

Focus on Galvanised / Colour Coated Steel in India

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Steel is a versatile product and has a wide range of applications. Infact, steel touches every sphere of our life. The only demerit of steel is its natural tendency to corrode. Corrosion eats away steel, causing significant economic loss. It has been estimated that corrosion costs about 4 percent of the GDP of an industrial country's economy.

Zinc coatings provide an effective way of protecting steel against corrosion. Zinc coated or galvanized steel offers a unique combination of high strength, formability, light weight corrosion resistance, aesthetics, recyclability and low cost that is unmatched by any other material. As a result, galvanized steel is an ideal material for a multitude of applications like buildings, manufacture of automobiles, household appliances to residential, commercial and industrial construction.

Advantages of Zinc Coating

Zinc coatings have two fold advantages which are as follows :

- i) The zinc coating protects steel from corrosive attack in most atmospheric conditions, acting as a continuous and lasting shield between steel and atmosphere, as long as the zinc sheath remains unbroken.
- ii) It acts as a galvanic protector, sacrificing itself slowly in presence of corrosive elements, by continuing to protect the steel even when moderate size areas of the bare metal is exposed. This ability of zinc results from the fact that zinc is more electro-chemically active than steel. Of all industrial coating materials, zinc alone possesses this dual capability.

Due to the above qualities of zinc coating, the manufacturers and consumers of galvanized steel all over the world are now demanding a higher content of zinc coated steel in construction, automotive and while goods sectors. There are presently over 700 continuous galvanizing lines in operation throughout the world.

Galvanising Processes

There are two major processes used in manufacture of galvanized products. These are:

- Hot Dipped Galvanising
- Electrolytic Galvanising

(a) Hot Dipped Galvanising :

It is one of the basic and efficient corrosion resistant techniques for producing galvanized steel. During this process, steel coils are previously cleaned and pickled and then dipped in a bath of molten zinc to form a series of zinc / iron alloys integrated with the surface of steel. As the steel is removed from the bath, a layer of relatively pure zinc is deposited on the top of alloy layer. On solidification, zinc assumes a crystalline metal structure, often called "Spangling". The spangles can be enhanced or reduced depending on the end user.

Earlier, hot-dipped galvanized steel products effectively met the corrosion requirement but had a limited formability and lacked in surface quality. Hence they were used in non-stringent applications like construction and were unacceptable to the automobile and while goods sectors.

However, with the dramatic development of the technology in the last three decades like use of radiant tube furnaces, coating control and especially with the development of galvanizing (GA) process, there has been a significant shift in use from electro



galvanized to hot-dipped galvanized steels particularly in the automobile sector.

(b) Electro – Galvanising :



In the electro-galvanising process, zinc ions from the electrolyte are deposited on the strip surface (cathode) under the influence of electric current using either soluble or insoluble anodes. The electrolyte is

usually zinc sulphate or zinc chloride or mixed. The electro galvanized sheets ships are post – treated with passivation solutions such as phosphate or chromate.

The plating process controls the coating thickness and help to achieve much thinner sheets as well as double side coatings. These sheets have excellent surface finish and press formability for corrosion protection of autobody fuel tanks, exhaust pipe etc.

The investment cost of an Electro Galvanizing Line (EGL) is almost the same as that of a Continuous Hot-Dipped Galvanizing Line (CGL) with GA facility. However, the EGLs do not have the annealing and temper rolling facilities in-built in the system. Thus, to produce annealed electro-galvanized products, annealing and temper cooling have to be done prior to electro-galvanising. This requires an additional investment cost on capacity in the annealing unit and skinpass mill which makes the process more expensive.

It may be mentioned here that the cost of electricity in India is much higher than that of the developed countries which makes the operation of EGL's more expensive. Hence, under the Indian conditions, continuous galvanizing lines (CGL's) are economically more attractive.

Application of Galvanized Steel Products

Galvanized steel products (GP/GC sheets) are used in construction sector in roofing, side claddings, agricultural sites, railway platforms, factory sheds and in various areas of housing. These coated products have also major uses in the automobile and appliance sector.

The use of galvanized steel in automotive body panels allows the present day automakers to guarantee a corrosion free life of over 12 years, adding only a fraction of a percentage to the total cost of production. In the appliance manufacturing sector, galvanized steel sheets are used in white goods and other household products providing a corrosion free life of over 15 years. In the construction sector, zinc coated products have a life of about 50 years.

Attributes & Applications of Galvanised Products

The various industrial applications and key attributes of galvanized products are shown in Table – 1.

