SUMITOMO SEIKA

TECHNICAL DATA SHEET

AQUPEC SER W-150C(CT-1), W-300C(CT-1)

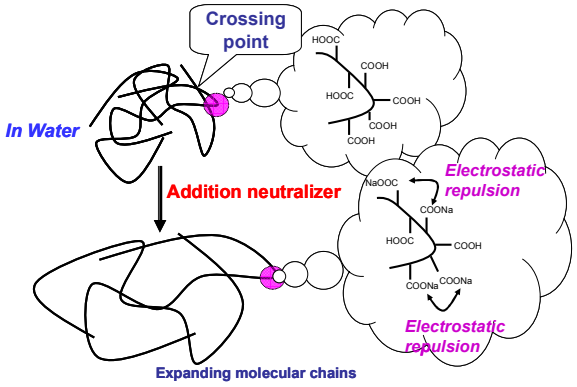
INCI Name: Acrylates/C10-30 Alkylacrylate Crosspolymer

Introduction

Electrolytes solutions are difficult to thicken. Generally, viscosity of AQUPEC gel decreases in the presence of some electrolytes. AQUPEC SER series has been specially designed to thicken this type of medium.

Moreover, AQUPEC SER series can emulsify a large group of different oils. Due to this, AQUPEC SER is strongly recommended for the preparation of emulsions and creams.

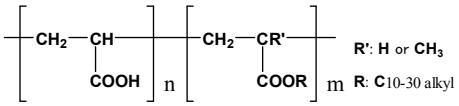
Figure 1. Mechanism of thickening of AQUPEC



AQUPEC SER series products are Acrylates/C10-30 Alkylacrylate Crosspolymer. AQUPEC SER Series in water (before neutralization) is an acid (pH approx. 3) cloudy dispersion (Figure 1). In this state, AQUPEC`s chains are tangled giving a low viscous medium. During neutralization, acid moieties of AQUPEC are neutralized. The resulting acrylate groups repulse each other expanding AQUPEC`s chains (Figure 1). This result is a high viscous clear gel.

Chemical and physical characteristics:*

* not to be used as specification

Chemical Name	Acrylates/C10-30 Alkylacrylate Crosspolymer
CAS No.	Confidential
Chemical Structure	 R': H or CH_3 R: C10-30 alkyl
INCI name	Acrylates/C10-30 Alkylacrylate Crosspolymer
Appearance	White Powder
Bulk density	0.11-0.15g/ml
$pH_{(0.5\ \%\ aqueous)}$ [a)]	Approx 3

a) Before neutralization

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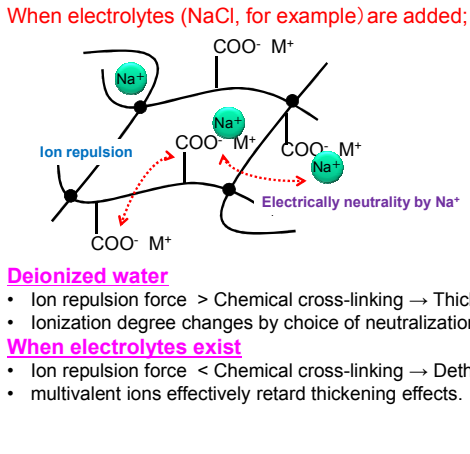
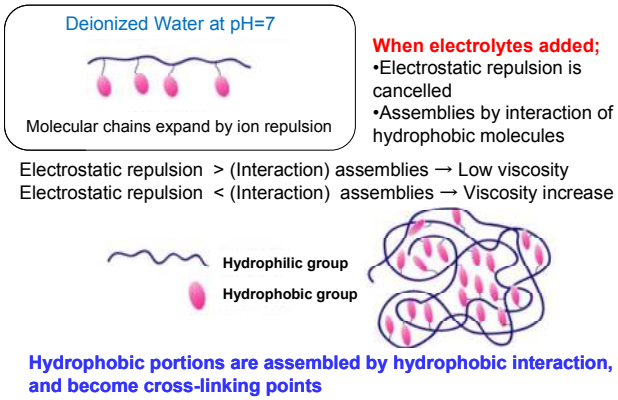
Figure 2. Mechanism of thickening of AQUPEC in the presence of electrolytes



