

CHEMICAL PROFILE

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Acrylamide

USES

Acrylamide is a water-soluble monomer that is primarily consumed in the production of polyacrylamides (anionic, cationic, nonionic and Mannich). Major producers are forward integrated to polymer. About 37% of global acrylamide is used in waste and wastewater treatment, 20% each in petroleum (mostly drilling fluid) and pulp/paper, 8% in mining, 5% in coating and 2% in printing/dying. Acrylamide also is used in cosmetic/personal care, comonomer in superabsorbent polymers, production of n-methylolacrylamide, construction, irrigation purposes in agriculture and food applications, if approved by the appropriate authorities. Water management is the dominant segment in the United States and Western Europe, accounting for about 47%, while paper uses dominate the Japanese market with 60%. EOR is the largest segment in the Chinese market with some 35%.

Acrylamide is commercially available as 30-50% solution in water and crystalline form. The most common being the solution form.

SUPPLY/DEMAND

Global capacity for acrylamide stood at 1.16m ton/year in 2013, 53.7% in Asia Pacific, 16.9% in the US, 15.6% in Western Europe and 9.3% in Japan. China is the largest producer in the world with a capacity of 594,000 ton/year. China is also the biggest acrylamide consumer with 440,000 ton/year, followed by 175,000 ton/year in Western Europe, 162,000 ton/year in the US, 43,000 ton/year in Japan and 26,000 ton/year in Asia/Middle East. The values in this profile are all in 100% active ingredient basis. Japan, the largest exporter of acrylamide, shipped some 54,000 ton out of the country in 2013.

PRICING

The price of acrylamide depends on its physical form. The price of acrylamide in China for crystalline and 50% solution in 2Q 2014 were negotiated between ¥11.82/kg and ¥14.4/kg and between ¥9.4/kg and ¥10.5/kg, respectively. The prices in the US and Western Europe are higher by 10-15%.

TECHNOLOGY

There are two main routes leading to acrylamide. The first one involves hydration of acrylonitrile on copper catalyst in a fixed bed reactor. The resulting solution is shipped as is or dried to produce crystalline acrylamide. The second process uses a microbial catalyst containing nitrile hydratase in aqueous medium in a tank reactor wherein acrylonitrile undergoes hydration reaction. The resulting acrylamide is concentrated to 50%. The enzyme process is more cost

effective than the copper based process; especially with the new trains which have a capacity of 60,000 ton. As a result, almost all the new installations are based on this process.

HEALTH and SAFETY

The Maximum Containment Level (MCL) set by US Environmental Protection Agency (EPA) is zero. EPA has found exposure to acrylamide for relatively short periods of time above the MCL level potentially causes damage to the nervous system, weakness and incoordination in the legs. Long term acrylamide has the potential to cause permanent damage to the nervous system, paralysis and cancer. Federal Drug Administration has many guidelines regarding direct and indirect use of acrylamide content of polymer in food and drinking water.

OUTLOOK

Global demand growth is forecast at 5.1%/year to 2018, the highest growth rates being expected in China (7%/year) and Asia/Middle East (5%/year). The growth rate in other regions will be in 2-3%/year range in the US and Western Europe, less than 1% in Japan and about 4% in the remaining regions.

The use in enhanced oil recovery (EOR) will be the fastest growing market segment, 10%/year in China and 8% globally, followed by mining at 5%/year and water management at 4%/year.

New projects are mainly being brought on-line by SNF, CNPC and Kemira, the main players in the acrylamide market. Globally, some 290,000 ton/year capacity will be brought on stream within 2014-2016 periods. No shortage of acrylamide is expected by 2018.

