Haj Exports

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HAJLYN 22 Rheology Modifier/Stabilizer

A Very Efficient Thickener for Difficult to Thicken Surfactant Systems

This bulletin focuses on our HAJLYN 22 rheology modifier, a very efficient thickener for difficult to thicken surfactant systems. Our HAJLYN rheology modifiers find utility in an ever-increasing breadth of personal care applications because of their unique ease of use, wide compatibility, cost effectiveness and favorable balance of rheological properties.

HAJ EXPORTS is committed to providing technology enhancement to the personal care industry. To learn how our expertise in polymers and preservatives can spark your own creativity, please contact us.

Description

HAJLYN 22 rheology modifier is an anionic hydrophobically modified alkali-soluble acrylic polymer emulsion (HASE) with unusually high aqueous thickening and stabilizing efficiency. This thickener is a liquid, cold-processable product that instantaneously thickens upon neutralization providing ease of handling and increased manufacturing efficiency. HAJLYN 22 is offered at 30% solids and is compatible with high levels of surfactants. The polymer has a well-established toxicological profile and is safe in normal use.

CTFA/INCI Name: Acrylates/Steareth-20 Methacrylate Copolymer

Features

- High efficiency
- Yields clear gels
- Highly associative
- Very pseudoplastic
- High surfactant synergy
- Synergistic interaction with inorganic clays
- Particulate stabilizer
- Emulsion stabilizer
- Foam stabilizer
- Broad pH range stability
- Peroxide compatible
- Salt tolerant
- Shear tolerant
- High yield value
- Instant neutralization/thickening
- Cold-processable
- Liquid
- Broad compatibility

Benefits

- Easy to handle
- No preparation necessary
- Non hygroscopic
- Increased manufacturing efficiency
- Allows for use of continuous production processes with use of in-line static mixers
- Can be processed with membrane pumps and, when diluted, with turbine mixers and high speed propellers
- Able to formulate clear products
- Can be used with electrolytes
- Synergistic interaction with surfactants, particulates and hydrophobic raw materials
- Stabilization of hydrophobic (low solubility) components
- Compatible with nonionic, anionic, Zwitterionic and some cationic surfactants
- Ability to stabilize suspensions
- Mild, soft, non-greasy, non-sticky
- Stable in pH 5.5 to 12 formulations
- Thickens and stabilizes hydrogen peroxide
- Does not promote or support contamination, unlike natural thickeners
- Flexibility in choice of preservative system
- Supported by comprehensive environmental, health and safety data

Applications

- Anti-dandruff shampoos
- Bath foams
- Curl activators
- Depilatories
- Emulsifier free formulations
- Foaming facial cleansers
- Hair styling gels
- Liquid soaps
- Lotions
- Moisturizing creams
- Shampoos
- Shower gels
- Skin masks
- Waterless hand cleaners
- Wave sets

Physical and Chemical Characteristics

These properties are typical but do not constitute specifications.

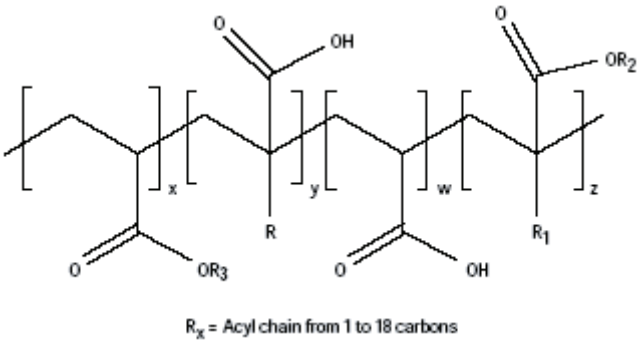
Chemistry	HASE polymer
Association	very high
Ionic nature	anionic
Appearance	milky liquid
Solvent	water
Solids, %	30
pH (as supplied)	2.7
Density	1.06
Equivalent weight*	218
Rheology	short, non stringy
Shear thinning	very high
Viscosity, mPAs (as supplied)	100
Pseudoplastic index (viscosity @ 6 rpm/viscosity @ 60 rpm)	7.0 (2% solids in water)
INCI Name	Acrylates/Steareth-20 Methacrylate Copolymer

*grams of dry polymer neutralized by 1 equivalent (40 grams) of NaOH.

