A visit to the foundry

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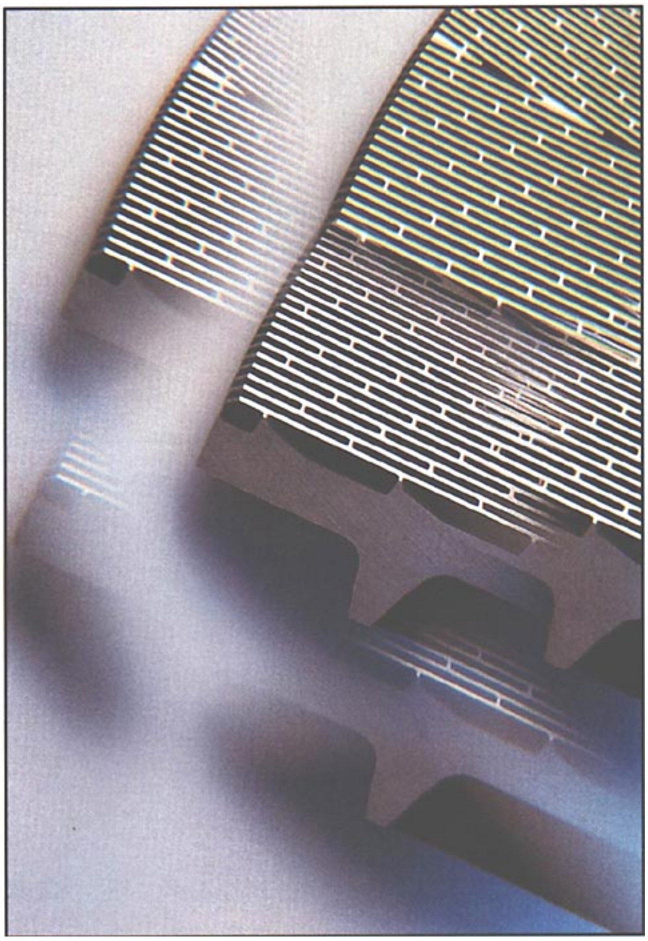
Talk with anyone involved in the refiner segment casting process at Sunds Defibrator's Valkeakoski foundry, and chances are, they'll tell you that in their case, being in the red is very, very good.

Following a trend throughout Europe, Finland's secondary fiber consumption outpaced recovery by more than 20% in 1992, while the country's mechanical pulp production stagnated. News like that might concern a company that has a substantial interest in the mechanical pulping market, but Sunds' ability to design competitive products and follow the geographically shifting market to China and Southeast Asia have helped the company stay in the black.



Invoiced sales in 1992 in Sunds mechanical pulping technology segment rose 2% from 1991 to comprise 28% of the company's sales. (Other technology areas include chemical pulping, panel board, wood handling, and stock preparation.)

The industry will renew its interest in virgin fiber and thermomechanical pulp, says Mechanical Pulping Systems President Arto Aaltonen, and Sunds continues to perform research in these areas.

A year ago, Sunds Defibrator acquired a 90% majority interest in General Machinery Works, Inc., in Tokyo. A licensed partner of Sunds since 1975, GMW is a major manufacturer of refiner segments for mechanical pulping and stock preparation applications. The acquisition is, according to Aaltonen, a "logical step to enhance our presence."

Sunds adds GMW to its Valkeakoski, Finland, foundry that makes conical refiner segments and its flat disc refiner segment foundry in Hagfors, Sweden. While presence is critical to market penetration, it always helps to have a good product.

To be competitive, Sunds turned to computer aided design to develop what the company calls *selective segments.* Sixty years of experience became the foundation for a decade of development time. The result is the company's proprietary Refiner Segment Performance Calculator (RSPC). A CAD system, calculator program, and catalogue make up the RSPC, a tool used to develop conical and flat disc segments. The catalogue has all of the designs, as well as data points from trials run from different types of segments over the years.

A design engineer can call up an existing design on the CAD system, enter different operating parameters, and learn almost immediately where open areas and steam generating points are in the design. From the parameters, the system will predict the performance of the segment. A design engineer can develop a refiner segment, simulate conditions under which it will perform, and analyze how well the segment functioned under these conditions before the segment is ever cast.

The engineers also use RSPC to conduct finite analysis to understand where failure modes could occur. They can see edge rounding and corrosion and areas where the bars have been reduced to the point where stock can't pass through them, all

