

STUDY OF SYNTHESIS, MATTER S PROPERTIES AND APPLICATION OF MICA/TiO₂/SiO₂ PIGMENT IN COSMETICS AREA

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Abstract

Generally pigment differs from dye stuff because it cannot be melted in water but also because it is stable physically and chemically. In this study you will discover the function, properties and effects of Mica/TiO₂/SiO₂ pigment as abase material pigment.

But until now used Mica of the base material is about 7 ~ 15µm with an average diameters of 15µm. A new characteristic superficial pigment was obtained from covering the TiO₂ and SiO₂ with the adsorption result of isoelectric point of a Mica flake, TiO₂ and SiO₂.

In the composition reaction study of adsorption was done as well as the physical characteristics of the superficial texture of the obtained material. L,a,b of color change as oil was absorbed, optical nature and change of reflection according to direct and diffused reflection.

In the composition of Mica slurry the best result obtained was in a solution with pH 2.0 to 2.3. Following this result, we can come to the idea that electrical attraction was done during the change of electrical charge of the Mica and TiO₂ deposit.

Also this pigment shows a big scale between the direct reflection and diffused reflection light. Using this characteristic in cosmetic, it was obtained a natural but a contrast between light and shadow making possible a sculptured make-up. Color change due to oil adsorption was insignificant which improved the last of make up.

Introduction

Recently the cosmetics industry is being developed fastly. Especially development of new ingredients and texture aim to the concept of skin protection and natural long lasting make up effects texture is in active work. ⁽¹⁾In the make-up area studies and products development concerning with natural make-up, transparent finish, and skin protection, long lasting effects are the unfinished works for the laboratory researchers. In this study the formulation and the effect of a pigments that can

control the darkening phenomenon done from the sebum, that can hide the wrinkles and protect from the ultraviolet through the diffused reflection and that can do a long lasting effect of make-up will be demonstrated. To obtain this purpose, I have infiltrated the acid treated micro titanium dioxide, known as an outstanding scattering opaque particle in the excellent transparent agent, Mica. In the around of mica with micro titanium dioxide, the silica, an easy use particle with outstanding adsorption ability of oil, was infiltrated. So far, the most use ingredients in the make-up were mica, micro TiO_2 and SiO_2 . Mica is transparent, easy to use and has a strong brilliancy. The TiO_2 has good covering effects and it is very efficient against the ultraviolet but its touch is hard. ⁽²⁾ Nowadays the mica coated with TiO_2 , as a pearl is well employed but this ingredient has too much brilliancy to be used in the powders and foundations. The silica is a multi-porous ingredient, which absorbs the oil and sebum. The purpose to use the silica is to delay the darkening phenomenon but it can not resolve this problem completely. ⁽³⁾ Therefore, the purpose of this study is to understand the characteristic of each ingredients to make possible the formulation of an ingredient capable to fulfill the requirement of the nowadays cosmetics for its application and for its improvement in the matter of efficacy and results.

Materials & Method

Materials

Mica (10 to 20 μm , Japan), Micro TiO_2 (TAYCA, Japan), Silica (Sun-jin, Korea.), H_2SO_4 , HNO_3 , HCl, distilled water. All solvents are analytical grade.

Experimental method

(1) Mica/ TiO_2 adsorption

In distilled water, stir the mica and micro TiO_2 with the propeller mixer for more than 10min.

Agitate adding a proper amount of acid. At this moment select the moment when the pH gets between 1.0 ~ 2.5 to stir.

Add the acid slowly enough to make possible the adsorption of the micro TiO_2 and the mica on the surface. Agitate during some minutes, maintaining the proper pH and add a proper amount of distilled water to agitate again for 30min. Settle down the solution to separate and remove the precipitation and the supernatant liquid.

After washed with the distilled water, with the centrifugal separator make it evaporate to dry.

When drying keep the temperature of 100 ~ 120°C for more than 24hr. Pulverize the powder obtained

(2) Mica/ TiO_2 / SiO_2 Adsorption powder

In the Mica/ TiO_2 complex powder after applied a proper amount of distilled water, add the silica powder to be agitated with the propeller mixer. Select in proper point the pH and stir.

Settle down the solution to separate and remove the precipitation and the supernatant liquid to be pulverized and dried. Dry the obtained powder in 100 ~ 120°C for more than 24hr.

Check the physical nature and its characteristics.

