

## An investigation into the properties of a bioactive polymer for renal failure patients

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The present work provides insight regarding the physicochemical properties of a Polyallylamine hydrochloride (PAA-HCl) hydrogel, the active pharmaceutical ingredient of an oral drug prescribed to prevent the absorption of dietary phosphate for renal patients. Different formulations of PAA-HCl hydrogels using an aqueous crosslinking reaction were synthesised. The key attributes of hydrogels that modulate their properties and the link between these attributes and hydrogel behaviour were investigated. Results showed that the properties of the PAA-HCl hydrogels can be controlled by varying the crosslinker epichlorohydrin (EPI) and NaOH concentrations. The effect of the degree of crosslinker concentration on the properties of the hydrogels has been studied using swelling ratios, thermogravimetric analysis (TGA), differential scanning calorimetric (DSC), and solid state nuclear magnetic resonance (SSNMR). Increasing the crosslinking concentration decreases the swelling ratio, the thermal stability and increases the glass transition temperature of the hydrogels. The linear relationship between hydrogel morphology and the glass transition temperature  $T_g$  obtained using DSC could be used to tailor-make hydrogels of specific  $T_g$ 's. SSNMR was found to be a promising tool for characterising solid biomaterials and examining the dynamic mobility of polymer chains. A series of kinetic studies were carried out in an agitated batch reactor in order to understand the mechanism of the phosphate binding reaction. It was found to follow pseudo second order kinetics. Thermodynamic parameters such as  $\Delta G^\circ$ ,  $\Delta H^\circ$  and  $\Delta S^\circ$  were evaluated in order to assess the relationship of these parameters and the polymer morphology. The binding reaction was found to be a spontaneous endothermic process with increasing entropy at solid liquid interfaces.

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