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## **SURFACE MODIFICATION OF POLYSTYRENE BEADS WITH SULFONAMIDE DERIVATIVES AND APPLICATION TO WATER SOFTENING SYSTEMS**

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### **ABSTRACT**

Four types of sulfonamide derivatives were introduced on the surface of polystyrene (PS) resin and their feasibility of complex formation with calcium ions was investigated. Regeneration efficiency of each sulfonamide in different pH was also evaluated to examine their potentials in water softening industry. Finally, ion trapping ability and reuse condition of the product were compared with those of the commercialized chelate resin.

**Keywords:** water-softening, polystyrene beads, sulfonamide.

### **INTRODUCTION**

Water softening is a process removing magnesium and calcium cations from hard water for industrial or household use. It is an important procedure since these ions are known to cause significant problems on operation and maintenance of equipment or piping in facilities. Common methods for removing cations include reverse osmosis, ultrafiltration, distillation, using ion-exchange / chelate resins, and so on. Ion-exchange resin and chelate resin consist of chemically surface-treated porous polymeric particles that capture calcium ions dissolved in water and release other cations such as sodium from the resin.

A variety of sulfonamide derivatives were introduced onto the surface of polystyrene latex microbeads.  $1.88 \pm 0.05$  mmol/g of the sulfonamide-based ligand was introduced in maximal amount onto the surface of beads. Cation chelating capacity of the product was quantified by ion capturing test, and appropriate types of sulfonamides were chosen as candidates. Finally, their metal ion capturing capacity in actual circumstances and regeneration property in moderate acidic pH were verified. Among the surface-treated sulfonamide derivatives, glycine-conjugated sulfonamide (SA-Gly) group, which had  $0.90 \pm 0.01$  mmol/g of ion capturing capacity and rapidly regenerated at pH 5.0, was found to be most appropriate for water softening application.

### **RESULTS AND CONCLUSIONS**

The capacity of calcium ion capturing via chelating properties of SA-TETATA and SA-Gly ligands was plotted in Figure 1. As pH decreased from 7.0 to 3.0, calcium ion sorption by PS-SA-TETATA was gradually decreased from  $1.88 \pm 0.05$  to  $0.93 \pm 0.01$  mmol/g. Any drastic change in capacity at a certain pH was not observed since nitrogen atom in the sulfonamide group did not play any roles in cation chelation. On the other hand, sharp change in ion

binding ability of PS-SA-Gly was detected at pH between 5.0 and 6.0. Calcium ion capturing capacity of the SA-Gly ligand was decreased to nearly zero at a certain range of pH 5.0 to 6.0, which caused by the characteristic pKa value of sulfonamide group.

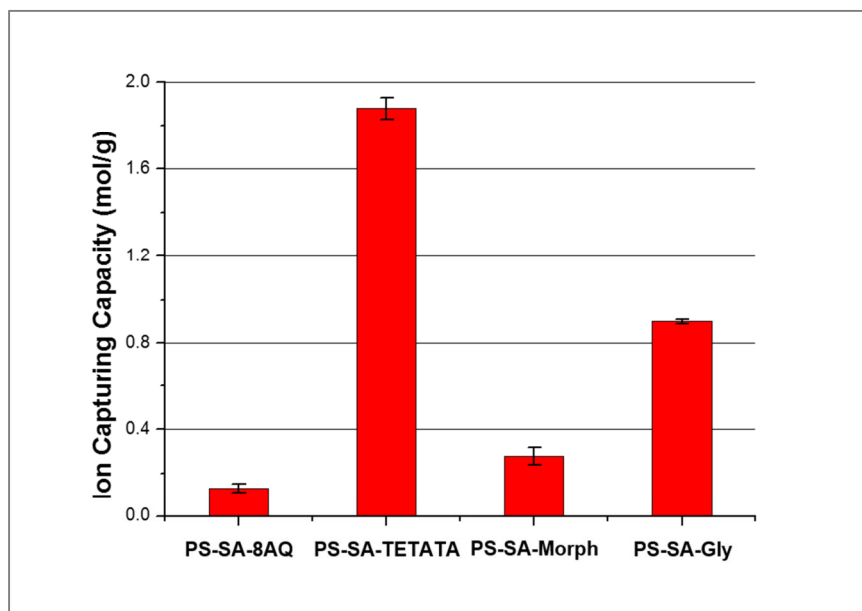


Fig. 1 - Calcium ion capturing of modified PS beads

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