SUMITOMO SEIKA

TECHNICAL DATA SHEET

AQUPEC MG N40R

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DKSH

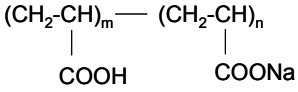
INCI Name: SODIUM CARBOMER

Introduction

AQUPEC MG is the most recent innovation of Sumitomo Seika. AQUPEC MG not only has the significant thickening capability of AQUPEC thickener family which allows getting highly viscous medium at low polymer concentration but also, due to its unique structure, is able to provide new fresher and lighter texture to a wide range of formulations. Moreover, its singular properties in solution make AQUPEC MG the best candidate for spray applications. In these applications, AQUPEC MG is able to achieve high viscosity without sacrificing essential spray properties such as sprayability.

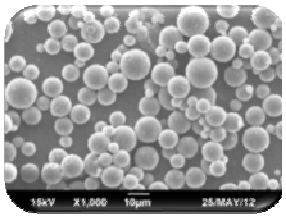
Chemical and physical characteristics:*1

*1 Not to be used as specification

Chemical name	Partially neutralized carboxyvinyl polymer sodium salt
CAS No.	9003-04-7
Chemical structure	
INCI Name	SODIUM CARBOMER
Appearance	White powder
State	Pre-neutralized
Viscosity (mPas, 0.5 % ac)	15,000-30,000
pH (0.5% aqueous)	Approx. 6
Bulk density (g/ml)	0.50-0.80
Shape	Spherical
Average particle size (μm)	10-30
Solvent type	Class 3*2 (Non-use of benzene)

*2 ICH guideline
ICH: International Conference of Harmonization of Technical Requirements for Registration of Pharmaceuticals for Human use

SEM (x1,000)



Benefits

- ○**High thickening capability**
- ○**Fresh and light texture**
- ○**Enhances sprayability**
- ○**Flexible addition**
- ○**Pre-neutralized carbomer**
- ○**Easy to disperse**
- ○**Better flowability**
- ○**Less creasing**

Additionally, as it is a pre-neutralized polymer, no addition of base is required, avoiding possible instability of pH sensitive raw materials and decreasing the overall cost due to the elimination of a process step. Furthermore, AQUPEC MG can be added in any preparation step, even at the end of formulation process, allowing modification and correction of formula viscosity.

Thickening mechanism

AQUPEC MG high thickening capacity lies in the polymeric structure of cross-linked polyacrylate. When AQUPEC MG is dissolved in water, due to the repulsion between carboxylates, polymer chains expand generating a three dimensional network, resulting in a highly viscous gel (Figure 1). In contrast to other carbomers, in the case of AQUPEC MG, neutralization step is not required, giving a pH close to neutral without any further pH modification.

Basic polymer properties in water

- Easy to disperse and handle
- High thickening capability
- Applicable for wide range of pH
- Fresh and light texture
- Less creasing
- Sprayable solution/emulsion

Easy to disperse and handle

One of the most important issues formulators face in the use of commonly-used carbomers is the management of addition method and dispersion time. Such carbomers are composed of irregularly shaped small particles of under 10µm, and the flowability of the polymers is poor. Thus, handling is not easy. On the other hand, the handleability has been significantly improved in AQUPEC MG. Due to its 10-30µm spherical and uniform shape, AQUPEC MG is easy to handle and has great flowability. Moreover, the dissolution process has been notably improved as well. In the case of commonly-used carbomers, slow addition, special equipment, and highly skilled operators are needed in order to avoid lump formation, which leads to longer dispersion time. However, AQUPEC MG has great dispersibility in water, and rarely forms lumps. As figure 2 shows, even the addition of AQUPEC MG without any stirring yields a fresh and free of lump gel.

