

Carbopol®* Ultrez 10 Polymer for Personal Care Applications (CTFA / INCI Name: carbomer)

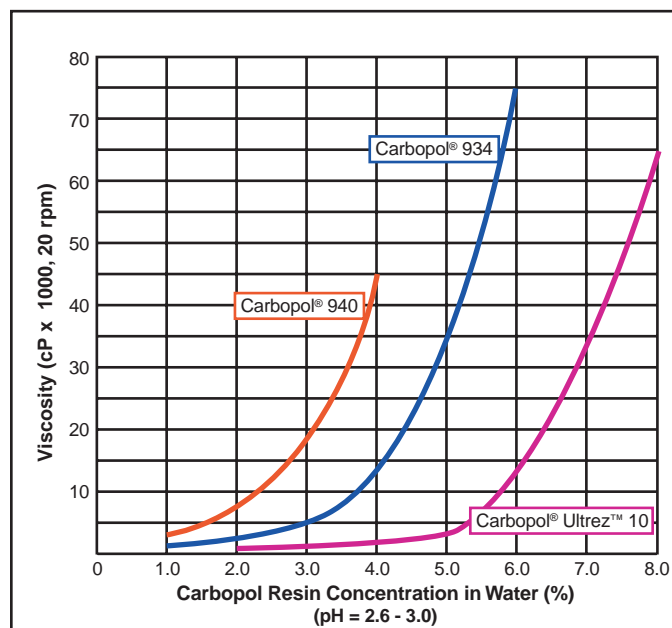
Introduction

Carbopol® Ultrez 10 polymer is a "universal" polymer in the Carbopol® family. It is an exceptionally easy-to-disperse polymer that offers a wide range of performance properties and can be used in a variety of personal care applications.

While various rheological additives are selected for their unique properties in a particular application, such as a gel, lotion or a cream, Carbopol® Ultrez 10 polymer can be used in all three. Because its dispersion properties are unique, Carbopol® Ultrez 10 allows greater versatility in formulating and processing.

Carbopol® Ultrez 10 polymer provides the formulation flexibility of a multi-use rheological additive. The superior dispersing properties of Carbopol® Ultrez 10 polymer make it a rheological additive which is much easier to process and can also lead to time savings in production. Since Carbopol® Ultrez 10 polymer "wets" extremely quickly, it requires less time and effort to achieve a lump-free dispersion. It is even possible to completely wet Carbopol® Ultrez 10 polymer without any mixing. Since the unneutralized dispersion viscosity of Carbopol® Ultrez 10 polymer is so low (Figure 1), concentrated dispersions can be made at levels much higher than previously possible. When a master batch of concentrated dispersion is needed, a single batch can be made more easily and less often, saving valuable production time.

Figure 1
Unneutralized Aqueous Dispersion Viscosity



Viscosity of Carbopol® Ultrez 10 Polymer

The viscosity profiles of Carbopol® Ultrez 10 polymer are shown in Figures 2 and 3, which compare the viscosity profiles of carbomers typically used in gel and emulsion applications, respectively.

As these figures show, Carbopol® Ultrez 10 provides thickening similar to traditional carbomers, and depending on the formulation, even greater efficiency. In emulsion formulations, the thickening efficiency is even higher in most cases. The difference in efficiency will be dependent on the specific type of formulation, but in many cases Carbopol® Ultrez 10 polymer may provide as much as 30 to 50 percent greater efficiency in emulsions.

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Figure 2
Viscosity Profile of Polymers for Gel Applications

