

Status of Cold Rolled Steel Sheet Industry in India

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Introduction :

Cold rolling is a process through which the hot rolled steel sheet or strip after pickling is introduced between the rollers by application of high pressure at temperatures below the re-crystallization temperature. This method basically imparts smooth surface finish, accurate thickness, high tensile strength, yield strength, hardness with corresponding decrease in ductility. Hence, selection of proper combination of steel composition, degree of cold working and heat treatment play a pivotal role to produce cold rolled sheets/strips with mechanical properties suitable for intended usage.

The process of cold rolling originated in Germany way back in early nineteenth century which involved cold reduction of high carbon wire to produce flattened cross sectional product. The concept materialized with the objective to reduce thickness of hot rolled steel coils/sheets to less than 1.24 mm; which are otherwise unattainable in hot strip mills. The early cold rolling mills used to be of single stand non-reversing type with narrow hot rolled coils as the input. 1920s made a beginning towards cold reduction of wider hot rolled coils with single stand reversing mills with developments to evolve at the present day's high speed Tandem mills. Today's cold rolling mills offer better control of thickness, shape, width, surface finish and other special quality features that compliment the emerging need for highly engineered end use applications.

Cold Rolling Processes :

Cold rolling involves production of permanent deformation of steel for any given pass by exceeding the elastic limit of the steel as a result of the compressive forces of the rolls on the steel and the tensile forces along the length between the reels and the rolls. Here, the work load has to be uniformly distributed at various stages of rolling and the maximum



load in general, is determined by the mill design, power, steel width, total amount of reduction, lubrication, steel cross sectional contour, hardness of the steel, steel surface, steel tension, roll diameter and roll surface. However, the lowest % reduction is in the last reduction pass to permit better control of flatness, gage and finish of the product.

Based on the design, the cold rolling mills can be broadly classified as Reversing Mills and Tandem Mills.

Reversing Mills :

In these mills, the steel is passed back and forth until the required amount of reduction is obtained. The reversing mills are highly flexible for production of varied dimensions of steel coils for various orders, the passes are considerably slower than the Tandem Mills and suffer from higher cost of production due to lower productivity in spite of the lower installation costs of this mill. Presently, the reversing mills used are of the type 4 High, 6 High & 20 High.



Tandem Mills :

These mills are continuous mills specifically for carbon steel rolling and consist of 5 or 6 closely spaced stands. The hot rolled product is given one pass through the stands with each contributing to thickness reduction and driving the steel rolled at speeds that are synchronized such that the steel sheet is in tension at each stage between the pay off reel, different sets of work rolls and the recoil reel. In these mills, the lowest amount of reduction is given in the last pass to permit better control of flatness, gauge and finish of the product. In 4 High Tandem Mills, the reduction in individual passes typically vary from 25% to 45% on all stands and in the last pass, it is about 10% to 30%. Though the initial installation costs are higher, these are high speed mills and are well known for higher productivity and cheaper cost of cold rolled sheet/strip/coil production.

sheets. However, the production of cold rolled sheets/coils could be maintained through duty free import of hot rolled coils.

Import & Export Scenario :

India emerged as a Net Exporter of cold rolled steel coils/sheets since 2001-02. The exports were to the tune of 19.36% of the total production. There has been a continuous growth in exports from 2001-02 except for the last fiscal which is expected to have declined slightly. This can be attributed to some extent on the increased export figures in 2005-06 & increased domestic consumption. Import & export statistics of cold rolled sheets/coils is shown in Table 2.

