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HAJSOL 445/445N

Detergent Polymers for Industrial Machine Dishwash (Warewash)

Description

HAJSOL 445 is a homopolymer of acrylic acid with an optimized molecular weight to be used in industrial and institutional detergents.

It is supplied in liquid form and available as partially (HAJSOL 445) or fully (HAJSOL 445N) neutralized grades.

Chemistry and Mode of Action

HAJSOL 445 is a homopolymer of acrylic acid with selected molecular weight around 4500 in order to optimize the following properties:

- Anti-precipitation: HAJSOL 445 will increase solubility of precipitating salts by threshold effect. This allows it to reduce in the wash bath precipitation of inorganic salts (carbonates, phosphates, sulphates of Ca and Mg).
- Crystal distortion: this polymer gets entrapped into crystal lattices, preventing their growth and facilitating their breakage. This minimizes adherence of salts on surfaces and facilitates their elimination by rinsing.
- Dispersing properties: this polymer is a good dispersant for soils and will help to prevent their re-deposition on surfaces in particular glass and dishware.
- Processing aids: the polymeric and chemical nature of HAJSOL 445 will bring binding properties which can be useful in several detergent manufacturing processes, especially tableting.

Benefits

HAJSOL 445 is a key ingredient in institutional and industrial cleaners. It might also perform in dishwash detergents. By using this polymer, the detergent manufacturers will enjoy the following advantages:

- Inhibition of crystal growth, thus preventing precipitation of carbonates, phosphates, or silicates.
- Dispersion of precipitates in the cleaning bath to avoid settling and scaling on surfaces and fibers.
- Improvement of filming maintenance by soil dispersion, which minimizes organic components deposition on glass and dishwares.
- Increase of bleach stability, especially in chlorinated formulations, by binding heavy metals which destabilize chlorine species through catalytic reactions.
- Use in medium alkaline to very alkaline formulations, due to high solubility of HAJSOL 445 in caustic products. Caustics should be added slowly to a water premix containing polymer to avoid high pH gradients.

Typical Properties

These properties are typical but do not constitute specifications.

445 445N

Appearance

: Clear solution to slightly yellow Clear solution to slightly Yellow

Grade

: Partially neutralized

Na form

Average molecular weight (Mw)

: 4500 4500 4500

Total solids (%)

: 48 45

Specific gravity (at 25°C)

: 1.24 - 1.32

pH as is (at 25°C)

: 3.7- 6.9

Brookfield Viscosity (mPa.s/cps at 25°C)

: 650 800

Residual acrylic acid (ppm)

: 10

Formulating Tips

- The builder capacity alone of the formulation in Table 1 will handle 12 grains of water hardness, however, HAJ SOL 445 dispersant extends the range to 20 grains.
- Sodium silicate can be used instead of potassium silicate with no adverse effects on the formulation stability. The use level of sodium silicate (40 Baume) should be reduced to 3.5% in the formulation.
- HAJ SOL 445 and alkali should be added to water before silicate addition in order to avoid a drop in the pH that may result in silicate precipitation.
- HAJ SOL 445 or HAJ SOL 445N can be used interchangeably (0.8 pounds HAJ SOL 445 = 1 pound HAJ SOL 445N). Polymer choice can depend on what is in customer inventory.
- For slurry systems, HAJ SOL 445N should be added to water before insoluble builders to aid in solid suspension/anti-precipitation.

Performance Benefits for Institutional Machine Dishwashing

Reduced Spotting and Filming of Glassware

Problems in machine dishwashing are encountered whenever stress conditions exist, such as low-built detergent or water having high water hardness, high water alkalinity or high total dissolved solids.

Soil re-deposition and precipitation of calcium salts combine to cause spotting and filming on glassware and associated equipment scaling.

The glasses washed demonstrate the excellent resistance to spotting and filming achieved with HAJ SOL 445 in a typical institutional machine dishwashing formulation. HAJ SOL 445 offers the formulator improved performance, in addition to economic advantages, by reducing the level of TKPP needed in the formulation. 445 added shows an outstanding improvement in both filming and spotting.

Table 1. Chlorinated Liquid Machine Dishwashing Formulation

Ingredient Percent as Supplied

Water	:	29.1
HAJ SOL 445N dispersant (48%)	:	9.5
Tetrapotassium Pyrophosphate (60%)	:	16.6
Potassium Hydroxide (45%)	:	22.2
Potassium Silicate (Kasil #1) (29.1%)	:	6.0
Sodium Hypochlorite (12%)	:	16.6

* Ingredients should be added in the order listed above.

Physical Properties: Recommended Use Level: 0.2%-0.25%

Solids, % 23.8

pH 13.9

Density @ 25°C, lb/gal 10.2

Brookfield Viscosity, mPa.s/cps (#4 @ 50 rpm) 12.0

Chlorine Stability

Chlorine release agents are used in machine dishwash formulations. Detergent polymers must have a minimal effect on the available chlorine in the liquid formulation.

Figure 2 shows the excellent stability of HAJ SOL 445N in a hypochlorite solution compared to a phosphonate and conventional acrylic/maleic copolymer.

Toxicity

HAJ SOL 445 produces a slight eye and skin irritation in rabbits. The acute oral (LD50) for rats is 5 g/kg and acute dermal (LD50) for rabbits is 5 g/kg.

Caustic Solubility

The caustic solubility of HAJ SOL 445N is outstanding compared to other copolymers and similar to other polyacrylic acid homopolymers. In general, HAJ SOL 445N is soluble up to 35% active caustic solids. HAJ SOL 445 showed a NOEC of 5.6 mg/l in *Daphnia magna* (the most sensitive aquatic species tested). Acute and chronic toxicity studies showed HAJ SOL 445N to be non-toxic to aquatic and terrestrial species studied.

Summary of Toxicity Data

Ecotoxicity

	HAJSOL 445N Polymer
Bacteria sludge O ₂ /glucose consumption (EC ₅₀)	>100 mg/l
Algae <i>Scenedesmus</i> (Brown algae, EC ₁₀)	180 mg/l
Daphnia magna acute (48 hr)	>1000 mg/l
reproductive (21 days, NOEL)	5.6 mg/l
Fish	
Acute:	
trout (96 hr, LC ₅₀)	700 mg/l
bluegill sunfish (96 hr, LC ₅₀)	>1000 mg/l
zebra fish (96 hr, LC ₅₀)	>200 mg/l
Chronic:	
early life stage (fathead minnow NOEL)	56 mg/l
Plant	
growth inhibition - corn, soybean, wheat and grass seed (NOEC)	225 mg/kg
Earthworm	
acute 96 hr (LC ₅₀)	>1000 mg/kg soil

Dose Rates

To obtain an optimal effectiveness this polymer should be used at levels between 100 and 500 ppm in the wash baths for industrial purposes. This will generally correspond to 2-6 % (as is) in liquid formulation. HAJSOL 445 is designed to be used in phosphate based or phosphate free detergents, the latter based on carbonate, silicate, citrate and NTA.

Material Safety Data Sheets

HAJ EXPORTS maintains Material Safety Data Sheets (MSDS) on all of its products. These contain important information that you may need to protect your employees and customers against any known health and safety hazards associated with our products.