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Catalysis, Kinetics and Reaction Engineering

Process optimization study on the carbonylation of methyl acetate

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Abstract: Acetic anhydride is the important organic chemical raw material, and is used widely in chemical industry, pharmaceutical industry, dyes, spices and other fields. In this paper, the process of carbonylation of methyl acetate in rhodium iodine catalyst system was studied, and the suitable reaction conditions were determined. At the same time, the kinetic model was established. The optimum reaction conditions were as follows: the reaction pressure was 5 MPa, the hydrogen content was 8 %, the amount of iodomethane was 15 %, the amount of lithium iodide was 3 %, the reaction temperature was 150 ℃ and the reaction time is 3h. Under the above reaction conditions, the selectivity of the reaction is close to 100% and the conversion is as high as 92 %. The macroscopic kinetic model of the reaction was established in the temperature range of 120 ℃-150 ℃. The reaction is an irreversible reaction without the formation of by-products and the dynamic equation is also given in the Conclusions.

Key words: carbonylation; rhodium iodine catalyst; reaction conditions; kinetics

1 Introduction

Acetic anhydride has the appearance of colorless transparent liquid. It is slightly soluble in water and slowly hydrolyzed into acetic acid in water. Acetic anhydride is an important organic chemical raw material, and it has a very wide range of applications in cellulose synthesis, pharmaceutical synthesis and dye synthesis [1].

The industrial production methods of acetic anhydride [2] are mainly acetaldehyde oxidation co-production method, acetic acid cleavage method and carbonylation of methyl acetate method. The carbonylation of methyl acetate process has the advantages of short process, good product quality, low consumption and less waste. This paper mainly studies the carbonylation of methyl acetate in rhodium catalyst system.

Inspired by the process of carbonylation of methanol [3-8], many researchers found that metal carbonyls have a significant catalytic effect on the carbonylation reaction