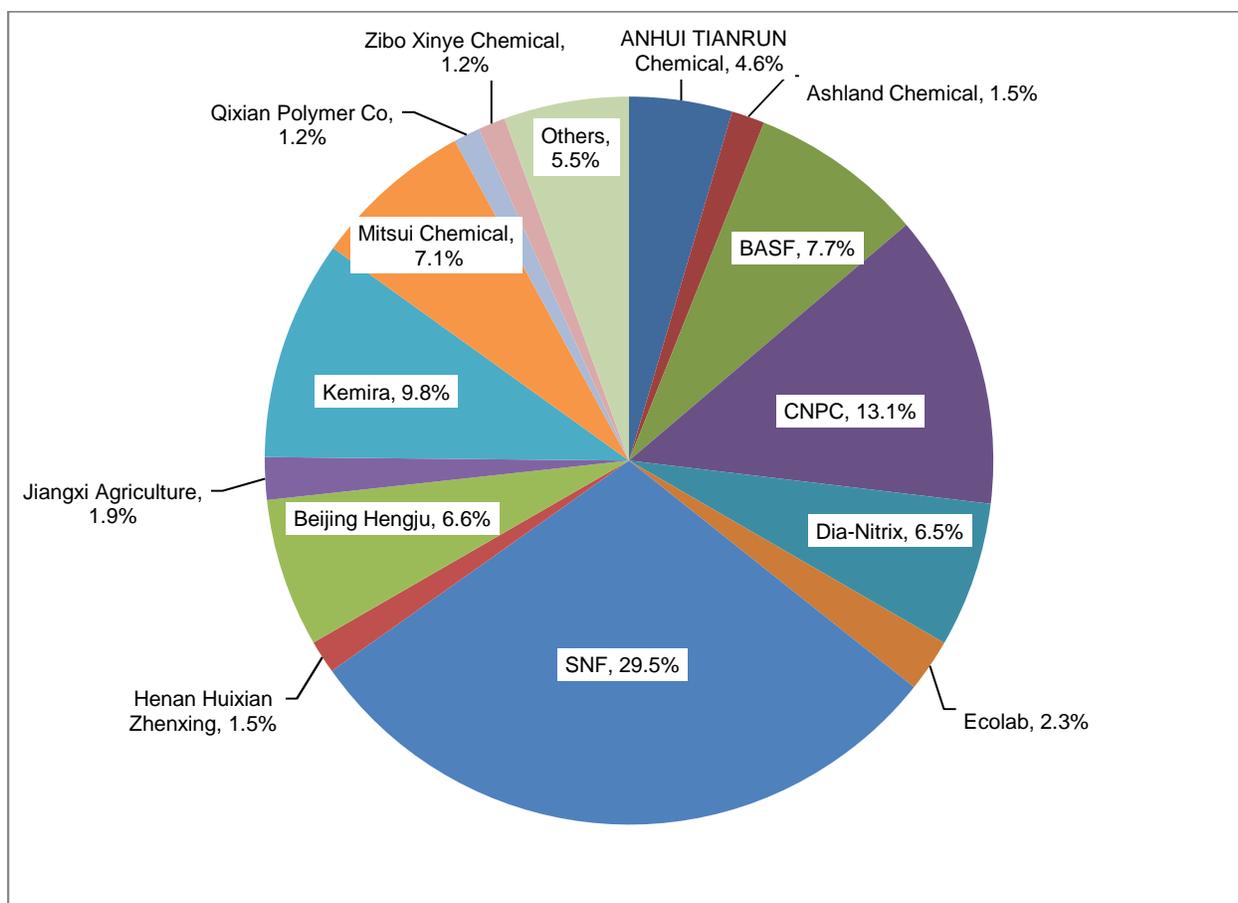
MAJOR GLOBAL ACRYLAMIDE CAPACITY, '1000 TON/YEAR(*)

| Name | Location | Capacity |
|------------------------------|------------------------------------|----------|
| AnHui JuCheng Fine Chemicals | Suixi EDZ, China | 40.0 |
| Anhui Tianrun Chemicals | Bengbu, China | 50.0 |
| Ashland | Perm, Russia | 15.0 |
| BASF | Suffolk, VA, USA | 15.0 |
| | Bradford, England | 60.0 |
| Beijing Hengju Oilfield | Hengju, China | 85.0 |
| Black Rose | Jhagadia, India | 40.0 |
| CNPC | Daqing, China ⁽¹⁾ | 150.0 |
| Dia-Nitrix | Yookohama, Japan | 25.0 |
| | Kurosaki, Japan | 40.0 |
| Ecolab | Garyville, LA, USA | 19.1 |
| Henan Jiaozuo Duoshengduo | Jiaozuo, China | 15.0 |
| Jiangxi Agriculture Academy | Nanchang, Chia | 20.0 |
| Kemira | Fortier, LA, USA | 38.2 |
| | Botlek, Netherlands | 40.5 |
| | San Giorgio, Italy | 20.0 |
| | ? Aberdeen, MS, USA ⁽²⁾ | 40.0 |

| | | |
|----------------------------|------------------------------------|-------|
| Mitsui Chemical | Chiba, Japan | 43.0 |
| PT. Tridomain Chemicals | Merak, Indonesia | 15.0 |
| Qixian Polymer Co | Qixian, China | 12.0 |
| Shandong Dongying Chemical | Dongying, China | 9.0 |
| SNF | Visakhapatnam, India | 18.0 |
| | Taixing, Chia ⁽³⁾ | 150.0 |
| | Plaquemine, LA, USA ⁽⁴⁾ | 60.0 |
| | Riceboro, GA, USA | 63.6 |
| | Andrezieux, France ⁽⁴⁾ | 60.0 |
| Yongsam-Mitsui-Tomen JV | Ulsan, South Korea | 12.0 |
| Zibo Xinye Chemical | Zibo City, China | 12.5 |

(*) Over 4 kt; (1) Expansion to 200 kt in 2014-2015; (2) New in 2015; (3) Expansion to 180 kt in 2015-2016; (4) Expansion to 120 kt in 2015-2016

GLOBAL MARKET SHARES FOR ACRYLAMIDE IN 2013



For more information about plant, market and site-specific/technology-specific investment and production cost data for acrylamide and some 1000 more chemicals, please send your inquiries to trantech@chemplan.biz.