



Benefits of Carbopol® Polymers in Oral Care Formulations

Carbopol® polymers can be used in toothpastes and an array of oral care products including gels, mouthwash, desensitizing and whitening products, as well as denture adhesives. They primarily function as efficient thickeners and binders and provide suspension of non-soluble actives or excipients. The viscoelastic structure of Carbopol® polymers imparts shear-thinning rheology and low thixotropy which enables a clean ribbon of toothpaste to be extruded from the tube.

Additionally, Carbopol® polymers can be used to aid in the adhesion and delivery of dental formulations to the teeth and mucosa. Carbopol® polymers can be incorporated in buccal tablets, lozenges and films to provide bioadhesive and/or controlled release properties.



Benefits of Carbopol® Polymers

Application Benefits:

- Bioadhesion to teeth and mucosa
- Polymeric mineral surface active agent
 - Protects enamel from demineralization
 - Prevents biofilm attachment to enamel
 - Delays plaque mineralization

Formulation Benefits:

- Efficient co-binder and thickener
- Suspension of non-soluble actives
- Compatible with common formulation ingredients
- Stabilization of peroxide gel systems
- Cold processable
- Provides good stand-up properties

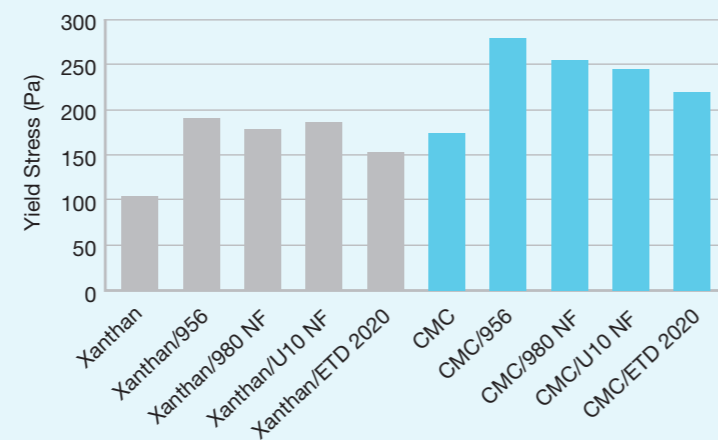
In CMC or xanthan systems, partial replacement of co-binder (gum) with Carbopol® polymer provides higher yield stress, resulting in better stand-up properties and aesthetics.

Table 1: Aqueous Toothpaste Formulation

Ingredients (wt%)	Formulation without Carbopol®	Formulation with Carbopol®
Carbopol® polymer	0	0.25
Xanthan or CMC*	1	0.75
Thickening grade silica (Zeodent® 165**)	5	
Deionized water	24.6	
Sorbitol (70%), USP	24.6	
Glycerin, USP	24.6	
Sodium fluoride	0.24	
Sodium tripolyphosphate	3	
Sodium saccharine	0.3	
Sodium benzoate	0.1	
Abrasive grade silica (Zeodent® 113**)	15	
Titanium dioxide	0.5	
Peppermint natural	0.7	
Sodium lauryl sulfate	0.36	

*Keldent® supplied by CPKelco; CMC-9M31XF supplied by Ashland Inc.

Figure 1: Aqueous Toothpaste Yield Stress with Various Binders



Carbopol® polymers show better rheological performance and higher efficiency compared to xanthan gum in anhydrous toothpastes. Carbopol® polymers perform better in a partially neutralized toothpaste than un-neutralized system and offer excellent aesthetics, overall.

Table 2: Anhydrous Toothpaste Formulation

Ingredients (wt%)	Xanthan-Containing	Carbopol®-Containing
Carbopol® polymer	-	0.75
Xanthan	0.75	-
Thickening grade silica (Zeodent® 165)	5	
Glycerin, USP	51.51	
Abrasive grade silica (Zeodent® 113)	15	
PEG-8, USP	20	
Sodium fluoride	0.24	
Sodium pyrophosphate	5	
Sodium saccharine	0.3	
Titanium dioxide	0.5	
Peppermint natural	0.7	

Figure 2: Viscosity of Anhydrous Toothpaste System – Carbopol® Polymer vs. Xanthan

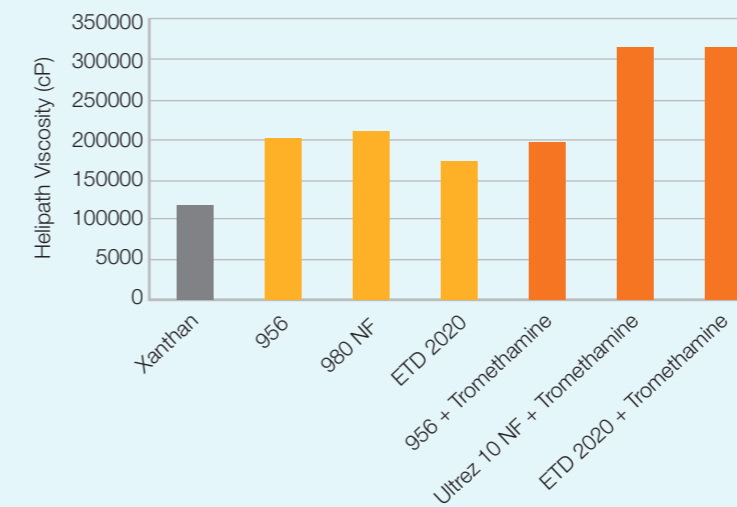


Table 3: Recommended Polymers

Carbopol® Polymer	Residual Solvent	Brookfield RVT, 20 rpm pH 7.3 – 7.8, 25°C	Homopolymer	Interpolymer	Easy to Disperse
956	Ethyl acetate	20,700 – 41,300*	•		
971P NF	Ethyl acetate	4,000 – 11,000*	•		
974P NF	Ethyl acetate	29,400 – 39,400*	•		
980 NF	Cosolvent	40,000 – 60,000*	•		
ETD 2020 NF	Cosolvent	47,000 – 77,000**		•	•
Noveon® AA-1	Ethyl acetate	2,000 – 12,000***	•		

* .5 wt.% viscosity, cP
 ** 1.0 wt.% viscosity, cP
 *** 0.2 wt.% viscosity, cP

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