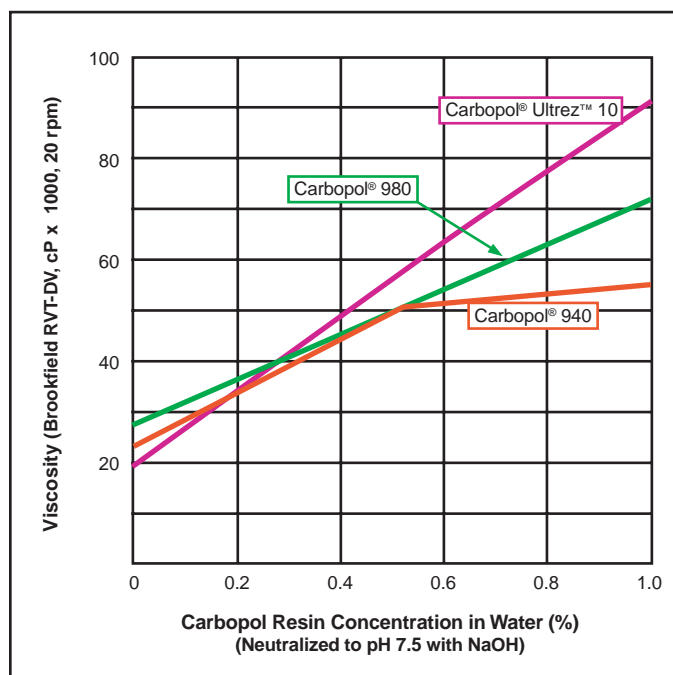
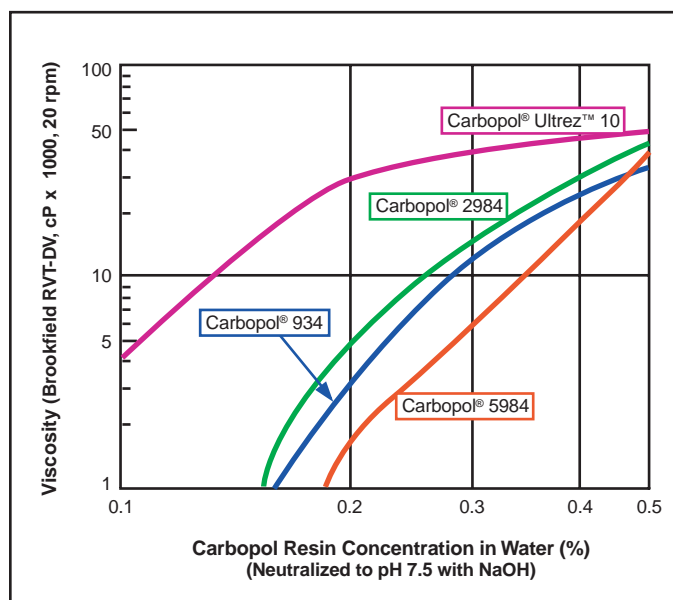


Figure 3
Viscosity Profile of Polymers for Gel Applications



Incorporating Carbopol® Ultrez 10 Polymer

When using Carbopol® Ultrez 10 polymer in an aqueous or gel product, the polymer can be added directly to the water. This can be done in two ways, depending on the equipment available.

When using a variable speed mixer, Carbopol® Ultrez 10 polymer can be slowly poured or sprinkled into the water under moderate agitation. After only a few minutes, the polymer should be completely wetted. Carbopol® Ultrez 10 polymer will continue to swell slowly with additional mixing, but neutralization can proceed as soon as the polymer is wetted. It is recommended to reduce the mixing speed to minimize air entrapment or foaming. Using typical laboratory mixing equipment, dispersions of up to 8% polymer have been prepared easily.

If mixing equipment is not available, Carbopol® Ultrez 10 polymer can be sprinkled easily onto the surface of the water and allowed to stand until wetted. Wetting time will vary depending on the concentration and batch size. For example, a 500 gram dispersion at 0.5% polymer (2.5 grams) will take only about 5 minutes to completely wet **without** mixing. Again, as soon as Carbopol® Ultrez 10 polymer is completely wetted (no white particles evident on the surface or in the dispersion), neutralization or other process steps may begin.

Note: Because the dispersion viscosity of Carbopol® Ultrez 10 polymer is so low, some settling of the dispersion may occur with concentrations below 4%: dispersions at lower concentrations should simply be stirred briefly prior to use to ensure a homogeneous distribution of the polymer.

The neutralizing agents most commonly used in personal care can also be used with Carbopol® Ultrez 10 polymer, including sodium hydroxide or various amines such as triethanolamine (TEA) or tromethamine (Tris Amino®, Angus Chemical).

Formulating Emulsions with Carbopol® Ultrez 10 Polymer

When formulating emulsions, Carbopol® Ultrez 10 polymer can be incorporated into the water phase of the formulation as described above, or the polymer instead may be added to the oil phase, using a method called *indirect addition*. Carbopol® Ultrez 10 polymer is slurried into part or all of the oil components; any small aggregates can be broken easily with gentle stirring. When the oil phase is added to the water phase, Carbopol® Ultrez 10 polymer will migrate into the water phase and then swell to provide thickening. Neutralizing agents can be incorporated into the water before or after addition of the oil phase.

