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# EFFECT OF PLASTICIZERS ON THE PROPERTIES OF COSMETIC MASK USING POLYVINYL ALCOHOL (PVA) AS A FILM FORMER

J. H. Park, K. Y. Kyong, T. J. Kwak, M. S. Yoon and S. H. Kang.

Cosmetics R&D Center, LG Chem., Taejon, Korea.

## ABSTRACT

Cosmetic mask is one of the traditional cosmetic product and is used to keep skin healthy and beautiful through moisturizing effect, cleansing effect and acceleration effect on microcirculation. There are several types of cosmetic mask such as peel-off type, tissue-off type, wash-off type and cotton sheet type immersed in cosmetic water. It is important for cosmetic formulators to develop an adequate type of cosmetic mask that meets the needs of the target consumers because each type of cosmetic mask has benefits and problems in its usage and efficacy.

Polyvinyl alcohol (PVA) is widely used as an active ingredient of peel-off type cosmetic mask and the physical property of the PVA film changes with the usage of other ingredients. We studied the change of physical properties of the film containing PVA by formulating peel-off type cosmetic mask with the variation of humectants. Methylgluceth-20 and glycereth-26 reduce the interaction between skin surface and PVA film without serious weakening of tensile strength and they can alleviate irritation. Glycerin, urea and betaine help PVA film soften and they also have excellent efficacy as humectants.

## 1. INTRODUCTION

Polyvinyl alcohol is a white powdered synthetic resin, which is manufactured by the hydrolysis of polyvinyl acetate. It is widely used in household and cosmetic industry due to its water-solubility. The grade of PVAs can be determined by the grades of hydrolysis and the water solubility is maximized when the degree of hydrolysis is about 86~89%. To make polymers easy to use or modify, plasticizers are used and the most widely used plasticizer for PVA is glycerin because it is compatible in substantial proportions with partially and completely hydrolyzed grades and is odorless. The well-known properties of plasticizers for PVA are high-boiling, water-soluble organic compounds containing hydroxyl, amide or amino groups. Ethylene glycol and some of the lower polyethylene glycols are also effective plasticizers for PVA and water itself works as a plasticizer for PVA. Here we, cosmetic chemist, should concentrate on the substances that plasticize PVA. Some of them are frequently used in the cosmetic industry as humectants and they have functional groups such as hydroxyl, amide or amine groups. As we use PVA and humectants to manufacture peel-off type cosmetic masks, the studying on the changes of physical properties of PVA films along with the usage of variety of humectants can be useful to understand and to improve the quality of cosmetic products.

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## 2. EXPERIMENTAL

### 2.1 Materials

PVA powder used was a commercial product (Gohsenol EG-25) of Japan Synthetic Chemical Inc. The molecular weight and the degree of saponification were about 80,000 and 87.5%, respectively. Glycerin (LG Chemical, Korea), propylene glycol (Union Carbide, USA), 1,3-butylene glycol (Daicel Chemical Industry, Japan), betaine (Asahi Chemical Industry, Japan), methyl gluceth-20 (Amerchol, USA) and glycereth-26 (Lipo Chemical, USA) were used as plasticizers in this study.

Table 1. The formulation of the peel-off type cosmetic mask

Ingredient	% Wt.
Ethanol	12
Methyl paraben	0.1
D. I. Water	66.4
Carboxymethyl cellulose	3
Humectant	5
PVA	13.5

### 2.2 Preparation of polymer film

The test film of the peel-off type cosmetic mask (formulated along with the table 1.) with the thickness of 0.1 mm was prepared by applying cosmetic mask on the clean molding plate. The wet film was dried in the drying oven(40 °C) for 20 minutes. The final sample was sized as 15 mm x 15 mm.

### 2.3 Tensile strength of polymer films

Tensile strength of the test films were measured and calculated using a universal tester (Chatillon Vitrodyne V1000, USA). Drawing of the test films was conducted with a rate of 3 mm sec<sup>-1</sup>.

### 2.4 Efficacy of humectants

The water solution(5%) of each humectant is applied on the forearm and electrical impedance of skin surface was measured before and after (1hour, 3hour) sample application.

## 3. RESULTS AND DISCUSSION

As a film former of peel-off type cosmetic mask, PVA is widely used and the physical properties of the PVA film can be changed by the other ingredients included in the formulation of peel-off type cosmetic mask. Among these ingredients, humectants that effect on the hydration state of skin surface influence on the physical properties of PVA film. Because the most of the humectants contain hydroxyl, amino or amine groups in their molecular structure they can reduce tensile strength of PVA films. As shown in the figure 1, the tensile strength of the PVA film is reduced and the effects vary with the humectants used. The relatively large molecules such as

