News Release

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Mandom Corporation succeeds in forming Pickering emulsion using "mica titanium" hydrophilic powder

Both dry feeling of use and prolonged tone-up effect are realized

Mandom Corporation (headquartered in Osaka City; Motonobu Nishimura, President) has been conducting research and development with a focus on "Pickering emulsion technology," a means of creating an emulsion of oil and water by use of a powder, to improve retention of preparations on the skin.

We placed our focus on the Pickering emulsion technology and aimed to develop a preparation that feels both dry and waterproof in use and brightens or enhances the tone of men's skin color using "mica titanium," which has highly hydrophilic and light-scattering properties. As a result, we succeeded in creating a Pickering emulsion formulation using mica titanium by blending a fatty acid and a specific type of dicarboxylic acid diester into the oil base. We have applied this technology to "LUCIDO Brightening Lotion," a makeup cosmetic intended mainly for middle-aged men that was first marketed in August 2020.

1. A technology required for men's makeup cosmetics: prolonged tone-up effect on the skin, sweatproof (waterproof), and a dry feeling in use

Common makeup cosmetics such as liquid foundations mainly contain water and oil for their ease of use/effect and additionally contain powder pigments such as mica titanium to brighten the skin color or change the tone of the skin. The formulations are largely categorized as oil-based (W/O) or water-based (O/W) type (Figure 1). Conventionally, surfactants (substances with affinity for both water and oil) are used to emulsify water and oil. Oil-based makeup cosmetics have excellent waterproofness and repel water after they are applied to the skin; however, this causes men with skin that secretes a large amount of sebum to have an uncomfortable sense in use, such as "stickiness" or "clogged feeling." Therefore, water-based formulations (O/W type) are considered to be more appropriate for men who prefer a dry feeling in use, like that of a milky liquid. However, common O/W-type emulsification with a surfactant causes re-emulsification of the oil due to water on the skin, such as sweat, after application of the formulation, and results in issues regarding the waterproofness of powders used to provide a tone-up effect to brighten the skin color or change the tone of the skin.

In this context, Mandom Corporation focused on "Pickering emulsion technology"* as a means to improve waterproofness of powder pigments even in O/W-type formulations. We considered that we would be able to develop a makeup cosmetic having both waterproofness and a feeling of use appropriate for men by formulating an O/W-type Pickering emulsion using mica titanium that can make the skin look brighter with its light-scattering effect.

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*“Pickering emulsion technology” is a technology to stably emulsify oil in water by absorbing fine particles like powders, instead of surfactants, into the oil-water interface (Figure 1). The balance of wettability of the powder with (or blending of the powder into) water/oil is an important factor for emulsion formation. Surfactants are not used in the Pickering technology, so the oil is hardly re-emulsified on the skin, even with water as the base, and the powder is present in a properly blended form, which prolongs retention on the skin. The technology has been applied to sunscreen preparations and other products in the field of cosmetics.

2. Success in forming Pickering emulsion with “mica titanium” hydrophilic powder

Since mica titanium powder naturally has a hydrophilic surface, it is not absorbed in oil and is dispersed into the water when water and oil are simply mixed. In this case, a Pickering emulsion is not formed (Figure 2, left). Therefore, we considered that we needed to find an oil medium with higher affinity to mica titanium to achieve stable formation of Pickering emulsion. As a result of screening of oily components with higher affinity, we found that a fatty acid and a specific type of dicarboxylic acid diester work effectively, and achieved formation of Pickering emulsion using mica titanium. Microscopic images reveal that the mica titanium is completely absorbed to the surface of the oil and forms a spherical Pickering emulsion (Figure 2, right). When a hydroxyl (-OH base) on the surface of mica titanium forms a hydrogen bond with the specific oil that we have discovered, the affinity of the mica titanium for the oil is increased and becomes absorbable to the oil-water interface, which is considered to have made it possible for us to form a Pickering emulsion (Figure 3).

3. Sweatproof Pickering emulsion

The waterproofness of the formulation was validated with two types of emulsified formulations containing mica titanium (Figure 4).

A. O/W-type emulsified model formulation with a surfactant

B. O/W-type model formulation with Pickering emulsion, a blend of the same amounts of mica titanium and the oil base

After the two model formulations were applied to pieces of black leather, water was sprayed onto them. Comparison of photographs showing the tone differences (L-value: brightness) after spraying demonstrates that the applied mica titanium remains in a larger amount and better maintains the tone differences with the model formulation with Pickering emulsion formation than with the model formulation with a surfactant, which shows that the model formulation with Pickering emulsion formation has excellent waterproofness (Figure 4) and is considered to result in the prolonged tone-up effect.

