

Overview - Indian Pig Iron Industry and its Growth Potential

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Pig iron is crude form of iron which, after smelting from its ore, has been allowed to run off into channels and moulds to solidify in the form of ingots or 'pigs' of about 3 foot long and 3 - 4 inches thick. It is of varied composition, a typical grade of pig iron containing, in addition to iron, about 4 percent carbon and 2 percent silicon together with smaller amount of sulphur, manganese and phosphorus. Some of this carbon is combined with iron; some of it is dissolved in the iron. If much of the carbon is combined, the metal has a light appearance and is known as 'White Pig Iron'. If majority of

the carbon is merely dissolved or 'free', the metal appears grey and is known as 'Grey Pig Iron'.

Pig iron is not malleable or ductile. It cannot be mechanically worked or welded. It can only be used as feed for the production of cast iron. Pig iron forms the starting point for the manufacture of wrought iron and steel. In the present article efforts are made to analyse the pig iron industry in India and assess its future prospects.



Characteristics

Pig iron is broadly classified into two grades depending on the alumina-silica ratio. These are foundry grade and basic grade. Foundry grade pig iron is used to manufacture various types of iron castings and basic grade for steel making. The composition of foundry grade pig iron is given in Table-1. The composition of low sulphur and low phosphorus pig iron is presented in Table-2. Low sulphur low phosphorus pig iron finds extensive use in the foundry industry for the manufacture of Malleable Iron Castings and S.G. Iron Castings.

Table - 1 : Chemical Composition of Foundry Grade Pig Iron (Specn. No. IS: 224-79)

Material	Si	Mn	P (Max)	S (Max)
High Manganese grade (1.00-1.50)				
PG 16 Mn 5 P38	Above	1.0-1.50	0.40	0.05
PG 14 Mn 5 P38	3.75	1.0-1.50	0.40	0.05
PG 12 Mn 5 P38	3.25-3.75	1.0-1.50	0.40	0.05
PG 10 Mn 5 P38	2.75-3.25	1.0-1.50	0.40	0.05
PG 8 Mn 5 P38	2.25-2.75	1.0-1.50	0.40	0.05
PG 6 Mn 5 P38	1.75-2.25	1.0-1.50	0.40	0.05
PG 4 Mn 5 P38	1.25-1.75	1.0-1.50	0.40	0.05
Low Manganese grade (0.50 to 1.00)				
PG 16 Mn 5 P38		1.0-1.50	0.40	0.05
PG 14 Mn 5 P38	Above	1.0-1.50	0.40	0.05
PG 12 Mn 5 P38	3.75	1.0-1.50	0.40	0.05
PG 10 Mn 5 P38	3.25-3.75	1.0-1.50	0.40	0.05
PG 8 Mn 5 P38	2.75-3.25	1.0-1.50	0.40	0.05
PG 6 Mn 5 P38	2.25-2.75	1.0-1.50	0.40	0.05
PG 4 Mn 5 P38	1.75-2.25 1.25-1.75 0.75-1.25	1.0-1.50	0.40	0.05



Table-2 : Chemical Composition of Low 'S' Low 'P' Pig Iron (IS: 2841-1978)

Sub-Grade	Grade Designation	Chemical composition (%)			
		Si	Mn	P (Max)	S (Max)
A1	PG14Mn3P2K	3.25-3.75	0.5-1.0	0.04	0.02
	PG14Mn3P2K	3.25-3.75	0.5-1.0	0.06	0.02
	PG14Mn3P2K	3.25-3.75	0.5-1.0	0.08	0.02
A2	PG12Mn3P2K	2.75-3.25	0.5-1.0	0.04	0.02
	PG12Mn3P2K	2.75-3.25	0.5-1.0	0.06	0.02
	PG12Mn3P2K	2.75-3.25	0.5-1.0	0.08	0.02