HAJLYN 22 Chemistry

HAJLYN 22 is a Hydrophobically-modified Alkali Soluble Emulsion (HASE). HASE polymers are synthesized from an acid/acrylate copolymer backbone and a monomer that connects the hydrophobic groups as side chains. The polymer is made through emulsion polymerization.

HAJLYN 22 is synthesized from acrylic acid, acrylate esters and a steareth-20 methacrylate ester. The general structure for HALYN 22 is shown to the right.



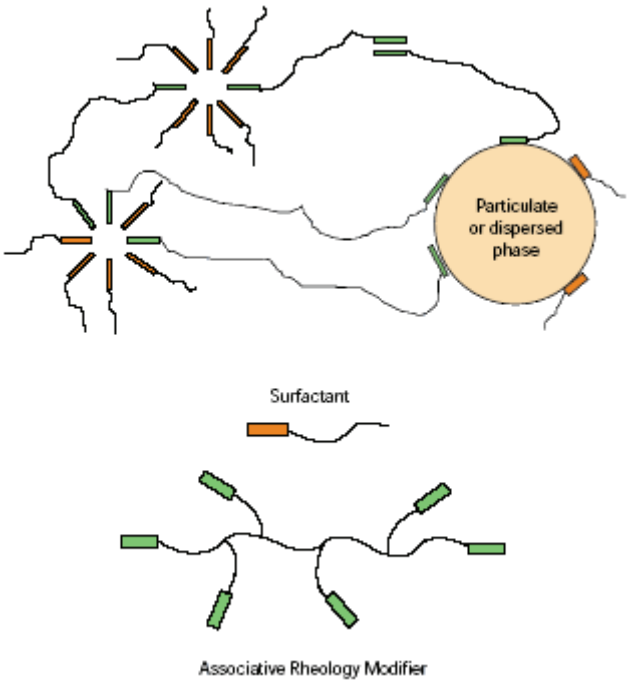
R_x = Acyl chain from 1 to 18 carbons

Mechanism of Action

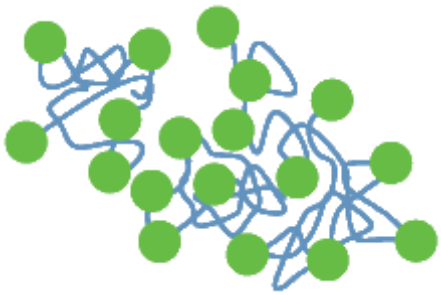
HAJLYN HASE rheology modifiers are able to thicken by two mechanisms that can act simultaneously and are synergistic, i.e. by the effect of charge-induced polyelectrolytic chain extension and by association of hydrophobe groups.

When the acid groups present in the HAJLYN HASE molecules are neutralized with inorganic bases or organic amines, they become anionically charged and water-soluble. HAJ LYN 22 thickens above pH 6.5. HAJLYN HASE rheology modifiers dissolve and swell due to charge-charge repulsion and therefore thicken instantly.

When HAJLYN HASE polymers swell, the pendant hydropho bic groups are free to build associations with one another and with other hydrophobes available in the formulation, such as surfactants, particulates, emulsion droplets and dyes. This phenomenon creates a network structure that results in a significant viscosity build.



These associative structures can also act to stabilize and disperse particulates in a formulation.



And because of the ethoxylated hydrophobic group on the rheology modifier, HAJLYN 22 can also act as a primary emulsifier for some emulsion systems, such as water-resistant sunscreens, to minimize the level of surfactant or emulsifier.

Features of HASE Rheology Modifiers

The chart to the right shows features indicative of the behavior of HASE rheology modifiers under different conditions. Please note that these behaviors may vary to some extent according to specific formulations.

All HAJLYN rheology modifiers are easy to formulate, have good to excellent salt tolerance, compatibility with anionics and nonionics and low odor. HASE polymers have excellent shear thinning properties and good stability in two-part peroxide systems. Blending of the ASE and HASE chemistries can offer further enhancements and synergies.

