The Swedish Steel Industry

Steel accounts for about 4% of the total value added of Swedish industry. Almost 25,000 people, or roughly 4% of the total industrial labor force, are currently employed in the Swedish steel industry. Large investments have been made in research and development, as well as in restructuring and modernizing production facilities. As a result, the same tonnage of finished steel as in the peak years of the 1970s is produced by less than 50% of the labor force of that time. More than 80% of steel is exported and the net income from this amounts to about SEK 15 billion. It is therefore evident that the Swedish steel industry still plays a major role in the national economy.

Historical background

As early as the 13th century, men began mining the rich iron ore deposits of central Sweden, where a large number of charcoal blast furnaces and hammer forges eventually developed. The conditions for manufacturing iron were ideal; the ore was of high quality, the forests provided a plentiful supply of timber and charcoal as fuel, and numerous waterfalls could furnish blast furnaces and hammer forges with the necessary power.

Gradually the industry grew to considerable size. By the mid-18th century, Sweden had become the world's leading iron manufacturer, accounting for an estimated one third of the global iron trade. Exports grew along with production, and until the breakthrough of industrialization in the mid-19th century, Sweden remained one of the world's foremost suppliers of iron. This position had been achieved mainly due to the high quality of Swedish ore and the abundance of forests. But the industrial revolution completely changed the market situation for Swedish iron. New metallurgical processes using coal and coke as fuel and reducing agents were introduced in England and on the Continent. Having no coal reserves of its own, Sweden was unable to mass-produce ordinary commercial steel by the new processes. Instead, the Swedish industry shifted increasingly toward production and export of high-grade iron and steel. This trend has continued up to the present day, facilitated by the introduction of new production methods especially suited to Swedish conditions.

Current structure

Of approximately 600 blast furnaces and hammer forges existing in the 19th century, only 13 steel-smelting plants remain. In addition, rolling of steel is undertaken at nine places. The location of the steelworks is largely a heritage from the past, and most are still found in central Sweden

Specialty steels, i.e., alloy and high-carbon steels, comprise more than 45% of Sweden's total crude steel production, a higher proportion than in other major steel-producing countries. In terms of tonnage, production is relatively small. Although manufacturers of specialty steels usually concentrate on producing a limited range of grades and types, they nonetheless often assume a prominent position both on the Swedish and

international markets. The largest manufacturers of specialty steels include Avesta Sheffield, Sandvik Steel, Ovako Steel and Uddeholm.

Radical structural changes took place in the stainless steel industry during the first half of the 1980s. The production of stainless steel was regrouped from four to two companies, Avesta Sheffield and Sandvik.

In addition, Avesta and Sandvik established a new company for welded tubing, Avesta Sandvik Tube AB (Avesta Sheffield 75% and Sandvik 25%), and a company for steel wire production in Fagersta, Fagersta Stainless AB (Avesta Sheffield and Sandvik 50% each). Avesta Sheffield and Sandvik supply the steel semis for the pipe, tube and wire production of the two companies. The production of stainless seamless tubes has been concentrated at Sandvik Steel.

In 1991 Avesta AB merged with the British Steel Stainless Group and formed Avesta Sheffield AB. Avesta Sheffield is, in international terms, a very large company in the stainless field. In certain market sectors, such as wide sheet and plate products, it ranks as number one in the world. The new company's sales are about SEK 17 bn.

AB Sandvik Steel (part of the Sandvik Group) has sales of more than SEK 8 bn and is one of the leading companies within specific product ranges, e.g., stainless strip steel and stainless seamless tubing. Gusab Stainless AB, a stainless wire producer, was acquired by Sandvik at the beginning of 1989.

Ovako Steel, with a smelter and rolling mills at Hofors as well as mills at Hällefors, has an annual crude steel production of 0.4 Mt (million metric tons). Its most important products are roller bearing steels and engineering steels.

In 1991 Uddeholm Tooling AB, one of the world's leading producers of tool steels, was acquired by the Austrian specialty steel company Böhler. The company has its smelter and main forging plant at Hagfors. Böhler Uddeholm AB also owns Uddeholm Strip Steel AB at Munkfors. The most important products from Uddeholm Strip Steel are cold-rolled strip of high carbon, stainless and other alloy steels.

Erasteel Kloster AB, owned by the French company Erasteel S.A., is the world's leading supplier of high speed steel and operates at Långshyttan, Vikmanshyttan and Söderfors.

Ordinary steel, i.e., non-alloy steel with a low carbon content, is produced by three companies, SSAB, Fundia AB and Inexa Profil AB. Fundia, owned by the Finnish company Rautaruukki and Norway's Norsk Jernverk Holding, has a smelter and two rolling mills at Smedjebacken, as well as a hot-rolling mill at Boxholm. Main products are merchant and reinforcing bars.

SSAB, the biggest steel producer in the Nordic countries, was privatized in the beginning of 1994. It operates two fully integrated steel production units with 100% continuous casting at Luleå and Oxelösund—together with an annual raw steel production capacity

of about 3.5 Mt. SSAB's strip mill is situated at Borlänge (annual capacity: 2 Mt). SSAB's main products are coils, galvanized and organic coated strip, heavy plate and semis. High tensile grades of plate and sheet now provide the company with an important competitive edge. Surahammars Bruk AB, jointly owned by SSAB (25%) and British Steel (75%) is the only manufacturer of electrical sheet and strip in the Nordic countries.

Inexa Profil AB produces rails, ship profiles and round bars at mills in Luleå.

Höganäs AB, with production units in the South of Sweden, is the world's leading manufacturer of iron and steel powder for metallurgical purposes. The Swedish Steel Producers Association (*Jernkontoret*) was founded in 1747. It represents the steel industry in all matters of common interest except labor relations, which are handled by a separate organization, the Employers' Association of the Swedish Steel and Metal Industry(*Stål- och Metallförbundet*).

