Chapter 3
Mukand—Quality Leadership in Stainless Steel, and Special and Alloy Steel Long Products

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Abstract The article traces the growth of Mukand as a specialist in the production of special, alloy and stainless steel long products, starting with re-rolling mills and a foundry in Mumbai and Lahore in 1937. Over 400 grades of steel including stainless steel long products, alloy and special steel long products for the automotive industry are manufactured today. The company was a pioneer in adopting and making a success of continuous billet casting technology, Vacuum Oxygen Decarburisation technology and Oxygen Top and Bottom blown Converter technology for the manufacture of stainless steel. Today, Mukand is a leading premium producer and exporter of stainless steel long products of austenitic, ferritic, martensitic, precipitation hardening and duplex varieties.

3.1 Introduction

Born in the pre-independence era, Mukand Ltd. was incorporated in the year 1937. The company commenced operations with re-rolling mills and a foundry in Mumbai and Lahore respectively. After India gained independence from the British and the subsequent Partition, the Lahore operations shifted to Mumbai.

Today the company is a large multi division, multi-location, engineering company specialising in the manufacture of Special, Alloy and Stainless Steel Long products. The company also designs, manufactures and commissions Heavy Industrial Machinery including execution of turnkey engineering projects. Mukand's growth story has traversed several milestones (Fig. 3.1).

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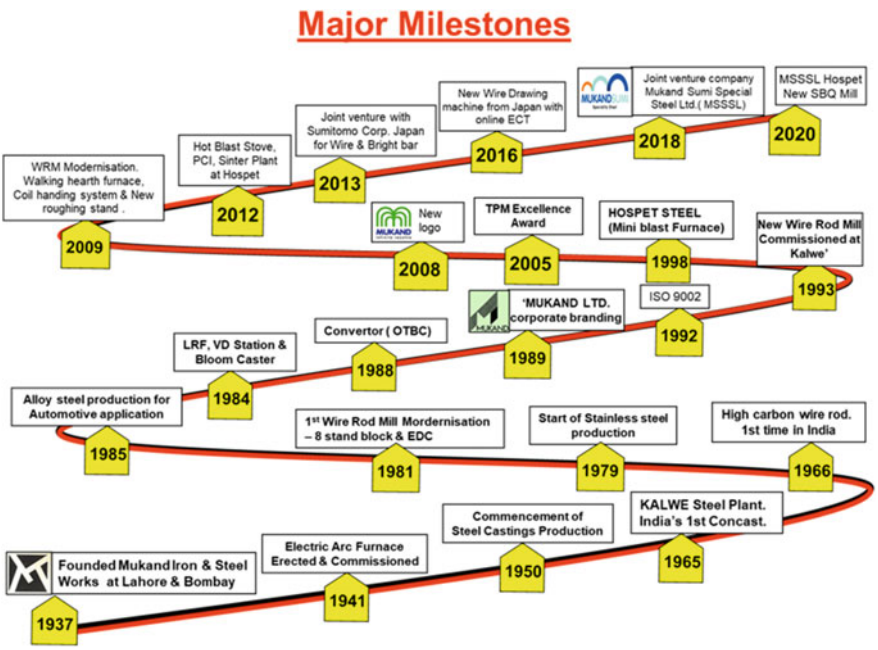


Fig. 3.1 Major milestones of Mukand's growth story

3.2 The Foundry

The Steel Foundry of Mukand used to be the largest in the non-government sector in India until it shut down in the year 2000. The foundry produced castings ranging from tiny components weighing a few kilo grammes to large castings weighing 100 tonnes a piece to customer specifications and drawings. It was one of the first in the country to develop and manufacture high speed cast steel bogies for freight cars. Mukand's foundry was the largest supplier of bogies and couplers to the Indian Railways.

Mukand exported bogies and couplers to Germany, Korea, Taiwan, United Kingdom, USSR (erstwhile) and the USA apart from many countries in Asia and Africa.

Mukand developed the CASNUB bogies for the Indian Railways and became one of its major suppliers (Fig. 3.2).

Fig. 3.2 CASNUB bogie developed for the Indian Railways and alloys steel castings of Kurla foundry

3.3 The Steel Plant

It is rightly said that Mukand is steel as the company today manufactures over 400 different grades of Stainless Steel and Alloy Steels. It is a leading exporter of stainless steel long products, and one of the country's leading suppliers of alloy and special steel long products to the automotive industry.