Ease of formulation	Excellent
Associative	Yes
Salt tolerance	
NaCl	Excellent
Di/trivalent ions	Good
Shear thinning behavior	Excellent
Solvent compatibility	Excellent
Low pH compatibility	Good
Anionic surfactant compatibility	Excellent
Nonionic surfactant compatibility	Excellent
Zwitterionic surfactant compatibility	Good
Cationic surfactant compatibility	Some
Peroxide stability	
1 part system	No
2 part system	Excellent
Lack of odor	Excellent

HAJLYN 22 Behavior Profile

HAJLYN 22 rheology modifier possesses many properties that make this polymer highly desirable for use in personal care applications, as shown by the data presented below.

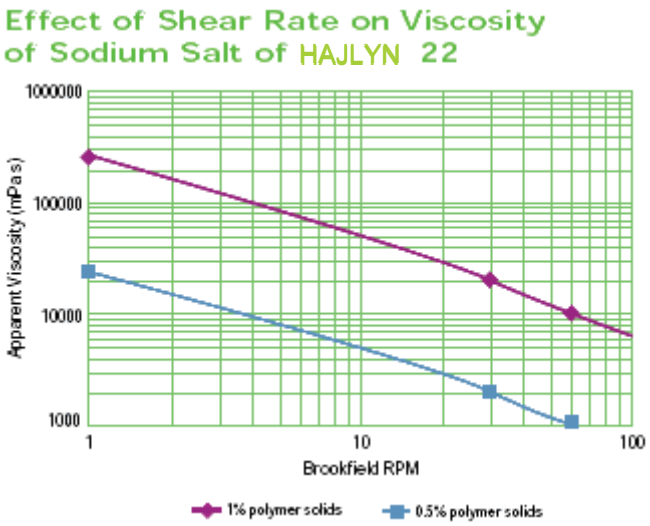
Rheology

Effect of Shear Rate

HAJLYN 22 thickener is a low-viscosity dispersion that becomes a highly viscous clear solution when neutralized with alkali. Provided that proper mixing conditions are used, HAJLYN 22 thickens instantaneously upon addition of base, allowing rapid preparation of solutions and products. There is no need for pre-wetting, high shear mixing or long soak times.

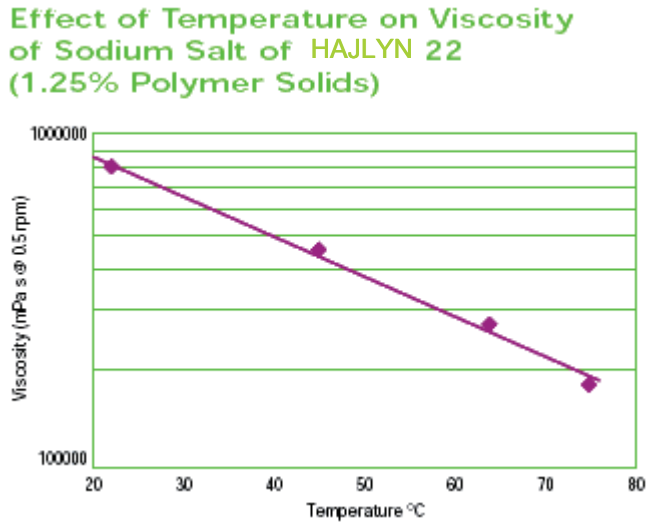
The presence of the C_{18} hydrophobe causes neutralized solutions of HAJLYN 22 to be very pseudoplastic, in general showing a high degree of shear thinning because of easily broken van der Waals forces. The yield value also allows the thickener to stabilize suspensions, while still being pourable.

The alkaline solutions are clear, and their flow properties are characterized by a complete lack of stringiness and tackiness and by shear thinning. At the same time, the solutions are viscous at low shear rates. The log-log plot of apparent viscosity vs. shear rate is linear for the sodium salt over the range of spindle rotation rates between 0.5 and 60 rpm. The shear thinning behavior in the following graph is measured in water and the behavior can change in formulations.



Effect of Temperature

Thickening with HAJLYN 22 undergoes a modest decrease as the temperature rises from 20°C to 75°C.



Compatibility

Surfactant Synergies

General Effect of Surfactants

Certain anionic and nonionic surfactants give a synergistic increase in the viscosity and thickening efficiency of neutralized HAJLYN 22 solutions. 10 to 1000 fold increases in viscosity can be achieved. Each surfactant has an optimum concentration at which maximum viscosity is obtained.

