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A Comprehensive Analysis of the Rheological Properties of Polymer Hydrogels in Order to Explore Their Potential for Practical Utilization in Industries

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Abstract : Hydrogels are three-dimensional structures formed by the interweaving of polymeric materials, possessing the remarkable ability to imbibe copious amounts of water. Numerous methodologies have been devised for examining and understanding the properties of these synthesized gels. Amongst them, spectroscopic techniques such as ultraviolet/visible (UV/Vis) and Fourier-transform infrared (FTIR) spectroscopy offer a glimpse into molecular and atomic aspects. Additionally, diffraction methods like X-ray diffraction (XRD) enable one to measure crystallinity within the gel's structure, while microscopy tools encompassing scanning electron microscopy (SEM) and transmission electron microscopy (TEM) provide insights into surface texture and morphology. Furthermore, rheology serves as an invaluable tool for unraveling the viscoelastic behavior inherent in hydrogels—a parameter crucial not only to numerous industries, including pharmaceuticals, cosmetics, food processing, agriculture and water treatment, but also pivotal to related fields of research. Likewise, the ultimate configuration of the product is contingent upon its characterization at a microscopic scale in order to comprehend the intricacies of the hydrogel network's structure and interaction dynamics in response to external forces. Within this present scrutiny, our attention has been devoted to unraveling the intricate rheological tendencies exhibited by materials founded on synthetic, natural, and semi-synthetic hydrogels. We also explore their practical utilization within various facets of everyday life from an industrial perspective.

Keywords : rheology, hydrogels characterization, viscoelastic behavior, application
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