3.4 Pioneering Spirit

Mukand erected its first Electric Arc Furnace in 1941 and in the year 1965, was the first in the country to adopt and make a success of the continuous billet casting technology using the 'S' type continuous casting machine when it was still nascent in the world. The company was also the first in India to adopt the Vacuum Oxygen Decarburisation (VOD) technology and the first to instal an Oxygen Top and Bottom blown Converter (OTBC) for the manufacture of stainless steel when there were only three other plants that used the technology in the world.

In 1987, Mukand installed an Ultra High Powered Furnace which was then one of the most modern anywhere in the world, equipped with computerised process controls, scrap pre-heating arrangements operating on a waste recovery system and with eccentric bottom tapping and oxyfuel burners as part of its configuration. A ladle refining furnace was added as part of the secondary refining station.

Mukand installed a fully automated wire rod cum bar mill with its walking-beam type cooling bed and an eight stand, no twist block mill. Mukand was the fourth plant in the world to introduce the Easy Draw Continuous cooling system (EDC) for wire rods.

At the time of installation in India, it was the first EDC in India for modifying the microstructure of high carbon wire rods using a hot water quenching technique. The resultant fine pearlitic structure allowed for direct drawing of rolled wire rods to wire with a very high reduction, eliminating the need for patenting. High tensile

wire so produced found applications in areas such as the Prestressed Concrete (PC) wire.

3.5 Development of Stainless Steel at Mukand

Mukand commenced production of stainless steel in the year 1979 using the conventional dilution and remelting technique in an Electric Arc Furnace. This process was not economical as it involved using expensive low carbon ferro-alloys, especially low carbon ferro-chrome which was imported. This was a time when India had to depend on imports for all its stainless steel requirements. Mukand continued with the conventional process till 1987, when the introduction of new technologies revolutionised the stainless steel production. The UHPF-OTBC-VOD process flow was unique to Mukand and was christened the TRIPLEX process (Fig. 3.3).

One of the challenges faced in the manufacture of stainless steel in the initial period was how to maintain carbon below 0.08% which was the limit for the popular austenitic 18–8 grade. This was resolved by maintaining the slag basicity at <1.3 to prevent Carbon pickup from slag.

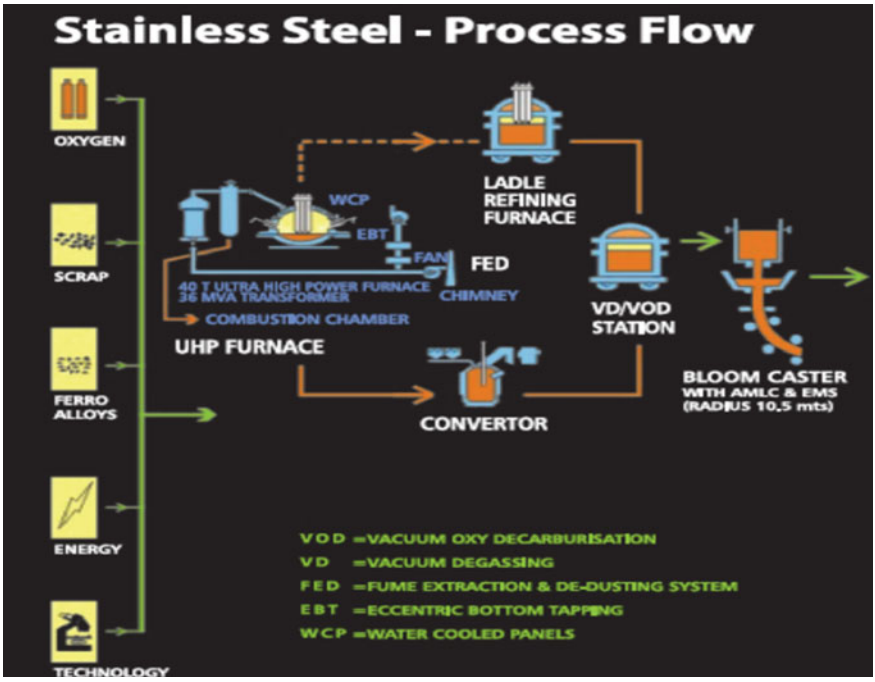
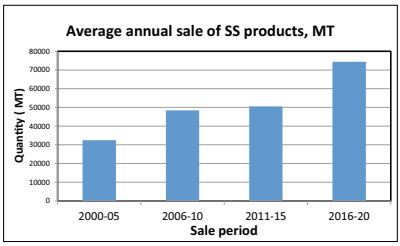


Fig. 3.3 Stainless steel TRIPLEX process route



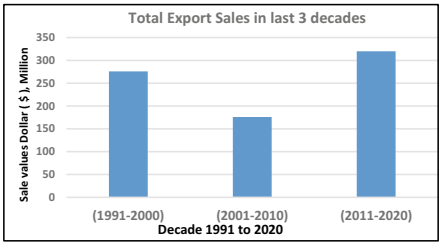


Fig. 3.4 **a** Average annual sale of SS long products, **b** Total SS export sale value for last 3 decades

The other challenge was to prevent excessive oxidation of Chromium. This was done by maintaining a controlled Silicon level in the steel between 0.5 and 0.6%. This process continued for around 5 years after which the TRIPLEX process route and closed stream continuous casting revolutionised stainless steel making. Improved quality and productivity levels could now be easily achieved.