Carbomer as anionic thickener is significantly affected by the medium ionic strength. When some electrolytes such as sodium chloride are added, electrostatic repulsion between chains (which keeps chains expanded) is compensated and chains are entangled (Figure 2). The result is a loss in viscosity. This effect is more notable in the case of divalent and trivalent cations (Such as Ca^{2+} or Al^{3+}).

Figure 3. Mechanism of thickening of AQUPEC SER.



SER is slightly cross-linked polyacrylate. By ion repulsion (after neutralization), chains expand. In contrast to normal carbomer, when some sodium chloride is added, viscosity of AQUPEC SER increases. In the presence of sodium cation, polymer volume decreases allowing hydrophobic groups (grafted into the SER chains) to get closer (Figure 3). These assembled hydrophobic groups act as “pseudo-cross-linking” points increasing the medium viscosity.

Typical Specifications

Table 1. Properties of AQUPEC SER series.

Item	SER W-150C	SER W-300C
1wt% mucilage + 1.0 wt% salt [a)]	-	5,000 max (pH5.8-6.3, Spindle #7)
1 wt% mucilage + 3.0 wt% salt [a)]	5,000 max (pH7.3-7.8, Spindle #5)	-
Residual Solvent	5,000 ppm max	5,000 ppm max

a) Viscosity [mPa·s] (BH Type Viscometer, 20rpm).

Key Benefits.

- AQUPEC SER is a copolymer of acrylic acid (hydrophilic) and alkyl methacrylate (hydrophobic). Due to this nature, it is possible to prepare creams and emulsions with low amount of low molecular weight emulsifier.
- AQUPEC SER gels are not as strongly affected by the ionic strength as normal carbomer polymer, keeping high viscosity even in the presence of salts such as sodium chloride.
- Benzene free.
- SER W-150C and SER W-300C electrolyte tolerance is different. Depending on the desirable performance, one or another can be chosen (Figure 4).

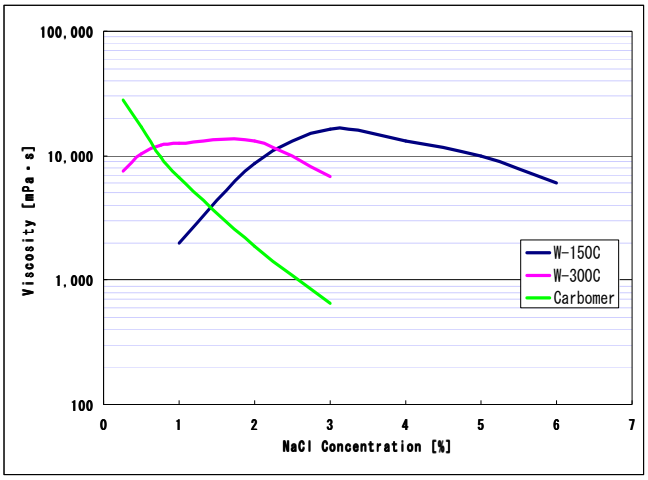
Features.

Basic Polymer Properties in Water.

1) Effect of electrolytes.

AQUPEC SER gels are not as strongly affected by the ionic strength as normal carbomer polymer, keeping high viscosity in the presence of salts such as sodium chloride (Figure 4).

