Heavy Reformate-to-Xylenes Conversion Over Novel Zeolite Catalyst: Eliminating the Addition of Toluene

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Environmental regulations on fuel quality have substantially limited the allowable amount of heavy (C9+) aromatics in gasoline, the principal components of heavy reformate. Thus, alternative routes for the utilization of heavy reformate have been taken, one of which is its conversion into value-added xylenes with the facilitation of catalysts. Toluene is most always an additive in this process. This project develops a novel beta zeolite catalyst in which porosity is altered to enable the catalyst to convert heavy reformate into xylenes without the addition of toluene, thereby minimizing the process' environmental impacts and overall cost. Two catalysts, an experimental one and a metal-loaded commercial one, were developed, hydrotreated, and run in a bench top reactor system through a feed with no toluene. The feed's initial and product composition were analyzed using a gas chromatograph. The highly siliceous experimental and metal-loaded commercial catalysts had overall conversion rates of approximately 76% and 97%, and selectivity ratios of 238:100 and 124:100 xylenes to toluene, respectively. The xylene yields obtained were 27.1% and 27.6%, compared to 22.5% attained by the reference zeolite catalyst. Both catalysts were characterized using x-ray diffraction, scanning electron microscopy, and energy-dispersive spectroscopy; demonstrating their structures. Two feed samples were then tested for toxicity. The one with no toluene was less toxic on the growth of general aerobic bacteria, signifying its adverse health effect on organisms. Apart from its prominent application in hydrocarbon synthesis, the suggested porous catalyst could be used in catalytic cracking, isomerization, hydrocracking, dewaxing, and alkylation.