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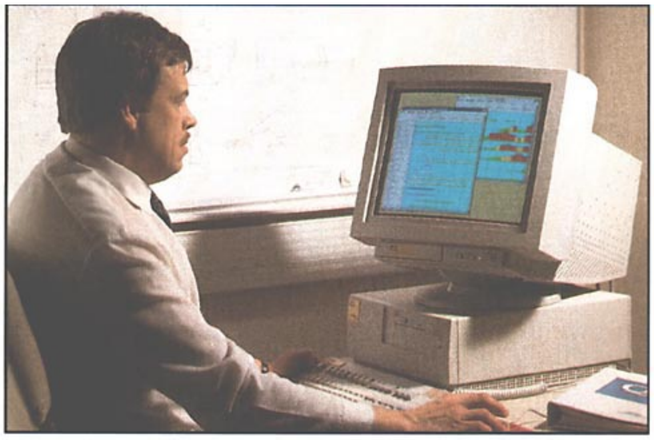
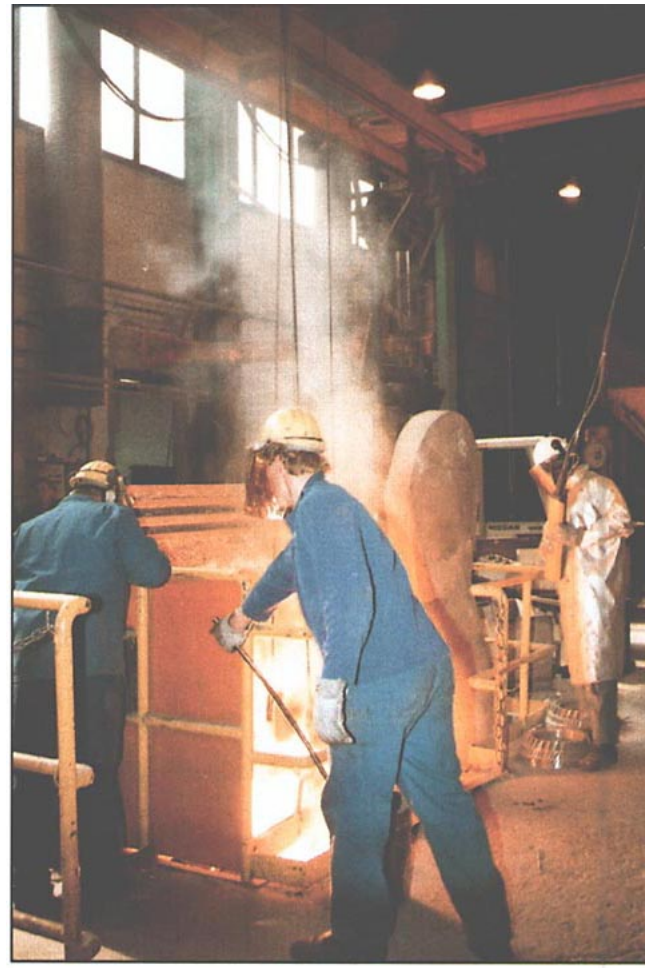


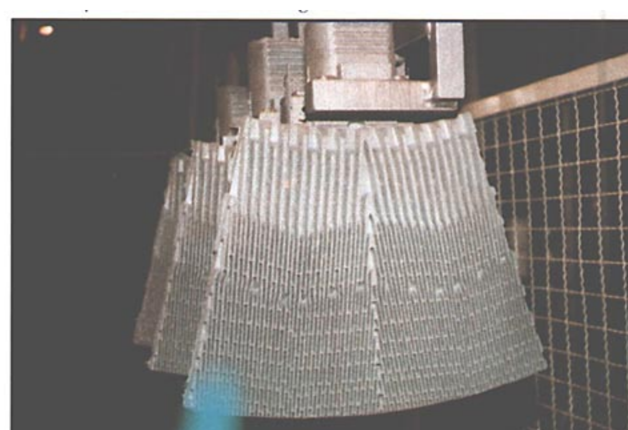
Spitting fire, the 1600°C mixture is poured into the segment molds.

A robot places a refiner segment to temper the piece.

Molten metal glows burnt orange as it is mixed in a steel vat.



The tempered flat disc refiner segment



before they occur. "Doing that kind of analysis has helped us to design plates to counteract certain failure modes," says Robert Guiller, Sunds refiner segment production manager.

By approaching refiner design this way, the company is able to build products that improve throughput while reducing hydraulic demand.

Successful designs are published in the RSPC catalogue and become potential standard product offerings. The catalogue contains several hundred active designs.

Once a segment pattern is designed, it is manufactured and assembled in the foundry. While this is taking place, raw material alloys are melted and the composition of the mixture is analyzed.

The mixture, at a temperature of 1600–1700°C, is poured into the segment mold. The temperature variance may be due to the mold and alloy used. Typical metal would comprise medium- or high-carbon chromium steel (about 17% chromium, with molybdenum, manganese, and nickel). The mold must cool at least four hours before the part is removed. It is fettled to remove any excess material. The surface of the part is cleaned by blasting it with small steel shots. Excess material from where the two halves of the mold join is ground off. The part is tempered through heat treatment so that it will attain the optimum hardness it needs in the refiner. The pieces are heated to temperatures in excess of 1000°C, then they are cooled and become hard. The pieces are heated a second time to 300°C.

After the pieces cool, they are visually inspected for cast defects such as cracks, voids, and missing bars. The parts' surfaces are hardened, tempered, and inspected. Up to this point the sequence of operations for flat refiner segments and conical fillings is, essentially, the same. It is in the grinding shop that each will be handled differently.

Flat refiner segments consist of a rotor and a stator. The rotor is a dynamic piece that spins in the refiner and must be balanced prior to assembly. Similar to balancing an automobile tire, the rotor is dynamically balanced by mounting the it on a shaft and turning the shaft at 500–600 rpm, the speed at which it will run in the refiner. The rotor's pieces are each given a Roman numeral so that when the segments arrive at the customer's mill, they can be assembled in the correct order.

The taper is ground. Through electronic discharge machining, a hole is added to the segments for a true disc clearance sensor. Patented by Sunds, the sensor is a safety device that keeps the plates from crashing together by measuring the distance between the rotor and the stator. It also helps to facilitate startups and shutdowns. The stator is a stationary piece that is ground on the back, face, and edges. The pieces are inspected, packaged, and shipped to the customer.

When conical fillings enter the grinding shop, their surfaces are turned and they are drilled, threaded, and dynamically balanced. The balance is measured in the smaller end of the cone and the larger end of the cone. Pieces of metal are mounted on the fillings to compensate for detected imbalance. The fillings undergo final inspection prior to being shipped to the mills.

***Clites is associate editor of* Tappi Journal.**