methylgluceth-20 and

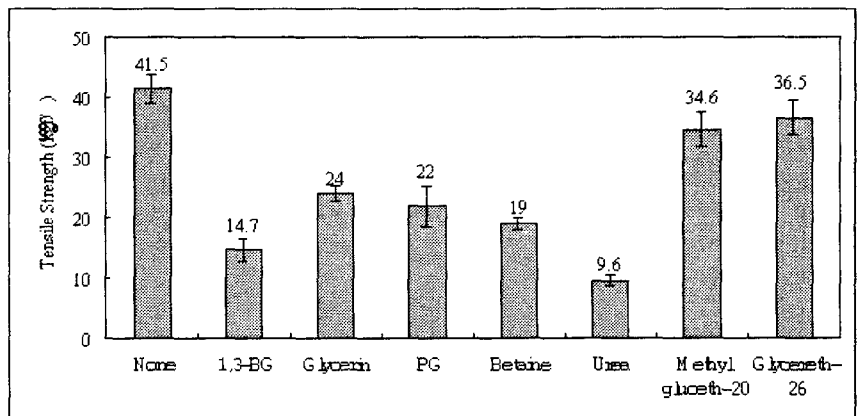


Figure 1. Tensile strength of the test films

glycereth-26 do not reduce the tensile strength so much as the small molecules. However, there are variations among the tensile strength of the test films containing small size humectants. Glycerin, the most widely used plasticizer for PVA, show relatively low reducing effect on the tensile strength and urea which has two amine groups in their unit molecule reduces the tensile strength of the PVA film dramatically. We can also observe the fact that 1,3-butylene glycol that has similar molecular structure to PVA lowers the tensile strength much more than propylene glycol, which is much smaller molecule, does.

Reducing the tensile strength is not the only effect of humectants on the PVA film. We can observe another change of physical property of PVA film, softness(Fig. 2). Contrary to the previous results, small molecules advance softness of PVA film. Especially, urea increased softness very effectively.

To make it easy and comfortable to use peel-off type cosmetic mask, the film formed after use should not be torn. So the film should have relatively high tensile strength which can endure external force. On the other hand customers want soft feeling when they use it. Furthermore there is another very important property we should consider. It

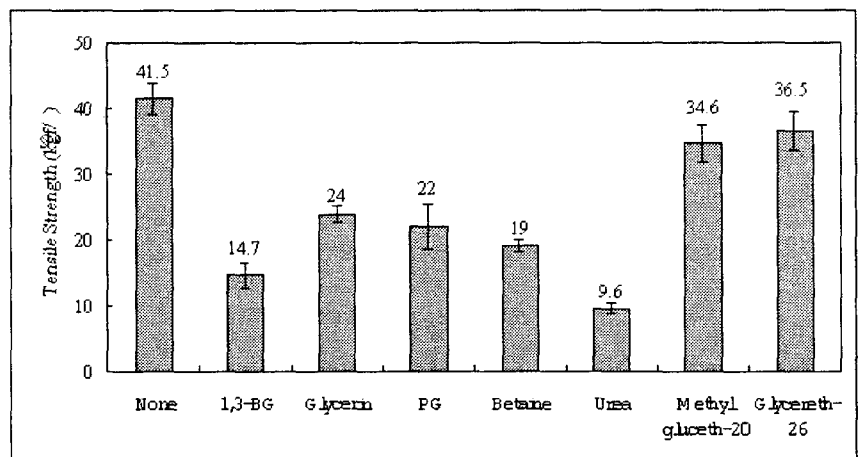


Figure 2. Softness of the test films

is the adhesion of the PVA film on the skin. When the adhesion is too tight the users feel irritation while they peel the film off. Because PVA is very adhesive to the skin we should reduce the interaction between PVA and skin surface. While using the test samples we observe that glycereth-26 and methylgluceth-20 reduced the interaction between them, but the force needed to peel off the film was so little that we can not differentiate the samples with the data.

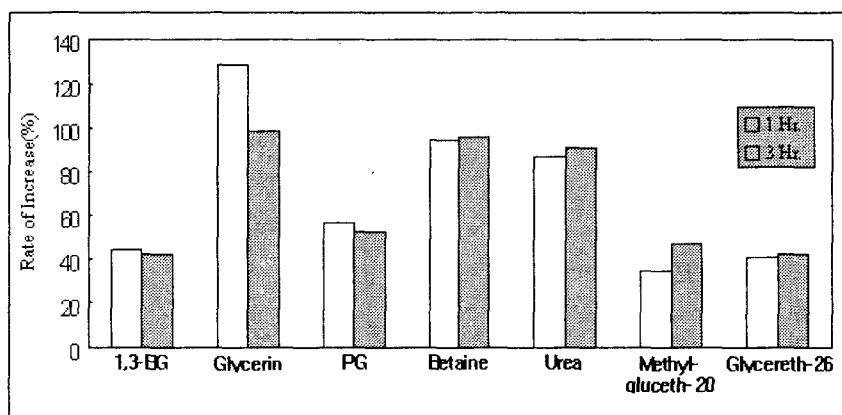


Figure 3. Rate of increase of electrical impedance of skin surface applied by humectant solution

The main purpose to use humectants in the formulation of cosmetic mask is to improve hydration state of skin surface. So we checked the efficacy of humectants by measuring electrical impedance of skin surface applied each humectant solution (Fig. 3). As we can expect, glycerin is most effective ingredient as a humectant. It helps skin surface keep moisturized very long period. Betaine and urea are also good humectants we can use in the cosmetic formulations.

#### 4. CONCLUSION

The cosmetic humectants reduce the tensile strength and enhance softness of PVA film and some of them reduce interaction between PVA film and skin surface. To make peel-off type cosmetic mask easy and comfortable to use, the tensile strength of the polymer film should be strong enough and the film has softness. These properties can be obtained by using several humectants in one formulation. Large molecules such as glycereth-26 can preserve tensile strength and reduce the interaction between the film and skin surface. Small molecules like urea improve softness of the film. Glycerin, urea or betaine is recommendable to advance the efficacy of the peel-off type cosmetic mask in the point of skin moisturization.

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