

DSM: 50 years in caprolactam

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This year marks two important anniversaries for the Dutch chemical group: DSM NV, Geleen, 100 years as a corporation and 50 years as a producer of caprolactam, the main raw material for nylon 6 polymers and fibers. DSM now has caprolactam capacities in The Netherlands and the USA with a combined capacity of 500,000 tons/year, making it the world's leading supplier [1]. The company will soon also own 60 % equity in a plant in PR China (capacity 140,000 tons/year).

DSM was founded in 1902 as De StaatsMijnen (Dutch State Mines) to exploit the coal mines in the south of The Netherlands. In the 1930s, the company began coal-related chemical activities, such as fertilizers and other nitrogen based-products. Coal mining ceased in 1973 and by the 1980s DSM's portfolio of mainly bulk chemicals had expanded to include performance materials and fine chemicals. DSM became a public company in 1989, and the Dutch state ceased being a shareholder four years ago.

DSM started preliminary investigations into polyamide 6 in the 1930s. Having begun collaboration in 1940, DSM and AKU (the predecessor of Akzo) recommenced and intensified their research co-operation on caprolactam and nylon 6 in 1946, following the end of the Second World War. In 1948, DSM obtained from the Allied Forces a license on the patents of I.G. Farben as war reparation. At the same time, it was agreed that DSM would build a pilot plant for caprolactam and AKU a plant for PA spinning trials.

The caprolactam pilot plant became operational in 1950 and on January 2, 1952 the first Dutch nylon 6 yarn, called Enkalon, was produced. Construction of a commercial caprolactam plant in Geleen, The Netherlands, began in 1951 and commercial production was first manufactured in October 1952.

The predecessor of DSM's US caprolactam plant, Colombia Nitrogen Coopera-

tion, a joint venture between DSM and Pittsburgh Plate Company (PPG), was established 40 years ago (1962) for the production of ammonia and fertilizer.

A year later, Columbia Nipro was set up between the same partners for the production of caprolactam. This plant, with an original capacity of 20,000 tons/year was located in Augusta/GA, and started commercial production in April 1966. DSM became the plant's sole owner in 1972 when PPG transferred its shares in the joint venture to DSM. Today, the US company is known as DCNA (DSM Chemicals North America).

DSM's commitment to caprolactam goes way beyond its production. The company has also developed its own proprietary technologies, including the HSO, HPO, HPO^{plus}, Recycling and Altam processes, which are used by 18 of the 42 commercial caprolactam plants operating worldwide. Licenses have been sold through the DSM affiliate Stamicarbon NV.

New caprolactam technology

A bench-scale research project aimed at developing a new process for caprolactam based on alternative raw materials was completed in 2001. The next stage will be the construction of a demonstration unit.

As part of its current corporate strategy, DSM aims to exploit and strengthen its global leadership position in caprolactam. According to *Dick Venderbos*, business group director of DSM Fibre Inter-



Fig. 3 Modern view of DSM's first commercial caprolactam production plant in Geleen

mediates, all players in the nylon 6 industry must continue to focus on the development of the properties and performance of this material. "Further chain integration, such as joint ventures or partnerships along the value chain, are both essential and inevitable," he said. "We will have to maintain the balance between scale, which is needed for cost competitiveness, and flexibility to meet the ever-changing requirements of the markets we serve. In addition, we will need to balance supply and demand along the entire chain to sustain profitability for all players involved."

Today, nylon 6 is a versatile material with applications in a wide, and ever increasing, range of applications [2]. "Its future will be driven by the value we together add to the business chain," Venderbos said. "DSM is committed to co-operating with our partners to secure this future."

JV in China

DSM and Sinopec have signed a founding agreement to start the joint venture DSM Nanjing Chemical Company (DNCC). DSM Fibre Intermediates will participate 60% in this joint venture whereas Sinopec Nanjing Chemical Industries Co. Ltd. will represent the other 40 % of the shares.

The agreement involves an initial investment from DSM of US\$ 30 million for its 60% share. The DNCC plant has a current capacity of 60,000 metric tons caprolactam based on DSM's HPO technology and started production in 1993. DNCC will purchase a license on the most advanced HPO^{plus} technology from DSM. This technology will enable the joint venture to expand production to 140,000 tons/year in the years to come.

[1] Chemical Fibers International 52 (2002) 168

[2] Fiber Tables, Polyamide Fibers, 4th Edition 1997, Deutscher Fachverlag, Frankfurt/Main, Germany

[3] Chemical Fibers International 52 (2002) 168

DSM's commitment to caprolactam

1952	Start of commercial caprolactam production in Geleen, The Netherlands
1952	Total caprolactam production 612 tons
1962	Total caprolactam production 27,000 tons
1966	Caprolactam capacity in Geleen increased to 100,000 tons/year
1966	Start of caprolactam production in Augusta, GA/USA, with a capacity of 20,000 tons/year
1972	Production of 1 million tons of caprolactam in Geleen
1977	Caprolactam capacity in Augusta increased to 140,000 tons/year
1979	Production of 2 million tons of caprolactam in Geleen
1983	Production of 1 million tons of caprolactam in Augusta
1986	Production of 3 million tons of caprolactam in Geleen
1991	Production of 2 million tons of caprolactam in Augusta
1992	Production of 4 million tons of caprolactam in Geleen
1997	Production of 5 million tons of caprolactam in Geleen
1998	Production of 3 million tons of caprolactam in Augusta/USA
1999	Inauguration of the world's first commercial-scale nylon carpet-to-caprolactam recycling plant in Augusta/USA
2002	Production of 6 million tons of caprolactam in Geleen