RETHINKING ANION EXCHANGE WITH QUATERNARY AMMONIUM COMPOUNDS

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ABSTRACT

The anion of quaternary ammonium compounds (quats) contributes significantly to the properties of the compound. For any anions of interest, the quat cannot be synthesized directly and other methods of anion exchange (Muldoon, M. J., S. N. V. K. Aki, J. L. Anderson, J. K. Dixon, and J. F. Brennecke. 2007. Improving carbon dioxide solubility in ionic liquids. Journal of Physical Chemistry B 111:9001-9009.) are not clean or efficient. When tertiary amines are methylated with dimethyl carbonate, the resulting methyl carbonate quat was easily and cleanly anion exchanged by direct reaction with an appropriate acid. Acids stronger than methyl carbonic acid (K_a=2.44 x 10^-6) (Behrendt, W., and G. Gattow. 1973. Chalcogenolates. LXII. Hemiesters of carbonic acid. 2. Preparation and properties of monomethyl carbonic acid. Zeitschrift fuer Anorganische und Allgemeine Chemie 398:198-206.) are expected to react completely producing methanol and carbon dioxide. The extent of reaction for weaker acids depends on the efficiency of CO_2 removal which drives the equilibrium toward products. Acids with a range of K_a’s were combined with an equivalent amount of tributylmethylammonium methyl carbonate in ethanol, refluxed for 30 minutes to 24 hours under N_2 flow, and placed under vacuum to remove the volatile components. Longer reaction times were used for the weaker acids. NMR spectra at 300 MHz indicated stronger acids completely replaced the methyl carbonate while weaker acid reactions were nearly complete.