

## Carbopol®\* Ultrez 21 Polymer

INCI name: Acrylates/C10-30 alkyl acrylate crosspolymer

### Technical Data Sheet

#### Product Overview

Carbopol® Ultrez 21 Polymer is a hydrophobically modified crosslinked polyacrylate polymer designed to efficiently impart thickening, stabilizing, and suspending properties to a variety of personal care applications. The polymer incorporates patented technology, which allows it to quickly and easily self-wet – without any mixing required. (Please note that typical mixing/agitation is needed to make a final product).

#### Physical Properties

Physical properties of Carbopol® Ultrez 21 polymer are listed in Table 1 and indicate typical values and properties; they are not intended to be used as product specifications.

Table 1

Carbopol® Ultrez 21 Polymer Typical Properties (not to be used as specification)	
• Appearance	white powder
• Odor	mild acrylic odor
• Total solids	100%
• pH (in water)	3
• 0.5% mucilage* viscosity at 20 rpm	55,000 mPa·s
• 0.5% dispersion wetting time	3 minutes
• 0.5% mucilage* clarity (% Transmission):	~ 95

\* A mucilage is defined as an active polymer dispersion in water neutralized with a base, preferably NaOH, to a specified pH.

#### Benefits

In addition to the benefits that all powdered Carbopol® polymers provide, which include thickening, yield value, shear thinning rheology and favorable toxicology profile, Carbopol® Ultrez 21 polymer offers the following benefits:

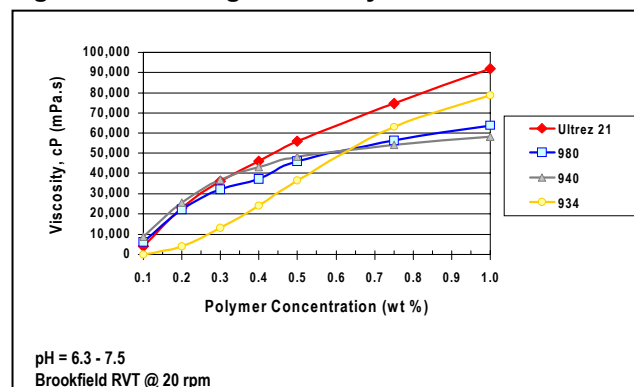
- **Rapid wetting ...**

Carbopol® Ultrez 21 polymer has self-wetting properties similar to Carbopol® Ultrez 10 polymer. Dispersion of 0.5% Carbopol® Ultrez 21 polymer can self-wet within minutes without any mixing.

- **High thickening efficiency ...**

Carbopol® Ultrez 21 polymer provides more efficient thickening than other Carbopol® polymers, such as Carbopol® 934, Carbopol® 940 and Carbopol® 980 polymers (see Figure 1). For instance, a reduction of about 15% polymer is recommended when using Carbopol® Ultrez 21 polymer to achieve a similar viscosity in most emulsion formulas.

Figure 1 – Mucilage Viscosity



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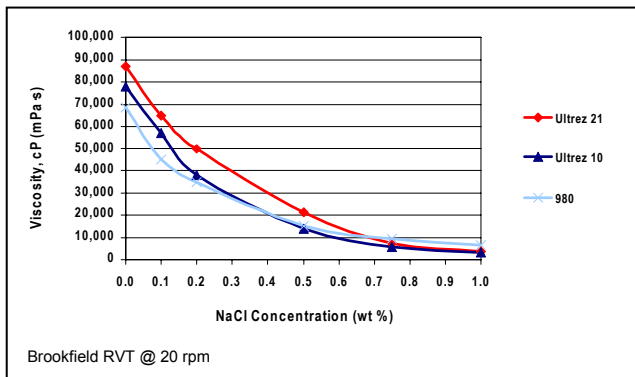
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- **Improved electrolyte tolerance ...**

Carbopol® Ultrez 21 polymer provides superior electrolyte tolerance compared to most Carbopol® polymers, resulting in improved clarity and higher viscosity in electrolyte containing systems.