Result & Discussion

1) The physical nature of a complex powder

First, to verify if the micro-titanium dioxide particle has been adsorption on the surface of mica observed by the microscope the surface nature. In case of the transparent characteristic of mica, it was easily perceived the opacity of the micro-titanium dioxide particle. And it looks like the Fig.1. This is because of the suspension stability gives a strong influence to its derived pH. Specially when the solid particle of oxide system has the isoelectric point, in the up and down of the pH area of the isoelectric point shows a peculiar movement. That is, in the moment when the pH is higher than the isoelectric point of the pigment, the pigment particle goes to the negative electric charge. And when the pH is lower the isoelectric point goes to the positive electric charge. The isoelectric point is different following the sort of the pigment. But all the pigments are in the area of pH 4.0 ~ 10.0.

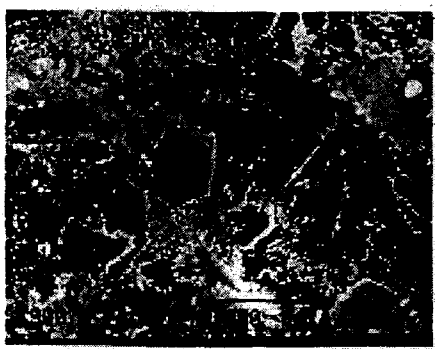


Fig.1 SEM and photograph of Mica-TiO₂ adsorption powder

In case of the titanium dioxide the isoelectric point is between pH 4.0 ~ 6.0.⁽⁴⁾⁽⁵⁾ Therefore the surface electric charge of micro titanium dioxide changes from the negative to the positive charge, but the mica has the nature to keep the negative charge. Using this nature characteristic of mica, it was possible to treat with acid the micro titanium dioxide to be infiltrated on the surface of mica. Helped with the isoelectric point of pigment it was taken the result of Fig.2, which shows SiO₂ infiltrated in mica and Fig.1, which shows Mica/TiO₂.



Fig.2 Powder of Mica/SiO₂ adsorption powder

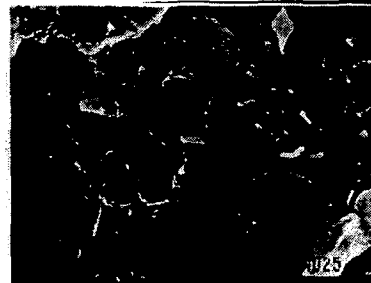


Fig.3 Powder of Mica/TiO₂/SiO₂

Comparing this two experiment it was known that the reflection rate of the SiO₂ which is 1.55 was lower than that of Mica/TiO₂. The SiO₂ shows a lower reflection rate than the micro titanium dioxide. Because the SiO₂ has a transparency nature, it was difficult to confirm with the naked eyes the weather or not the infiltration was done. So to confirm the infiltration fact, using the microscope it was confirmed that at the edge part of the mica the infiltration trace were founded. The Fig.3, it is the SiO₂ infiltrated on the Mica/TiO₂ particle. Through the microscope it shows the TiO₂ and the silica infiltrated on the mica.

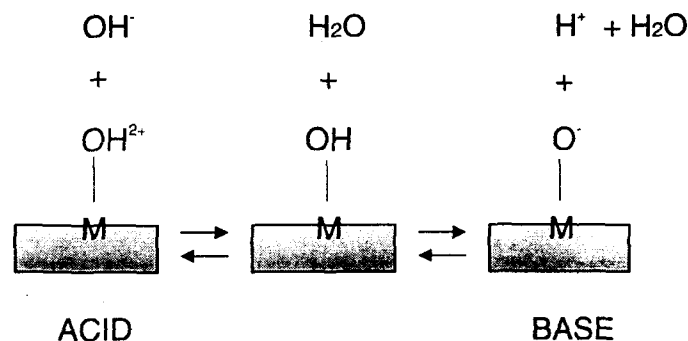


Fig.4 is the picture of the change of electric charge when the pH changes, taking as a standard the isoelectric point.

2) Color and reflection measurement

Generally, in the measurement of color difference, the spectrophotometer is used to indicated the area of the visible lay incidence lay by the spectro-reflective curve of sample. To measure the spectro-reflective curve and color differency the computer color matching system (data color, co) was used. The differency between the mica with TiO₂ infiltrated and the mixing particle was almost the same, which means that the mica with TiO₂ infiltrated has no influency in color.

Fig.5 shows the result of the measurement of the diffused reflection of the complex powder. The incident light was fixed at 45°. And it was changed from a interval of 0 to 85°. As the picture demonstrated the diffused reflection has been increased. As the result shows, in the case of



infiltration of TiO_2 in mica there in no change in color but internally demonstrates a high-diffused reflection, which improves the effects of hiding the wrinkles.

3) Contrast measurement

To measure the contrast ratio of the new obtained powder sample was manufactured. After in the contrast ratio paper the applicator was uniformly applied and measured. The hiding capacity is an important factor because in make-up products with the reflectance ratio have the function to cover the skin default and wrinkles. The contrast ratio shows the capacity to hide the different color of the base color of the paper. The contrast ratio measured as the above method shows a result as Fig.6.