Mukand today is a leading premium producer and exporter of stainless steel long products of austenitic, ferritic, martensitic, precipitation hardening and duplex varieties.

The Quality leadership and wide product mix has helped Mukand achieve significant growth in stainless steel sales, both domestic and export in the last decade (Fig. 3.4a and b).

3.6 Specialised Alloy Steel Development at Mukand

In 1985, Mukand decided to produce alloy steels for the automotive industry. Japanese specifications, however, demanded cleaner steel with Oxygen not higher than 15 ppm. With improvisations in the secondary refining process at the Ladle Refining Furnace (LRF), improved quality of steel with lower Oxygen levels was achieved. The closed stream continuous casting process also prevented the re-oxidation of steel.

Mukand's steel experts were able to achieve the required results and in 1986–87 began supplies to respective component makers. Initial production was high carbon wire rods for cycle spoke and PC wire application, and boron steels for cold heading fastener application.

In the early stages, customers were apprehensive of steel cast through the continuous caster. However, this was overcome with the effective use of Mould EMS and Secondary EMS thereby improving the internal structure of the steel. With extensive testing and trials, customers were convinced that even with 1:6 reduction ratio for Continuous Cast material, the product quality was equivalent to steel produced through ingot casting.

A rigorous process engineering was done to ensure and control Oxygen below 15 ppm. It was achieved by controlling the alumina inclusions and ensuring low calcium level in the steel. This process standardisation also the paved the way for

Fig. 3.5 Rolled steel products and auto component parts produced from Mukand material

ball bearing steel development with oxygen < 10 ppm, which was required for better fatigue life in the bearings.

Mukand installed the Short Time Cycle Furnace (STC) in 1992 for spheroidised annealing. The controlled atmosphere furnace imported from the USA and made with patented Japanese technology, ensured minimum surface decarburisation and a uniform spheroidised structure to meet the requirements of the cold heading process.

All this has helped Mukand supply a variety of steel products for a variety of applications to the Indian steel market (Fig. 3.5).

3.7 Increase in Production as Markets Mature

As the automobile market in India grew, the Original Equipment Manufacturers (OEMs) increased their sourcing of raw materials from within the country. In order to be globally competitive and also become a leading supplier to the auto component industry, Mukand decided to set up a green field steel plant based on the blast furnace route. This plant was commissioned in the year 1998 as a joint venture company in Hospet, near Bellary region, where the high grade iron ore reserves are situated. Best in class technology was adopted early on to ensure high productivity and to meet the stringent quality requirement of the multinational automotive companies who had set up base in India.

The Mini Blast Furnace (MBF)—Energy Optimising Furnace (EOF)—LRF—Vacuum Degassing route for Alloy Steel production entered the growth phase from 2001 onwards (Fig. 3.6). The Hospet Steel Plant now produces almost 0.7 Million MT steel per annum.

Today, Mukand is at the forefront of 'clean steel' production in the alloy steel long product sector by adopting superior process design. All the major passenger vehicle and two-wheeler manufacturers in the country use Mukand's steel for the manufacture of critical components. Several European and American auto makers too have approved Mukand steel for the manufacture of components that are then exported to various countries across the globe.

Annual sales of Special and Alloy Steel have doubled in the last 20 years (Fig. 3.7).