Figure 4. Viscosity vs NaCl concentration

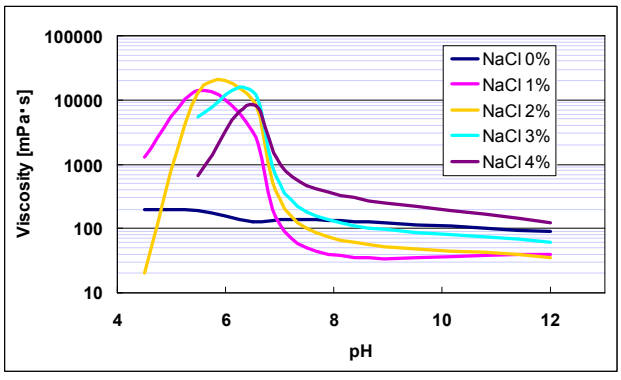


2) Effect of pH

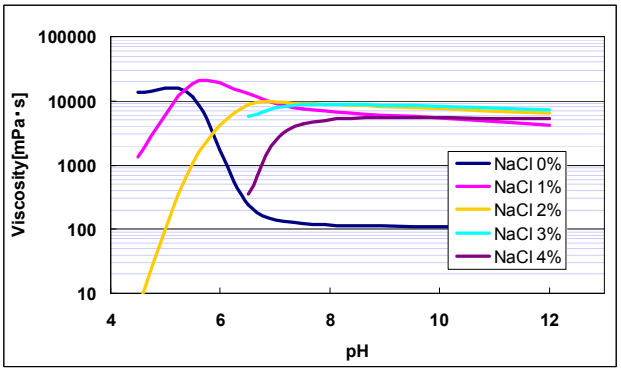
Viscosity of AQUPEC SER is influenced by the pH. Additionally, adding some sodium chloride, gel viscosity can be adjusted as wished (Figure 5).

Figure 5. Viscosity vs pH

SER W-150C



SER W-300C



Storage & Handling

AQUPEC SER 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

15 kg box.

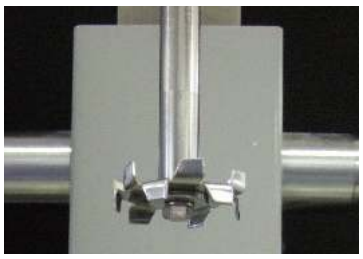
Shelf life

Two years from the date of the initial analysis (except for “loss on drying”).

Recommended Order of Addition

- Add AQUPEC SER gradually while stirring water or mixtures which contain more than 80% water. A common stirring blade can be used, but a dispersion blade as shown in figure 6 is recommended.
- Add AQUPEC SER (under stirring)
- After AQUPEC SER is dispersed uniformly, the addition of the proper neutralizer will form a gel. Other ingredients can be added as well to complete the formulation.
- Before neutralization, the addition of some compounds which act as electrolytes (such as anionic surfactant) may lead to the flocculation of AQUPEC.

Figure 6. Dispersion blade recommended for AQUPEC SER series



Suggestions for an easy dispersion of SER.

- If long dispersion time is an option, it is recommended to leave SER swelling overnight. (Figure 7).

Figure 7. Dispersion with and without stirring (Comparison)

After 1 night

After 20 min stirring

- In the presence of surfactant, the dispersion of AQUPEC SER is much faster (Figure 8).

Figure 8: Dispersion with and without surfactant (Comparison)[a)]

Stirring time	0.5 h	1 h
Water		
5. 0 % surfactant (aqueous solution)[b)]		

a) Water: 150 g. SER W-300C: 0.75 g

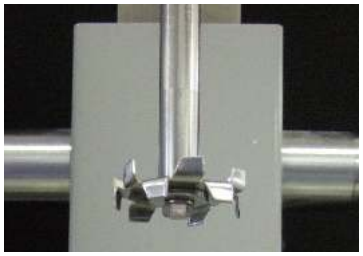
b) Surfactant: SLS

Viscosity Measurement Procedure.

