CHAOTIC MIXERS AS CHEMICAL REACTORS

Chemical conversion in diffusion limited reactive systems is seen to increase dramatically with the application of chaotic mixing. The time scale of chemical conversion is much shortened when ingredients are mixed in a chaotic mixer reactor. The uniformity of chaotic mixing provides narrow block length distribution in $A_2+B_2+C_2$ type polymerization schemes, such as polyurethanes, and creates fine scale morphology in polymeric systems with reaction induced phase separation.

The performance of chaotic mixers is analyzed in terms of the effects of mixer designs and mixer operating conditions on polymer molecular weight and properties. Specifically, the analysis involves computation of time scales of mixing and chemical reactions and finding their relationship to mixing torque, polymer molecular weight, and mechanical and thermal properties. It is found that the time scale of mixing has a strong dependence on the Liapunov exponent, a parameter used to characterize the degree of chaotic mixing. The results show that the highest polymer molecular weight is obtained when the mixer operates under globally chaotic conditions and when the magnitudes of the time scales of mixing and chemical reactions are made comparable to each other. The study also shows that hard segment phase separation can reduce the value of the reaction rate constant and hence hinder the progress of polymerization.

Publications:

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2. Jung, C.D., Gunes, I.S., Jana, S.C., 2007 Time scales of mixing and chemical reactions in synthesis of thermoplastic polyurethanes in chaotic mixers. Ind. Eng. Chem. Res. 46, 2413-2422.
3. Jung, C.D., Jana, S.C. 2005 Effect of chaotic mixing on catalyzed thermoplastic polyurethane polymerization. SPE ANTEC 63, 1800-1804.
4. Jung, C.D., Jana, S.C., 2004 Synthesis of thermoplastic polyurethanes by chaotic mixing. SPE ANTEC 62, 2812-2818.