Table – 1: Applications and Key Attributes of Various Galvanised Products

Galvanized Products	Applications	Key Attributes
Galvanised	Steel Frame – Heating, Ventilation, Air-conditioners, Roof & Floor Decking, Preprinted Building Panels, Agricultural Storage Bins, Autobody Inner Parts.	Formability and Durability Range of Coating Thickness Speed of Installation ; Easy Paintability and Cost Effective.
Electro-galvanised	Autobody Outer Parts, Computer Cases Etc.	Good Surface Finish, Weldability, Electro-magnetic Shielding.
Galvanneal	Autobody Outer Parts, Preprinted Appliances Wrappers	Weldability, Paintability and Formability
Galvalume (or Zinalume)	Bare and Painted Roofing, Side Claddings	Corrosion Performance for Bare Coatings, Paintability
Galfan	Preprinted Panels, Equipment for Automobile Industry	Corrosion Performance Form Ability and Patintability
Galbo	White Goods, Colour Coated Steel Sheets	Corrosion Performance, Form Ability, Durability, Paintability

Recyclability of Coated Products

All types of zinc coated products are recyclable. The Electric Arc Furnace (EAF) is the principal recycling route of zinc coated steel. According to the industry sources, about 80-85 percent of zinc available in India is being recycled.

Environment

Zinc itself and all types of zinc coated steel products are fully recyclable. Zinc is a natural element and is essential to all forms of life, including humans, animals, plants and micro-organics.

On a macro scale, the excellent corrosion protection provided by zinc coatings contributes significantly to the durability and life expectancy of steel products which in its turn helps to conserve natural resources and reduce the cost of maintenance, repairs and replacement for the steel industry.

Special Quality Galvanised Coated Sheets : Galvannealed (GA) Products

The galvannealing process was developed to satisfy the stringent quality requirements of the automotive industry for corrosion protection of outer and inner panels at optimum cost. In this process, an intermediate layer of iron and zinc is formed on the surface of the strip by diffusing iron (to the extent of 7-12 percent) in the coating from the substrate into the zinc coating the substrate characteristics become more important in galvannealing than in ordinary galvanizing. Typical coating range in GA products is 60-200 gm/m² (both sides). These steels are used in automotive industry because of improved manufacturing performance in models that use lighter and stronger grades of steel.

In India, Tata Steel was the pioneer in developing galvannealed steel.

Galvalume or Zinalume

Galvalume (also known as Zinalume) consists of 55 percent aluminium 43.5 percent zinc and 1.5 percent silicon by weight. It provides a tough barrier between the atmospheric condition and inner core of steel. Protection is offered by the corrosion resistance of the coating itself. Galvalume also protects steel from corrosion at cut edges and scratches which is achieved through the sacrificial protection provided by the zinc in the coating. Galvalume has a life three times more than that of ordinary galvanized steel.

Advantages of using Galvalume as a substrate are :

Corrosion Resistance : Resistance to atmospheric corrosion, cut edge and crack protection.

Yield Advantage : Aluminium makes up 55 percent of Galvalume by weight but comprises 80 percent by volume. So, the coating weighs less, giving the end-users more square feet per tonne of the material than ordinary galvanized steel.

Good Formability : Galvalume is suitable for all but severe forming operations. It can be easily bent, roll formed and drawn without sacrificing coating adhesion.

High Temperature Resistant : Galvalume can easily withstand temperature up to 600°F without surface discolouration. Galvalume is therefore, not only a superior material for roofing but also ideal for other operations such as component in toasters, ovens and gas heaters.

Thermal Reflectivity : Due to its good thermal reflectivity, Galvalume steel roofs with proper insulation, make it a cost effective roofing system.

Exceptions :

Galvalume coated steel cannot be used in frameworks in contact with wet concrete, products embedded in concrete, animal shelters where ammonia levels are constantly high, fertilizer storage sheds and containers, culverts where the materials is buried in the ground, water tanks, high alkaline environments, coastal and marine structure.

Galfan

Galfan is 95 percent zinc and 5 percent aluminium. When used as a substrate, longevity of products is much higher than that of ordinary galvanized steel. It finds applications in marine wire ropes, small springs, pre-painted building panels, appliances and automotive parts. Galfan coated steel has outstanding coating adhesion, it is an ideal material for deep drawn and 'zero thickness' bend applications. It is about 3 times more corrosion resistant than galvanized steel.

Galbo Sheets : These are special zinc coated products in which the base material is cold-rolled in Grade-D, skin passed and stretch leveled with normal spangles. It is corrosion resistant with good formability, durability and paintability Galbo sheets are used in white goods, colour coated sheets etc.

