Novel bifunctional anion exchange resins for the highly selective sorption of perchlorate and pertechnetate

Gilbert M. Brown,[1] Peter V. Bonnesen,[1] Baohua Gu,[2] Bruce A. Moyer,[1] Wallace D. Porter,[3] Spiro D. Alexandratos,[4] and Marc A. Klingshirn[1]

[1]Chemical and Analytical Sciences Division, Oak Ridge National Laboratory, P. O. Box 2008, MS-6119, Oak Ridge, TN 37831-6119

[2]Environmental Sciences Division, Oak Ridge National Laboratory, P. O. Box 2008, MS-6036, Oak Ridge, TN 37831-6036

[3]Metals and Ceramics Division, Oak Ridge National Laboratory, P. O. Box 2008, MS-6064, Oak Ridge, TN 37831-6064

[4]Department of Chemistry, The University of Tennessee at Knoxville, Knoxville, TN 37996 (Present address: City University of New York, 535 East 80th St, New York, NY 10021)

Abstract of a presentation to be given in the symposium "Fundamentals and Applications of Anion Separations," American Chemical Society National Meeting, Chicago, IL, Aug. 26 - 30, 2001.

The submitted manuscript has been authored by a contractor of the U.S. Government under contract DE-AC05-00OR22725. Accordingly, the U.S. Government retains a nonexclusive, royalty-free license to publish or reproduce the published form of this contribution, or allow others to do so, for U.S. Government purposes."

This research was sponsored by the following programs of the U. S. Department of Energy: 1) Division of Chemical Sciences, Geosciences, and Biosciences, Office of Basic Energy Sciences; and 2) the Efficient Separations and Processing Crosscutting Program, Office of Science and Technology, Office of Environmental Management. Oak Ridge National Laboratory is managed and operated by UT-Battelle, LLC under contract number DE-AC05-00OR22725 with the U. S. Department of Energy.

Novel bifunctional anion exchange resins for the highly selective sorption of perchlorate and pertechnetate

Gilbert M. Brown,[1] Peter V. Bonnesen,[1] Baohua Gu,[2] Bruce A. Moyer,[1] Wallace D. Porter,[3] Spiro D. Alexandratos,[4] and Marc A. Klingshirn[1]

[1]Chemical and Analytical Sciences Division, Oak Ridge National Laboratory, P. O. Box 2008, MS-6119, Oak Ridge, TN 37831-6119

[2]Environmental Sciences Division, Oak Ridge National Laboratory, P. O. Box 2008, MS-6036, Oak Ridge, TN 37831-6036

[3]Metals and Ceramics Division, Oak Ridge National Laboratory, P. O. Box 2008, MS-6064, Oak Ridge, TN 37831-6064

[4]Department of Chemistry, The University of Tennessee at Knoxville, Knoxville, TN 37996 (Present address: City University of New York, 535 East 80th St, New York, NY 10021)

The electrostatic model of anion transfer in which the size and hydration energy of anions govern selectivity for Type I strong-base resins was the basis for the design of a class of novel bifunctional resins that are selective for oxyanions. Selectivity for the sorption of large, poorly hydrated anions increases with an increase in the length of the alkyl chain of the quaternary ammonium groups. Optimum performance is exhibited by resins that combine two different quarternary ammonium groups in one resin, one having large alkyl groups for improved selectivity and one having shorter chains for improved kinetics. Thermogravimetric analysis of a series of resins shows that the amount of strongly bound water correlates with kinetics and equilibrium distribution ratios for anion sorption. These bifunctional resins have been shown to be very effective in processing groundwater contaminated with pertechnetate and perchlorate ions. Field studies have allowed the resin bed and flow parameters to be estimated for scale-up, including passive applications such as in situ treatment.