**Figure 2 – Salt Tolerance**



- **Excellent clarity ...**

Carbopol® Ultrez 21 polymer provides excellent clarity to applications such as hair gels and hand sanitizers.

- **Smooth aesthetic appearance ...**

Carbopol® Ultrez 21 polymer provides a non-grainy glossy appearance to gels and emulsions similar to gels and emulsions made with Carbopol® 940 and 934 polymers.

- **Superior skin feel ...**

Carbopol® Ultrez 21 polymer is less tacky than other Carbopol® polymers.

- **Broad application use ...**

Carbopol® Ultrez 21 polymer has the best overall performance in a wide variety of applications when compared with other Carbopol® polymers.

## Suggested Applications

Carbopol® Ultrez 21 polymer can be used in a wide variety of applications, such as:

- Hair Styling Gels
- Hand and Body Lotions
- Baby Lotions
- Hand Sanitizers
- Moisturizing Gels
- Sunscreen Lotions
- Bath Gels
- Shampoos

## Processing Guidelines

The development of the self-wetting technology has greatly improved the dispersability of Carbopol® polymers - especially in water. These polymers behave differently in their dispersion as well as hydration rates and need to be processed and handled in a slightly different manner.

### Using No Agitation (Self-Wetting) - Preferred

*This is the preferred method of dispersion and will result in less entrapped air.*

In most situations, Carbopol® Ultrez 21 polymer can simply be “sprinkled” onto the surface of the water without any special equipment or handling.

The powder will wet and drop below the surface in minutes. When there is no visible white powder on the water surface, mixing can begin.

### Using Moderate to High Agitation

Dispersions can also be prepared by slowly sifting the polymer into the vortex of a rapidly stirred solution, although this technique may entrap more air.

Techniques or devices which sprinkle the powder as discrete particles are the most effective. The ideal method should efficiently sprinkle the polymer at a controlled rate as well as break-up the soft agglomerates of dry powder formed by static electricity or humid conditions. This allows each particle to completely wet out in the water vortex.

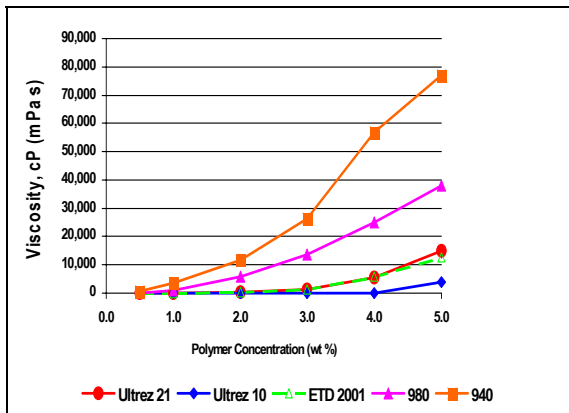
In general, high shear rates disperse the polymer very rapidly; however, extremely high shear mixers or homogenizers should be carefully employed because they can break down the polymer molecule - resulting in permanent viscosity loss. Moderate agitation equipment is the preferred choice. Conventional impellers such as propellers or turbines are recommended.

### Wetting Time, Dispersion Viscosity, and Others

The total wetting time is dependent upon the amount of Carbopol® Ultrez 21 polymer added, vessel geometry, and most importantly, water temperature. When the Carbopol® Ultrez 21 polymer dispersion is first neutralized, the surface texture may have a grainy “applesauce” appearance. Over the next 30-60 minutes, the neutralized gel clusters continue to relax and expand. Light mixing will yield a smooth gel.