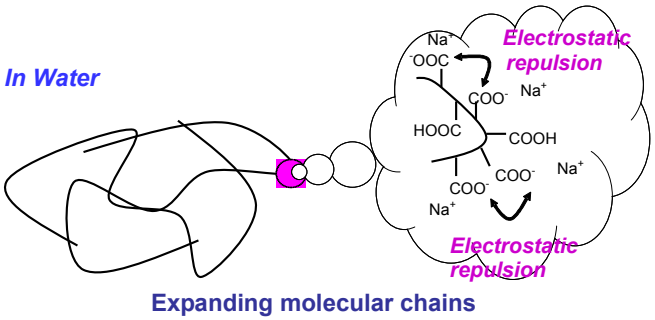


Figure 1: Mechanism of thickening of AQUPEC MG

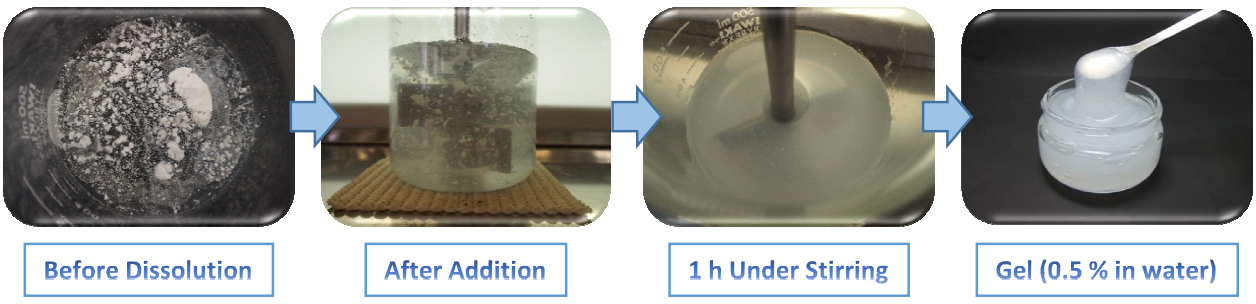


Figure 2: Dispersion process

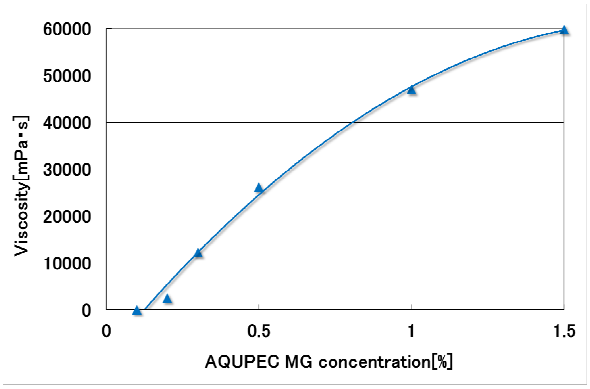


Figure3: AQUPEC MG concentration vs. viscosity

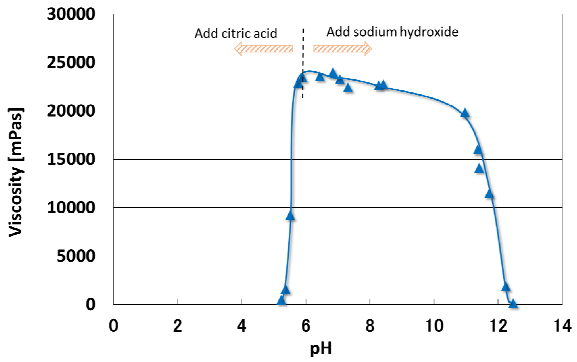


Figure4: Effect of pH in viscosity of 0.5% aqueous solution of AQUPEC MG

High thickening capability

AQUPEC MG is an extremely efficient rheology modifier with high thickening capability. The addition of small amount of AQUPEC MG into water enhances texture properties, resulting in a fresh and consistent gel. As figure 3 shows, even at low polymer concentration, medium viscosity is significantly high. The increase in polymer concentration leads to further increase in viscosity. Additionally, AQUPEC MG can be used in a large pH range (Figure 4) and the viscosity of AQUPEC MG gels is not significantly affected by temperature (Figure 5). Therefore, by tuning pH and polymer concentration, AQUPEC MG allows the preparation of a wide range of formulations by using it as single thickener.

The high shear thinning rheology profile of AQUPEC MG (Figure 6) is highly appreciated in formulations because it provides not only high viscosity and initial texture but also easy and comfortable rub-in characteristics.

