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Acrylonitrile

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Report Abstract
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Nexant

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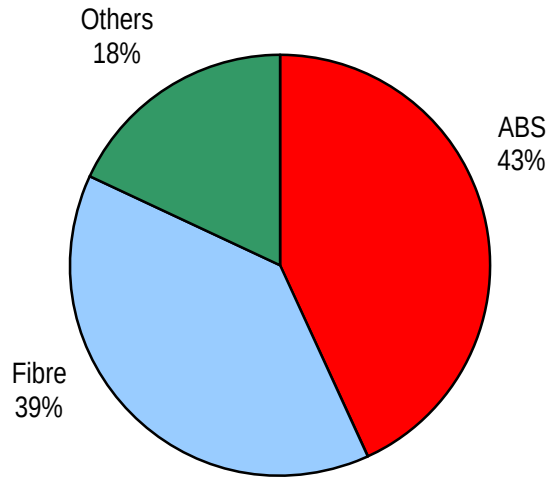
INTRODUCTION

Acrylonitrile ($H_2C=CHC\equiv N$) is a valuable and widely used chemical intermediate, taking the form of a colorless liquid (yellow when impure). The pure compound is very reactive, constitutes an explosive hazard and undergoes violent polymerization when exposed to air; thus it is typically stored with inhibitor.

Acrylonitrile's main applications are in the manufacture of polymers. Its largest commercial use is in the manufacture of acrylic and modacrylic fiber. Use of acrylonitrile in the manufacture of high impact strength thermoplastics, such as styrene acrylonitrile (SAN) or acrylonitrile butadiene styrene (ABS), is also growing rapidly. Notable other applications include its use in the manufacture of elastomeric thermoplastics such as nitrile butadiene rubber (NBR) and acrylonitrile styrene acrylate (ASA).

Figure 1 Global Acrylonitrile Consumption



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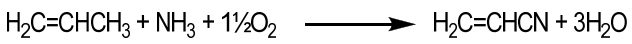
Nexant's report elucidates the following techno-economic aspects of the acrylonitrile industry:

- The history of acrylonitrile process technology, from early routes to recent research & development focuses by major players
- Key catalyst developments, associated mechanism and byproducts for state-of-the-art propylene ammoxidation technology
- Process flow description and flowsheets; discussion of separation and recycle performance metrics and issues
- Comparative economics for newly commercialized propane ammoxidation technology
- Mechanical design aspects for the reactors and other process equipment, as evinced by recent key patents

- Potential improvements based on a hypothetical improved (higher selectivity) catalyst for propylene ammoxidation
- Relevance of acetonitrile byproduct, including discussion of the process retrofitting completed to boost production during the 2008-2009 acetonitrile shortage

TECHNOLOGY

The vast majority of acrylonitrile monomer is produced via the propylene ammoxidation process. The most active propylene ammoxidation technology licensor is INEOS, which inherited the technology through acquisitions from BP, who in turn held the former Standard Oil Company of Ohio (Sohio) technology. Most of the world's currently-operating acrylonitrile plants either use the INEOS or similar process technology. The chemistry of the propylene ammoxidation process may be summarized as:



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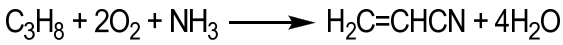
However, an interesting development has occurred recently with the successful industrial scale production of acrylonitrile via propane ammoxidation. Commercial-scale propane ammoxidation technology was sought for many years due to the attraction of cheaper propane feedstock. However, only Asahi Kasei has demonstrated the propane ammoxidation process at a commercially significant scale. In 2012 an Asahi JV started up a 200 kta world scale acrylonitrile plant in Thailand. The overall stoichiometry for the propane ammoxidation reaction can be shown as follows:



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A key difference in process operation between the propane based route and propylene based route is the lower reaction yield of acrylonitrile from propane compared with that obtained from propylene, which is off-set against the lower price of propane compared to propylene. In addition, there is about 2.5 times as many byproducts by weight produced in the propane based process.

A major objective of this report has been to assess the impact of these differences on the process economics. The result of the analysis has been surprising.

PROCESS ECONOMICS

Cost estimates for the production of acrylonitrile via the following processes have been evaluated:

- Conventional propylene ammoxidation technology - cost models on U.S. Gulf Coast (USGC), Western Europe, Southeast Asia and China bases are presented
- Newly commercialized propane ammoxidation technology - cost models on USGC and Southeast Asia bases are presented

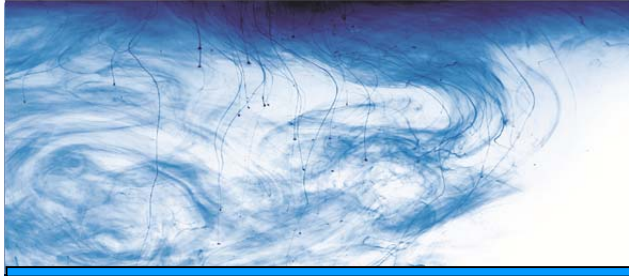
The sensitivity of the process economics to a number of key pricing parameters is examined in detail in the report. A high-level overview of the economic impact of a potentially improved catalyst for propylene ammoxidation, and high acetonitrile coproduction are mentioned.

All cost tables given in this report include a breakdown of the cost of production in terms of raw materials, utilities direct and allocated fixed costs, by unit consumption and per metric ton and annually, as well as contribution of depreciation to arrive at a cost estimate (a simple nominal return on capital is also included).

COMMERCIAL MARKET ANALYSIS

Acrylonitrile is a petrochemical intermediate, traditionally used principally as a monomer or co-monomer for synthetic fiber, as well as a constituent of certain important plastics and elastomer products. In the synthetic fiber sector, acrylonitrile is used in the production of acrylic and modacrylic fibers as well as to produce adiponitrile, a nylon intermediate. Despite the high underlying cost relative to competing fibers, acrylic fiber remains the material of choice in certain high-end applications. In the apparel sector, acrylic fibers are preferred where colorability and breathability are important. There is increasing demand in two key technical fiber sectors, which can be defined as outdoor uses and carbon fiber.

- Global acrylonitrile supply, demand, and trade data are given and discussed.
- In addition, supply, demand and trade data is given and discussed according to key regions (i.e., North America, Western European, and Asia Pacific)
- A list of plants in each of the key regions above is given showing specific plant capacities, owning company, location and annual tonnage produced



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