

# benecel™ e4m hpmc

## enhancing toothpaste foam quality and longevity

### description

Benecel™ E4M HPMC is a cellulose-based, polymeric surfactant which enhances foam characteristics and exhibits interaction with surfactants. It has been shown to increase foam volume and produce increased amount of smaller bubbles to enhance creaminess in model toothpaste formulations containing different surfactant systems. In addition, Benecel™ E4M HPMC exhibits synergistic foam enhancement with Aqualon™/Blanose™ carboxymethyl cellulose (CMC) in model toothpaste systems with cocamidopropyl betaine (CAPB) and sodium lauryl sarcosinate.

Benecel™ HPMC is high-purity, water-soluble, nonionic cellulose ether designed for use as a thickener, foam enhancer, foam stabilizer, water-binder, film former, as well as a co-suspending and co-emulsifying agent.

### how it works

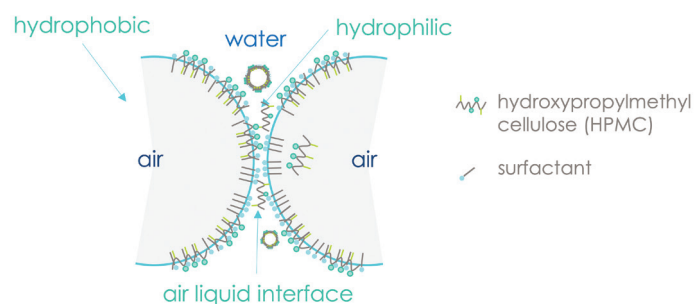
Benecel™ HPMC associates with surfactants and adsorbs at the air-water interfaces (figure 1). As a result, it impacts foam by (1) stabilizing bubble film by reducing drainage and (2) slowing the rupture and decay of bubble lamellar structure.

## key features and benefits

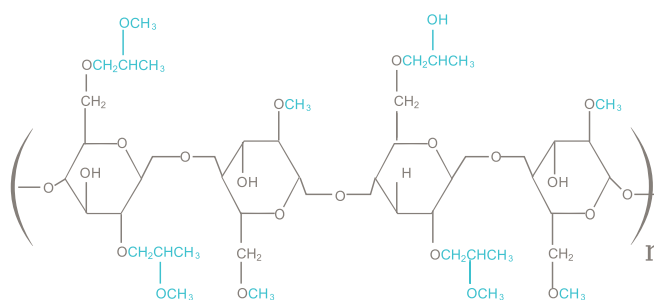
- acts as highly efficient foam booster and stabilizer
- forms stable foam (higher wall elasticity)
- improves foam volume
- enhances the brushing experience by enhancing foam texture
- builds creamy and dense foam
- is compatible with anionic and cationic ingredients
- works with a wide-range of surfactant types
- exhibits synergy with aqualon™/blanose™ carboxymethyl cellulose (CMC) in improved foam performance

Although toothpastes are formulated to deliver a range of oral health benefits, foam is an important attribute. It is common for consumers to equate higher foam volume with higher cleaning efficacy and thus cleaning performance. A rich and creamy foam can be a signal for quality and luxury; high foam volume can be a consumer preference and long-lasting foam can improve compliance. Thus, it is important for a toothpaste to have a foam profile to enhance the brushing experience.

figure 1. proposed foam mechanism shows hpmc film at air/water interface



### chemical structure



idealized structure of hydroxypropyl methyl cellulose (HPMC)  
CAS number: 9004-65-3

### typical properties

appearance	white to off-white powder
Brookfield viscosity, 2% aqueous solution <sup>1</sup>	2,700–5,040 cP
surface tension (0.1% at 20 °C)	44–55 mN/m
methoxyl content (%)	28–30
hydroxypropyl content (%)	7–12
particle size, Dv90, laser (µm)	170–250

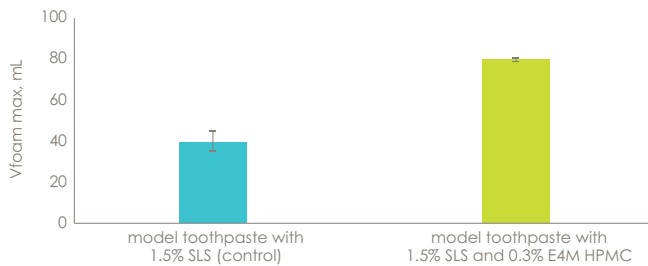
<sup>1</sup>RVT, 20 rpm at 20 °C

## boost foam

Sodium lauryl sulfate (SLS) is a good foaming surfactant; however, there are drawbacks to high levels of SLS for foam generation. Benecel™ E4M HPMC has been shown to boost foam from a model toothpaste with SLS.