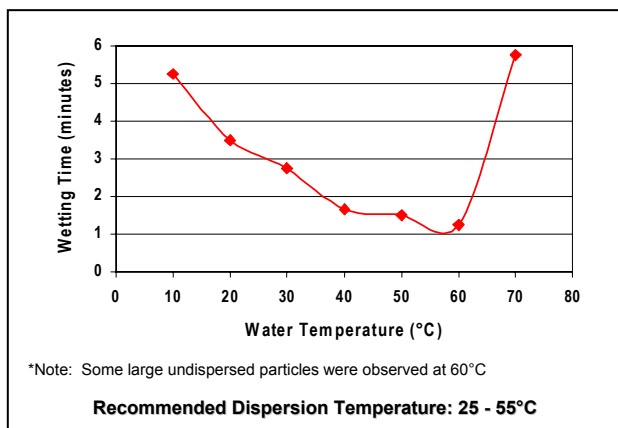
Some users choose to predisperse Carbopol® Ultrez 21 polymer in water and then add this dispersion to their formulation mix tank. Unlike the traditional Carbopol® polymers, Carbopol® Ultrez 21 polymer can be dispersed at concentrations up to 6% and still remain pumpable. See Figure 3.

Figure 3 – Dispersion Viscosity



Under high shear agitation, dispersions of Carbopol® Ultrez 21 polymer can stabilize entrapped air. Antifoam, at use levels of 0.02 - 0.05%, can be added to the water prior to the Carbopol® Ultrez 21 polymer in order to minimize or eliminate foaming.

Figure 4 – Effect of Water Temperature on Wetting Time



Water temperature can help speed the dispersion and swelling process. With traditional carbomers, warm water is avoided because of lumping problems it incurs. With Carbopol® Ultrez 21 polymer, however, any heating needed for formulation can begin before or during the dispersion process. As figure 4 shows, the wetting time of the polymer decreases with warmer temperatures to about 55°C. Once above this temperature, the effect is reversed and lumping may result.

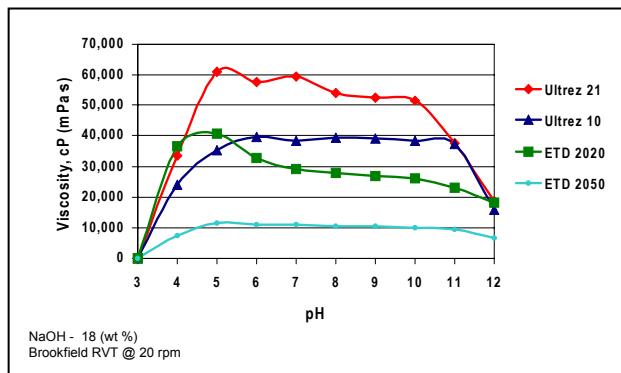
## Formulating Guidelines

In most situations, Carbopol® Ultrez 21 polymer should be added to the water at the start of the batch cycle. This will allow it time to thoroughly wet out and disperse. At this point, the pH will be about 3 with a very low viscosity.

### Neutralization

Upon neutralization, the Carbopol® Ultrez 21 polymer instantly thickens as shown in Figure 5.

Figure 5 – Effect of pH on Viscosity



Because of the high viscosity, the addition of the neutralizing agent is often best added towards the end of the batch cycle. For formulations with high levels of electrolytes or surfactants, the addition of a small amount of the neutralizer to the Carbopol® Ultrez 21 polymer dispersion is beneficial (partial neutralization).

Different neutralizers can be used, and different amounts are needed for the dispersion to reach a pH value of 7.0. Table 2 provides the weight ratios of commonly used neutralizers vs. Carbopol® Ultrez 21 polymer to achieve pH 7.

For a complete list of neutralizers that can be used with Carbopol® polymers, see TDS-237 - Neutralizing Carbopol® and Pemulen® Polymers in Aqueous and Hydroalcoholic Systems.

