Geoff Fisher

Textile Media Services Ltd
2 Washburn Court, Solsden
Keighley BD20 0QZ, UK
Tel. +44 1535 656489
Fax +44 8700 940863
Mobile: +44 7803 718443
E-mail: gfisher@textilemedia.com

No Room for New Caprolactam Plants

Abstract

A brief analysis of the world demand and the production capacities for caprolactam is demonstrated with special attention given to Asia and especially to China. A conclusion can be drawn that plans to build greenfield caprolactam plants are being shelved with producers able to meet demand over the next few years by debottlenecking existing plants.

Key words: *caprolactam, nylon 6, global trade, global demand, production capacity.*

While the global nylon fibre industry is undergoing challenging times, demand is growing steadily for caprolactam, the raw material used to make nylon 6. However, one of the world's leading caprolactam producers believes any additional capacity required over the medium term can be covered by existing facilities. Globally, China will show the largest consumption growth in the run up to 2005, and this country will increasingly dominate the Asian nylon 6 industry.

Despite recent rises, the market price for caprolactam has been falling over the longer term, resulting in a serious erosion of margins for producers. Speaking at the China/Asia Nylon Technology & Markets conference held in Beijing in 2002, Ed Sheu, director of DSM Nanjing, China, said several projects to boost caprolactam capacity in Asia have been placed on the back burner because of cost considerations. However, DSM, in partnership with Sinopec, will increase capacity at the existing facility in Nanjing, which is located in a rapidly growing market.

Global Trade

Caprolactam is the principal raw material of nylon 6, a versatile material used in numerous applications, principally as fibres for apparel and furnishing textiles, industrial yarns and floorcoverings, as well as for engineering plastics/films.

According to PCI Fibres & Raw Materials, caprolactam production last year in the Americas was fairly balanced, with 70,000 tonnes of surplus being exported to Asia. Europe had significant surplus capacity and exported around 465,000 tonnes to Asia. Asia is the main caprolactam consuming region and needs imports from the Americas and Europe to fulfil its requirements.

By 2005, PCI predicts the American market will become even more balanced as domestic consumption grows faster than increases in production capacity. In addition, Europe's exports will gradually reduce as demand in the region rises.

Global trade in caprolactam will decrease as Asia becomes more self-sufficient. Nevertheless, Asia will still need to import some 350,000 tonnes in 2005.

Global demand for caprolactam is forecast by PCI to rise from 3.5 million tonnes in 2001 to 3.9 million tonnes in 2005, in line with global GDP growth. However, as capacity utilisation was only 82% in 2001 and 89% is considered as the bottom-line rate for viable production, just 130,000 tonnes of additional capacity are needed to satisfy increased demand over this period. Mr Sheu said this extra volume can be produced at existing plants. "So there is no need to build new plants in the foreseeable future," he told the conference.

DSM believes that adding more grassroots capacity to the current global supply position will result once again in low global utilisation rates and poor financial returns throughout the entire business chain. The company's view is that no new caprolactam plants should be built at least until 2006.

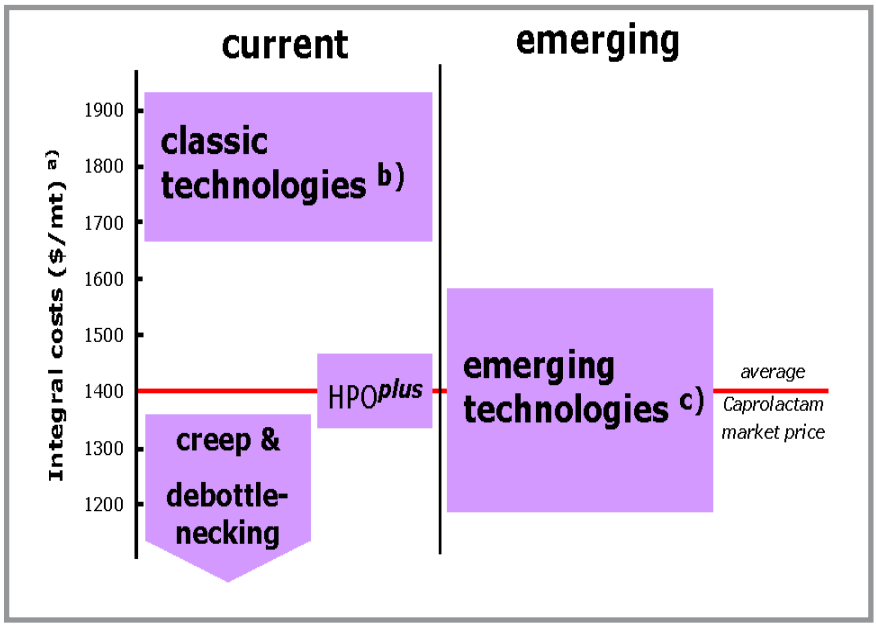

Figure 1. *Overview of caprolactam technologies. a) Integral costs = fixed costs + variable costs + capital charge, b) Classic technologies include DSM HPO, DSM HSO, BASF HSNO, Honeywall, Toray, Bayer, Mitsubishi, Polish, Snia, c) Emerging technologies include DSM Altam, BASF, Rhodia, Sumitomo/Enichem.*

Table 1. Asian caprolactam plants. Source: PCI Fibres & Raw Materials.