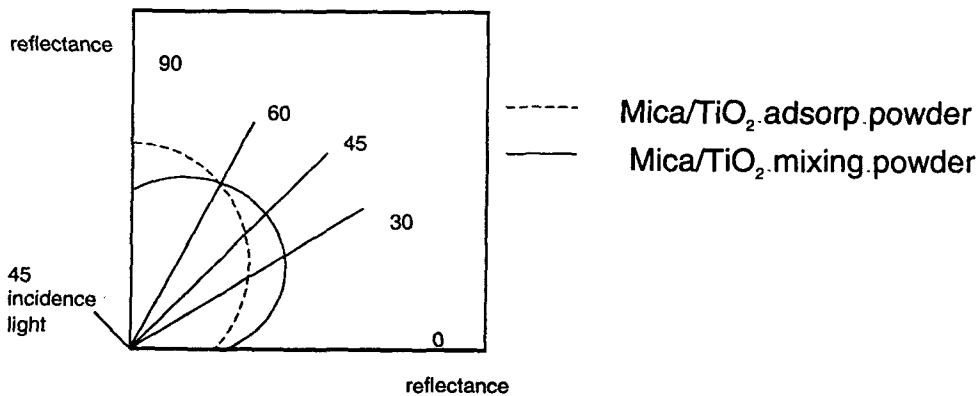
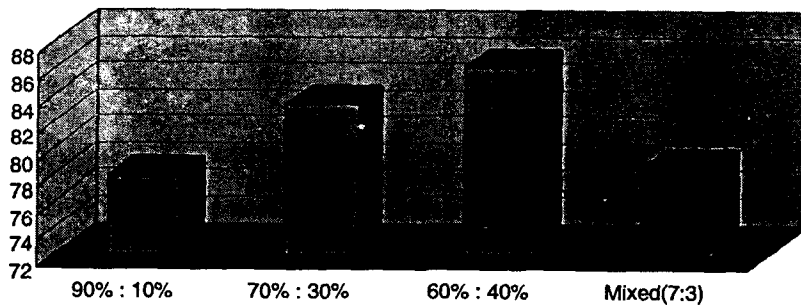


Fig.5 The result of the measurement of the diffused reflection of the complex powder

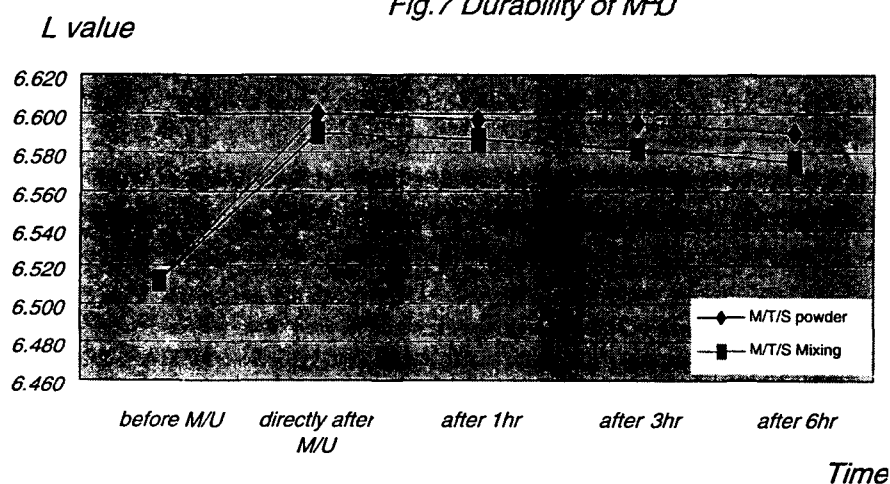
Fig.6 Contrast ratio of M/T Powder



For the result of the contrast ratio measurement we can see that the more titanium dioxide is adsorbed the contrast ratio more increase. And comparing with the mixing treated mica and TiO_2 , the contrast ratio is higher the adsorbed one. As it was demonstrated the micro titanium dioxide infiltrated in mica makes higher the diffusion reflect. So we get to reconfirm the fact of when used in the cosmetics it can improve the soft focus effects and satisfy the easy use of mica and outstanding make-up covering effects of micro titanium dioxide. There are several studies about titanium dioxide that has the medium, about 0.15 to 0.20 μm diameter, which improves the darkness, giving a natural

