



Enhanced Ca^{2+} binding with sulfonic acid type polymers at increased temperatures

Tian Wang, Chunhua Zhao, Jian Xu, Dejun Sun*

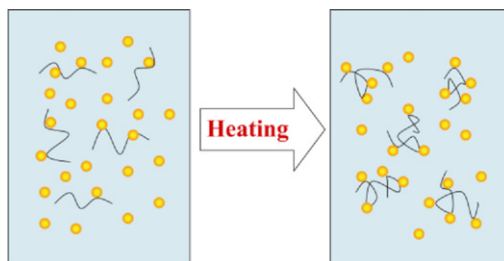
Key Laboratory for Colloid & Interface Chemistry of Education Ministry, Shandong University, Jinan, Shandong 250100, People's Republic of China

HIGHLIGHTS

- ▶ The combination of Ca^{2+} on PSS increased with temperatures and salt concentrations.
- ▶ The effect of Ca^{2+} and temperatures on polymers depended on the molecular structure.
- ▶ The hydrophobicity of PSS increased with concentrations of salt and temperatures.
- ▶ Some aggregates formed in the PSS system with high salt by heated treatment.

GRAPHICAL ABSTRACT

Possible explanation for the effect of heat treatment and CaCl_2 addition on the structure and distribution of PSS in aqueous solution. The black curves represent the PSS molecules and the orange circles indicate the calcium ions.



ARTICLE INFO

Article history:

Received 15 July 2012
Received in revised form
10 September 2012
Accepted 21 September 2012
Available online 17 October 2012

Keywords:

Sulfonic acid type polymers
Molecular size
Hydrophilicity
Dehydration

ABSTRACT

This paper focuses on the influence of Ca^{2+} binding and temperature on the molecular size and hydrophilicity of sulfonic acid type polymers. Two different molecule structural polymers employed were sodium polystyrene sulfonate and poly(2-acrylamido-2-methyl-1-propane-sulfonic acid). The effect of CaCl_2 and high temperatures on the polymer molecules was explored with gel permeation chromatography, calcium ion selective electrodes, Fourier transform infrared spectroscopy, transmission electron microscopy, dynamic light scattering, rheology, and surface tension measurements. The results indicate that high temperatures promote the binding of calcium ions with the two polymers and also lead to dehydration of the polymer chains. The variation rule of molecular size, apparent viscosity and surface tension of the two sulfonic acid type polymers depended on their molecular structure.

© 2012 Elsevier B.V. All rights reserved.

1. Introduction

Polyelectrolytes are polymers whose chains bear ionizable groups that dissociate in aqueous solutions and make the polymers charged [1,2]. Polyelectrolyte properties such as electrical conductivity and viscosity are thus similar to those of both electrolytes and polymers, and the materials are sometimes called polysalts. Charged molecular chains, commonly present in soft

matter systems, play a fundamental role in determining structure, stability and the interactions involving various molecular assemblies, which is attributed to their electrical conductivity and entropy effects [3]. Theoretical approaches to describing their statistical properties differ profoundly from those of their electrically neutral counterparts, while their unique properties are being exploited in a wide range of technological and industrial fields [4]. Their major roles, however, seem to be those played in biology and biochemistry. Many biological molecules are polyelectrolytes, for example, polypeptides and DNA [5]. Both natural and synthetic polyelectrolytes are used in a variety of industries.

* Corresponding author. Tel.: +86 531 88364749; fax: +86 531 88365437.
E-mail address: djsun@sdu.edu.cn (D. Sun).