Table 2. Cold Rolled Steel Sheet Import & Export Statistics

YEAR	IMPORT (Thousand Tons)	EXPORT (Thousand Tons)
2001-02	204	320
2002-03	302	574
2003-04	243	770
2004-05	330	1270
2005-06E	510	1180

Apparent Consumption :

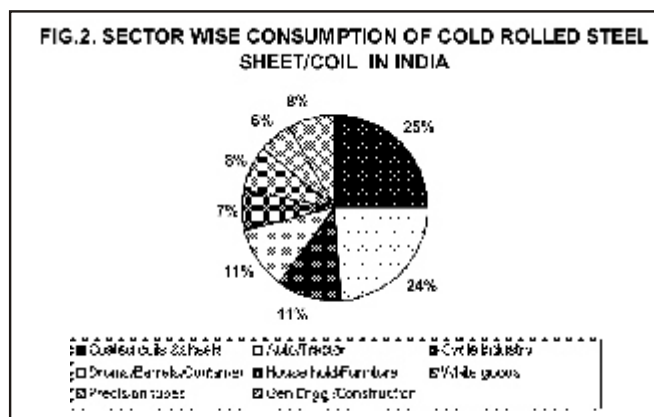
Cold rolled steel strips/sheets are consumed both in direct form and indirect form. In the **direct form**, the sheets produced are directly consumed in auto sector, drums & barrels for oil sector, consumer durable industry, precision tube mills, steel furniture and general engineering sector. In automobiles, the application includes outer skin panels, inner critical components, reinforcement and underbody components. Oil & Gas segment consumes for the tubes, barrels etc. Another area is the consumer durable industry where refrigerator doors, side panels, washing machine panels, ventilation and air conditioning ducting, electric panels etc. are made of cold rolled sheets. General engineering sector consumes cold rolled sheets for making bearing cages, paint cans, box strapping, electric sheets for motors, generators & transformers, tubes etc. Furniture sector involves in making of almirahs, chairs & office furniture components with the cold rolled steel products. Other areas of application include cycle making parts for cycle industry, containers, water tanks & silos.

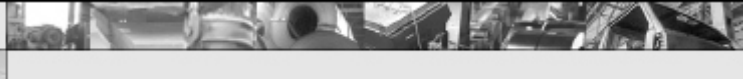
While the **indirect form** of consumption is through galvanized/colour coated, electrical sheet and tinplate/TMBP making. The galvanized /colour coated sheets are used for roofing in domestic & industrial buildings followed by electrical sheet utilization for making electrical machinery &

equipment as well as domestic goods, fans, pumps, motors etc. and tin plates/TMBP usage for edible/non-edible product packing, manufacture of toys, hoardings, boards, boxes, teachests, ammunition boxes and so on.

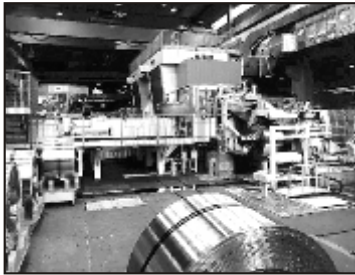
Cold rolled steel sheets/strips are available in varied dimensions, dimensional tolerances with regard to thickness, flatness, width, surface finish from brushed bright to matte and embossed, numerous metallurgical designations like commercial steel, drawing steel, deep drawing variety and so on with specified steel chemistry coupled with surface treatment either special cleanliness, dry lube or oiled to meet the application requirements. Along with the controlled sheet thickness, flatness and surface finish, cold rolled sheets/strips are metallurgically designed to provide attributes like high formability, deep drawability, high strength, dent resistance, enamelability, paintability etc.

The sheets/strips find usage in various segments. In **automobiles**, the application includes outer skin panels, inner critical components, reinforcement and underbody components. Galvanized corrugated sheets for roofing in the area of **construction**. Another area is the **appliance** sector where refrigerator doors, side panels, washing machine panels, ventilation and air conditioning ducting, electric panels etc. are made of cold rolled sheets. **General engineering** sector consumes cold rolled sheets for making bearing cages, paint cans, box strapping, electric sheets for motors, generators & transformers, tubes etc. **Oil & Gas** segment consumes for the tubes, barrels etc, **furniture** sector for making almirahs, chairs & office furniture components, **cycle industry** for cycle making parts are made from cold rolled steel sheets/strips. Other applications include containers, water tanks & silos. The sector wise consumption of the cold rolled steel coils in India are illustrated in Fig.2 which reveals the profound influence of the auto sector.