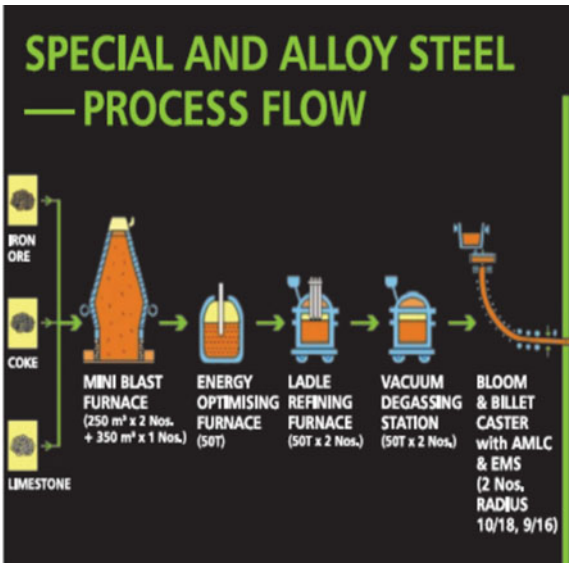


Fig. 3.6 Process flow for special and alloy steel making

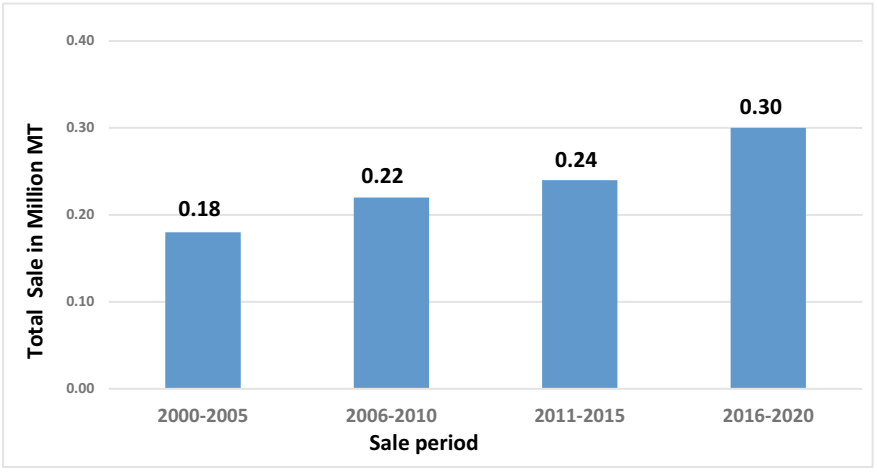


Fig. 3.7 Average annual sales of special and alloy steel

3.8 Research and Development (R&D)

Research and Development has been at the forefront of Mukand's growth in the steel sector. The Company established the R&D department in 1985. 'Super steel—60' dual phase steel bars for the construction industry, controlled surface layer (CSL)

process for colouring stainless steel parts for decorative purposes were some of the achievements in the initial years of this department. The company invested in equipment such as the Scanning Electron Microscope (SEM) and automatic computer controlled polishing machines way back in the 1990s. The R&D unit designed and installed a pilot plant for descaling of stainless steel wire rods through a 'Rapid Electrolytic Descaling' process. R&D activities were carried out in heat treatment and development of import substitution steel, viz., ball bearing, cold heading quality steel and high-speed machining steels. These achievements were well recognised in the metallurgical field and the R&D division of Mukand won 'Outstanding in-house R&D' award of 1993 in the Secondary steel Sector from Department of Scientific and Industrial Research (DSIR), Government of India. Recent focus of R&D has been on the development of new verities of Duplex stainless steels, Microalloyed steels and process improvements for clean steel production. Several technical papers have been published in national and international journals.

3.9 Total Quality Management

Mukand was one of the first companies in implementing Total Quality Management (TQM) systems in the steel sector. TQM was implemented by the company in the late 80s, starting with Quality Circles, and Juran Quality Improvement (JQI) programmes. The ISO 9000 standards were also adopted, as a Quality Management System. Mukand was the first steel company in the country to be certified to this standard in the early 90s.

In the year 1999, Total Productive Maintenance (TPM) was initiated with the help of JIPM, Japan. Mukand won the TPM Excellence Award from JIPM, in the year 2003 for its Machine Building Division and in 2005 for its Steel Division.

3.10 Awards and Recognitions

Mukand's leadership in consistent high-quality products has been well recognised. The company won the National Quality Award four times during the period 1994 to 2000 in the Mini steel sector category from the Indian Institute of Metals (IIM). Mukand won the Gold Certificate from the Ministry of Steel for the year 2016–17 for contribution to the secondary steel sector. Mukand has been regularly winning Supplier Quality Awards from its customers. Prominent among these have been the Global Quality award for the year 2012 and the Global best supplier award for the year 2019 from SKF, Sweden.

3.11 Gearing Up for the Millennium

Having forged a joint venture with Sumitomo Corporation of Japan, Mukand recently commissioned yet another green field project of a state-of-the-art modern Bar and Wire Rod rolling mill in Hospet, Karnataka with an investment of Rs. 6,500 Million. This modern bar and rod mill with PSM technology of SMS Germany has a capacity of 0.6 million MT.

This fully automated facility aims to embrace the Industry 4.0 norms. Becoming carbon neutral and embracing clean energy technologies to reduce the carbon footprint is the next giant step in sustainable development that the company hopes to achieve.

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