Extended Abstract

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Alternative green technology for reducing bromine index value of industrial benzene feedstock

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Abstract:

Benzene is commonly produced from various petrochemical processes such as thermal cracking of naphtha. It is used as a feedstock in the wide ranges of petrochemical processes to produce downstream valuable products such as Polystyrene and Phenol. It often contains trace amount of unsaturated hydrocarbon as impurity which can severely cause a deactivation of downstream catalysts. Therefore, unsaturated hydrocarbon must be removed before used as a feedstock in subsequent downstream processes. Standard analytical technique used for measuring trace amount of unsaturated hydrocarbon in benzene feedstock is the Bromine Index (BI) technique. This is an indirect technique used for determining trace amount of unsaturated hydrocarbon that conventional Gas Chromatography (GC) cannot do accurately (too low concentration to quantify). Nowadays, the existing commercial-available technology for reducing the Bromine Index value (BI) of the industrial benzene feedstock is a catalytic alkylation process operated at high reaction temperature and pressure. Reaction pathway is a conversion of reactant between unsaturated hydrocarbon and benzene to heavier alkyl aromatics that are able to separate by a conventional fractionation, thus a subsequent fractionation is required for this existing technology. In summary, the existing catalytic alkylation technology needs high operating cost because high reaction temperature and pressure are required the spent catalyst could not be regenerated and high investment cost due to a requirement of the subsequent fractionation. For the environment point of view, the spent catalyst could not be regenerated, then this hazardous material needs to go to landfill causing a big environmentally concern. In 2011, SCG chemicals could successfully develop and commercialize our own developed technology for Bromine Index (BI) reduction of benzene feedstock based on the adsorption chemistry. This new technology is capable to operate at room temperature and mild pressure, reuse the spent catalyst using mild regeneration temperature, and reduce Bromine Index (BI) value without the loss of valuable benzene feedstock (no need subsequent fractionation). This, of cause could result in much lower operating and investment costs with higher environmental friendly compared with the existing catalytic alkylation technology. Alternative technology for reducing the bromine index value, which represents trace impurity of unsaturated hydrocarbon, in the industrial benzene feedstock was systematically developed in this study using the adsorption approach. Effects of different physicochemical properties of MCM-22, Na-Y, HY, and ZSM-5 on the reduction of the bromine index value were investigated under ambient temperature and pressure. It was found that the molecular sieve approach by using the medium pore size zeolite and strong interaction between the adsorbent and unsaturated hydrocarbon by using the lower SiO_2:Al_2O_3 molar ratio were the key factors for designing the right adsorbent for this industrial application. Most of unsaturated hydrocarbon impurity was finally removed from the industrial benzene feedstock resulting in nearly zero of the bromine index value after passed through the right adsorbent with maximum adsorption capacity of 78.6 wt.%. Adsorption's active site was also determined in this study revealing that this adsorption technology was active site insensitive process. This adsorption technology has been started up in the commercial scale by SCG Chemicals since 2010 which can overcome various drawbacks of the existing technology.

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