[References]

Figure 1: Pattern diagrams of W/O emulsification, O/W emulsification, and O/W Pickering emulsion

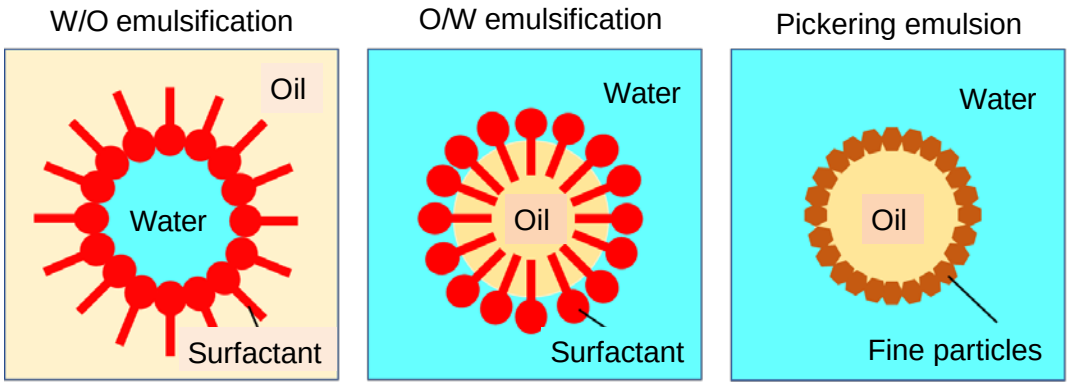

Figure 2: Microscopic images of Pickering emulsion with mica titanium (left: before formation, right: after formation)

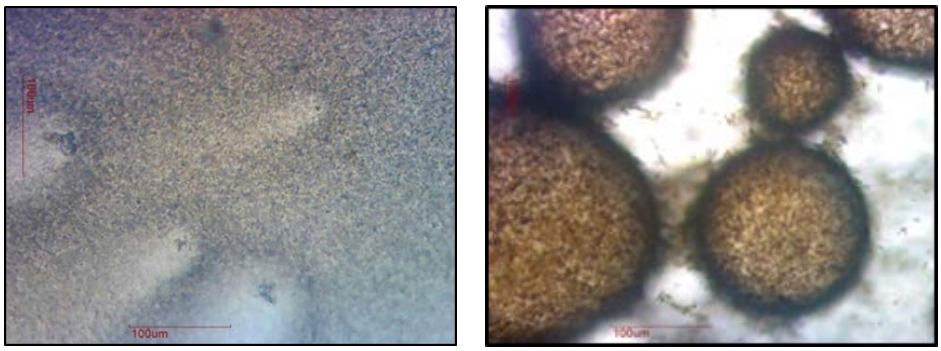

Figure 3: Possible mechanism of formation of Pickering emulsion with mica titanium

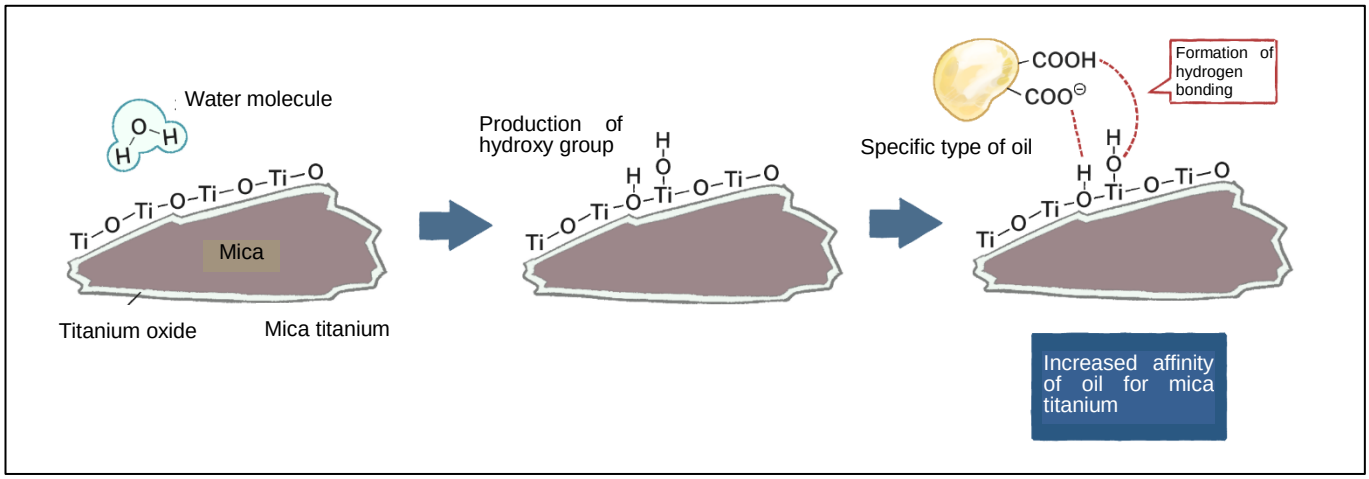

Figure 4: Waterproofness validation experiment

[Experimental method]

Samples (0.05 g) of the model formulations were applied homogeneously to pieces of black leather and

then dried. Photographs were obtained and the tone differences (L-values) were measured using spectrophotometric colorimetry. Tap water was then sprayed to the black leather 30 times from a distance of approximately 10 cm. After drying, photography and tone difference measurement were repeated (n=7).