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MDI Process Update

Process Economics Program Review 2016-13

March 2017 ihs.com

PEP Review 2016-13

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Abstract

Isocyanates are a major ingredient for the production of polyurethane products that are formed by the reactive polymerization of isocyanates with polyols. A long and difficult search for a reasonable economic pathway to produce isocyanates by vapor-phase phosgenation of diphenylmethane diamine (MDA) in place of liquid-phase phosgenation of MDA has been developed and commercialized since our last report on isocyanates (PEP Report 1E) was published in August 1992.

In this review, we investigate large-scale, single-train integrated technology and economics for the production of methylene diphenyl diisocyanate (MDI), including condensation of aniline with formaldehyde to produce MDA, production of phosgene from carbon monoxide and chlorine, gas-phase phosgenation of MDA to produce crude MDI, and separation/recovery of MDI products. The key gas-phase phosgenation step produces isocyanates from MDA at high pressure and temperature, enabling a significant shortening of residence time in the reactor. The rate determining step is the dissociation of the polymeric MDA–carbonyl chloride intermediate into polymeric MDI and HCl followed by HCl removal.

A summary of the process economics for the production of 373 million lbs/yr of crude MDI and 336 million lbs/yr of polymeric MDI (PMDI) and 37 million lbs/yr of pure MDI for continuous vapor-phase isocyanate production shows that on a US Gulf Coast basis, the world-scale, single-train, integrated vapor-phase technology–based plant will meet plant gate costs. On the same basis, a world-scale, dual-train plant approximately will meet net production costs. With lower capital and manufacturing costs, for example in China, manufacturing operations would likely be profitable.

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