Table 2

Weight ratios of commonly used neutralizers vs. Carbopol® Ultrez 21 polymer to achieve pH 7

Neutralizer Trade Name/Supplier	Neutralizer INCI Name	Weight Ratio – Neutralizer / Carbopol® Ultrez 21
TEA (99%)	Triethanolamine	1.5 / 1.0
AMP-95® / Angus	Aminomethyl Propanol	0.9 / 1.0
Neutrol® TE / BASF	Tetrahydroxypropyl Ethylenediamine	2.3 / 1.0
NaOH (18%)	Sodium Hydroxide	2.3 / 1.0
Diisopropanolamine / Dow	Diisopropanolamine	1.2 / 1.0

### Preservation

Carbopol® Ultrez 21 polymer does not support bacteria or fungal growth, but neither does it prevent such growth on nutrients found in normal water systems. The addition of a preservative is recommended for applications inclined to these issues.

Carbopol® Ultrez 21 polymer is compatible with most preservatives, such as Germaben® II, DMDM Hydantoin, Dowici® I 200, Parabens and Phenonip®. Phenonip® has limited solubility in clear gel formulations, which may result in reduced clarity.

## Compatibility

The viscosity of products with Carbopol® Ultrez 21 polymer is moderately sensitive to ions. Increased levels of monovalent ions (like sodium) will result in a decrease in application viscosity. The effect can be minimized by the use of potassium salts or amine neutralizing agents. Di- and multi-valent ions (like calcium and magnesium) will precipitate Carbopol® polymers. Therefore, formulating with deionized (or at least soft) water is highly recommended.

Due to its anionic nature, Carbopol® Ultrez 21 polymer has limited compatibility with cationic formulating materials.

## Handling and Storage

Carbopol® Ultrez 21 polymer is supplied in 20-kilogram cardboard boxes.

In the dry form, Carbopol® Ultrez 21 polymer is stable for a long period of time. It is important, however, to keep the containers tightly closed to prevent moisture pick-up.

See the Material Safety Data Sheet for Carbopol® Ultrez 21 polymer for further information on the proper handling and safety aspects of this product.

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## CARBOPOL® ULTREZ 21 POLYMER

*A High-Performance, Versatile  
Rheology Modifier for Personal  
Care Applications*

**CARBOPOL®**  
*Ultrez*  
POLYMER

# CARBOPOL® ULTREZ 21 POLYMER—A High-Performance, Versatile Rheology Modifier for Personal Care Applications

## CARBOPOL® ULTREZ 21 POLYMER

A new benchmark for enhanced properties, ease of use and polymer efficiency, Carbopol® Ultrez 21 polymer takes you to a higher level of product performance. Carbopol® Ultrez 21 polymer is a hydrophobically modified, crosslinked polyacrylate polymer designed to efficiently impart thickening, stabilization and suspension to personal care formulations while allowing a wide range of flow properties.

TYPICAL PROPERTIES	
INCI Designation	Acrylates/C10-30 Alkyl Acrylate Crosspolymer
Appearance	White Powder
Odor	Mild Acrylic Odor
Total Solids	100%
pH (in water)	3
0.5 wt% mucilage* viscosity (at 20 rpm)	55,000 mPa·s
Wetting time (0.5 wt% dispersion)	3 minutes
0.5 wt% mucilage* clarity (% transmission)	~ 95

\* A mucilage is defined as an active polymer dispersion in water neutralized with a base, preferable NaOH, to a specified pH.

In many applications Carbopol® Ultrez 21 polymer is more efficient than other Carbopol® polymers. Other key benefits of Carbopol® Ultrez 21 polymer include:

- Rapid wetting properties
- High thickening efficiency
- Improved electrolyte tolerance
- Excellent clarity in applications
- Smooth aesthetic appearance
- Superior skin feel – less tack

Carbopol® Ultrez 21 polymer provides optimal performance in a wide range of products, including:

- Hair Styling Gels
- Hand and Body Lotions
- Hand Sanitizers
- Moisturizing Gels
- Sunscreen Lotions
- Bath Gels
- Shampoos
- Ethnic Hair Lotions