The Indian Galvanised Steel Industry

The production of GP/GC sheets in India has recorded a significant growth in the recent years. Almost all the major producers of galvanized steel in the country have adopted state-of-the-art technologies and are manufacturing high quality products to stringent international specifications for high end applications. India's galvanized steel products have been well accepted in the global market. In 2006-07, India exported 1.84 Mt of galvanized steel products which was 42.93 percent of domestic production. In the first half 2007-08 (April to September, 2007), the country exported 1.1 Mt of galvanized steel products – 52.56 percent of domestic output.

Broad Sectorwise Consumption Pattern

The broad sectorwise consumption pattern of GP/GC sheets in India is shown in Table-2.

Table – 2: Broad Sectorwise Consumption Pattern of GP/GC Sheets India (%)

SECTOR	SHARE IN CONSUMPTION (%)
Construction	45
Consumer Durables	10
Drums, Barrels, Containers	9
Railways, Power, Irrigation	8
CPWD, PWD, Other Govt. Depts.	7
Tube Makers	4
Furniture Makers	5
Engineering Units	6
Automobiles	4
Others	2
TOTAL	100

Capacities of Major GP/GC Producers in India

The annual production capacities of major GP/GC producers are shown in Table– 3.

Table – 3 : Annual Capacities of Major GP/GC Sheet Producers in India

PRODUCER	ANNUAL CAPACITY ('000 Tonnes)
SAIL, Rourkela Steel Plant	160
SAIL, Bokaro Steel Plant	170
Tata Steel	400
Bhushan Steel & Strips	360
JSW Steel	550
Ispat Industries	780
Uttam Galva Steels	700
Sipla Coated Steels	100
Shree Precoated	510
National Steel	150
Essar Steel	50
Jai Corporation	100

Production of GP/GC Sheets in India

Production figures of GP/GC sheets in India between 1992-93 and 2006-07 are presented in Table-4.

Table – 4: Production of GP/GC Sheets India ('000 Tonnes)

YEAR	PRODUCTION			Y-o-Y GROWTH (%)
	ISPs	SECY. PROF.	TOTAL	
1992-93	296	270	566	= =
1993-94	290	315	605	6.89
1994-95	300	456	756	24.96
1995-96	311	547	858	13.49
1996-97	301	686	987	15.03
1997-98	345	777	1122	13.68
1998-99	301	911	1212	8.02
1999-2000	286	1144	1430	17.99
2000-01	423	1497	1920	34.27
2001-02	521	1835	2356	22.71
2002-03	666	2124	2790	18.42
2003-04	774	2356	3130	12.19
2004-05	804	2868	3672	17.32
2005-06	807	2975	3782	3.00
2006-07 (P)	813	3475	4288	13.38

Data Source: JPC, ISPs = Integrated Steel Plants (P) = Provisional

It may be observed from the above table that the average annual increase in production of GP/GC sheets in India between 1992-93 and 2006-07 has been about 46.97 percent. In the last five years between 2001-02 and 2006-07, the annual average growth in production was 16.4 percent.

The secondary producers contributed substantially in the total production of GP/GC sheets in India. In 2006-07, the share of secondary producers in the total production of GP/GC sheets in India was over 81 percent.

Imports



Due to higher demand of high quality galvanized products in India's domestic market, the volume of imports of GP/GC sheets has been increasing in recent years.

The import figures of galvanized steel products by India between 1999-2000 and 2006-07 as well as its share in the country's apparent consumption of GP/GC sheets are presented in Table – 5.

Table – 5: Imports Galvanized Steel Products by India & its Share in Apparent Consumption: 1999-2000 to 2006-07

YEAR	IMPORTS ('000 Tonnes)	SHARE OF IMPORT IN APP. CONSUMPTION (%)
1999-2000	75	6.23
2000-01	73	5.24
2001-02	97	5.54
2002-03	92	7.27
2003-04	102	6.03
2004-05	106	5.50
2005-06	134	6.53
2006-07 (P)	203	7.72

Date Source : JPC (P) = Provisional



Exports

India has been exporting substantial quantities of galvanized steel product in recent years. The exports figures as well as its share in India's domestic production are shown in Table-6.

Table – 6: Export of Galvanized Steel Products by India and Its Share in Total Production: 1999-2000 to 2006-07

YEAR	EXPORTS ('000 Tonnes)	SHARE OF EXPORT IN PRODUCTION
1999-2000	320	22.38
2000-01	589	30.68
2001-02	695	24.50
2002-03	1610	57.71
2003-04	1486	47.48
2004-05	1843	50.19
2005-06	1244	32.89
2006-07	1841	42.93

Data Source : JPC

Apparent Consumption

The apparent consumption of galvanized steel products are shown in the Table – 7.