The modern Tandem Mills are equipped with hydraulic automatic gauge control system, hydraulic work roll bending system for controlling strip shape/profile of the coil, high crown 6 high roll shifting system, quick work roll changing, on line shape meters to monitor and control the strip flatness and gauge display system, micro-processor controlled operation in



auto mode, agitation and filtration system for supplying emulsion to the rolls along with detergent strip cleaning in the last finishing stand. Also, developments include adjustment of roll gap profile by intermediate rolls featuring continuous

variable crown and enhanced shifting strategy for equalization of roll contact loads to result in lower roll wear coupled with design of work rolls as EDC rolls for reduction of the edge drop effect.

The cold rolled strip/sheet after exiting the reversing/tandem mill is extremely hard and stiff exhibiting greater amounts of spring back when bent and applications highly limited. This necessitates the sheet/strip to be annealed (batch or continuous type) for softening it and make it useful. Annealing can be either batch or continuous type. After annealing, the sheets/strips are subjected to pickling in case of stainless steels or else directly temper rolled. This is carried out in a 2 High Skin pass Mill which imparts small amounts of cold reduction typically about 0.25% to 1.5% to suppress the sharp yield point and eliminate luder bands/stretcher strains in subsequent deep drawing operations coupled with control of surface finish providing wide range of finishes from matte to luster finish and improved flatness.

Production Scenario :

The cold rolled steel industry constitutes of 6 integrated producers and about 85 non-integrated production units in

India. The estimated cold rolling steel capacity is about 9 million tons. This industry accounts for about 15.47% of the finished steel production in India compared to nearly 18% in the developed world. Also, cold rolled steel sheets constitute 24.88% of the total flat products produced in the sub-continent. The production trend of cold rolled steel sheets/strips in India is illustrated in Fig.1.

The average annual growth rate of cold rolled steel industry is about 7.77% from 2001-02 till date. However, the growth rate can be better assessed by the role of major producers (SAIL, TATA STEEL) & secondary producers (ESSAR, JVSL, ISPAT, BHUSHAN, UTTAM GALVA etc. along with mini/midi mills having no in-house hot rolling facility) on cold rolled steel sheet production. The production statistics of major & secondary players is shown in Table 1.

Table 1. Cold Rolled Steel Sheet Production of Major & Secondary Producers

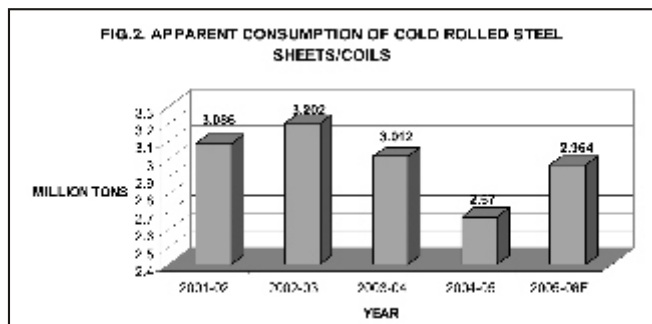
YEAR	MAJOR PRODUCERS (Million Tons)	SECONDARY PRODUCERS (Million Tons)	TOTAL (Million Tons)	Y-O-Y GROWTH%
2001-02	1.552	3.096	4.648	10.93
2002-03	1.766	3.275	5.041	8.46
2003-04	1.768	3.707	5.475	8.61
2004-05	1.843	3.875	5.718	4.43
2005-06E	1.904	4.189	6.093	6.55

It is evident from Table 1 that the secondary producers account for almost 68.75% of the total cold rolled steel sheet production in the country and remain a major force influencing this industry prospects. The increase in production is attributed to the healthy growth of 8.10% in production over 2004-05 by the secondary producers.

Hot rolled steel coil is the basic input for making cold rolled coils and accounts for about 70% production cost of cold rolled material. Hence, the cost and availability of hot rolled coil has a tremendous influence on global competitiveness, sustainable growth and prospects of Indian cold rolled steel industry. The domestic prices are mostly fixed on Import Parity or landed cost basis along with addition of ocean freight, customs duty & other costs to the global basis. In spite of India being a low cost producer of hot rolled steel coils, the domestic prices in general were much higher than the international prices. This has affected the competitiveness of the secondary producers which possess only cold rolling mills. Also, the high prices of the hot rolled coil and increased price fluctuations both on domestic & global front influenced the consumption of cold rolled steel



The continuous increase in the price of the hot rolled coils affected the performance of the Indian Cold Rolled Steel industry and the apparent consumption has been showing ups & downs as illustrated in Fig.2.

