A Brief Overview of the Nylon 6 Market in North America

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1. Total Production. The North American production of nylon 6 in 2001 is estimated to have totaled about 559 M lbs. This represents a 9% decrease from 2000. A modest upturn in the economy in early 2002 suggests that some of this drop, perhaps half, will be recovered this year.

2. End Use Markets. Unlike nylon 66, the most predominant usage of nylon 6 is in extrusion applications. Film, wire & cable, monofilament, stock shapes, and blow molded applications account for about 55% of all nylon 6 sold. Of the remaining 45% that is injection molded, half goes into automotive applications, primarily air intake manifolds and fasteners. The non-automotive half is split up among power tools, consumer housewares, industrial components, electrical connectors, and miscellaneous uses, in that order. It should be noted that the automotive "Big Three" have historically refused to approve the use of imported resin for parts.

3. Competitors. Nylon 6 usage in plastics applications is substantially less than its usage in fibers, roughly a 1:3 ratio. As a result, producers who have fiber operations have substantial economies of scale over producers who are only manufacturing for plastics markets. Each nylon 6 fiber producer is fully integrated, producing its own caprolactam. None of the other nylon 6 producers have this advantage. Even so, there are an unusually large number of producers, 14, in the region.

The largest nylon 6 producer in both North America and the world is Honeywell, which makes polymer for its captive use in film and fiber, as well as for merchant sale, in Hopewell, VA. The second largest is BASF, another major nylon 6 fiber producer. BASF's main nylon 6 plant is in Freeport, TX, from which it supplies both its fiber and plastics businesses; it also has a dedicated extrusion grade nylon 6 plant at this site, and has expanded it twice to its present capacity of 120 M lbs. BASF's fiber plants in North and South Carolina are capable of polymerizing nylon 6 for direct melt fiber production. DSM is the number three producer, with a plant in Augusta, GA; its fiber production goes through a joint venture with Beaulieu Industries in Dalton, GA. DSM supplies caprolactam to a number of non-integrated nylon 6 producers, such as the Custom Resins subsidiary of ALM.

DuPont offers nylon 6 glass reinforced compounds, but it is not known if they are producing their own polymer or swapping nylon 66 for it with another producer, e.g., BASF. Bayer offers a full range of nylon 6 resins, but its polymerization facilities are in Germany, so it is likely both importing and swapping for resin, but it does make nylon 6 compounds in both the USA and Germany.

There are a number of non-integrated producers: Ems-Grivory in Sumter, SC; Nytech (a joint venture between Rhodia and Snia) in Manchester, NH; Custom Resins in Henderson, KY (owned by compounder/distributor ALM Plastics in Wayne, NJ); Radicci Plastics in Sumter, SC (under construction); Firestone Canada in Woodstock, ON. Celanese Mexicana is periodically

active in U.S. markets, moving surplus inventory when (domestic) fiber demand is low. Some smaller producers that specialize in certain grades and markets include Shakespeare (SC) and Berkley (IA).

Finally, there are a number of overseas producers who export to the U.S. These include Ube and Unitika (Japan), unidentified producers in Russia, Korea, Poland, and Taiwan. Most of these plants were built by Ems's Inventa engineering unit, which has built literally dozens of them all over the world over the past 30 years. Most of these plants were designed to make nylon fiber chip, but the addition of an inexpensive pelletizer is a simple way to enter the plastics market as well.

All of the above describes only virgin resin producers. There has always been a vigorous reprocessing industry for as long as there has been fiber waste, too. While repro nylon was more or less limited to small independent compounders in the past, the majors have now entered this field as well. BASF and DuPont have small but commercial-scale plants that take nylon 6 and 66 carpets, for example, and chemically turn either nylon back into caprolactam, which can be repolymerized to virgin nylon 6 polymer. Honeywell/DSM has a joint venture with greater capacity, Evergreen LLC, which also recycles nylon 6 carpets back to caprolactam, but Evergreen's operations were suspended last year, citing higher than anticipated costs. These recycling efforts have been spurred by a demand from automotive companies for increased use of recycled materials to enhance their environmentally conscious image. It has been estimated that at least 10% (about 23 M lbs.) of the nylon 6 sold for injection molding is reprocessed (also called "repro," "recycled," or "regenerated"). Reprocessed material is used almost exclusively in injection molded applications because the typical color and reduced physical properties, as well as unclear FDA and UL compliance, exclude it from most extrusion applications. Repro is sold at a discount from prime, the amount of the discount varying with the quality of the product. Compounders utilize a significant amount of repro, typically 10-25%, in their products.

4. Pricing. The presence of repro in the nylon market has historically tended to keep virgin prices low. Also, there is a production cost differential vs. nylon 66 that has usually been reflected in pricing. The latter amount had been about $.08/lb. until 1999, when the difference widened to nearly $.15/lb.; it has since shrunken to about $.10/lb. While these rather dramatic changes appear to have stemmed mainly from the supply vs. demand imbalances that have marked the recent economic slowdown, they are also driven by technology improvements in nylon 6 manufacturing costs. This price differential is causing more end users to prefer nylon 6 over nylon 66 for those new applications where the relatively minor differences in properties are no longer worth the price differential. In 2001, compounding nylon 6 base resin went for $.75-.80/lb. (in volume), standard injection molding resin (unfilled) for about $.95/lb (also in volume). It would appear that producers have been able to stabilize or even slightly increase prices in 2002, but overcapacity relative to demand limits their ability to do anything more than this.