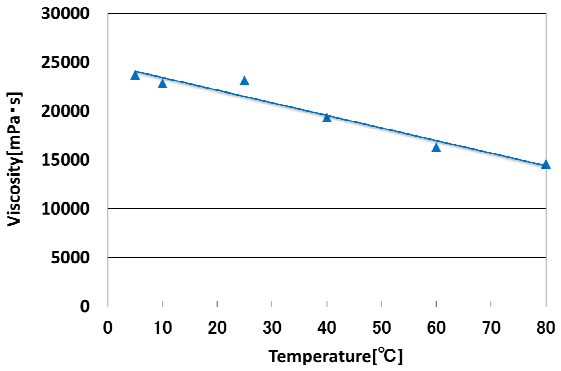


Figure5: Effect of temperature in viscosity of 0.5% aqueous solution of AQUPEC MG

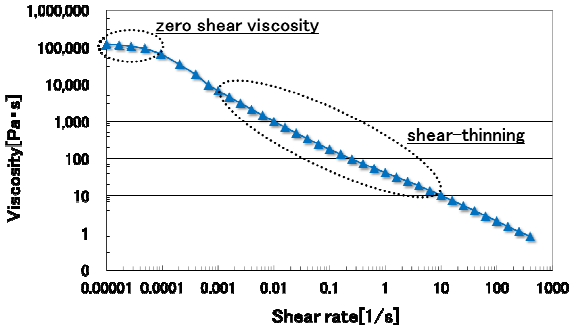


Figure6: Flow curve of 0.5% aqueous solution of AQUPEC MG

Texture

The unique structure of AQUPEC MG allows the preparation of formulations with new textures, especially with fresher and lighter feelings than those of normal carbomers.

Textures are related to product rheology in general, or more specifically, to rheology data in yield point. Strain and stress in the yield point can be correlated, respectively, with the freshness and lightness (Figure 7). Products with lower yield strain and yield stress respectively have fresher feeling and lighter feeling. As shown in Figure 7, compared with Carbomer (AQUPEC HV-505E), AQUPEC MG aqueous gel's yield strain and yield stress are lower, leading to fresher and lighter feeling.

Similar tendency is observed in the final products such as gel cream, cleansing gel and moisture cream. Both yield strain and yield stress of products with AQUPEC MG are significantly lower than those of Carbomer, proving that new texture observed in AQUPEC MG aqueous gel can be easily transferred to the final products (Figure 8).

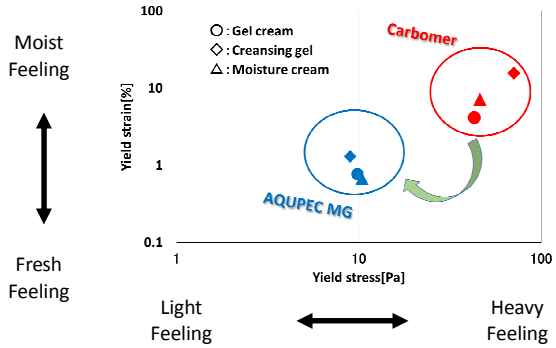


Figure8: Yield stress vs. strain of formulations

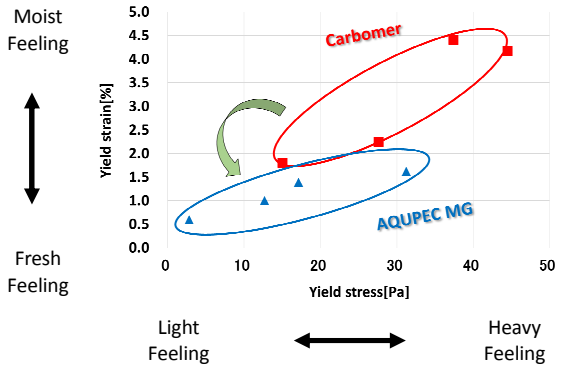


Figure 7: Yield stress vs. strain of aqueous gels

Creasing effect

Creasing effect, the polymer deposition when rubbed in, tends to occur in cosmetic products (especially in skin-care products) which contain polymers such as Carbomer. Creasing has a negative effect in the customer perception as it can be considered unpleasant, therefore, decreasing the product acceptance. Several studies have confirmed that, when compared with cosmetic products containing Carbomer, those containing AQUPEC MG produced hardly any creasing even at high concentration of AQUPEC MG (Figure 9 and Table 1).