Production methods

The industry has been quick to adopt new and improved methods of steelmaking, such as ladle metallurgy, electro-slag refining and continuous casting. In keeping with tradition, Swedish metallurgists have continued to make valuable contributions to technological development. A good example of this is the ASEA-SKF process, which produces very pure steel. This process allows refining, degassing, temperature control and analysis to be carried out with great precision, while significantly increasing the production capacity of the electric furnace.

A Swedish method for producing high-alloy specialty steels is the ASEA-Stora process, in which molten steel is pulverized using a gas jet and then subjected to isostatic compression at high temperatures. The result is an ingot which can then immediately be rolled or forged. The method produces a steel with a homogeneous structure and better properties than steel with the same composition but produced in the conventional way. The powder metallurgy technique is also used by Anval Nyby Powder AB, which has developed a method of making tubes of stainless steel from powder.

In a joint research project, the Nordic steel industry has developed a method for the submerged injection of powdered materials for refining, desulfurization, alloying, etc. in the ladle. This has been of great importance to the global development of ladle metallurgy. A computerized process control system, including calculation of mill scale formation for reheating furnaces, has been developed by the Foundation for Metallurgical Research (MEFOS). This system is in use at many plants in Sweden and abroad.

Energy consumption in Swedish steelworks is low in comparison with similar steelworks abroad. This is the result of investments in modern technology as well as energy conservation measures. Emissions from the steel industry have decreased since the early 1970s and are now only a few percent of the previous air and effluent levels. The regulations for dust emissions from steel furnaces are among the strictest in the world, especially since fugitive emissions must also be measured, which is very unusual in other countries.

A plasma technique for metallurgical and other purposes has been developed by SKF Plasma Technologies AB.

Production
In 1995, the Swedish steel industry produced 4.5 Mt of finished steels including semis at a total value of about SEK 34 bn, of which specialty steels accounted for more than 60%. Since a few kilograms of certain specialty steels are as valuable as a ton of ordinary steel, the overall unit value of Swedish steel is high.

More highly fabricated steel products will continue to account for an increasing proportion of the sales of Swedish steel mills, and specialty steels will represent a growing proportion of total production. Production of ordinary steel is expected to continue its trend toward costly types such as high-strength steels.

Products
Stainless, tool and high-speed steels have all traditionally bulked large in Swedish production of specialty steels. Besides manufacturing finished steel in the form of sheet, strip, bars, wire, and so on, specialty steel mills carry out extensive production of fabricated goods. Among the best-known products made of Swedish specialty steels are roller bearings, valve springs, razor blades, saw blades and rock drills. Other products are piping components for nuclear power stations, processing plants, and the like, where durability and serviceability requirements are exceptionally high.

About three quarters of Sweden's production of ordinary steel consist of sheet and plate for use in industry, construction and shipbuilding, a large part of which is exported. Rolled bars and rolled sections constitute nearly one quarter of production. As with specialty steels, in the ordinary steel sector the trend has increasingly been toward fabricated steel products. Examples of this are high-strength industrial plate, organic coated sheeting, rolled welded profiles and welded girders. Sponge-iron powder for powder-metallurgical purposes and welding electrodes are other specialties of the Swedish ferrous metal industry.

Foreign trade
The value of Swedish steel exports totaled SEK 27 bn in 1994, or about 6% of total exports. In addition there are considerable indirect steel exports in the form of tools, machines, vehicles, etc. from the Swedish engineering industry.

In 1994, the volume of steel exports amounted to 3.7 Mt, while imports totaled 2.4 Mt. As a rule, the per-ton value of exports is considerably higher than that of imports. Sweden has thus been a net exporter of steel for many years. Imports consist mainly of ordinary steel in such forms as bars, girders and sheets.

In 1994, Swedish exports of alloy steels including tubing totaled 1.2 Mt, with a value of SEK 16 bn. Stainless steel accounted for 44% of tonnage and 65% of total value. Stainless steel, especially in the form of hot-rolled and cold-rolled plate and sheets as well as tubing, thus occupies an important place in Swedish specialty steel exports. As for

exports of ordinary steel, these consist mainly of plates and sheets as well as reinforcing steel and other bar steel.

Research and development
The Swedish steel industry concentrates largely on special purpose products which require very high quality. The industry's continuing competitiveness entails substantial investment in research and development. All steelworks have their own well-equipped laboratories, in which they carry out advanced research and development work. The steel industry also supports two steel research institutions: the Institute for Metals Research (*Institutet för Metallforskning*) in Stockholm, founded in 1921, and MEFOS at Luleå, founded in 1965. Research in the field of metallurgy and metallography also takes place at universities and institutes of technology. The most important work of this type is being carried out at the School of Metallurgy and Materials Technology of the Royal Institute of Technology in Stockholm.

Extensive joint research work, nowadays involving steel companies in Denmark, Finland, Norway and Sweden, has been carried out for sixty years. It is administered and coordinated by the Technical Department of the Swedish Steel Producers Association.

SEK 1 (Swedish krona) = USD 0.14 or GBP 0.09 (1995 average)
SEK 1 bn = SEK 1,000 million

Swedish steel producers are world leaders in many areas:

Stainless steels
Sandvik-seamless tubes
AST-welded tubes
Avesta Sheffield-hot rolled plate Fagersta Stainless-one of the two biggest in wire rod

Tool steels
Böhler Uddeholm

High speed steels
Erasteel Kloster

Electrical resistance wire
Kanthal **Roller bearing steels**
Ovako Steel-one of the two biggest

Commercial steels SSAB-one of the biggest in high-strength and wear-resistant steels

Iron and steel powder
Höganäs

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