

Use of metal exchanged clay as catalysts in the reaction of acylation of toluene

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Acylation of aromatic compounds, commonly applied in fine chemicals and pharmaceutical industries, makes use of conventional catalysts such as metal halides (e.g., AlCl_3 , FeCl_3 , ZnCl_2) in order to expedite the acylation reactions. The conventional catalysts, though relatively cheap and readily available, inherent several drawbacks. Upon used, they are not recoverable and hence can not be reused as catalysts. Also, stoichiometric amounts, rather than catalytic amounts, are required for the reactions due to formation of stable complexes. Further, expensive equipments are needed to purify waste gases and additional production expenses occur for acids and bases used in work up procedure. Furthermore, emission of corrosive and hazardous gases raises significant environmental concerns.

Consequently, tightening environmental legislations are driving the fine and specialty chemicals industries to consider alternative processes that avoid the use of conventional acid catalysts in acylation reactions. This research concentrated on the development of environmentally friendly, recyclable, selective solid catalysts for the acylation of toluene to methylacetophenone. Two metal exchanged clay catalysts, aluminum-exchanged bentonite and sodium-exchanged bentonite, were used in place of conventional catalysts in acylation reaction to examine the effects on the reaction byproducts. Gas chromatography and gas chromatography-mass spectrometry were used to analyze the reaction products. The results revealed that aluminum-exchanged bentonite clay catalyst was highly active for the title reaction. In addition, unlike aluminum chloride (the traditional catalyst), new catalyst is not toxic, water sensitive or corrosive and it could vastly simplify catalyst removal, minimizing the amount of waste formed. Further, the new catalyst is economically viable as it is cheap and reusable. Sodium-exchanged clay catalyst, on the other hand, failed to produce favorable outcomes. This study, therefore, identified aluminum-exchanged clay catalyst as a promising alternative to, and can be successfully applied in place of, conventional catalysts.