1. With a graduated cylinder, measure one liter of distilled water (kept at 25°C) and pour into a clean dry 2000-mL beaker.
2. Set up TK Robomix with a dispersion blade (Figure 10). Introduce the blade into the beaker. Adjust the speed to 2000 rpm.
3. Weigh AQUPEC SER (10 g for a 1% solution).
4. Slowly add AQUPEC to water (under stirring at 2000 rpm). Keep stirring for 30 minutes.
5. Transfer 300 g of the solution into a clean dry 1000-mL beaker.
6. Set up TK Robomix with a dispersion blade. Introduce the blade into the beaker. Adjust the speed to 2000 rpm.
7. Using a graduated pipette, quickly add 5.3 g (4.5ml) of 18% NaOH solution. Stir it for 5 minutes.
8. Check pH of the gel with a pH meter to make sure it is between 6.0 to 6.5.
9. Transfer 150g of neutralized solution into clean dry 500-mL beaker.
10. Set up TK Robomix with a dispersion blade. Introduce the blade into the beaker. Adjust the speed to 2000 rpm.
11. Add 4.5 g of NaCl to neutralized 1% solution. Stir for 5 minutes.
12. Centrifuge it to remove bubbles. (for approx 800 g, 10 minutes are required)
13. Transfer gel to a 100-mL beaker to fill it up.
14. Check the temperature of the gel by placing a thermometer straight down into the center of the gel. Do not stir or incorporate any air into the gel. Leave in water bath for 2 hours (Temperature = 25±0.5 °C)

15. Measure the viscosity of the gel with VISMETRON at 20 rpm using spindle No. 5.

Figure 9. Dispersion blade recommended for AQUPEC SER



Suggested Applications

AQUPEC SER unique features make this polymer suitable for a wider range of applications where other thickeners can not give good performances. AQUPEC SER features can be summarized as follow:

- Jelly type feeling (elastic gels).
- Polymeric emulsifiers.
- Special thickening capacity.

Jelly type gels (elastic gels).

- Even in the presence of salts, high clean gel can be achieved (Figure 11).

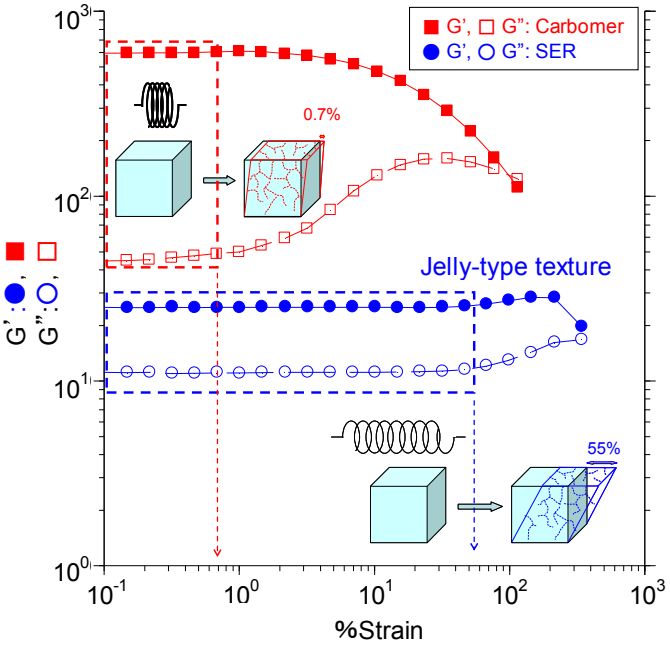
Figure 10. Clarity of gel in the presence of salt

SER W-300C + 1% NaCl

Carbomer + 1% NaCl

- Jelly-type felling is an interesting texture which can be easily achieved by AQUPEC SER (in contrast to other carbomers). As Figure 11 shows, G`/G`` linear region of strain sweep is much larger than that of carbomer. This is an essential property to obtain Jelly-type feeling.