## RAPID WETTING

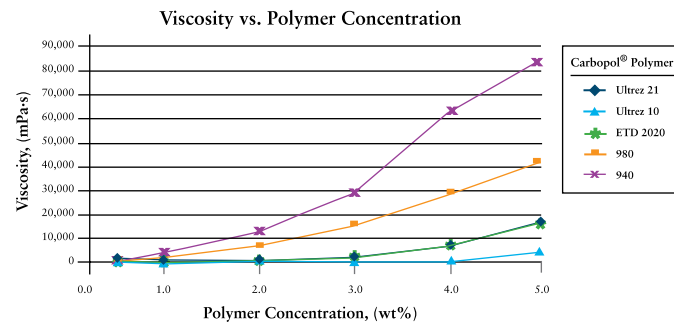
Compared to other Carbopol® polymers, Carbopol® Ultrez 21 polymer represents a significant improvement in wetting and dispersing. It self-wets in only minutes, without any mixing.

### Wetting Times During Initial Dispersion Stage (0.5 wt%)

CARBOPOL® POLYMER	WETTING TIME (MINUTES)
980	>50
Ultrez 10	5
Ultrez 21	2-3

## EFFECT OF CONCENTRATION ON DISPERSION VISCOSITY

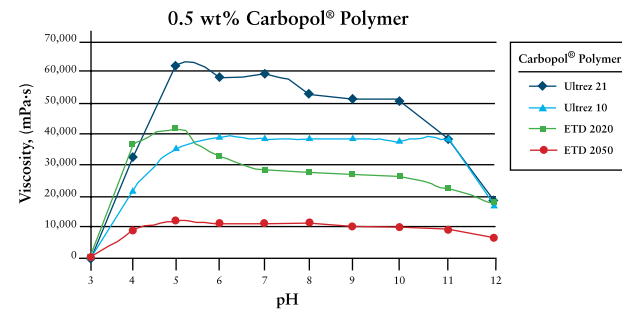
Unlike the traditional Carbopol® polymers, Carbopol® Ultrez 21 polymer can be dispersed at concentrations up to 6 wt% and still remain pumpable.



pH = 2.5 - 3.5  
Brookfield RVT @ 20 rpm

## EFFECT OF pH ON VISCOSITY

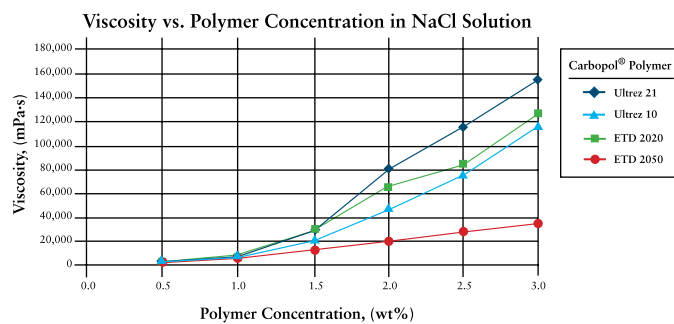
Compared to other easy to disperse Carbopol® polymers, Carbopol® Ultrez 21 provides improved efficiency across a wide pH range.



NaOH - 18 wt. %  
Brookfield RVT @ 20 rpm

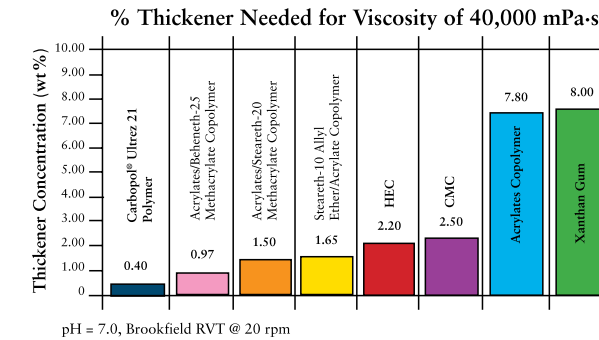
## POLYMER PERFORMANCE AND EFFICIENCY

Carbopol® Ultrez 21 polymer provides an optimal balance of properties. In addition to rapid wetting, it provides effective thickening at low use levels, excellent yield value and gel clarity, and improved electrolyte tolerance. The graphs that follow show the dramatic improvements.