Viscosity[a] of Thickened Surfactants[b]

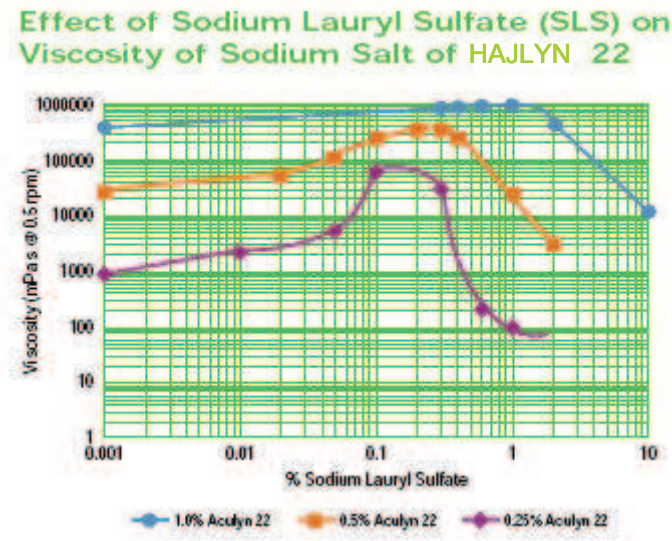
HAJLYN 22 (% solids)	C_{14-16} Olefin Sulfonate	TEALS[c]	SLES[c]	SLS[c]
0	50	50	50	50
1.0	800	900	525	550
1.5	14,600	4,500	4,900	1,400
2.0	54,000	21,000	15,200	4,600

[a]Brookfield viscosity @ 12 rpm, cps

[b]Surfactant level 15% solids, pH 7 to 9

[c]Surfactant legend: TEALS = Triethanolamine lauryl sulfate, SLES = Sodium lauryl ether sulfate, SLS = Sodium lauryl sulfate

With sodium lauryl sulfate (SLS), for example, the maximum occurs at a level of 40% based on the concentration of HAJ LYN 22 thickener.The effect of SLS on solution vi scosity as a function of the level of HAJLYN 22 thickener and the effect of SLS as a function of SLS concentration are shown in the graphs below.



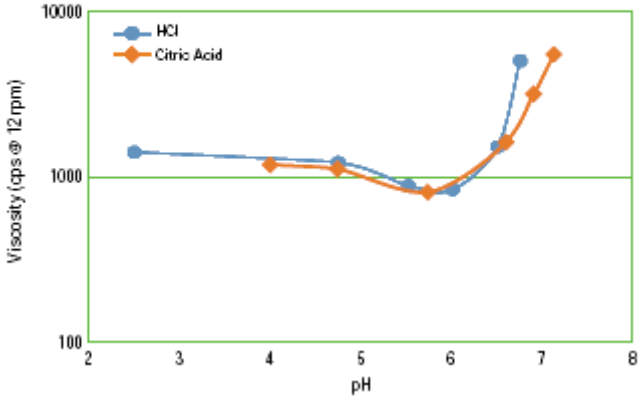
Thickening of Acid-Containing Surfactants Solutions

At high levels of anionic surfactants, acid-containing aqueous solutions with HAJLYN 22 display a high degree of thickening. By using a mixture of two surfactants, one an anionic (major component) and the other an amide (minor component), clear thickened compositions are obtained with HAJLYN 22 at pH 1 to 7. The presence of amide surfactant is necessary to ensure clarity in these formulations. Applications for these formulations include clear, low pH shampoos.

To correctly prepare these products, the HAJLYN 22 is dispersed in the water and the two (or more) anionic surfactants are added with stirring. The solution is neutralized with caustic or other base and allowed to stir for 15 minutes. Finally, the acidity is adjusted to the required level by adding citric acid (pH 4.5 to 7) or hydrochloric acid (pH 1 to 7) to the neutralized solution of the surfactants and thickener. Addition of cationic ingredients, if any, should occur after the pH is lowered to 6.0 or less to minimize the potential interaction of the carboxyl functionality.

The graph and table below show the Brookfield viscosity of a typical formulation over a broad range of low pH.

