EXECUTIVE SUMMARY

0.1 PROCESSES AND TYPES OF ROLLING MILLS FOR FLAT PRODUCTS

Flat product rolling mills can be broadly categorised into two groups, i.e., hot rolling mills and cold rolling mills. Plate mills and strip mills fall in the category of hot rolling mills whereas cold reduction mills and skin pass or temper mills constitute the cold rolling mills. The rolling mills are also categorised in various other ways, e.g., continuous, semi-continuous, steckel, tandem or reversing/non-reversing mills depending on equipment arrangement and 2-hi, 3-hi, 6-hi, 20-hi, planetary mills etc., depending on configuration of rolls in the mills housing.

Hot strip mills conventionally use thick slabs, either rolled from cast ingots or continuously cast slabs as the input material. Recent trends, however, point to greater use in future of continuously cast thin slabs with possible ultimate development of near-net-shape strip casting technology which will greatly reduce investment and operating costs.

Cold rolling mills which conventionally have been independent units are now being integrated with upstream and downstream processing units to form continuous lines for integrated processing in order to reduce investment and operating costs and reduce processing time.

02. HISTORY OF DEVELOPMENT OF FLAT ROLLING

The 19th century saw the first installation of a 4-hi mill and a cluster mill by Krupp of Germany, the first 3-hi universal plate mill in USA, the first reversing plate mill in England, and the production of HR strip upto 250 mm maximum width. During the first half of the twentieth century, DC motors were introduced in rolling mills, and the rolling industry expanded at a tremendous pace with the development of high capacity continuous hot rolling mills and tandem cold rolling mills. Since 1950, the accent has been on improvement of productivity and product quality and reduction in operating costs. Some of the major technologies introduced in the period include continuous slab casting, automatic gauge control system, strip profile and flatness control systems, extensive application of mill automation and computerization and energy saving techniques such as hot direct rolling.

0.3 STATE-OF-THE-ART SCENE - INTERNATIONAL

Following the oil crises of 1973 and 1979, new technologies have been introduced in rolling mills for energy savings, development of diversified products for meeting specific applications, improvement in product quality and material yield and for improved productivity. The recent trend in the industrialised world has been to restructure/downsize and modernize existing capacities for improved utilisation and profitability. Increase in production capacities has taken place mostly in the developed countries.

0.4 STRUCTURE OF INDIAN ROLLING MILL INDUSTRY FOR FLAT PRODUCTS

Bokaro Steel Plant, Bhilai Steel Plant and Rourkela Steel Plant (SAIL) are the major producers of hot and cold rolled flat products in the country. TISCO, which is setting up a 1.0 million tonne capacity hot strip mill is also set to become a major flat product producer soon. There are a large number of secondary producers in the private sector operating small capacity narrow cold rolling mills. The secondary sector is growing at a fast pace and a number of medium capacity wide cold rolling mills are in various stages of installation.

Except for the cold rolling mills complex installed under Bokaro, 4.0 million tonne expansion and the reversing cold mill of Nippon Denro Ispat. Ltd. and a few others, all the existing plate mills, hot rolling mills and cold rolling mills in the country need to be modernised to meet present day production and quality requirements. Large scale modernization of the public sector plants is on the anvil and some of the private sector units are also planning to modernize their mills.

The demand for flat products is expected to rise and a number of hot strip mills and cold rolling mills will be set up in 1991-2000. It is estimated that some export oriented units will also come up during this period.

0.5 DESIGNERS AND MANUFACTURERS OF ROLLING MILLS EQUIPMENT

The structure of Indian industry with regard to design, engineering and manufacturing aspects of rolling mills has been presented in the report. Broadly, the Indian companies

engaged in this field can be classified as follows :-

- Designers and suppliers of rolling mills mechanical and auxiliary equipment.
- Manufacturers of mechanical equipment
- Manufacturers of auxiliary equipment
- Designers, manufacturers and suppliers of electrical equipment.