Table – 7: Apparent Consumption of GP/GC Sheets in India

YEAR	APPARENT CONSUMPTION ('000 Tonnes)	Y-o-Y GROWTH (%)
1999-2000	1204	= =
2000-01	1393	15.70
2001-02	1750	22.63
2002-03	1265	(-) 27.71
2003-04	1691	33.68
2004-05	1926	13.90
2005-06	2051	6.49
2006-07	2629	28.18

Data Source : JPC

Special Applications of Galvanised Steel

Automotive Industry

Galvanized steel sheets are being extensively used in bus and truck bodies. Galvanized (GA) steel is used in autobody outer panels because of its improved performance in models which use lighter and stronger grades of steel.

Electro – galvanized steel sheets have an ultra smooth surface coating thickness which is desirable for autobody exterior panels. The coating thickness for electro-galvanized sheet is typically lower than that of hot-dipped galvanized sheet.

Galfan steel is also used for severally formed components like automotive parts that are prone to corrosion.

According to international experts, hot-dipped galvanized products are now reaching top quality level as required by the automotive and teletronic industries (Hi fi and hardware) with production rates as high as 100T/h per meter width of coated products. In addition, the substrates have moved from CQ 320MPa yield stress to Extra Deep Drawing Quality on the soft side as well as the TRIP and Dual Phase grades reaching the 1000MPa Tensile Strength on the high strength side.

Galvanized Rebars

Galvanizing protects steel reinforcement and other embedded components against corrosion in concrete. In India, the famous Lotus Temple in Delhi has used galvanized rebars. In western India such rebars have been used in port structures, Port Trust buildings, residential complexes and through out the country in hotels, railway coach washing facilities, railway platforms etc.

Light weight pre-cast cladding elements and architectural buildings, surface exposed beams, columns and exposed slabs.

Pre-fabricated building units like kitchens, bathroom modules and tilt up construction etc.

Immersed or buried elements that are subjected to ground water effects and tidal fluctuations.

Coastal and marine structures.

Transport infrastructures including bridge desks, road and crash barriers.

High risk structures that are exposed to moderately aggressive environments.

Colour Coated Steels

Colour coating usually refers to the application of liquid paint coat over the substrate in an automatic, continuous process after pre-treatment. The pre-painted colour coated steel is a high volume – added product that combines the best properties of both substrate and organic coating, additionally imparting it an aesthetic finish, high degree of durability and high corrosion resistance.

Colour coating is done on various substrates to produce most cost-effective, quality assured products with the top coat

compatible with environment.

The substrates usually used are :

- a) Hot-Dipped Galvanized Steel (HDG)
- b) Electro – Galvanized Steel (EG)
- c) Galvalume
- d) Galfan
- e) Aluminium

Pre-treatment

Pre-treatment of the substrate is a very important operation required for better adhesion, formability of pre-painted steel sheets.

Leading colour coated steel producers in India have introduced NO-RINSE technology in place of phosphate coating over galvanized strip because of better bath maintenance, uniform crystal structure of coating as well as to meet the demand of end – users for more flexibility of coated steel.

NO RINSE coating pre-treatment is a very thin layer of chemical treatment that bonds the coating surface of steel to the subsequently applied paint to ensure excellent paint adhesion and corrosion resistance of the steel substrate.

Primer

A uniform layer of primer is applied on the pre-treated surface. The primer provides flexibility to the paint system and corrosion resistance since it contains corrosion inhibitors. The primer is cured in the oven with precise temperature contracts.

Various types of primers are available based on different resins like epoxy, polyester, polyurethane and PVC. Epoxy primers are preferred for use in roofing as it contains chromate pigments for better corrosion resistance.

Hexavalent Chromium (Chromium VI) serves as an electro-chemical couplers that can resist corrosive action on most metal surface. However, these compounds widely used in industrial coatings, are classified as CARCINOGENS (Category Land 2) as well as being toxic and dangerous to environment. Hence, some producers have developed chromate – free primers.

Top Coat

After pre-treatment, the primer surface is over coated with top coat at uniformly controlled thickness and then cured in the oven. The top coat contains a combination of colour pigments and additives which provides the required colour and other performance properties like ultra-violet resistance. The coated product is then rigorously tested before clearing for further application. Most of the roofing and construction markets for colour coated sheets use top coats which are based on Polyester, Fluorocarbon (PVDF), Silicon Modified Polyester (SMP) and Plaslisols for cost-effectiveness and durability.

