外 国 語 要 旨

学位論文題目　Swelling of Poly (vinyl alcohol) Hydrogels in Congo Red Aqueous Solutions

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The swelling behavior of cylindrical poly(vinyl alcohol) (PVA) hydrogels, prepared by means of γ-ray irradiation technique with different irradiation dose, was investigated. The cylindrical gels were immersed in various concentrations of Congo red (CR) aqueous solutions, and the time course of the swelling degree of the gels was microscopically measured. The degree of swelling was increased with increasing the polymer content in the gels and time. However, the degree of swelling was decreased with increasing the irradiation dose. Sorption experiments with the batch system of CR by PVA hydrogels were also carried out. The progress of dye sorption onto PVA hydrogels was monitored by the CR concentration of the external concentration by measuring the absorbance of the solution at λ_{max} of CR. The gels irradiated in higher doses exhibited good sorption capacities for CR in neutral pH medium. The sorptions of the CR by the gels in both acidic and basic solutions were compared comprehensively. The sorption capacity of the gels for CR in acidic medium exhibited much higher than in basic one. DSC measurements were carried out to examine the melting temperature, T_m, of the gels before and after the sorption. A significant difference between the T_m's of PVA/CR and of PVA alone was observed. The results show that the interaction between PVA and CR affects the swelling and sorption properties of the gels. It is possible to conclude that PVA structure has a significant loss of crystallinity when PVA interacts with CR. The effect of incorporation of the dye on the chemical structure of the PVA was examined by using FTIR spectroscopy.

Chapter 1 presents the viewpoint of the research background and describes the review of recent related studies dealing with polymer hydrogels.

In Chapter 2, the gels obtained from 4, 6, 8, 10, and 12wt% polymer solutions irradiated in 10 and 40 kGy were immersed in 1, 2, 3, and 4 mM CR solutions. The degree of swelling, d/d_w, of each gel was microscopically investigated. The effect of polymer concentration of the gels, initial concentration of CR as the external solution, time course, and the value of equilibrium swelling degree was described. Due to research on swelling of PVA in CR aqueous solutions having not been done, the experimental results in this chapter are very important as a measure of the experiments in the following chapters.

In Chapter 3, the dye sorption and the swelling of PVA hydrogels in CR aqueous solutions were investigated. The gels obtained from 8, 10, and 12wt% polymer solutions irradiated in 20 and 50 kGy were immersed in further diluted CR solutions of 0.03, 0.05, 0.2, 0.5, and 1.0 mM. The d/d_w of the gels was determined in the same way as the aforementioned. In addition, the dye uptake, q, per gram of swollen gel in neutral condition was measured. Characteristic features of the PVA gels were noted in this chapter.

The degrees of swelling and sorption behavior on the PVA gels were extended in Chapter 4. To improve the results of either d/d_w or q of the gels, even more diluted CR solutions were employed. The 0.003, 0.01, 0.03, 0.05, and 0.1 mM CR solutions were used for the experiments. In the same way, the gels obtained from 8, 10, and 12wt% polymer solutions irradiated in 20, 50, and 100 kGy were prepared in the same method. The swelling and dye sorption in the gels involving more diluted CR solutions than in the previous experiments were discussed with various pH values. The significant results of swelling behavior accompanying the dye sorption in neutral, basic, and acidic mediums were discussed in relation to the effect of the polymer content of the gels, time pass, irradiation doses, and initial concentration of CR.

Finally, in Chapter 5 the general conclusions of whole results of each chapter were summarized. Through the interpretation of these works, the fundamental experimental results is expected to give additional information in the interaction between uncharged PVA gels and CR, and the findings obtained in the thesis would give alternative soft materials in the future.