The first mentioned category of designers and suppliers of rolling mills, are few in number and have either development design and engineering capabilities through long-term collaboration with reputed foreign mills builders or are supplying rolling mills based on short-term arrangement with foreign designers and suppliers on a case-to-case basis. The design and engineering companies have either no manufacturing facilities of their own or have only marginal facilities and have to depend on the Indian engineering industry for manufacture of indigenous equipment.

In the second category of manufacturers of mechanical equipment, are included the medium and heavy engineering companies. These companies are catering to the manufacturing needs of all industries. Rolling mill equipment manufacture can be undertaken by these companies in varying degrees of capability depending on the facilities available and based on design and manufacturing drawings supplied by the purchaser. These firms generally do not have any collaborations with foreign companies for manufacture of specialised rolling mill equipment.

In the category of manufacturers of auxiliary equipment are included firms specialised in the manufacture of hydraulic and pneumatic systems, lubrication system, pumps and valves, etc. Besides undertaking equipment supply, these firms also carry out system design meeting the purchasers specifications. In most cases, these companies have foreign collaborations for know-how.

The fourth category pertaining to designers and manufacturers of electrical equipment covers such Indian firms which have collaborations with reputed foreign suppliers for industrial systems design and also undertake manufacture of electrical equipment.

0.6 TECHNOLOGY ABSORPTION - EFFORTS AND GAPS

The status of technology in India in the flat products rolling mill industry is a unique blend of old and new technologies. Upgradation/modernization of the plants currently

using outdated technologies is essential with a view to increase mill productivity, improvement in yield and product quality, production of diverse range of value-added products and conservation of depleting energy resources.

Regarding technology absorption in the operating plants, it can be said that by and large the technologies have been successfully absorbed and adapted to Indian working conditions. A fairly high degree of import substitution has already been achieved in most plants. However, most of the plants are not producing to their rated capacities because of constraints of poor quality of raw materials, poor mill availabilities due to problems of maintenance, power supply interruptions, etc. Efforts, are being made for improvement in plant performance by introduction of wide ranging modernization plans and improvements in operating practices.

In the field of design and engineering of rolling mill equipment, the leading companies have successfully absorbed and adapted know-how obtained through foreign collaborations. However, fostered by an increasingly competitive international market, new processes and technologies are being introduced abroad at a very fast pace. As a result, even in spite of complete absorption of technology/technologies already introduced in India by the Indian design and engineering companies through their collaborators, new gaps in technology continue to emerge.

The heavy and medium scale engineering industry in the country is today equipped to manufacture most of the equipment required for a high capacity hot or cold rolling mill. The equipment still required to be imported include heavy cast steel mill housings of the order of 100 tonnes piece weight, mill rolls of certain types and weight, large size bearings and oil film bearings, drive spindles, high pressure pumps, special valves, instruments and sensors, electronic components, etc.

0.7 HUMAN RESOURCE DEVELOPMENT

The rolling mill industry is poised for large scale modernization and absorption of the latest technologies. Against this background, the importance of human resource development cannot be over-emphasised. A large body of trained man-power and specialists already exists in the country, with experience in the fields of mill design, manufacturing and installation, commissioning and operation. This vast resource has to be drawn upon for bridging the current technology gaps through an elaborate process of training as well as exposure to the operation of modern plants. Greater stress has to be put on the development of skills for computer aided design, development of mathematical models

and software for specific automation and control applications and development of state-of-the-art equipment through research and development efforts as well as through technology acquisition through foreign collaborations.

0.8 CONCLUSIONS

i) The changing conditions in the recent years have placed increasing demands on rolling mill designers for better and cost effective design for improved performance of machines, plants and systems, superior quality of mill products, quicker and more rational mode of manufacture through NC machines, use of advanced automation and computerisation, energy saving and environmental protection. In order to meet these demands, equipment designers and engineers are constantly developing new technologies for optimising the operating process. Some of the important recent innovations are equipment for direct rolling for energy saving, thermo-mechanical rolling for production of high strength material, endless rolling for high productivity, hydraulic roll positioning systems for quick and exact thickness and width control, improved means for roll bending and shape control for achieving higher degree of crown and shape control capabilities, minimum tension control for obtaining closer tolerance values, complete automation of the rolling process to improve material yield and mill productivity.

