

466e Laboratory/Pilot Plant Experimentation for Developing a Liquid-Liquid Mixing Process Involving Complex Chemical Reactions

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Development of continuous processes of mixing of immiscible liquids with reactions requires extensive experiments on laboratory and pilot plant scales. In addition different size pilot plants may be required to determine scale-up criteria. This methodology consumes large volumes of expensive reacting liquids and generates same volumes of products requiring costly disposal.

This paper discusses mixing issues and scale-up difficulties with this process development. It is critical to determine the type of data that must be obtained in batch stirred tank experiments before designing a pilot plant. An optimum size pilot plant must be chosen for generating data for commercial scale design while minimizing consumption of reacting liquids. A robust approach must be followed using literature information on drop size functionalities with mixing parameters in agitated tanks as well as in in-line mixers.

In most situations the flow regime in the pilot plant is significantly different from that in a commercial plant. This issue must be addressed by selecting appropriate ranges of operating conditions in the experimental program. An intermediate size pilot plant may be needed to establish high degree of confidence in scale-up. A robust mathematical model based on extensive data must be developed to assist in guiding the pilot plant and developing a commercial design. Such a model would be useful in troubleshooting as well after the plant startup. Complex processes may also warrant incorporating flexibility in the commercial mixing system design so that flow regimes and mixing energy can be adjusted without requiring extensive equipment modifications. This paper covers optional strategies to provide such design flexibilities.