Various Cellulose Beads Modifications and Functions in Cosmetic Applications

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1. Introduction

The world-wide contradictive tide against microplastic beads makes increasing demands of green alternatives. Cellulose will be the one of expected candidate, since it is the degradable product in the nature. We have been marketed spherical cellulose for almost 20 years.

In this study, the biodegradability of cellulose beads is evaluated with OECD301F. And we have developed smaller size of cellulose beads compared with conventional ones. We have found very unique properties of these smaller size ones in the formulation of cosmetics. We show the application for cosmetics using these.

2. Materials and Methods

Spherical cellulose beads (INCI Name: Cellulose) was prepared by the phase separation method from cellulose solution.

2.1. Biodegradability

Biodegradability of cellulose beads was evaluated referring to OECD301F and ASTM D6691 method.

2.2. Modifications of cellulose beads

The particle size of cellulose beads could be controlled by changing the manufacturing conditions from 4 to 200 microns. Cellulose beads whose particle size are 4, 9, and 13 microns were selected for the evaluation in cosmetic applications. The specific surface area was also controlled from 1 to 220 m^2/g, nonporous or porous type. The surface treatment on cellulose beads with magnesium stearate was evaluated.

2.3. Evaluation in cosmetic applications

Cellulose beads were evaluated in powder foundation, liquid foundation and lipstick formulations.

3. Results

3.1. Biodegradability

OECD301F: The biodegradation degree of cellulose beads after 28 days was 67%, so they are biodegradable.

ASTM D6691: The biodegradation degree of cellulose beads after 28 days was 93%, so they are biodegradable. ASTM D6691 is a method for confirming biodegradability in seawater.

3.2. Modifications of cellulose beads

Particle size, light scattering effect as haze index, specific surface area, oil absorption and SEM image of various cellulose beads whose particle size is 4 microns with porous surface (CB-4P), 4, 9, 13 microns with nonporous surface (CB-4N, CB-9N, CB-13N) were compared in table 1. Surface treatment with magnesium stearate was made on CB-4N, CB-9N, and CB-13N.

3.3. Evaluation in cosmetic applications

- Powder foundation: smaller cellulose beads showed better compact stability against drop test, and better blurring effect. However, bigger cellulose beads showed better spreadability.

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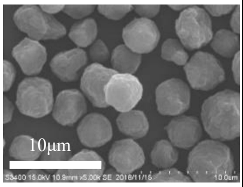
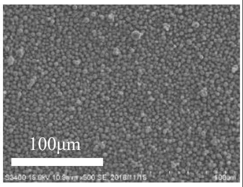
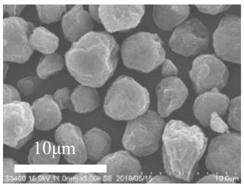
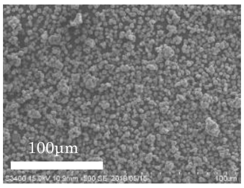
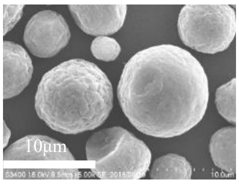
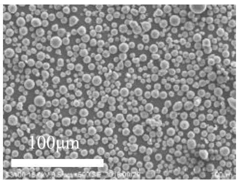
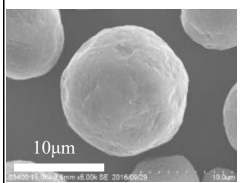
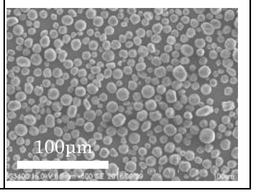
- Liquid Foundation: Surface treated cellulose beads showed better dispersibility and stability in W/O emulsion system.
- Lipstick: Bigger cellulose beads with surface treatment showed better spreadability with good color intensity on the lip.

Table 1. Comparison of cellulose beads

	CB-4P	CB-4N	CB-9N	CB-13N
Particle size (μm)	3～5	3～5	8～10	12～15
Total transmission Td (%)	98.5	96.8	96.4	98.1
Haze index H (%)	85.1	83.2	53.1	33.1
Specific surface area (m^2/g)	220	1～2	1～2	1～2
Oil absorption (ml/100g, oleic acid)	213	73	48	43
SEM image (X5000 and X500)	 	 	 	 

4. Discussion and Conclusion

By the technology of modifications of cellulose, various cellulose beads showing different functions could be prepared. Suitable cellulose beads can be chosen for each cosmetic applications depending on the purpose.