QUATERNARY AMMONIUM SYNTHESIS

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ABSTRACT

Industrially and domestically, the importance of quaternary ammonium compounds can not be overestimated. Their uses range from hair care products to additives in asphalt.

The synthesis of quaternary ammonium compounds presently entails using methyl chloride or dimethyl sulfate as the methylating agent in conjunction with a secondary or tertiary amine. Though efficient as methylating agents, methyl chloride and dimethyl sulfate are both highly toxic and pose a significant health risk. In addition the quaternary ammonium compound formed in this way are very slowly biodegradable. An alternative methylating agent is clearly needed.

An alternative has been found in the compound dimethyl carbonate. The advantages of using dimethyl carbonate are, its low toxicity and its biodegradability. Dimethyl carbonate’s ability to methylate tertiary amines is poor however, and fairly extreme conditions are needed to cause alkylation. These extreme conditions unfortunately place this reaction beyond the reach of industrial reactors. Less extreme conditions must be found, while at the same time keeping the reaction time to a minimum.

Using quantitative nuclear magnetic resonance spectroscopy the half-life of a reaction could be determined. From this rudimentary kinetic information the best conditions for running the reaction could be determined by manipulating parameters such as: pressure in the reaction vessel, volume, ratios of reactants and solvent, and temperature. These parameters were manipulated not only to give the best rate of reaction but also to keep the pressure and temperature within reach of industrial capabilities.