Number of Colour Coated Units in India, their Capacities & Production

The number of colour coated units in India, their capacities and

production figures between 2004-05 and 2006-07 are furnished in Table-8.

Table – 8 : Number of Colour Coated Units, their Capacities & Production : 2004-05 to 2006-07

YEAR	NO. OF LIMITS	CAPACITY ('000 Tonnes)	PRODUCTION ('000 Tonnes)
2004-05	4	110	141
2005-06	5	400	244
2006-07	5	465	386

Data Source : JPC

It may be observed that in 2006-07 capacity and production of colour coated steel units have increased by 16.25 percent and 58.20 percent respectively over the previous year.

Demand of Colour Coated Sheets

According to industry sources, the domestic demand of colour coated sheet in India in 2002-03 was 39,000 tonnes. It rose to 60,000 tonnes in 2004-05. The estimated demand of these sheets between 2005-06 to 2007-08 are as follows :

YEAR	DOMESTIC DEMAND ('000 Tonnes)	Y-O-Y GROWTH (%)
2005-06	85	41.67
2006-07	110	29.41
2007-08	140	27.27

Producers of Colour Coated Sheets in India

Earlier, Ispat Industries and Shree Precoated Steels Ltd. (SPSL) were the only two producers of colour coated sheets in India, each having a capacity of 50,000 tpy. But now, Ispat is planning to raise its capacity to 100,000 tpy and SPSL has also planned to expand its capacity to 300,000 tpy. Bhushan Steel and Strips has also commissioned a 120,000 tpy colour coating line at Khopoli in Maharashtra.

New Entrants

Tata Steel and BlueScope Steel of Australia have entered into a Joint Venture on 50:50 basis for setting up a metallic coating and painting facility at Bara near Jamshedpur in Jharkhand and an investment of Rs. 1400 crore. The new facility will have a metallic coating capacity of 250,000 tpy and a painting line of 150,000 tpy capacity. Commissioning of the plant is scheduled for 2008.

Jindal Iron & Steel Co. (JISCO) is setting up a 100,000 tpy capacity colour coated facility at Tarapur at an estimated cost of Rs. 21 crore. It may become operational by mid-2008.

Uttam Galva Steel is installing a 80,000 tpy capacity colour coating line at Khopoli in Maharashtra. It may be commissioned by mid-2008.

Steel Corporation of Gujrat, now owned by Essar Steel, is setting up a new colour coating line of 50,000 tpy capacity.

This facility may come up by 2008.

SAIL's Bokaro Steel Plant has plans to build a 50,000 tpy capacity colour coating line, the construction work of which will be taken up by 2008-09.

JSW Steel Ltd. has announced that if had re commissioned one of its units after modification exercise to produce Galvalume, a zinc – aluminium coated steel product. The company may go for production of colour coated sheets in future.

Market Price Trend

According to the JPC sources, the average market price of GP sheets (0.40mm and 0.63mm thicknesses) in the Mumbai market as on 1st January, 2007 which was Rs. 41,500 per tonne has increased to Rs. 43,125 per tones as on 1st January, 2008 recording a rise of 3.9 percent. Similarly, the average market price of G. C. Sheets in the above thicknesses during the same period, has gone up from Rs. 42,000 per tonne to Rs. 43,875 per tonne – a rise of 4.46 percent.

In the other markets in Kolkata, Delhi and Chennai, the prices were much higher as on 1st January, 2008.

All the above market prices are indicative and are inclusive of Excise Duty, Sales Tax and VAT Taxes.

Conclusion

Indian galvanized steel industry including the colour coated segment has recorded remarkable growth in recent years. The producers are now capable of manufacturing products for high and applications which have been well accepted in the global markets. India exported 1.84 Mt of these products in 2006-07 which was 42.93 percent of domestic production.

However, in the first nine months (April-December, 2007) of the year 2007-08, galvanized product output of the country at 3.126 Mt declined by 3.37 percent over the same period of the previous year. In the above comparative period, imports at 0.19 Mt has increased by 31.94 percent with a share of 10.88 percent of apparent consumption, exports at 1.56 Mt has gone up by 15.3 percent with a share of 49.90 percent of domestic production while apparent consumption at 1.746 Mt has gone down by 13.08 percent. The decline in production and apparent consumption may be due to high prices of the galvanized products which had to face a hike in the price of zinc.

Other probable reasons are virtually more placement of CR use by galvanized steel as projected by experts some years ago and intrusion of aluminium in the galvanized steel market. The leading Indian producers should upgrade their technology to a higher level to ensure production in a cost effective and eco-friendly manner. The Government on their part should support the industry by improving the infrastructure in a big way and by reduction of duties.

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