (meq/g) of **Acrylates Copolymer**

N = % neutralization required (decimal)

E = equivalent weight of base

A specific example of 100% neutralization of 100 grams of **Acrylates Copolymer** film-forming polymer with triethanolamine:

$$B = \frac{100 \times 2.4 \times 100 \times 149.2}{1000} = 38.5 \text{ grams TEA}$$

W = 100 grams

A = 2.4 meq/g

N = 1.00

E = 149.2 meq/g

Incorporation

Acrylates Copolymer film-forming polymer can be formulated into the water phase or the oil phase of emulsions. It can also be formulated into alcohol or hydro-alcoholic systems.

Water phase incorporation

Acrylates Copolymer film-forming polymer is typically incorporated into the water phase with neutralization. Neutralization levels of 80-100% are recommended. The neutralizing agent (i.e., TEA) may be added to the water phase and heated to 80°C before adding the polymer. The **Acrylates Copolymer** may then be slowly sifted in with good agitation and mixed for 20 minutes. To simplify addition of **Acrylates Copolymer** into the water phase, pre-slurry together the neutralizing agent, glycol or glycerin, and **Acrylates Copolymer**.

The recommended slurry ratio is 2 parts **Acrylates Copolymer** to 5 parts polyol. Add enough alkali to the slurry to neutralize the **Acrylates Copolymer** and any other ingredients that require neutralization (i.e. Carbomer). This pre-slurry should then be immediately added to the water phase of the emulsion. The polymer dispersion in the water phase will appear slightly opaque.

Oil phase incorporation

Water resistance may also be attained by incorporating **Acrylates Copolymer** film-forming polymer into the oil phase. Long chain amines, added at 80-100% neutralization levels, are the neutralizing agents of choice. Prior to adding the polymer, all oil phase ingredients (including neutralizing agent) should be combined and heated to 80°C. **Acrylates Copolymer** should then be slowly sifted in using good agitation and mixed for one half hour. If using fatty alcohols that are solid at room temperature, it will be necessary to heat these fatty alcohols above their melting temperature, begin mixing, and then add the **Acrylates Copolymer** with mixing.

Incorporation into alcoholic systems

Acrylates Copolymer film-forming polymer is soluble in and can be easily incorporated into alcoholic systems. In the mixing vessel, begin stirring the alcohol. Slowly sift in the **Acrylates Copolymer**. If neutralization is required, neutralize with base after the polymer is in solution.

Incorporation into hydro-alcoholic systems

Acrylates Copolymer film-forming polymer can be easily incorporated into hydro-alcoholic systems. First, add the alcohol to the mixing vessel and begin stirring. Add the **Acrylates Copolymer** to the alcohol, in a polymer to alcohol ratio of no greater than 1:4. Once the **Acrylates Copolymer** is in solution, neutralize with a base. For a clear system, **Acrylates Copolymer** should be neutralized at least 90%. Finally, add the water, UV filters and other formulation ingredients.

In all cases, grittiness is an indication of poor dispersion caused by either under neutralization or improper incorporation. Grittiness can be eliminated by adjusting the neutralization level, the temperature or the mixing time used.

Compatibility

Acrylates Copolymer film-forming polymer is compatible with a broad range of ingredients commonly used in cosmetic formulations. Because **Acrylates Copolymer** is anionic, compatibility must be evaluated when formulating with cationic raw materials. The polymer's solubility may decrease in the presence of high concentrations of non-polar products, such as paraffin waxes.

Performance properties

SPF retention from an alcohol-based system

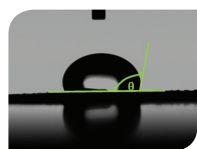
Acrylates Copolymer film-forming polymer is soluble in ethanol without neutralization making it the ideal choice for alcohol-based sunscreen sprays. The following table shows a target SPF 30 and SPF 50 formulation and the in-vivo SPF measurements for static and 80 minute very-water resistance.

