that of the heat-treated sample, but the great difference is not to be found among them, that is, the change of the degree of crystallinity has no great effect upon the shape of the $\beta$-absorption.

At last, in order to discuss the effect upon the value of ($e_0 - e_\infty$), the values of ($e_0 - e_\infty$) at $-60^\circ$C, $-40^\circ$C, $-20^\circ$C, $0^\circ$C and $20^\circ$C for each sample are determined from fig. 7 and these values are plotted against the degree of crystallinity of the three samples in fig. 10. As shown in fig. 10, each plot of ($e_0 - e_\infty$) vs. the degree of crystallinity at a fixed temperature decreases linearly with the increase of the degree of crystallinity.

The value of ($e_0 - e_\infty$) represents the magnitude of polarization and is proportional to the concentration of the dipoles which contribute to the dielectric absorption (6). The above mentioned fact, therefore, suggests that the dipoles in the amorphous region chiefly contribute to the dielectric absorption. The fact that the increase of the degree of crystallinity causes the decrease of the magnitude of the dielectric absorption is also observed in the semi-crystalline polymers such as polyethylene terephthalate (7), polyvinylidene chloride (8) and cellulose (3).

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Summary

Three samples of polyvinyl alcohol having different degree of crystallinity were prepared by heat-treatment. The frequency characteristics of three samples of those samples were measured over frequencies from 100 c/s to 2 M c/s at various temperatures, and only the $\beta$-absorption could be observed, while the $\alpha$-absorption was masked by the low frequency conduction.

With the increase of temperature, the magnitude of the $\beta$-absorption became larger and the shape of the $\beta$-absorption became sharper in the measurement of all samples. The change of the degree of crystallinity had no great effect upon the apparent activation energy for dielectric response and the shape of the $\beta$-absorption. The effect of the change of the degree of crystallinity on the dielectric behavior, however, was found in the fact that the magnitude of the $\beta$-absorption, ($e_0 - e_\infty$), linearly decreases with the increase of the degree of crystallinity. This fact suggests that the dipoles in the amorphous region will chiefly contribute to the dielectric absorption in the semi-crystalline polymers.

References

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Studies on Dielectric Properties of Polyyvinylidene Chloride*)

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With 7 figures

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Introduction

In the previous report (1), the authors investigated the dielectric properties of polyvinyl chloride. In this report, the dielectric properties of polyvinylidene chloride are investigated and the differences between these dielectric properties are discussed, from the view-point of their chemical structure.

Experimental

The sample is prepared by moulding and contains 10% phenylglycidylether. The thickness of sample is

*) Containing 10% phenylglycidylether.
0.3 mm and the diameter is 5 cm. This sample is dried at 60°C under 10⁻⁴ mm Hg for a week. Before measurement, silver is spattered on the surface of the sample as electrodes and a guard ring. Dielectric measurement is made over a frequency range from 100 c/s to 2 M/c/s by the mutual inductance bridge (2). The method of measurement is similar to that of the previous report (3).

Results

The frequency-characteristics of \( \varepsilon' \) and \( \varepsilon'' \) of polyvinylidene chloride are shown in figs. 1 and 2. In the range of frequencies from 100 c/s to 2 M/c/s and temperatures from 60°C to 50°C, only one dielectric absorption could be observed. At lower temperatures, something like the tail of the different dielectric absorption was seen at higher frequencies, but the location of the loss maximum could not be observed at the temperatures reached by the mixture of solid carbon dioxide and alcohol.

In order to discuss quantitatively the magnitude and the shape of the dielectric absorption, Cole-Cole's circular arc law (4) is applied to the data. The results of the Cole's plots at each temperature are shown in fig. 3. The value of \( (\varepsilon_0 - \varepsilon_\infty) \) represents the magnitude of the dielectric absorption and the value of \( \beta \) represents the shape of the dielectric absorption. The larger \( \beta \) corresponds the sharper dielectric absorption.

The values of \( (\varepsilon_0 - \varepsilon_\infty) \) and \( \beta \) determined from the Cole's's arc, are plotted against temperatures in fig. 4.

As at the temperatures under - 3°C, the location of loss maximum moves out from the measurement range, it is impossible to draw the Cole's arcs. Considering however, that at very low temperature, the

![Fig. 1. Frequency-dependence of \( \varepsilon' \) at various temperatures for polyvinylidene chloride investigated](image1)

![Fig. 2. Frequency-dependence of \( \varepsilon'' \) at various temperatures for polyvinylidene chloride investigated](image2)

![Fig. 3. Cole-Cole's plots at various temperatures for polyvinylidene chloride](image3)