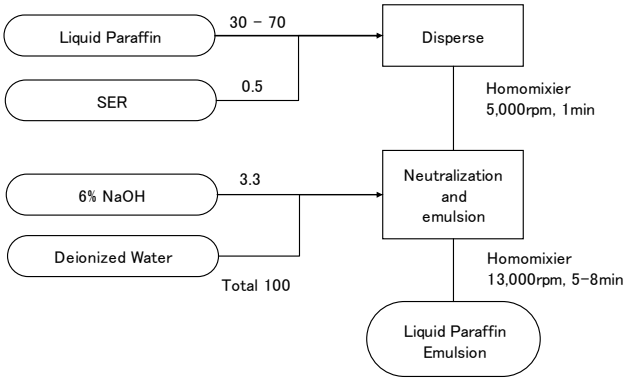
Figure 11. Strain sweep of Carbomer and SER



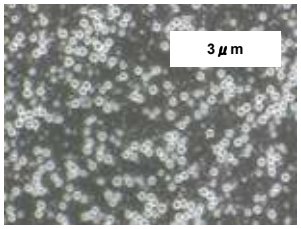
Polymeric emulsifiers (surfactant free emulsion).

- Due to the particular structure of AQUPEC SER, surfactant-free emulsions can be prepared (Figure 12).

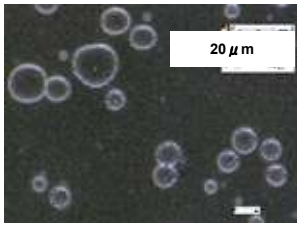
Figure 12. Emulsification process.



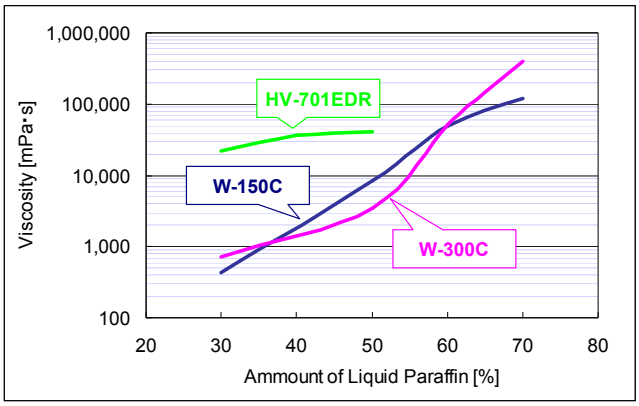
Emulsion droplet sizes (Liquid Paraffine 60%)



SER W-300C



AQUPEC HV-701EDR



Special thickening capacity.

- Even at low concentration of surfactant (12 wt %) high viscous shampoo can be obtained.

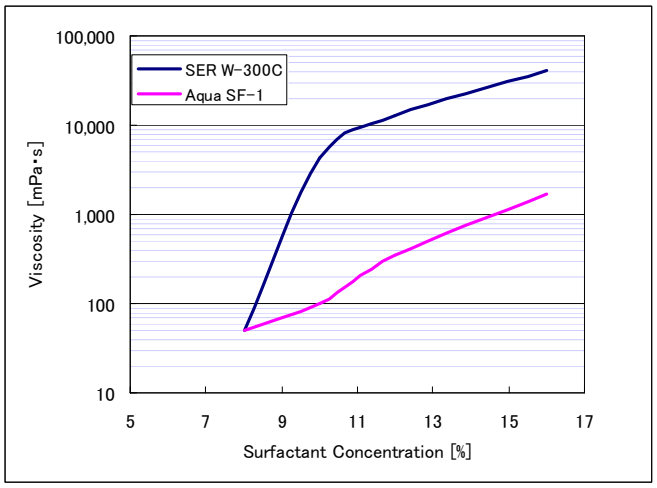
Clear Economy Shampoo (Amount of Surfactant 12 wt %, pH 6.5)	
PART A	
AQUPEC SER W-150C or W-300C	0.5 %
Water	40.0 %
PART B	
Sodium Lauryl Sulfate (98.0%)	10.4 %
Cocamidopropyl Betaine (30%)	6.7 %
Water	42.4 %
	100.0 %
PART C	
18% NaOH	Adjust pH
PART D	
Sodium Chloride	0.5 %

Procedure

1. PART A: Disperse AQUPEC SER in water.
2. PART B: Mix PART B ingredients in a separate beaker.
3. Mix PART A and PART B and stir at room temperature.
4. Add PART C to adjust pH.
5. Add PART D and stir.