finishing make-up effects and the characteristic of the light diffusion following the difference of the diameter of titanium dioxide. The micro titanium dioxide particle before and after the 0.15 μ m diffuse strongly the short blue color light. For this reason the external color of micro titanium dioxide looks like a strong blue than the titanium dioxide and has the characteristic to have as a transmitted color the opposite color of blue, the yellow. For this characteristic the application on the foundation for the transmitted light area of the yellow is higher than the blue, it improves highly the darkness. In make-up there are another reason, excluding the darkness for which the face loss its transparency. But there was a study reported of the relation of the skin transparency by the skin reflectance light in visible lay region. That is, a beautiful skin has more light that penetrate to the inside which make to the melanin and hemoglobin improves and make uniform the tonicity of the skin that light that remains in the surface to the diffused. Therefore, to development of a powder ingredient which make weared a tonicity to the skin like almost a naked skin are in the study.⁽⁶⁾

Fig.7 Durability of MU



A spherical powder used with the low diffused ratio ingredient silica with the high-diffused ratio ingredient micro titanium dioxide was developed. For this observation in the complex of Mica/TiO₂ the silica was infiltrated and onetime more infiltrated to higher the luminous reflectance. And helped by the multi-porous characteristic of the silica it was improved the absorption capability to oil and sebum to control the darkening phenomenon caused by the oil and to higher the make-up long lasting effects it was manufactured a light-luminous reflectance powder. After the elaboration of this powder, its effects and efficacy were measured. Because the outstanding contrast ratio and diffused reflection ratio was already proven, in the Mica/TiO₂/silica particle the point to observe was pointed on the efficacy against oil and sebum, the long lasting of make-up, the use. First, to test the efficacy of the Mica/TiO₂/silica two powder foundation were elaborated, one with the Mica/TiO₂/silica and the other without it. The first point to observate was the long lasting efficacy of the make-up (Fig.7). In the Fig.7 shows that after the time the make-up doesn't remove and it is still as the same way as the beginning.

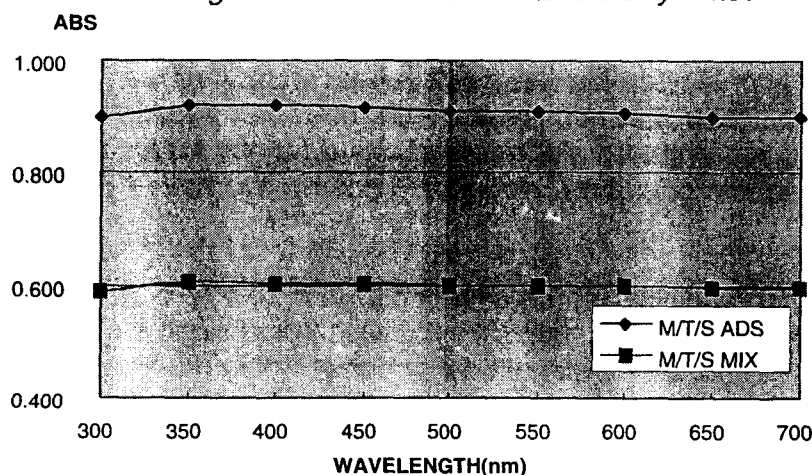


This is because the silica absorbs the sebum and the oil which make the silica transparent and also because the high refractive index micro titanium dioxide diffuse the light making decrease the darkening phenomenon. For your help the oil absorption value used normally in the cosmetics is shown in the Table.1. In the Fig.8 the infiltrated Mica/TiO₂/silica and only mixed powder are compared in the point of transparency. The results show a low rate of transparency. For the infiltrated Mica/TiO₂/silica powder. This is appeared because of the low refractive index of mica and silica with the high diffusion rate micro titanium dioxide, inside the powder plenty of refractive point has appeared and for this reason strong dispersed. Following this conclusion we can reach to the definition of the Mica/TiO₂/silica complex as outstanding against the ultraviolet, outstanding brilliancy, not very transparent for which the diffused reflection ratio is high. Still now are the characteristic obtained from the characteristic of mica and titanium dioxide. The Mica/TiO₂/silica complex shows also a delay of the darkening effects caused by the make-up film, thanks to the silica.

Powder materials	Oil absorption value
Porous spherical silica	85
Talc	35
Sericite	43
Titanium dioxide	28

Table.1 Oil absorption value of cosmetic use powder

Fig.8 Transmittance of M-T-S and only mixed



Conclusion

Helped by the isoelectric point of the inorganic oxide compound, in the outstanding transparent mica particle were infiltrated the TiO_2 and silica to higher the application area of the pigment, to higher the ultraviolet diffusion reflect, and to higher the contrast and diffused reflection ratio to give the effects of soft focus. For the oil and sebum absorption characteristic it controls the darkening phenomenon and give a long lasting effect in the make-up product.

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