ii) The growth of the steel industry as a whole and rolling mills in particular is dependent on adoption of new technologies. Introduction of the state-of-the-art technologies is necessary not only for the new plants but also for modernisation of the existing plants.

iii) While the rolling mill industry abroad has generally kept pace with the modern developments, most of the modern technologies are yet to be introduced in the rolling mill in India.

iv) As far as the status of technology in the rolling mills for flat steel products in India is concerned, most of the rolling mills, barring a few, have out-dated technologies-lagging behind their Western counterparts. No sincere efforts have been made in the past for upgradation of existing technologies and acquisition of new technologies.

v) The demand for flat steel products in the country is poised for a rapid growth with increasing demand from the consumer durable and automobile sectors. The emphasis today is on improvement of product quality and production of value

added products. If the industry is to remain self-reliant in steel, it is imperative that this sector of industry plans its production in a manner which not only meets the projected demand in terms of tonnage but also in terms of right quality and product -mix.

vi) The basic areas where technology imports are felt necessary have been identified in the report after making a detailed review of the state-of-the-art of technologies available abroad and their relevance to Indian conditions. The technological improvements need not only be incorporated in the new mills but also in the modernisation of the existing mills.

vii) The strength and the weakness of the indigenous companies engaged in the design, manufacture and supply of mechanical and electrical equipment and auxiliary systems for the rolling mills for the flat steel products have been described. The Indian industries for design and manufacture of rolling mills have grown at a rapid pace during the last two decades as evident from the fact that some of the prestigious mills, incorporating the state-of-the-art of technologies, have been set up recently with indigenous efforts.

0.9 RECOMMENDATIONS

i) The growth of the steel industry as a whole and rolling mills in particular is dependent on adaptation of new technologies. Introduction of the state-of-the-art technologies is necessary not only for the new plants but also for the modernisation of existing plants. Most of the modern technologies are available with the leading Western & Japanese companies, many of which are being covered under the patent rights. The technologies provided by these companies are generally proven. However their adoption in Indian Plants will require careful planning and case studies based on Indian conditions and design. Introduction of the new technologies have to be supported by integrated operation, more efficient operation and maintenance practice, improved level of personnel and technological disciplines, increased usage of instrumentation, automation and computerization. Introduction of the modern technologies must be preceded by proper training of manpower and appreciation courses. Tie-up with foreign companies on case to case basis, if necessary, may be considered provided such technology collaboration ensures that a high percentage of equipment are designed and manufactured indigenously.

ii) A committee of experts drawn from different design and manufacturing companies, R&D establishments, SAIL and other operating plants may be constituted to take up in-depth study of the requirement of the new technologies relevant to the Indian conditions and analyse the various designing and manufacturing constraints not only in terms of capability limitations but also with regard to quality of output and delivery schedule. The committee should make specific recommendation on ways and means removing the present gaps and bottlenecks.

iii) Promotion of a steel development fund may be considered which may cater to specific research and development programmes wherein greater interaction may be assured between R&D establishments, design institutes, equipment designers, manufacturers and users for development of new designs and for testing of the same through pilot plants and actual field trials.

iv) There is need for augmentation of indigenous designing and manufacturing capabilities by introduction of computer aided design and computer aided manufacturing techniques necessary through know-how and training from reputed foreign companies.

v) As a part of the technology modernisation and upgradation, if it is found that modification of an existing mills would yield limited results and would not be cost effective, it would be advisable to replace the whole equipment/machinery by modern one.

vi) There is urgent need for going in for large scale export, where the product quality and the cost of production would have to be kept at par with those available from the competing nations. This objective can be achieved by upgrading the technology of the existing plants in terms of equipment design and processes and also introducing process automation and computerisation on a large scale.

vii) In order to augment the indigenous capability for equipment design, manufacture and supply of rolling mills, foreign collaboration may be needed. In such cases design of state-of-the-art of equipment for control of profile and flatness of rolled products should be undertaken through close interaction with the foreign collaborator.