

## Abstract of the Thesis

### Title: Application of Ceramic Foam Supported Catalysts in Alkylation Reactions

This dissertation focuses on the utilization of SiC ceramic foam as catalyst support for various alkylation reactions catalysed by zeolites and metal modified zeolites. Two solid acid catalysts, namely, H-ZSM-5 and zeolite beta along with alumina prepared in laboratory have been considered to play the role of catalyst in the form of coating over ceramic foam. The zeolites (H-ZSM-5 and beta zeolite) were modified with transition metal (Nb) and rare earth metals (La and Ce) by dry impregnation method. Each of the catalysts, in its modified and unmodified versions was characterized to make sure of its change in different physicochemical properties that can affect the alkylation reactions. Characterization through BET analysis, pore volume distribution, microporous nature determination, type of adsorption –desorption isotherm determination, SEM and EDXS, X-ray mapping, XRF, XRD were found to be successful to find out the change in different properties of catalysts.

Toluene alkylation reaction with methanol, Toluene alkylation with benzyl alcohol, Phenol alkylation reaction with cyclohexene have been chosen as model alkylation reactions. A reactor, with square cross sectional area and has been used to accommodate the SiC ceramic foam (40 mm × 40 mm × 15 mm) supported catalyst blocks and all reactions were carried out in this reactor itself. The vapour phase alkylation reactions were carried out and the product vapour was condensed in the condenser. All samples were analysed in Gas Chromatograph. The variation of reaction parameters, such as, temperature, mole ratio, weight of catalyst to feed ratio, reusability and comparison of foam coated and pellet catalysts were done.

Alumina has been found to be less effective catalyst compared to zeolites for alkylation reaction since it has no Bronsted acid sites. It was found that foam supported catalysts gave almost 10% higher conversion compared to pellet catalyst with only 0.8 g of catalyst. Among metal modified H-ZSM-5, La-ZSM-5 gave maximum selectivity towards desired product with 9% metal loading. More metal loading decreased the selectivity of desired product. Among metal treated beta zeolite, La treated one was found to be effective for toluene alkylation with benzyl alcohol in terms of the selectivity of mono-benzyl toluene.

*Keywords: Ceramic Foam, H-ZSM-5, Beta zeolite, Lanthanum, Cerium, Niobium, Alkylation Reaction, Kinetics.*