

Simultaneous Production Benzene and Gasoline from C-6 heart cut of FCC gasoline

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Abstract

The MSAT – II regulations active since January 1, 2011 (“EPA Regulatory Announcement” – EPA420-F-07-017, February 2007), restricts the annual average benzene level in Gasoline sold in U.S (except California), to 0.62 % vol. Currently FCC gasoline comprises nearly 10-20 % of the gasoline pool in a typical refinery. Full range FCC gasoline contains around 15-30 vol. % aromatics with up to 2 vol. % benzene and 1000 – 2000 ppm sulfur. A narrow C6 heart cut fraction of the full range gasoline will contain anywhere between 11 – 19 wt. % benzene and up to 500 ppm sulfur. Unprocessed FCC Gasoline contains reactive impurities like oxygenates, metals, chlorides, sulphur compounds, nitrogen compounds, di-olefins and organic peroxides. Complexity of the feedstock has hindered the development of an economic and reliable benzene recovery process in the industry so far. Hydro-processing routes for benzene reduction result in olefin saturation which lowers the octane rating of the final product.

Reliance Industries Ltd (RIL) operates two 220,000 bpsd FCC units at its world class refineries and petrochemical complex at Jamnagar, India. The gasoline from these two FCC units is a major contributor of Benzene in gasoline pool. It thus seemed imperative to remove benzene from this stream in order to meet the forthcoming benzene limit in gasoline pool. CSIR IIP and RIL jointly developed a first of its kind technology for simultaneous production of high purity benzene and U.S grade gasoline from C6 heart cut of FCC gasoline.

The process developed serves a dual role of recovering high purity benzene and producing environmental friendly gasoline from FCC C6 heart cut stream using extractive distillation without the requirement of any prior hydrogenation or pre-processing step to saturate di-olefins in feedstock and reduce impurities. The indigenous technology has been granted patents in several countries including, Russia, China, Japan, European Union and U.S. (US. 8722952 B2). A ~0.7 MMTPA (17.4 KBPSD) plant based on this technology has been commissioned in Reliance Industries’ petrochemical complex at Jamnagar, India in May 2016. The unit has been operating consistently as per expectations even at a throughput of 125% of design.

This technology, which has now been proved at world scale, is now available for licensing. Also it can give huge benefits to producers who already have an existing benzene recovery unit, which can be re-structured/optimized at very low costs in lines with the said technology to process complex feedstocks like FCC gasoline.

The paper highlights the entire journey of technology development starting from proof of concept study to plant commissioning, while explaining various aspects of the technology from a scientific Perspective.