Ingredient	2364-52A	2622-18
	SPF 30	SPF 50
	%	%
Ethanol	69.00	63.00
Acrylates Copolymer	3.00	3.00
Avobenzene	3.00	3.00
Octocrylene	2.00	5.00
Homosalate	12.00	13.00
Ethylhexyl Salicylate	5.00	5.00
Benzophenone-3	4.00	6.00
Glycerin	2.00	2.00
Label SPF Static	33	54
Label SPF 80 min VWR	33	50

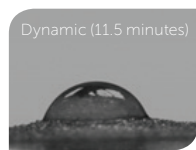
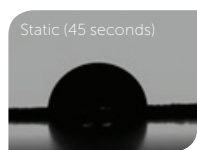
Film properties

Contact angle

Acrylates Copolymer film-forming polymer maintains integrity after water exposure, allowing for the formulation of durable and long-lasting products.



Model systems (2mg/cm² dosage) applied to pre-hydrated Vitro Skin® (N-19). Drop of deionized water was placed on sample substrate θ measured of image captured within 45 seconds (static) and after 11.5 minutes (dynamic)



Acrylates Copolymer
 $\theta = 82.4 \pm 2.86$

Shine – gloss meter

Evaluation of gloss was performed with the films cast from model systems containing **Acrylates Copolymer** film-forming polymer on black and white opacity charts. Gloss was measured on the scale of 0-90 degrees at a 60° angle. 0-20 degrees is considered a matte finish, 21-69 degrees is considered a semi-gloss finish, and 70-90 degrees is considered a high gloss finish. Gloss meter evaluations on model SPF systems containing **Acrylates Copolymer** showed a lower shine performance, 28.1 degrees on a white background and 30.9 degrees on a black background.

Acrylates Copolymer provides a low shine film when applied in ethanol-based sunscreen systems.

SPF retention from an emulsion

Acrylates Copolymer film-forming polymer can be made soluble in water by neutralizing with a water soluble base, making it an option for formulating water resistant emulsions. The following table shows two formulations, one with **Acrylates Copolymer** and one without, and their in-vivo SPF measurements before and after 80 minute immersion in water. The use of **Acrylates Copolymer** in this formulation increases the static SPF and maintains the actives on the skin after an 80 minute immersion in water.

Ingredient	12689-125C2	12689-125C3
	with Acrylates Copolymer	no polymer
	%	%
Phase A		
Water	54.84	57.20
Carbomer	0.20	0.20
Structure® XL starch	1.70	1.70
Phenoxyethanol, Methylparaben, Butylparaben, Ethylparaben, Propylparaben	1.00	1.00
Phase B		
Glycerin	5.00	5.00
Acrylates Copolymer	2.00	
Triethanolamine 99%	0.76	0.40
Phase C		
Ethylhexyl Methoxycinnamate	7.50	7.50
Benzophenone-3	6.00	6.00
Ethylhexyl Salicylate	4.00	4.00
Octocrylene	9.00	9.00
Glyceryl Stearate	2.50	2.50
Stearic Acid	2.50	2.50
Isostearyl Alcohol	1.00	1.00
DEA Cetyl Phosphate	2.00	2.00
SPF static	32	21
SPF 80 immersion	30	17

pH 6.5-7.5

pH 5.7-6.7

Storage and handling

Acrylates Copolymer film-forming polymer is supplied as a white, free-flowing powder. Some settling will occur in the drum during shipping. **Acrylates Copolymer** can be stored at ambient conditions. When not in use, the drums should be kept covered to prevent contamination and moisture absorption from the atmosphere.

Health and safety

A health and safety summary for **Acrylates Copolymer** film-forming polymer is available on request. Information on **Acrylates Copolymer** relating to EU Cosmetics Directive 76/768/EEC is also available upon request. The suitability of the final formulations should be confirmed in all respect by appropriate evaluation. The marketer is advised to evaluate the final formulation with regard to performance and health and safety.