1 wt% NaCl solution at pH 7.5  
Brookfield RVT @ 20 rpm

## Thickening Efficiency Comparisons



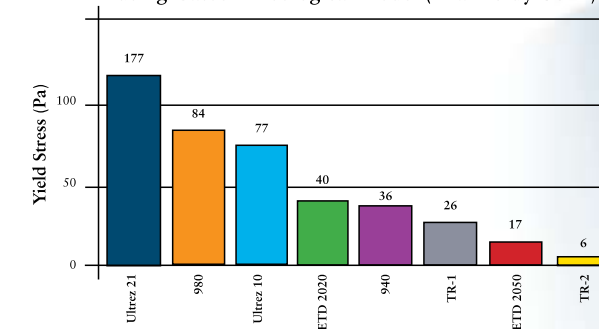
pH = 7.0, Brookfield RVT @ 20 rpm

## Viscosity vs. Yield Value

POLYMER (wt%)	BROOKFIELD VISCOSITY (mPa·s)	BROOKFIELD YIELD VALUE (dyn/cm <sup>2</sup> )	SAND SUSPENSION
0.1% Carbopol® Ultrez 21	6,800	200	Permanent
2.5% Locust Bean Gum	22,800	80	8 Hours
1.5% Sodium CMC	5,900	36	3 Hours
1.5% Guar Gum	8,040	32	4 Hours
2.5% Sodium Alginate	8,360	16	2 Hours

## Yield Stress Comparison of Carbopol® & Pemulen™ Polymers

Yield Stress predicted from PAAR Physica Rheometer using Casson rheological model (1Pa=10 dyn/cm<sup>2</sup>)

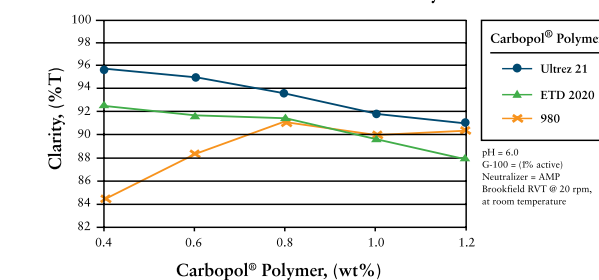


1 wt% Carbopol® and Pemulen™ polymer mucilages

## Excellent Clarity in Applications

Carbopol® Ultrez 21 polymer is more electrolyte tolerant than many other rheology control polymers. The result: Improved clarity and higher viscosity in electrolyte containing systems.

Effect of Polymer Concentration on Clarity of Hair Gel with Fixate™ G-100 Polymer



pH = 6.0  
G-100 = 1% active  
Neutralizer = 3MMP  
Brookfield RVT @ 20 rpm,  
at room temperature



## APPLICATIONS FOR CARBOPOL® ULTREZ 21 POLYMER

In performance testing, Carbopol® Ultrez 21 polymer shows a broad range of use, performing well in lotions, hair gels, hand sanitizers, bath gels and shampoos. It has excellent clarity and efficiency and forms gels that have a smooth, aesthetically pleasing appearance. It helps create emulsions that are glossy and creamy, with very little tack.

## PROCESSING & FORMULATING GUIDELINES FOR CARBOPOL® ULTREZ 21 POLYMER

- Sprinkle polymer on surface of water and allow to self-wet (vigorous agitation produces foam)
- Gently begin agitation
- Carbopol® Ultrez 21 polymer can be pre- or post-neutralized (depending on application)
- Keep agitation to a minimum (to avoid air entrapment) while adding remaining ingredients to formulation.
- Typical preservatives can be used and are recommended in formulations with Carbopol® Ultrez 21 polymer.

