Synthesis and characterization of environment-friendly hydrogel based on natural polymer for application in agriculture

Warunee Tanan¹, Jate Panichpakdee², Sayant Saengsuwan¹*

¹Laboratory of Advanced Polymer and Rubber Materials (APRM),
Department of Chemistry and Centre of Excellence for Innovation in Chemistry (PERCH-CIC),
Faculty of Science, Ubon Ratchathani University, Warincharam, Ubon Ratchathani 34190, Thailand

²Thailand Institute of Scientific and Technological Research, Khlong Ha,
Khlong Luang, Pathum Thani 12120, Thailand

*E-mail: sayants181@gmail.com, sayant.s@ubu.ac.th

Abstract: With the aim of improving fertilizer use efficiency and reducing negative impact on the environment, a new low-cost and eco-friendly hydrogel of starch-g-polyacrylic/natural rubber/poly vinyl alcohol blends CSt-g-AA/(NR+PVA) were prepared. The hydrogel was synthesized by aqueous solution polymerization method in the presence of initiator ammonium persulfate (APS) and N,N'-methylene-bis-acrylamide (MBA) as a crosslinker. The semi-IPN hydrogels were characterized by Fourier transform infrared (FTIR) spectroscopy, scanning electron microscopy (SEM), and thermogravimetric analysis (TGA) Factors affecting the swelling capacity of the obtained hydrogel such as the ratio of polymer and crosslinker contents on the swelling behavior were studied. Under the optimized conditions viz. CSt = 7.5 g, AA= 6 g, APS= 2 wt% and MBA = 1.0 wt%, the degree of water swelling of the optimal final product in distilled water and 0.9 wt% NaCl solution were 564.5% and 242.79% respectively. In addition, water retention and swelling behaviours of the hydrogel samples in difference saline solution (0.9%wt NaCl, MgCl₂, CaCl₂ and FeCl₃) were examined. The product also had excellent water retention and salt resistance properties with lower decreased rate. Thus, the biodegradable hydrogel with good comprehensive properties is expected to apply as an encapsulated material for applications in agriculture.

Keywords: Biodegradable hydrogel; Starch; Natural rubber; Acrylic acid; Polyvinyl alcohol; Salt-responsive