

수용성폴리머를 사용한 안정한 O/W 형 에멀전에서 첨가제의 영향

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Effects of additives on Oil-in-Water emulsion stabilized with carboxyl polymer

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Introduction

The applications of emulsions are various. In recent years the cosmetic industry has acknowledged the importance of rheological properties of emulsion as well as finished products.

Product rheology plays a significant role in defining and controlling these attributes.

Rheology, or flow behavior, may be modified to produce pseudoplasticity, thixotropy, gel structure, or short or stringy pituitous flow(1). The ability of thickener to modify finished product's rheology has direct impact on shelf stability, whether it is due to viscosity control, emulsion stability, suspension of actives, or prevention of syneresis(2). The emulsions are complex because the drops can deform and the surfaces are fluid(3).

The formation of emulsion is a dynamic, yet thermodynamically unfavorable, process due to the increase in interfacial area following emulsification.

Macroemulsions composed of drops in the micron-size range are not thermodynamically stable and there are various sources of instability leading to phase separation.

In order to investigate systematically the steady shear flow properties of aqueous (carboxyl polymer) solution having various molecular weights and concentrations, the steady flow viscosity has been measured with a Rheometrics(HAAKE).

There are five main mechanisms that can contribute to emulsion instability; ①

creaming, ② flocculation, ③ ostwald ripening, ④ partial coalescence, and ⑤ phase inversion (walstra)(5).

Creaming is due to differences in density between the two phases under the influence of gravity which leads to phase separation.

Oil-in-water emulsions are fluid and may contain a crystalline oil phase.

These methods utilize additives to enhance either the coalescence or the flocculation of the emulsion droplets, increasing the separation efficiency. Viscosity enhancement is only one of properties affected by rheological additives(3). The oil-in-water emulsion was added carboxyl polymer as a stabilized in cosmetics prescription oil-in-water emulsions was added the additives of multi type and the viscosity changes of emulsions are measured and observed in consistency of additives with rheometer.

The objectives of this study are to investigate how the used components, the addition ratios of the additives, and the types of the oil-in-water emulsions will affect the stucture and rheological properties of the stabilized oil-in-water emulsions.

Materials and methods

Materials : The carboxyl polymers increasing emulsification were Cabomer 941. The surfactant was non-ionic P.O.E(20)Sorbitan monostearate(Tween60). The oils were olive oil and liquid paraffin. The emulsifiers were stearic acid, cethyl alcohol, glycerin monostearate, glycerin stearate, and PEG100stearate. The preservations were methyl parahydroxybenzionate, buthyl parahydroxybenzionate, and buthyl hydroxyl toluene. The neutuilized material was triethanolamine. The addictives of alkali were sodium hydroxide and calcium hydroxide. The addictives of acid were hydrochloric acid and sulfuric acid. The addictives of salt were sodium chlroride and magnecium chlroride.

Methods : Emulsions were prepared in laboratory scale(batch size 100g). Distilled water was added to the mixture of surfactant and oil at the temperature of 75~80°C within 3min, and mixed at a speed of 2000rpm with blender (T.K.ROBO MICS, Tokushu kika kogyo CO.,Ltd, Japan). During the cooling phase the emulsion was continuously mixed. The mixture was introduced into additives solution, previously brought to agitated with direct driven stirrer.

Rheology : A rheometer (HAAKE RT-20, Germany) was used to determine viscosity. A cone plate geometry was employed for high accuracy and sensitivity. The temperature is 25°C. The distance between the shearing surfaces was 1.055mm.

pH meter : The emulsions pH were mearsument with pH meter. The error range of pH controlled was ± 0.1 .

Motor centrifuge : The stabilized emulsions were confirmed motor centrifuge. Centrifugation experiments were performed with a Brushless D.C Motor VS-15CF, Korea apparatus at 3000rpm for 10min. The physical stability of emulsion was described with the separation of the aqueous and oil phase and with the volume of

the separation water.

Zeta-potential analysis : Measurement was made with a Malvern, Zetasizer 3000HS in which microelectrophoresis was coupled with a photocalorrelation spectroscopy, based on helium/neon laser. The evaluation was carried out by an on-line computer. The buffering solution KCl 0.020 m(20mM) electrolyte at pH 7. The injection was made at 25°C with an applied electronic field from -150 to +150 mV.

Results and discussion

Cosmetic oil-in-water emulsions are typically stabilized by cross linked carboxyl polymers whose effectiveness can be further improved with the introduction of hydrophobic side-chain(4).

In order to investigate how partial coalescence affected the emulsion using centrifuge.

The flocculation appears. It follows to obtained maximum the addition of 0.00144 (w/w)%. So over the addition of 0.00144 (w/w)%, experiment didn't do that.

In the cosmetics emulsions, skin bringing up for discussion pH similar condition 5.5~6.5 and it fixes in the pH which is emulsion prescription.

The additives of stabilized emulsions having different concentrations were determined by use of pH meter. The effects of additive HCl concentrations on the emulsion is shown in Fig.2. The viscosity of the emulsions with different additives' concentrations was determined. The effect of oil-in-water emulsion viscosity is obtained upon increasing in concentration of additives.

As show in Fig.2 and 3. pH was reduced with addition and they are similar.

