Chapter 1

Catalysis in Alkylation of Benzene With Ethene and Propene to Produce Ethylbenzene and Isopropylbenzene

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ABSTRACT

The alkylation of benzene with ethylene or propylene to form ethylbenzene (EB) or cumene is an industrially significant transformation. EB is used as an intermediate in the manufacture of styrene, which in turn is an important in the manufacture of many kinds of polymers. The primary use of cumene is in the co-production of phenol and acetone, which in turn are important in the manufacture of many kinds of chemicals and polymers. In industry, EB and cumene are mainly manufactured by the alkylation of benzene with ethene or propene via two methods, the gas and the liquid phase in the presence of Lewis and Brønsted acids. The development of efficient solid catalysts has gained much attention over the last decades. The objective of this chapter is to provide an overview of the history of the alkylation of benzene with ethene and propene, the development of homogeneous and heterogeneous Lewis and Brønsted acids and zeiolite catalysts, the liquid and gas phase alkylation processes, and the industrial technologies for EB and cumene production.

INTRODUCTION

Alkylation of aromatics: Alkylation is the transfer of an alkyl substituent from one molecule to another via an alkyl carbocation or carbonuim ion, a carbanion, a free radical, or a carbene, which are generated from electrophilic alkylating agents such as olefin or alkyl halide in the presence of catalyst, such as Brønsted acid, Lewis acid or zeolite.

The ethylene (ethene) feed used for ethylation of benzene is produced from the cracking of fractions obtained from distillation of natural gas and oil. The processes are:

(a) the steam cracking of ethane and propane (from natural gas and from crude oil),
(b) the steam cracking of naphtha from crude oil,
(c) the steam cracking of gas oil from crude oil.

The choice of feedstock depends on availability, price and what other products from cracking are needed for other chemical processes.

The alkylation of benzene with ethylene or propylene to form ethylbenzene or isopropylbenzene (cumene) over acid catalystisan industrially significant and the main commercial route for the production of important petrochemical intermediates, such as ethylbenzene(EB) as the key building block for manufacture polystyrene and isopropylbenzene (IPB - cumene), a precursor to solvents and chemical intermediates

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