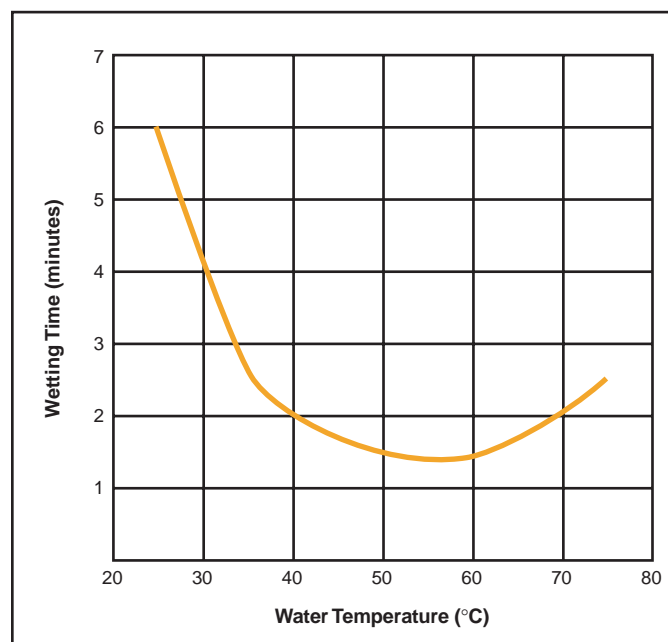
Note: The indirect method should be used only when the oil phase(s) is non-polar. This can be checked easily by mixing Carbopol® Ultrez 10 polymer into the oil component(s) beforehand. If any swelling or thickening occurs, this indicates that one of the oil components is partially polar and is causing the polymer to swell prematurely. The mixing container should be completely dry of moisture to prevent the polymer from migrating prematurely to any water already present and becoming gummy. As in the case of other carbomer polymers, the polymer/oil slurry should not be heated above 70°C or the polymer may become plasticized.

Optimizing the Performance of Carbopol® Ultrez 10 Polymer

As with most carbomer polymers, the best *gel clarity* is obtained using water which is relatively free of metal ions (demineralized or deionized). If the water is too "hard," the gel will have a hazy appearance. Small amounts of an appropriate chelating agent may be used to improve long term UV stability. The large amount required to completely chelate significantly hard water will, however, effectively reduce the viscosity by "salting out" the polymer.

Water temperature, on the other hand, *can help speed the dispersion and swelling process*. With traditional carbomers, warm water is usually avoided because of the lumping problems it incurs. With Carbopol® Ultrez 10, however, any heating which is required for the formulation can begin before or during the dispersion process. As shown in Figure 4, the wetting time of the polymer decreases with warmer water temperatures up to about 60°C (140°F). Once above this temperature, the effect is reversed and lumping may result.

Figure 4
Effect of Water Temperature on Wetting Time



Universal Properties of Carbopol® Ultrez 10 Polymer

Many rheological additives have viscosity and rheology characteristics which make them useful in specific types of applications. For example, typical emulsion thickeners may provide good viscosity, rheology and skin feel properties, but lack the clarity needed for gel products. Conversely, some gel thickeners have excellent viscosity and clarity, but are too rigid for elegant emulsions. Carbopol® Ultrez 10, however, can be used in both lotions and gels to provide the properties sought across a diverse range of product types including clarity, highly efficient viscosity, non-tacky feel, emulsion stability and rich buttery texture. And because of its synthetic nature, formulations with Carbopol® Ultrez 10 polymer are relatively easy to preserve, compared to many other "natural" rheological additives.

Carbopol® Ultrez 10 polymer is also different from other polymers in that it is the *first polymer which can be effectively dispersed with no mixing*. Carbopol® Ultrez 10 wets in minutes, faster than even the Carbopol® ETD (Easier To Disperse) polymers.

Limitations Using Carbopol® Ultrez 10 Polymer

Because Carbopol® Ultrez 10 polymer has been designed to give highly efficient thickening in emulsions (similar to Carbopol® 934 polymer), its structure can make it more vulnerable to ions, such as the salts found in surfactants and in vegetable extracts. Therefore, when formulating products with high levels of ions, such as shampoos, bath or cleansing gels or aloe vera gels, it is highly recommended to use Carbopol® ETD 2020 polymer which has excellent performance properties in the presence of ions.

Flow Properties of Carbopol® Ultrez 10 Polymer

Carbopol® Ultrez 10 polymer systems are viscoelastic with a pseudoplastic rheology, as is the case for most Carbopol® polymers. The three-dimensional network structure of the closely packed, swollen microgels provides a significant resistance to flow, or viscosity. The polymer microgels maintain their closely packed structure under low shear stresses. Once an applied stress exceeds the critical yield stress, the polymer microgels begin moving past each other and the bulk gel begins to flow. The combination of a low number of entanglements between particles and the exhibited yield value accounts for the short "buttery" flow of Carbopol® Ultrez 10 polymer, which may be considered a hybrid between a Carbopol® 940-type (more rigid) and a Carbopol® 934-type (softer, more deformable) polymer.

Stability of Products Made with Carbopol® Ultrez 10 Polymer

Although Carbopol® Ultrez 10 polymer is a new addition to the Carbopol® family, it has been evaluated in a wide range of very different applications including gels, lotions and creams. Stability testing is ongoing, and Carbopol® Ultrez 10 is expected to provide the same stability which is characteristic of all Carbopol® polymers.