Plant	Country	Capacity ('000 tonnes)
Mitsubishi, Kurosaki	Japan	115
Ube, Sakai	Japan	114
Ube, Ube city	Japan	104
Sumitomo, Niihima	Japan	95
Toray, Tokai	Japan	90
Toray, Nagoya	Japan	88
Baling Yingshan, Yueyang (Hunan)	China	60
Nanjing Donfang, Nanjing (Jiangsu)	China	50
Shijiazhuang, Shijiazhuang (Hebei)	China	30
Gujarat, Vadodara	India	70
FACT, Udyogamandal	India	50
Hankook, Ulsan	Korea	120
CPDC, Kaohsiung	Taiwan	120
CPDC, Toufen	Taiwan	65
Thai Caprolactam (Ube 80%), Cheong Nern	Thailand	78
TOTAL	**ASIA**	**1,249**

DSM's Commitment

DSM has been committed to caprolactam production for the past 50 years, its first commercial plant opening in 1952. The Dutch-based group currently operates four world-scale caprolactam plants - two in the Netherlands and two in the USA - with a combined capacity of 500,000 tonnes. The company has also developed its own proprietary technology, including the HSO, HPO, HPO^{plus}, Recycling and Altam processes, which are used by 18 caprolactam plants worldwide.

Figure 1 shows how DSM compares different caprolactam technologies. These are evaluated in terms of the integral costs (including fixed costs, variable costs and a reasonable capital charge) for a grassroots world-scale plant using a standardised location and cost base as well as a standardised price set for raw materials and co-products.

The long-term average caprolactam market price is used as the yardstick for evaluating and comparing the economic feasibility of building a new production plant. Previously, DSM used $1500/tonne as the average price. However, it now believes a figure of $1400/tonne is more appropriate - and this could even fall further. Figure 1 demonstrates that new plants using classic technologies (top left corner) are not viable, because they require a caprolactam price of $1700-1900 to make a decent return on the capital to be invested. The same applies for most of the emerging technologies, although DSM claims that its Altam technology is a viable exception.

DSM says creep and debottlenecking (see below) of existing plants is the only realistic solution to add economically viable production of caprolactam over the coming years. The company recommends using its HPO^{plus} technology to expand existing HPO plants.

Asian Demand

According to PCI, there are currently 15 caprolactam plants operating in Asia - six in Japan, three in China, two in India, two in Taiwan, and one each in Korea and Thailand (Table 1). In 2001, some 63% of Asia's 1.3 million tonnes (excluding Japan) of nylon 6 demand was used in the textile market, 26% in industrial yarns, 10% in engineering plastics/films and just 1% in the carpet sector. By 2005, textiles will account for 53% of nylon 6 consumption, with industrial yarns 26%, engineering plastics/films 17% and carpets 2%.

Given the above economic scenario, many projects to establish new caprolactam capacity in Asia have been stalled for cost reasons. Further, a proposed new plant in Korea would be located in a declining market and uses classical technology. A sizeable part of the output is earmarked for export to China, which will further add to logistical costs, Mr Sheu said.

Meanwhile, a project in Japan is a relatively small prototype plant with as yet unproven technology (high risk). Moreover, it is located in a country faced with growing oversupply and high costs; the output is similarly earmarked for export, mostly to China.

Chinese Potential

China will show the largest increase in consumption in the medium term, with growth at the expense of Taiwan and South Korea. However, the country currently produces less than 30% of its needs, with the bulk of demand covered by imports.

In 2001, China consumed 400,000 tonnes of caprolactam, of which textiles accounted for 45%, industrial yarns 38%, carpets 3% and engineering plastics/films 14%. By 2005, consumption is forecast to rise to 500,000 tonnes, with a similar breakdown of demand, according to PCI.

Chinese self-sufficiency in caprolactam is bound to increase and could reach 50% by 2005. "As part of this development, DSM and Sinopec, through its subsidiary Nanjing Chemical Industries, have teamed up to construct what we believe is the most competitive caprolactam plant in Asia," Mr Sheu stated. The joint venture between DSM and Sinopec, called DSM Nanjing Chemical Company (DNCC) will expand the capacity of the existing production facility from 60,000 tonnes to 140,000 tonnes using DSM's HPO^{plus} technology.

The DNCC plant in Nanjing has 80% of its customers within a radius of 600 km. The required investment will be moderate and the facility will supply the best quality caprolactam in molten form at the lowest logistical cost, Mr Sheu told delegates. "DSM-Sinopec will co-operate with and support China's nylon-6 industry in order to make it more competitive," he said.

Editorial note:

Creep and debottlenecking

Strictly speaking, creep is a small increase in capacity using better operations and without the need for major investment. Debottlenecking is a small or large expansion of capacity obtained by investing in equipment. However, there is a grey area: the two approaches can be combined and these definitions are not adhered to universally. These terms are usually used in combination to describe the economically viable increase in capacity of existing plants.

Received 12.12.2002