The combination of SLS and Benecel™ E4M HPMC in a model toothpaste increases foam volume as shown in figure 2. The addition 0.3% Benecel™ E4M HPMC also increases bubble count significantly and reduces mean bubble area and bubble radius, thus improving overall foam performance.

**figure 2. the addition of 0.3% benecel™ e4m hpmc increases model toothpaste foam volume**

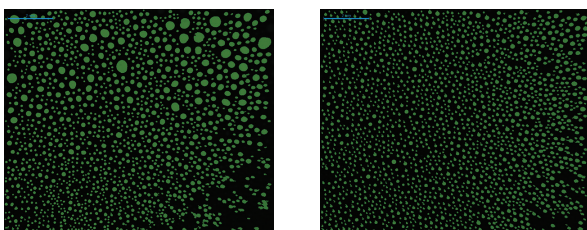


## form creamy and dense foam

Sensorial experiences are key to engaging consumers. A product's foam profile can help create a pleasant and desirable brushing experience. By creating a creamier and denser foam, the brushing experience can be enhanced. The addition of Benecel™ E4M HPMC to a model toothpaste has been shown to result in creamier foam.

In the pictures (figure 3), the bubble size is larger and the number of bubbles in a defined area is lower for control model toothpaste with 1.5% SLS compared to the model toothpaste with both SLS and Benecel™ E4M HPMC. With the addition of 0.3% Benecel™ E4M HPMC, the bubble size is smaller and the number of bubbles in a defined area is higher indicating a creamier toothpaste.

**figure 3. the addition of 0.3% benecel™ e4m hpmc results in a creamier toothpaste as indicated by the foam profile (right)**

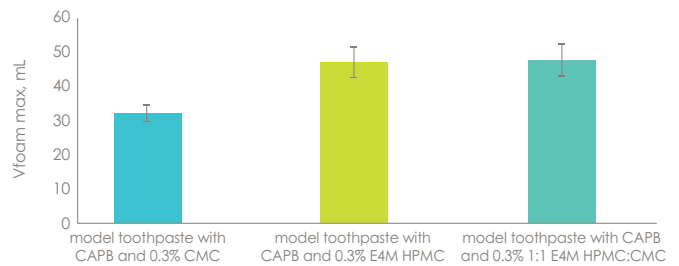


## synergy with cellulose gum

Toothpastes with low foaming surfactants, such as cocamidopropyl betaine (CAPB), can see improvements in foam characteristics with the addition of Benecel™ E4M HPMC alone or in combination with carboxymethylcellulose (CMC).

As shown in figure 4, a model toothpaste with 0.3% 1:1 HPMC to CMC yields the same foam volume as a toothpaste with 0.3% Benecel™ E4M HPMC alone. The optimum ratio between HPMC to CMC is dependent on the toothpaste formulation.

**figure 4. the addition of benecel™ e4m hpmc increases foam volume with capb surfactant**

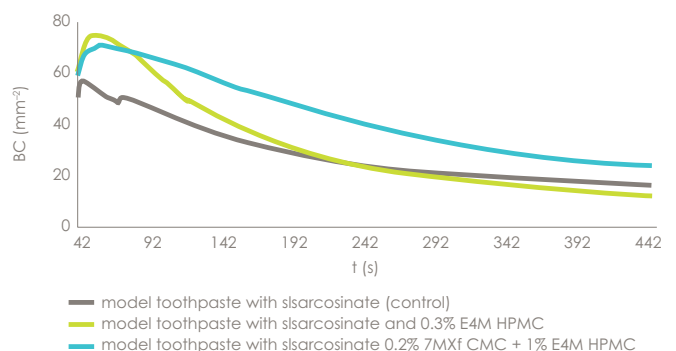


## create long-lasting foam

As consumers equate foam with cleaning efficacy, it is important to provide a long-lasting foam experience. Toothpastes with sarcosinate surfactants typically provide less foam. The addition of Benecel™ E4M HPMC to toothpaste can improve foam volume and foam stability.

The addition of Benecel™ E4M HPMC in combination with Aqualon™/Blanose™ CMC to a model toothpaste with sodium lauroyl sarcosinate (slsarcosinate) results in initial high bubble count (figure 5). In addition, the bubble count for the toothpaste remains higher over time demonstrating improved foam stability compared to the control.

**figure 5. foam stability is improved with the combination of benecel™ e4m hpmc and aqualon™/blanose™ cmc**



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