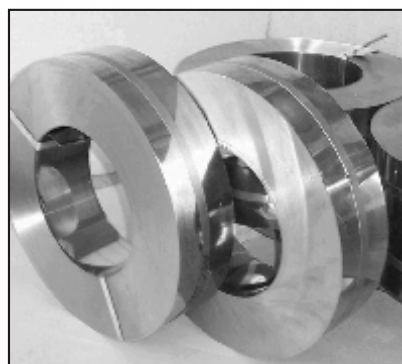


The increased export statistics of the cold rolled coil and the high apparent consumption last fiscal vividly reveals the booming auto sector in the sub-continent influencing the fortunes of the cold rolled steel industry.

Categorization of Cold Rolled Steel Sheets :

Based on the intended use of the cold rolled sheets/strips, carbon steel sheets are broadly classified with regard to combination of cold rolling and annealing as **No.1 Hard Temper** (highly stiff with no bending but limited to flat work only), **No. 2 Half Hard Temper** (less stiff but limited to 90 bends across rolling direction

and around radius equal to the thickness), **No.3 Quarter Hard Temper** (bent 90 in the direction of rolling around radius equal to thickness and 180 across the rolling direction over its

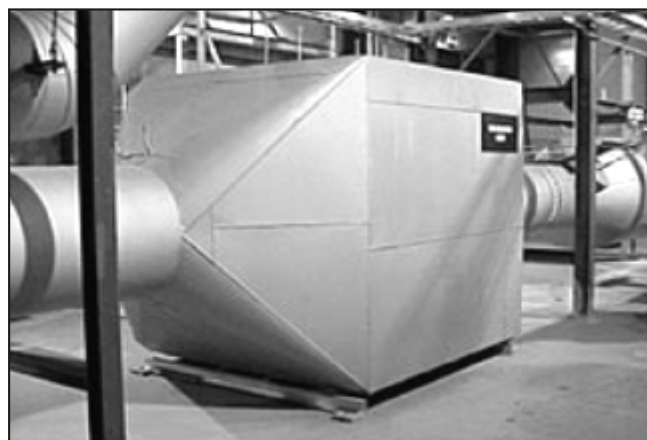


own thickness), **No.4 Skin Rolled Temper** (bending flat upon itself in any direction and for deep drawing and avoid stretcher strains) & **No.5 Dead Soft Temper** (annealed temper intended for severe cold forming operations where stretcher strain formations is not objectionable). The finishes can be dull or bright or use of various textures on work rolls. For stainless steel sheets/strips, the categorization involves **No.2** (Cold

rolled, annealed and pickled in bright/dull finish), **No.4** (Cold rolled, annealed, pickled, skin passed), **No.8** (Cold rolled, annealed, pickled, skin passed, mirror finish) etc.

Future Prospects of Cold Rolling Industry :

The global market for auto components is estimated at \$700 billion with India emerging as a hub for this market with expectations to capture 50% market share. This appears to be a healthy sign for the Indian Cold Rolling industry. The option of de-integrated structure of the steel industry with major producers based near raw material sources focusing on intermediates/semis and the mini-mills near consumption



centers or even a structural adjustment between the major producers & the mini/midi mills can in a big way would brighten the future growth of this industry and can help to capture the markets of the growing auto & infrastructure sectors. Also, Rational Pricing Strategy with the price of domestic HR coils should be in line with the prices in other nations to provide level playing field in the cold rolled steel industry especially with countries where Free Trade Agreements concluded for sustainable growth.

Of course, there lies large potential for Cold Rolled steel consumption in the rural market. The demand for cold rolled steel products is projected to grow steadily to 20 million tons by 2015 with major expansion of production capacities and inducing technological advancements by the integrated and secondary producers to produce high grade Cold Rolled products at globally competitive prices.

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