ULTRASIL™ ANIONIC SILICONES — *Complexing Agents for C*

Introduction

Personal care systems with multifunctional benefits can be prepared by complexing Ultrasil™ anionic silicones with quaternary ammonium compounds. Clear rinse off conditioner gels can be prepared, allowing the introduction of novel product forms. Styling gels with improved viscosity, conditioning, clarity and product aesthetics are also possible with this concept. Beyond the creation of clear products, this technology can be utilized to improve the efficacy of conditioning systems based on silicones and cationic conditioning agents and to reduce the irritancy potential of quats.

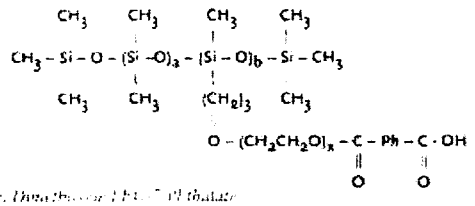
Quaternary ammonium compounds are well known to be incompatible with Carbopol® polymers. But when first complexed with Ultrasil™ anionic silicones, quats may be incorporated into Carbopol® polymer containing systems. The resulting gels can show low turbidity (high clarity), lack of precipitate and display the characteristic rheology of Carbopol® polymers.

Conditioning properties of products prepared with silicone complexes are improved versus those containing blends of silicones and quaternary compounds. Furthermore, complex formation with Ultrasil™ anionic silicones can serve to reduce the irritancy of low molecular weight quaternary compounds.

Anionic Silicones

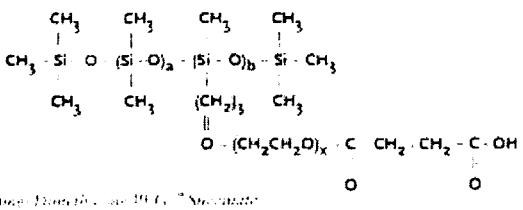
Anionic silicones used to create complexes are based on the modification of dimethicone copolyol with carboxylic, sulfamic or polyphosphonic acids. Variations in the product can be created by altering the nature of the siloxane backbone, the degree of ethoxy substitution and the functional group. Two examples are shown below:

Ultrasil™ CA-1 Structure — Reaction of dimethicone copolyol and pyromellitic anhydride produces a dimethicone copolyol carboxylate with the structure:



INCI Name: Dimethicone PEG-7 Pyromellitate

Ultrasil™ SA-1 Structure — Reaction of dimethicone copolyol and succinic anhydride produces a dimethicone copolyol succinate with the structure:



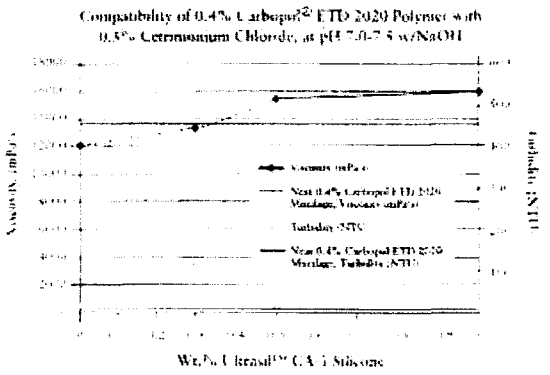
INCI Name: Dimethicone PEG-7 Succinate

Quaternary Ammonium Compounds

Quaternary compounds are often used in hair conditioning applications where they provide excellent wet comb, static and anti static properties. The downside to these quats is their incompatibility with Carbopol® polymers, making clear gel formulation difficult. Cationic quats are also irritating to skin, limiting their use in many applications.

Compatibility between Carbopol® polymers and quaternary ingredients can be obtained by first complexing the quat with Ultrasil™ anionic silicones. Best results are observed when the silicone and the quat are blended in aqueous media, adjusted to match the pH of the gel, and finally added to the gel. The appropriate silicone to quat ratio is formulation dependent; it increases as the pH decreases, and as the usage level of the quat is raised.