Effect of pH on Viscosity of SLS solutions thickened with HAJLYN 22

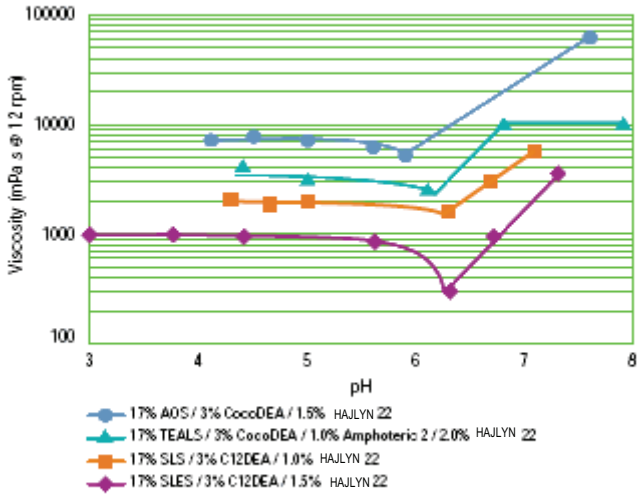


Acid Shampoos

	SLS (28%)		SLES (27%)		TEALS (40%)		AOS (40%)	
	Solids	As supplied	Solids	As supplied	Solids	As supplied	Solids	As supplied
Surfactant	17.0	60.7	17	63.0	17	42.5	17	42.5
Lauramide DEA	3.0	3.0	3.0	3.0	—	—	—	—
Cocamide DEA	—	—	—	—	3.0	3.0	3.0	3.0
Miranol C2MSF (70%)	—	—	—	—	1.0	1.4	—	—
HAJ LYN 22 (30%)	1.0	3.3	1.5	5.0	2.0	6.7	1.5	5.0
NaOH (10%)	0.09	0.9	0.14	1.4	0.18	1.8	0.14	1.4
Water		32.1		27.6		44.6		48.1
Citric acid to pH 4.5 to 5.2								
Viscosity, Brookfield, cps @ pH 5, 12 rpm	2100		900		3000		5700	

The graph below presents the effect of pH on the viscosity of formulations based on various anionic surfactants with HAJLYN 22.

Effect of pH on Viscosity of Shampoo Systems Thickened with HAJLYN 22

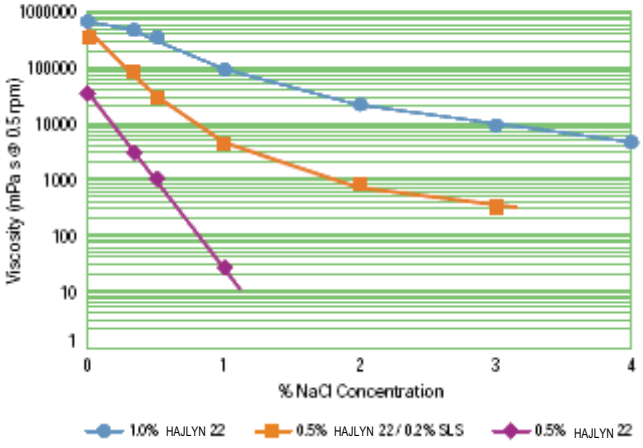


Note: The levels of HAJLYN 22 and surfactants as listed in the above chart are on a 100% solids basis.

Salt Tolerance

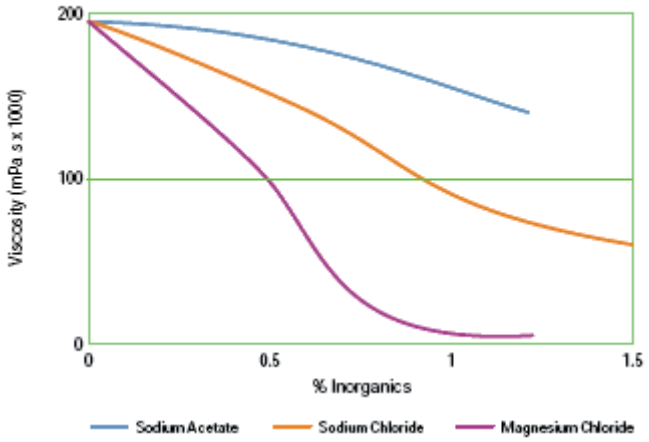
Neutralized solutions of HAJLYN 22 can th icken salt solutions. The thickening efficiency decreases with increasing level of salt, and solutions with low concentrations of thickener are particularly sensitive to the presence of salt. Addition of low levels of surfactant, even when salts are present, substantially increases the thickening efficiency of HAJLYN 22.