AQUPEC SER has a strong interaction with surfactants. This interaction leads to a significantly increase in viscosity (Figure 14).

Figure 14. Viscosity vs surfactant concentration



- Easy dispersion of hydrophilic pearlizing agents.

Figure 15. Dispersion of pearlizing agents

SER Carbomer 1 Carbomer 2

Generally speaking, in comparison with carbomer or acrylates/C10-30 alkylacrylate crosspolymer , dispersion and uniformity of hydrophilic pearlizing agents.

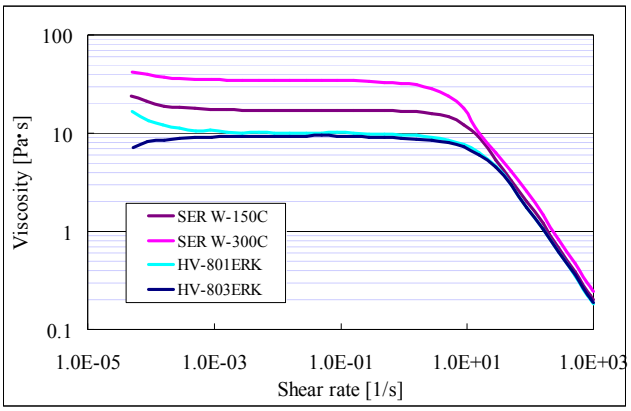
agent is much better in the case of AQUPEC SER (Figure 15)

Pearlizing Shampoo	
PART A	
AQUPEC SER W-150C or W-300C	0.2 %
Water	9.8 %
PART B	
Sodium Laureth Sulfate (3mol, 25%)	44.0 %
Potassium hydroxide (5%)	2.2 %
Water	9.5 %
PART C	
Mica/Titanium Dioxide	0.2 %
Water	6.0 %
PART D	
Sodium Benzoate	0.3 %
Disodium EDTA	0.1 %
Water	6.0 %
PART E	
Cocamidopropyl Betaine (30%)	21.3 %
PART F	
Citric Acid	0.4 %
Water	10.0 %
	100.0 %

Procedure

1. PART A: Disperse AQUPEC SER in water and heat to about 60°C.
2. PART B: Mix PART B ingredients in a separate beaker at about 60°C.
3. PART C: Disperse Mica/Titanium Dioxide in water in separate beaker.
4. PART D: Mix PART D ingredients in separate beaker.
5. Mix PART A and PART B and then add PART C and PART D at about 60°C.
6. Add PART E and PART F.

Figure 16. Viscosity vs shear rate.



In shampoo containing AQUPEC SER the mentioned uniformity (Figure 15) is maintained, giving much better appearance (Figure 17).

Figure 17. Appearance of shampoo

SER

Other Acrylates/C10-30 Alkylacrylate Crosspolymer

- High compatibility with cationic polymers (Fig 18).

Test of compatibility with cationic polymers	
PART A	
AQUPEC SER W-150C or W-300C	0.5 %
Water	96.3 %
PART B	
Sodium hydroxide (6%)	3.2 %
	100.0 %
PART C	
Polyquaternium-11(PQ-11)	1.0

Procedure

1. PART A: Disperse AQUPEC SER in water.
2. Add PART B to adjust pH.
3. Add PART C and stir vigorously.

Fig 18. Compatibility with cationic polymers.

	SER W-300C	Carbomer
Viscosity [mPa·s]	22,000	20,000
Clarity [%T]	96%	25%

SER W-300C

Carbomer