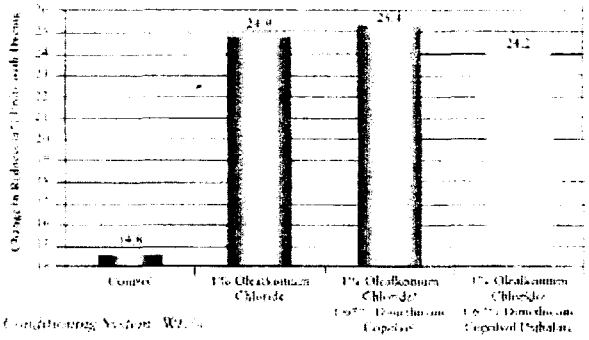
Ultrasil™ CA-1 Silicone and Cetrimonium Chloride Complex with Carbopol® ETD 2020 Polymer — As the level of Ultrasil™ anionic silicone is increased, the gel consistency trends low and that of a gel containing no quaternary material whatsoever. The tendency to form precipitate is greatly reduced and the viscosity may even be enhanced.



Deposition on Hair

Complexing quats with Ultrasil™ anionic silicones does not reduce the deposition of the quat onto hair as confirmed by rubine dye testing.

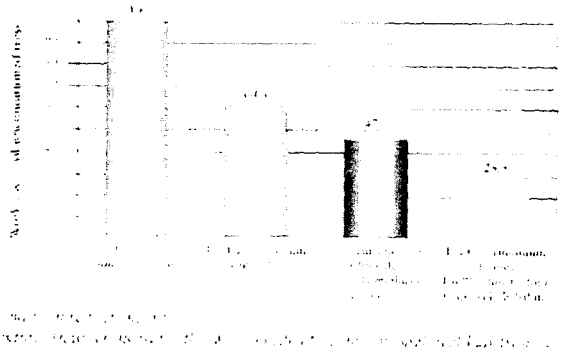
Rubine Dye Test — Rubine dye tests were used to substantiate the conditioning effects. An increase in redness intensity corresponds to an increase in deposited cationic material. Testing indicates that the interaction of the quat with the anionic hair is not affected, through interaction with the anionic Carbopol® polymer, has been limited by the complex formation.



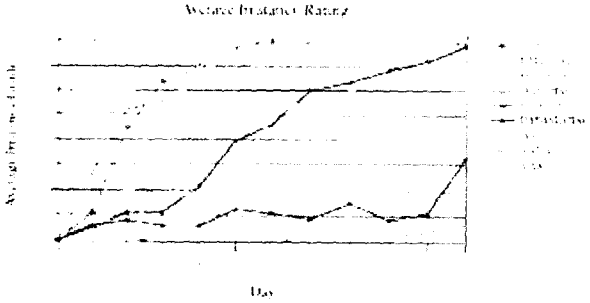
uaternary Compounds

ULTRASIL

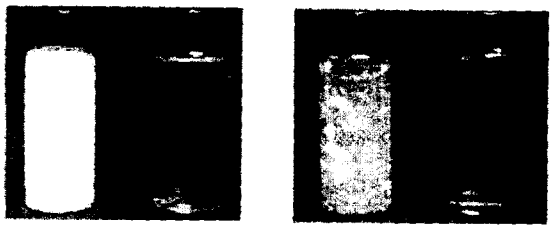
Silicones complexed with quats exhibit better wet combability than a blend of a silicone with a quat. Rinse conditioning systems show equal deposition of the quat onto the hair. The improvement is seen in the wet comb properties when the complex of the silicone and quat is used indicates greater deposition of silicone onto the hair from this system.



Complexing with Ultrasil™ anionic silicones reduces the irritancy of cationic quaternary actives. A study of irritancy potential was carried out and determined that the irritancy of cetrimonium chloride can be greatly reduced by complexing it with Ultrasil™ anionic silicones.



When silicone complexes comprised of an anionic silicone and a cationic conditioning agent are formed, they show improved viscosity and clarity in systems containing Carbopol® polymers.



The photo on the left shows a gel comprised of 0.5 Wt.% Stearalkonium Chloride and 0.4 Wt.% Carbopol™ ETD 2050 polymer without silicone and with the addition of Ultrasil™ SA-1 silicone. The photo on the right shows a gel comprised of 0.4 Wt.% Cetrimonium Chloride and 0.4 Wt.% Carbopol® ETD 2050 polymer without silicone and with the addition of Dimeticone PEG-7 Phosphate.

Each example dramatically shows the improvement in gel clarity and the elimination of precipitation that can be achieved by using anionic silicones in conjunction with cationic quaternary compounds.

For formulations or additional information, please contact your Noveon representative, or visit www.carbopol.com.

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