Table 1: Results of creasing evaluation

Polymer	Polymer concentration (%)[a)]	Creasing[b)]
AQUPEC MG	0.5 %	Not observed
	1 %	Not observed
Carbomer	0.5 %	Observed
	1 %	Large amount

a) 30 % Propylene glycol

b) Evaluation method: Rub 0.5g of polymer gel in forearm during 5 min. Repeat the operation twice and observe results.

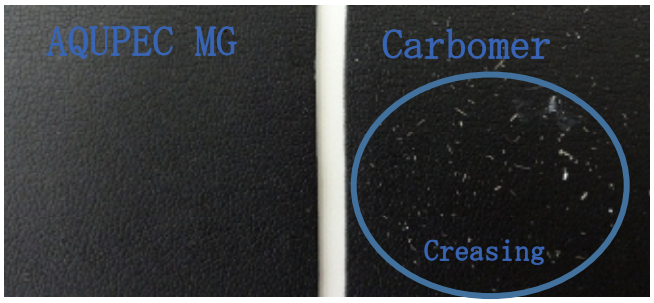


Figure9: Creasing examples by evaluation method

Spray applications

Spray products (non-aerosol) have several beneficial features such as better and faster to rub in when compared with other types of products. With the use of traditional thickeners, a compromise between good standing up/feeling properties and sprayability should be made when spray is formulated. On the other hand, high viscosity of AQUPEC MG provides better stability, texture and stronger hold and prevents dripping after spraying. Generally speaking, viscosity decreases product pumpability through nozzle and spray atomization area. As figure 11 shows, when Carbomer is used, an increase in viscosity significantly lowers spray

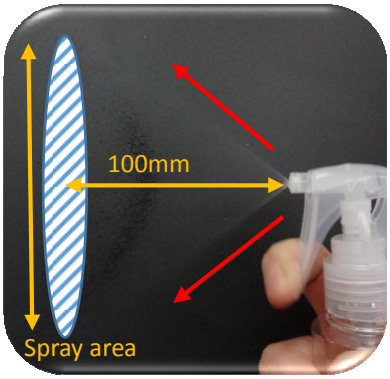


Figure 10: Measuring method of spray area

area and therefore applicability.

The use of AQUPEC MG solves this issue, facilitating the preparation of highly thick spray products, and opening a door for improvements in current formulation and the preparation of new ones which have been difficult to achieve until now. As shown in figure 11, comparing with the normal behavior explained previously, highly viscous stiff gel containing AQUPEC MG is easy to spray, and has similar spray area, while keeping all the excellent properties AQUPEC MG gives to products such as high stability and fresh texture as well as non-drip property.

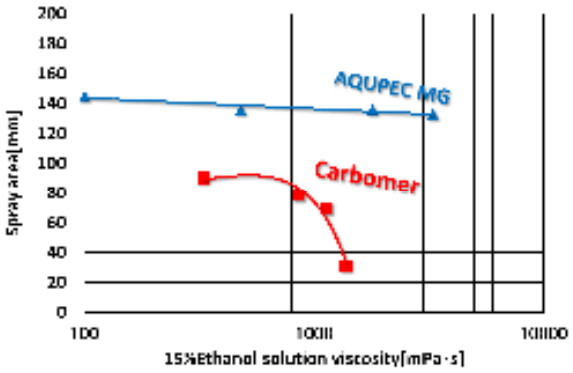


Figure11: viscosity vs. Spray area

Storage & Handling

AQUPEC MG is very hygroscopic and swells quickly in the presence of water. Keep the container closed when not in use, and store in a dry and dark area.

Packing

20kg paper with Alumium/PE internal protective layer.

Figure 12: Package of AQUPEC MG

Guide line formulation examples

- Gel Cream: Fresh and light texture.
- Milky lotion (non-aerosol): High spray area even at high viscosity.

