平成 11 年度博士論文要旨

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論文題目：セルロース系材料の吸水過程におよぼす吸着分子の影響
英訳題目：Effects of Adsorbed Molecules on Water Absorption Processes ofCellulosic Materials

- **Abstract**

It is possible that the adsorption of molecules to the surface of polymericsolid improves the properties of the solid and that it adds the functionswhich the surface originally does not have. The mechanism, however, havenot been clarified yet. In this study, the water absorption process wasfocused. The effects of adsorbed molecules on the water absorption and itsmechanism were discussed for the following systems:

1) Agar gels containing dimethyldioctadecylammonium chloride DMDOAC andpolyvinylacetate PVAc as a model system.

2) Cotton fabrics adsorbed by a softener (corresponding to DMDOAC) anda starch (corresponding to PVAc) as a system that is a practical use.

The weight of water absorbed by dried agar gels including DMDOAC or PVAcdecreased to logarithmic function like with the increase in the concentrationof DMDOAC or PVAc. However, the weight of water remarkablydecreased in thecase that the concentration of PVAc was 0.1 wt%, and the minimum was shown.And, the initial rate of water absorption remarkably increased about 1.5times at the concentration of DMDOAC 3.41 × 10−4 mol/L and PVAc 0.02 wt%compared with the initial rate in case of agar gel, and the maximum wasshown. The initial rate of water absorbed by dried agar gels including 2kinds of molecules of DMDOAC and PVAc increased at the low concentrationof them. The structure of inside and surface of the gels were examined usinga scanning electron microscope and an atomic force microscop in order toclarify the mechanism of such phenomena. And, the vesicle condition of thesurfactant was examined by a dynamic light scattering spectrophotometer.The structure of inside and surface of the gels were remarkably reformedby DMDOAC or PVAc, and then the water absorbency of the gels changed asthe results.

The amount of water absorbed by the cotton fabrics that were adsorbedwith the change in the amount (for adsorption time and concentration) ofsoftener or starch was respectively measured by Bilec method and improvedLarose method. In the cotton fabrics adsorbed by softener, the amount ofabsorbed water showed a minimum at some adsorbed amount, and the amountof water increased afterward with the increase in the adsorbed amount. Inthe meantime, in the cotton fabrics adsorbed by starch, the amount of watershowed the minimum at some adsorbed amount as well as the case of softener,and though the amount of water showed the maximum afterward, it rapidlydecreased. In the cotton fabrics adsorbed by the mixture of softener andstarch, the amount of water gently decreased

with the increase in the adsorbedamount of the mixture. The decrease of amount of water on these fabrics,in the adsorption at short time and low concentration, was slighter thanthe case that the softener and starch respectively adsorbed to cotton fabrics.And, there was not large change at the amount of water, even if the adsorbedamount was changed. When the mixing concentration of softener and starchwas changed, the amount of water greatly decreased at some mixing concentration.These results were qualitatively same to the results got by the model system,and then these results were examined on the water absorption mechanism onthe basis of the knowledge that was got in the analysis of the model system.

From this study, the mechanism on the reforming of the water absorbencyof the cellulosic materials was clarified. By adding surfactant or microemulsion,the surface structure of the polymers received the reforming, and then therate and amount of absorbed water decreased. When the mixture of surfactantand microemulsion were added to the polymers, the competition of the twomaterilas happened, and then the decrease in the amount of absorbed waterwas suppressed. These results are the knowledge that is important for thefunction improvement technique of polymers by the reforming of the polymersurface, and the wide application is considered. For example, this studyis essentially same to the daily washing in the home. From the results ofthis study, the lowering of water absorbency is suppressed by combiningat the appropriate concentration and by using the mixture.