Effect of Sodium Chloride on Viscosity of Sodium Salt of HAJLYN 22



HAJLYN 22 also has a tolerance for other salts. Divalent salts such as magnesium chloride will have an impact on viscosity, more of an impact than monovalent salts such as sodium chloride or sodium acetate.

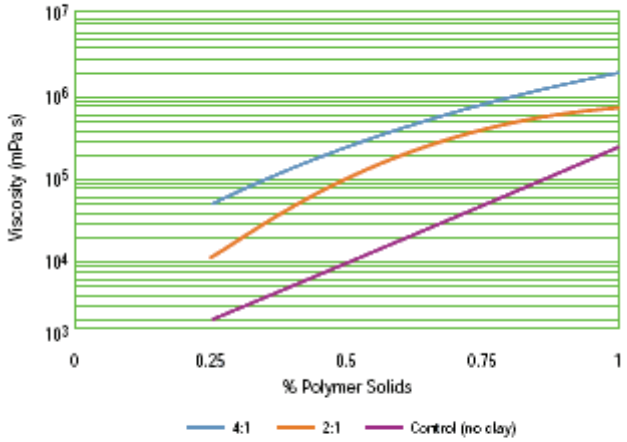
Viscosity vs. Concentration with Various Salts of Neutralized HAJLYN 22



Synergies with Inorganic Clays

Adding low-cost bentonite clays appreciably increases the thickening efficiency of neutralized HAJLYN 22. Combining appropriate levels of HAJLYN 22 thickener and bentonite clays can produce free-standing gels.

Effect of Bentonite Clay on Viscosity of Neutralized HAJLYN 22



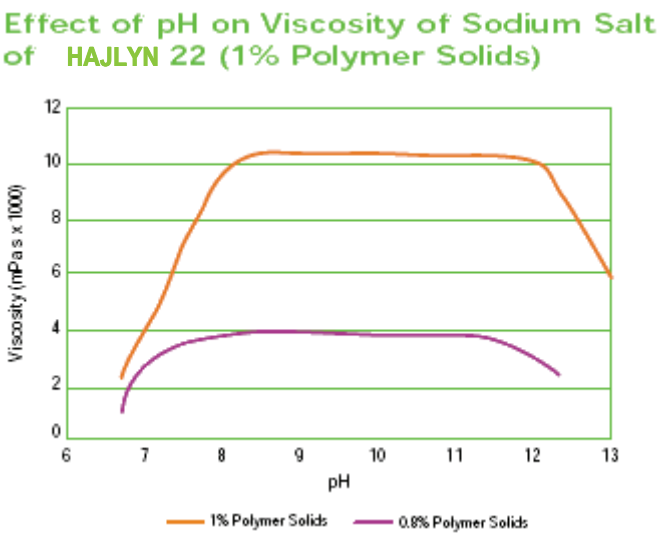
Values are low shear viscosities (Brookfield RVT at 0.5 rpm).

The figures give the ratios of clay to polymer for each curve.

Mixes of Bentonite with the **HAJLYN** *22 polymer show a significant yield stress (point).*

pH Tolerance

Thickening drops precipitously below pH of about 7, a range in which the polymer is insoluble. With sodium hydroxide as the base, the viscosity reaches a maximum and remains steady over the pH range from 7.5 to 12. HAJLYN 22 can thicken aqueous solutions containing a high level of surfactant below pH 6.5.



Performance

Extremely Efficient Thickener

HAJLYN 22 achieves thickening of solu tions at very low concentrations and is therefore very efficient and cost effective. The thickening efficiency of HAJLYN 22 is significantly superior compared to other types of thickeners such as cellulosics and carbomers. HAJLYN 22 can be neutralized with sodium hydroxide, ammonia, soda ash (sodium carbonate), and triethanolamine as well as other bases.

Formulation and Use Guidelines

HAJLYN 22 rheology modifier is compatible with surfactants, solvents, oils and salts commonly found in cosmetic and toiletry products. These products undergo instantaneous thickening when neutralized with base.