Table 2: Gel cream formulation

Gel cream composition		
Feature: Fresh and light feeling		
Phase A		**%**
1	Water	87.00
2	**Sodium Carbomer (AQUPEC MG)**	**0.90**
3	Glycerin	4.00
4	Xanthan Gum	0.10
Phase B		**%**
5	Butylene Glycol	4.00
6	Pentylene Glycol	0.90
7	PEG-60 Hydrogenated Castor Oil	0.60
8	Glyceryl Caprylate	0.90
9	Cetyl Ethylhexanoate	0.40
10	Squalane	1.20
Total		100.00

Procedure:

1. Prepare Phase A by stirring materials 2, 3 and 4 into water (room temperature) until dissolved. Keep stirring until clear homogenous gel is obtained
2. In a separate beaker, prepare Phase B. Mix materials 5 to 10 and stir well until dissolved at 70°C (optimum temperature).
3. Slowly add Phase A to Phase B. Stir until emulsion is uniformly made (Homomixer is recommended).
4. Cool down the formulation to 40°C while stirring.
5. Allow it to cool until room temperature and store it.

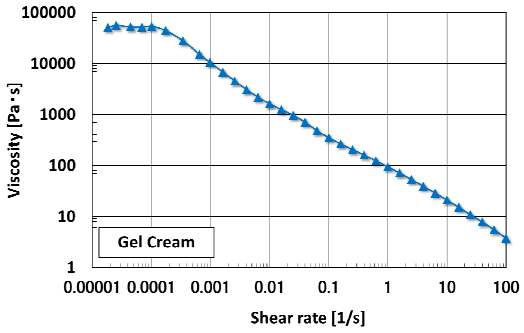


Figure 13: Flow curve of gel cream

Table 3: Milky lotion formulation

Milky lotion composition		
Feature: High viscosity sprayable		
Phase A		**%**
1	Polysorbate 60	2.00
2	Sorbitan Stearate	2.00
3	Olea Europaea (Olive) Fruit Oil	2.00
4	Simmondsia Chinensis (Jojoba) Seed Oil	0.50
5	Squalane	2.50
Phase B		**%**
6	Glycerin	5.00
7	Dipotassium glycyrrhizate	0.10
8	Sodium hyaluronate	0.01
9	Glycine Soja (Soybean) Seed Extract	0.05
10	(Extract)	0.05
11	Water	85.17
Phase C		**%**
12	**Sodium Carbomer (AQUPEC MG)**	**0.20**
Phase D		**%**
13	(Ceramide)	0.01
14	Succinoyl Atelocollagen	0.01
15	Phenoxyethanol	0.40
Total		100.00

Procedure:

1. Prepare Phase A. Mix materials 1 to 5 and stir until dissolved at 80°C.
2. In a separate beaker, prepare Phase B. Mix materials 6 to 11 and stir until dissolved at 80°C.
3. Slowly add Phase C to Phase B. Keep stirring until polymer is fully dissolved.
4. Prepare Phase D by mixing materials 13 to 15.
5. Slowly add Phase A to Phase B. Stir well until emulsion is uniformly made (Homomixer is recommended).
6. Cool down the formulation to 40°C while stirring and stir in Phase D.
7. Allow it to cool until room temperature and store it.

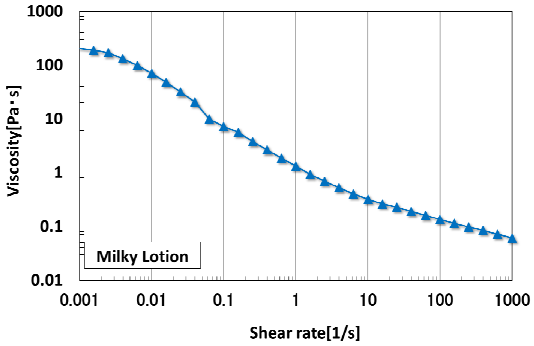


Figure 14: Flow curve of milky lotion

Figure 15: Sprayability of milky lotion containing AQUPEC MG

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