STEELS IN THE ORDNANCE FACTORIES

by

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ABSTRACT

The growth and development of iron and steel industry in the country, particularly in Ordnance Factories, including their future scope are described.

Early history

The art of making iron and steel was known to India long ago. With the advent of machine age, and development of modern science and technology, the processes adopted in earlier days for the manufacture of iron and steel have greatly changed; the manually operated ore–dressing and ore-concentration equipments have been replaced by modern fully mechanised ore-beneficiation and sintering plant, the bloomeries fitted with hand-operated bellows have gone and completely mechanised and instrumented high top-pressure blast furnaces have emerged in their place; good quality n etallurgical coke have displaced charcoal, the few varieties of iron and steels have been now superseded by innumerable types of iron and steels and further new types of iron and steels are being added almost every day to keep pace with the all-round developments of modern science and technology.

In India the earliest attempts to manufacture iron and steel by modern methods were made in 1830 by the Porto Novo Iron and Steel Company. The blast furnaces were set up first at Port-Novo in South Arcot, then near Beypur on the Malabar Coast and also on the Cauvery near Coimbatore. In the Ordnance Factories, manufacture of steel by modern acid openhearth process started in 1892 at the Foundry and Steel Factory subsequently renamed as Metal and Steel Factory. Manufacture of steel by the acid openhearth process and steel sections by rolling and forging continued since then for use in Ordnance Factories, State Railways and other Govt. departments.

Growth and development of steel industry in the Ordnance Factories

During 1925-26, Metal and Steel Factory produced about 40 different varieties of low, medium and high carbon as well as nickel, nickel-chromium alloy steels to meet the then requirements of the Services as well as to render as much assistance as possible to Railways and other civil engineering industries. Later, with the installation of a small capacity electric arc furnace in 1931-32 and a few high frequency induction furnaces in subsequent years, manufacture of many more high and low grades alloy steels and engineering steels was established. Our steel melting units at present consist of acid and basic open hearth as well as acid high frequency induction and basic electric arc furnaces and our manufacture includes more than 100 different types of

carbon and alloy, tool and engineering steels to meet various requirements of the Services, Railways and many other engineering industries. The present production practically covers the whole range of carbon and alloy steels. Imposition of strict process production control at every stage of manufacture to ensure quality production, right from segregation of different classes of steel scrap and other steel-making raw materials up to the finished product stage, has enabled to-day to bring the quality of our production at par and in some cases even superior to the quality of similar stores imported from abroad. It may be said in brief that production of steel in the Ordnance Factories is confined mostly to quality steels.

The recent installation of an additional arc furnace which is now quite a fairly big unit in the country, would enable stepping up the manufacture by a substantial amount of special quality carbon and alloy steel ingots to meet the increased requirements of such steels both for the Services and other civil engineering industries, as manufacture of such high grade special steels could best be carried out in electric furnace only. In view of the above, as well as for reasons of economy manufacture of electric steel is becoming popular and gaining much importance all over the world as apparent from the table quoted below which indicates that the percentage of production in the electric steel compared to the total steel production is steadily increasing in most of the countries including India.

Electric steel production as percentage of total steel output

	1954	1955	1956	1957	1958
U.S.A.	6·11	6·83	7·48	7·04	7·74
U.K.	5·0	5·6	5·8	5·6	5·8
F. R. Germany ..	5·0	5·2	5·5	5·5	6·0
India	5·2	5·3	6·1	6·2	6·2

In the Ordnance Factories, the electric-steel production both in electric arc and high frequency induction furnaces constitutes over 25% of the total steel production.

Range of products

Since all the steels produced in Ordnance Factories are ultimately used for the production of precision/intricate castings, critical forgings, deep-drawing and cold finishing work, the steel needs careful processing and rigid metallurgical control at each stage of manufacture.

Our steel castings now range in weight from 2 lbs. to 10 tons, iron-castings from 8 oz. to 10 tons individual pieces and in wrought form the product varies from individual free-shaped forging having dimensions of 34″ dia.×96″ long weighing 15/16 tons to high tensile musical wire 0·010″ dia. weighing 1·42 lbs. per mile.

Soft magnetic iron for tele-communication, free cutting steels for cycle and other light engineering components, spring steels for Rly. wagons and coaches, trucks and tractors, case hardening steels for engineering parts, die-block steels for drop stamping and other shaped forgings, carbon-chromium hard steels for ball-bearings and roller-races, carbon and alloy high speed and

hot-die steels for tools, jigs and fixtures, stainless steels for corrosion resistance purpose etc. are some of the ferrous items which are produced in the Ordnance Factories to help the engineering industries both in the private and public sectors. Like other integrated iron and steel industries, Ordnance Factories also have got a future expansion programme to step up the present production of special quality steels by more than 100% and the above manufacture will mostly remain confined only to such types of special steels which are at present neither produced indigenously in the country nor imported from abroad.

Saving of scarce steel making materials

Countries like U.S.A. and U.K. have their own nickel ores, and extraction plant to produce nickel of high purity and adopt methods for maximum economy in the expenditure of this highly useful but scarcely available metal. India lacking in nickel ores, has to develop substitutes for nickel on high priority basis. Contribution of the National Metallurgical Laboratory, Jamshedpur, in developing nickel-free austenitic stainless steel is quite significant and a great advancement in this regard. Every endeavour should however be made to see how best nickel could be substituted in other nickel-bearing engineering irons and steels also.

Manufacture of chromium metal as well as good quality ferro-chroms have not yet been fully established in the country; the use of this metal also is therefore to be economised to the extent possible till sources in the country are fully developed and manufacture established.