This product is supplied as a low viscosity emulsion and can be incorporated directly into formulations with none of the concerns about dissolution, particulate clumping or dusting problems that can be encountered with dry products. HAJLYN 22 is also cold processable.

Because thickening occurs instantaneously upon neutralization with base, in-line mixing with static mixers is possible. Upon neutralization, the HAJLYN 22 emulsion becomes a clear, highly viscous solution.

The preferred order of addition when using HAJLYN 22 rheology modifier in aqueous formulations is as follows:

1. Add HAJULYN 22 to the water
2. Add other ingredients from the most acidic to the most alkaline
3. Add the neutralizing agent

If this sequence is not desirable, Hajlyn HASE and ASE polymers can be added directly to an alkaline formulation after first diluting the Hajlyn 22 product with two parts of water. Addition of the water prevents gel particles (small particles with neutralized swollen surfaces and unneutralized cores that will take considerable time to dissolve completely).

Preparation of Emulsions and Dispersions

Neutralized HAJLYN 22 thickener can also be used to make oil-in-water emulsions of organic liquids such as mineral oil, lanolin or kerosene. HAJLYN 22 can also be used to suspend fillers and pigments, such as calcium carbonate, silicate clays and titanium dioxide, in water.

If HAJLYN 22 is being used in an emulsion formulation, the general order of addition is as follows:

1. Add HAJLYN 22 to the water phase at temperature
2. Add the other water phase ingredients
3. Mix separately the oil phase ingredients at temperature
4. Mix the oil phase into the water phase maintaining temperature
5. Neutralize the HAJLYN 22 polymer
6. Cool the mixture with constant stirring
7. Add the preservative (if any) at a safe temperature

Environmental, Health and Safety Record

Toxicology

Acute Toxicity Profile

Test/Species	Results
Oral LD_{50} – rat	>5.0 g/kg non-toxic
Dermal LD_{50} – rabbit	>5.0 g/kg non-toxic
Eye irritation – rabbit	Non irritating (US and EEC)
Skin irritation – rabbit	Slightly irritating (US); Non irritating (EEC)

US — United States classification
EEC — European Economic Community classification

Sensitization Toxicity Profile

Test/Species	Results
Sensitization, Guinea pig	Non sensitizer

Genetic Toxicity Profile

Test/Species	Results
Ames Test	Non mutagenic with and without metabolic activation

Ecotoxicity Profile

Test/Species	Results
Daphnia magna EC_{50} — 48 hr	>1000 mg/L — non toxic
Rainbow Trout LC_{50} — 96 hr	>1000 mg/L — non toxic
Bluegill Sunfish LC_{50} — 96 hr	>1000 mg/L — non toxic

Overall Evaluation

HAJLYN 22 is considered non-toxic by single oral and dermal exposure, produces minimal to no irritation to the eyes and skin, a non-sensitizer, non-mutagenic in the Ames assay and non-toxic to aquatic organisms. This material is safe and appropriate for use in a broad range of rinse-off and leave-on personal care applications.

HAJLYN 22 is cleared under the major chemical inventories such as CTFA, MITI, EINECS, TSCA, AICS and Canada.

Storage and Handling

Storage

Keep from freezing; material may coagulate. The minimum recommended storage temperature for these materials is 1°C/34°F. The maximum recommended storage temperature is 49°C/120°F. These materials may coagulate if exposed to temperature outside this range. The coagulation process is irreversible.

Material Safety Data Sheets

HAJ EXPORTS (MSDS) contain pertinent information that you may need to protect your employees and customers against any known health or safety hazards associated with our products. Under the OSHA Hazard Communication Standard, workers must have access to and understand MSDS on all hazardous substances to which they are exposed. Thus, it is important that you provide appropriate training and information to your employees and make sure they have available to them MSDS on any hazardous products in the workplace.

Upon initial shipment of non-OSHA-hazardous and OSHA-hazardous products (including samples), HAJ EXPORTS Company sends the appropriate MSDS to the recipient. If you do not have access to one of these MSDS, please contact your local HAJ EXPORTS representative for a copy. Updated MSDS are sent upon revision to all customers of record. MSDS are also sent annually to all customers receiving products deemed hazardous under the Superfund Amendments and Reauthorization Act (SARA). MSDS should be obtained from suppliers of other materials recommended in this bulletin.

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