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Yield study with the release property of polysaccharide-based physical hydrogels

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Highlights

- The fluid released extent of kappa-carrageenan hydrogels in permeable tube is higher than that in non-permeable tube.
- The pressure caused by the gel own weight influences the fluid release extent and kinetics rate
- The gels shrink and strain under pressure to release fluid
- Shrinkage and yield induced release are separately described by exponential decay functions

Abstract

Water-release from kappa-Carrageenan (kC) hydrogels (syneresis) has been studied by two experimental methods: (1) one in which the exudate is enabled to surround the gel and (2) one in which the exudate is continuously removed from the gel surfaces. The pressures P_g caused by the gel weight decrease from 1 Pa for method (1) and 500 Pa for method (2). The syneresis of the gels at 2 g/L kC with 40 mM KCl has been observed to decrease with P_g for the highest pressures. However, for the lowest pressures, the pressure-dependence of the syneresis has not been found, although this gel shrank remarkably. This gel exhibits yielding at approximately 0.15 Pa during rheological testing and exhibits creep at stress well below its yield stress. The result is consistent in demonstrating that similar gels in the conditions of method (1) or (2) yield while releasing fluid. The release kinetics have been fitted with a sum of two exponential decay functions, one for shrinkage and the other for yielding. The kinetic rate, k_1 for shrinkage, is almost $0.035 \pm 0.005 \text{ h}^{-1}$ for all of the gels studied, except for very soft and stiff gels; for that

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