While there are good deposits of manganese ore and manufacture of ferro-manganese, both of blast-furnace and electric furnace quality, have been established, it is worth considering to economise the use of manganese to the extent possible by restricting the manganese limits in various structural steels except where for technical reasons the higher manganese contents have to be retained.

Molybdenum which is second to chromium in importance, has steadily risen to a position of high utility as an alloying metal for steels and certain high-duty irons. Molybdenum is almost an invariable constituent of special quality steels both for heavy duty engineering and armament purposes. Being a very good alternative for tungsten both in high speed and hot-die steels, molybdenum is a very useful metal in alloy tool steels also. In spite of the fact that the World's supply of molybdenum arises within the U.S.A., the American authorities are practising strict economy in the use of this metal in low alloy engineering steels. India too has to develop economical use of this metal even though her present requirement is not of a high order.

With regard to tungsten, it is well known that there is world shortage of this metal. As mentioned above, molybdenum is greatly used in substitution for tungsten in tool steels as well as in electronic applications. The use of ceramic tipped turning tools and milling cutters in lieu of tungsten-carbide tipped tools has effected certain economy towards saving of the above important scarce metal.

Since only a small quantity of ferro-titanium and ferro-ziroconium is consumed in the manufacture of special quality steels, no special emphasis is laid on the saving of these scarce metals. However, about 0·75% titanium in the 18/8 austenitic stainless stabilised type steel is added to prevent weld-decay. It has recently been established that good austenitic welding rods should preferably

have niobium (columbium) which deposits readily in the weld metal compared to titanium which burns out due to greater affinity for oxygen during the welding operation, Niobium (columbium) is nowadays conserved for special high temperature steels and alloy applications. Though there has not been any significant application of this important scarse metal at present in our country, there is a great future for it. It is learnt that certain complex high alloy steels used for jet engines rotor blades contain up to 4% niobium (columbium).

Another important scarce metal is cobalt which is used in the manufacture of permanent magnets and other magnetic materials. With a view to conserve this important rare metal, its use in the manufacture of super high-speed steels has been greatly eliminated. Experiments are also in progress in many countries to find out a substitute of cobalt for magnetic materials. It has recently been observed that in some of the cobalt-rich alloys, cobalt could be satisfactorily replaced by tantalum although no such work on cobalt has yet been commenced by us.

Effect of iron and steel industry on world economy

The iron and steel industry occupies a very prominent place in the world economy. The growth and prosperity of the iron and steel industry of a country is an indication of its economical and sociological development. After World War I; all the leading countries of the world made their earnest endeavours to establish iron and steel industry as a part of their economical development programme, with the result that the world annual steel production stepped up from 70 to 125 million tons nearly during the year 1920–1930. After tiding over the world economic crisis during 1930–32 when the production dropped down by approximately 50 million tons per year, the production figures again rose up and before the out-break of World War II, the world steel production reached a figure of approximately 115 million tons per year, of which the biggest contribution was made by U.S.A. as she did even before World War I.

The out-break of World War II created an unprecedented demand of various new types of iron and steels and vigorous development took place in many countries. The after-effects of World War II brought a great change on the economic structure of almost every country. As far as is known the World Steel production to-day is above 300 million tons which may go up to 400 million tons in the next couple of years. United States still maintains the lead as she produces about 40% of the total world steel production now and next to her is U.S.S.R. who contributes about 18 to 19% of the total production.

The future of the iron and steel industry is very great since most of the countries of the world are now trying to build up their own iron and steel industries. Both the living standards as well as the sociological structure of a country could be judged to a great extent by her per capita consumption of steel. In the United States, the per capita consumption of steel is approximately 12·5 cwt which is the greatest in the world; in India it is approximately 14/15 lb. and India is trying to develop iron and steel industries both in the Public and Private Sectors in a phase-wise planned programme on high priority basis, so as to step up production by over 100% immediately and over 250% in the distant future.

The target production of 10 million tons by the end of the third Five-Year Plan should not be considered as a very big quantity since, even with the above production, our per capita consumption of steel will still remain lowest in comparison with other advanced countries in the world.

For a country which will be producing 10 million tons of steels annually in the next 5-years' time, it is most essential that production of special quality, tool and alloy steels should also be proportionately increased in order to provide necessary tools with which the 10 million tons of steels could effectively be worked up. The production figures of different qualities of steels in different countries show that, in spite of the forceful drive towards conservation of alloys to the greatest extent possible and the acute shortage of alloying elements, the production of tool and alloy special quality steels in most of the advanced countries still constitutes about 6 to 7 per cent of the total crude steel production. On an analogy, there is an immediate necessity in India to set up a half-million ton production capacity in the country for the manufacture of tool and alloy special quality steels. The Ordnance Factories with their accumulated experience and knowledge on the manufacture of tool and alloy special quality steels and with the installation of the new 12-ton Electric Arc Furnace could surely make some contribution towards the above requirements of Special quality steels.

The future

The manufacture of high quality steels in the Ordnance Factories dates back to the beginning of the first regular alloy steel production in the country and results from more than fifty years of development and improvement in the manufacturing technique, that is from 1906 when this Metal and Steel Factory produced 3 per cent Nickel Gun steel for armament purposes. The requirements of special quality steels for various industrial development work are steadily increasing and more so in the recent years as a measure to achieve self-sufficiency. The existing technical skill and production facilities in Ordnance Factories are now concentrated on the development and production of still finer alloy steels and other metalic materials to meet new and special requirements of both the services and other engineering industries.