When HCl and H₂SO₄ are add effects of them on the viscosity of emulsion obtained at high concentrations where a sudden decrease was observed.

As show in Fig.2,3, additives 0.0006~0.0010 (w/w)% the viscosity and the pH are well.

Like this features as the pH change which it follows in the concentration and viscosity probably comes to predict.

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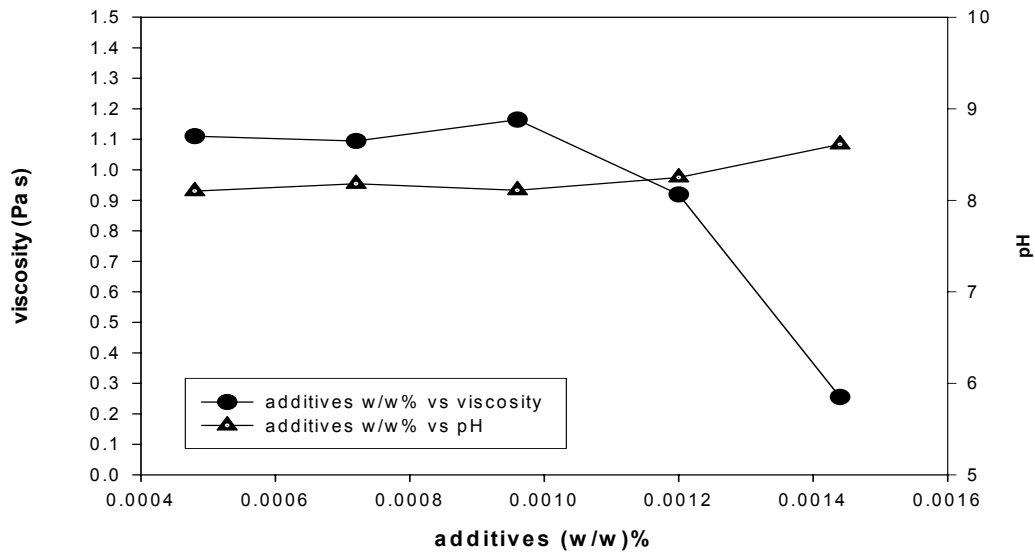


Fig.1 The additive (Ca(OH)₂) course of pH and viscosity

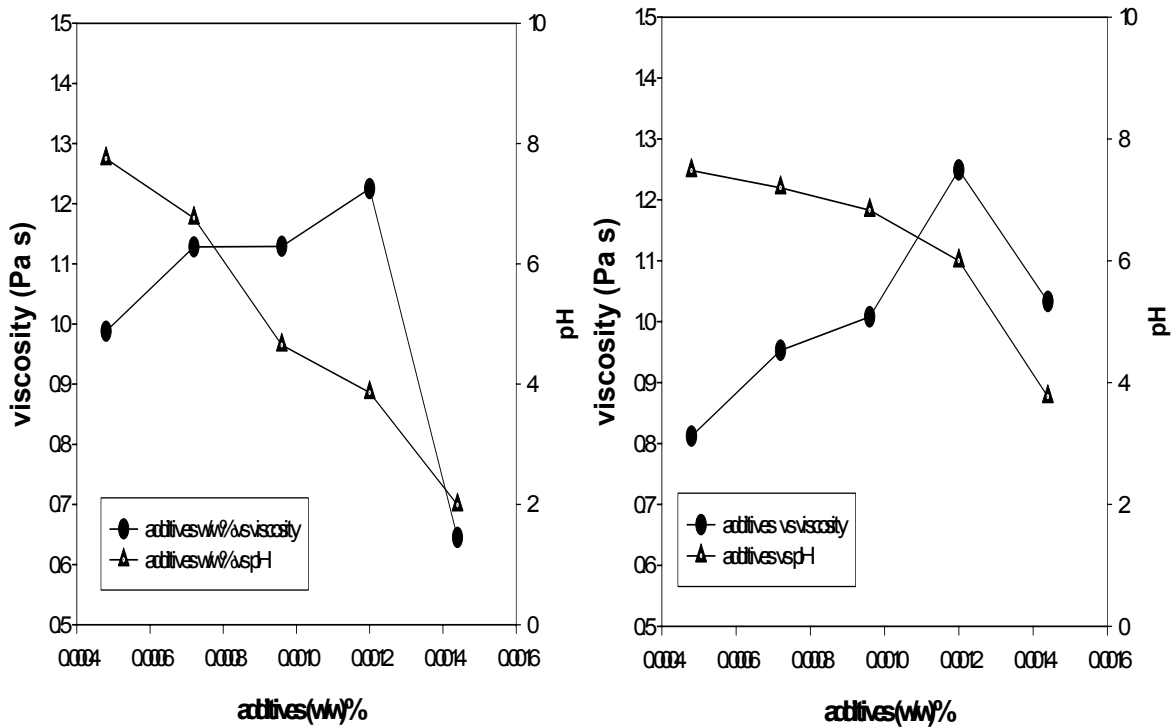


Fig.2 The additive (HCl) course of pH and viscosity (Left)

Fig.3 The additive (H₂SO₄) course of pH and viscosity (Right)