A3	PG10Mn3P2K	2.25-2.75	0.5-1.0	0.04	0.02
	PG10Mn3P2K	2.25-2.75	0.5-1.0	0.06	0.02
	PG10Mn3P2K	2.25-2.75	0.5-1.0	0.08	0.02
A4	PG8Mn3P2K	1.75-2.25	0.5-1.0	0.04	0.03
	PG8Mn3P2K	1.75-2.25	0.5-1.0	0.06	0.03
	PG8Mn3P2K	1.75-2.25	0.5-1.0	0.08	0.03
A5	PG6Mn3P2K	1.25-1.75	0.5-1.0	0.04	0.03
	PG8Mn3P2K	1.25-1.75	0.5-1.0	0.06	0.03
	PG8Mn3P2K	1.25-1.75	0.5-1.0	0.08	0.03
A6	PG4Mn3P2K	0.75-1.25	0.5-1.0	0.04	0.03
	PG8Mn3P2K	0.75-1.25	0.5-1.0	0.06	0.03
	PG8Mn3P2K	0.75-1.25	0.5-1.0	0.08	0.03
A7	PG2Mn3P2K	< 0.75	0.5-1.0	0.04	0.04
	PG8Mn3P2K	< 0.75	0.5-1.0	0.06	0.04
	PG8Mn3P2K	< 0.75	0.5-1.0	0.08	0.04

Market Analysis of Pig Iron

Demand Analysis



Pig iron is consumed mainly by the iron foundry industry which serves as backbone of manufacturing and construction sectors. Therefore, demand for pig iron is associated with the growth of the iron foundry industry.

The data compiled on apparent consumption of pig iron during 1980-81 to 2008-09 is furnished in table-3.

Table-3 : Apparent Consumption of Pig Iron

(In '000 tons)

Year	Production	Import	Export	Apparent Consumption
1980-81	1438	0	0	1438
1990-91	1514	189	0	1703
1993-94	2251	21	620	1652
1995-96	2873	8	503	2378
1999-00	3193	2	285	2910
2000-01	3408	2	223	3187
2001-02	4091	2	312	3781
2002-03	5285	1	629	4657
2003-04	3768	2	576	3194
2004-05	3226	8	176	3058
2005-06	4704	3	304	4403
2006-07	4995	4	707	4292
2007-08	5284	11	560	4735
2008-09	5285	8	350	4943

Source: Steel Scenario Yearbooks

Major countries where India exported pig iron during recent years are; China, Indonesia, Japan, Korea, Malaysia, Singapore, Taiwan, Thailand and UAE,

The apparent consumption of pig iron has increased from 1.7 Mt in 1990-91 to 4.9 Mt in 2008-09 with an average annual growth of about 6 percent. Table further reveals that India has been a net exporter of pig iron since 1993-94.

The compound average annual growth rate (CAGR) in pig iron consumption in the country over different time period is furnished in table-4.

Table - 4 : CAGR in Consumption of Pig Iron in India

Year	Growth Rate (%)
1990-91 to 1995-96	6.9
1995-96 to 2000-01	6.0
2000-01 to 2008-09	5.7
1993-94 to 2008-09	7.6
2004-05 to 2008-09	12.8

The above table reveals that the Indian pig iron industry started picking up since 1993-94. There has been a growth of 6 percent per annum during 1995-96 to 2000-01 and about 5.7 percent per annum during 2000-01 to 2008-09 in apparent consumption of pig iron. Annual average growth rate during 1993-94 to 2008-09 is of the order of about 7.6 percent. The Indian pig iron industry has recorded higher growth since 2004-05 onwards the CAGR in consumption of pig iron during 2004-05 to 2008-09 is estimated to be around 12.8 percent per annum.

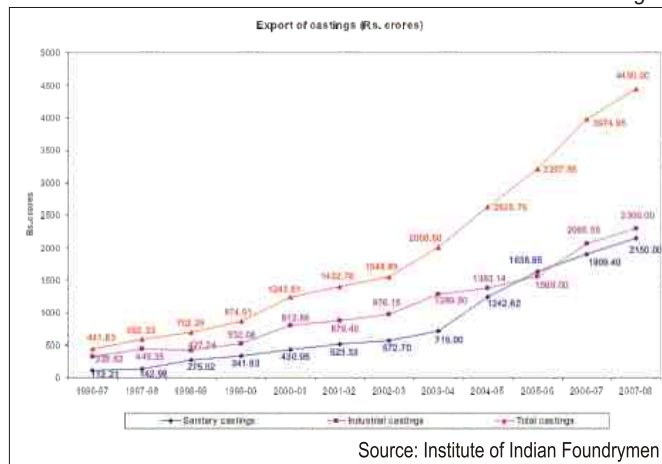
Pig iron is being consumed by the foundry industry which is producing different varieties of iron cast products. These

iron cast products are used in the manufacture of a number of machineries including automobiles under capital goods industry. A brief review of the foundry industry and capital goods industry is mentioned as under:

Foundry Industry

The Indian foundry industry ranks among the topmost in the world along with USA, China, Japan, Russia and Germany. In terms of number of units and the workforce employed, it stands next only to China. There are about 4500 recognized foundry units of which around 90 percent are in the small scale sector. These foundry units are located in clusters in Batala, Jalandhar, Rajkot, Agra, Belgaum, Chennai, Coimbatore, Pune, Howrah, Kolhapur and Ludhiana. The Indian foundry industry has a substantial export turnover which was to the tune of around Rs.4500 crores during 2007-08. The growth in the foundry industry is primarily driven by the growth in the auto components industry which registered a staggering turnover of around 18 billion USD during 2007-08. The liberalized policies of the Govt. have allowed the Indian foundry industry to expand in order to cater to the domestic as well as export demand. India produced around 7.5 Mt of castings of various grades (malleable iron, SG iron, non ferrous, steel, grey CI) during 2007-08. There has been tremendous growth in the exports of various grades of castings over the last decade as depicted in fig-1.

fig-1.



Capital Goods Industry

A relative growth in capital goods industry is measured by Index of Industrial Production for capital goods (IIP for capital goods) and the same is being estimated and published by the Central Statistical Organization of the Ministry of Statistics and Programme Implementation, Govt. of India. Growth of IIP for capital goods (base: 1993-94) over the period from 2000-01 to 2008-09 is mentioned below.

Growth in IIP for Capital Goods

It reveals that capital goods industry has grown rapidly during the period 2002-03 to 2007-08. Industrial and

Year	Growth rate (%)
2000-01	1.8
2001-02	(-)-3.4
2002-03	10.5
2003-04	13.6
2004-05	13.9
2005-06	15.5
2006-07	18.2
2007-08	18.0
2008-09	7.0

Source : Central Statistical organisation, GOI

economic growth suffered a major setback during the year 2008-09 as a result of the global financial meltdown. This slump was also observed in India, which has affected industrial growth. However the Indian economy is on the road to recovery and as such it is expected that growth in IIP for capital goods is likely to achieve the past growth rate in coming years.

Taking into consideration the growth in consumption of pig iron achieved during the past and anticipated future growth of consuming industries in the country, moderate average annual growth rates of 7 percent and 5% percent are assumed for projecting future domestic demand for pig iron for the milestone years 2011-12 and 2016-17 respectively which is furnished in table-5.

Table-5 : Projected Domestic Demand of Pig Iron

(In '000 tons)

Year	Domestic Demand
2011-12	6060
2016-17	7740

Anticipated domestic demand of pig iron in the country during 2011-12 is estimated as about 6.0 Mt, which is likely to increase to about 7.7 Mt during 2016-17 i.e. by the end of 12th Five Year Plan.

Demand Projection by Econometric Modeling

The method of econometric modeling for demand forecasting has been accepted world-wide and based on the principle of development of mathematical models between the variable under study and the explanatory/ auxiliary variable which is associated/ correlated with the study variable. In the present article, consumption of pig iron is study variable and the index number of industrial production (INIP) for capital goods are considered as the explanatory/ auxiliary variable. The different mathematical models attempted with the past data on consumption of pig iron and INIP (capital goods) are furnished below:



Model	Equation	R ²
Linear	$Y = 942.89484 + 11.35 * \text{INIP capital goods}$	0.831
Log Linear	$\text{Log}(Y) = 3.01326 + 0.00183 * \text{INIP capital goods}$	0.774
Log Log Linear	$\text{Log}(Y) = 2.04811 + 0.63733 * \text{log INIP capital goods}$	0.833

* - Multiplication sign ; Where Y is apparent consumption of pig iron.

Among the three mathematical models fitted to the past data, the log-log linear equation yields the better fit, as the coefficient of determination i.e. R-square value which indicates the amount of variation being expressed by the regression model, obtained as highest. Therefore, the same has been adopted for future projection of the demand for pig iron. The projected demand for pig iron based on econometric modeling as worked out is furnished in table-6.

Table-6 : Projected Domestic Demand of Pig Iron Based on Econometric Modeling

(In '000 tons)

Year	Demand
2011-12	5968
2016-17	6857

The demand of pig iron during 2011-12 emerges as about 6.0 Mt, which is likely to increase to 6.9 Mt by 2016-17. The projected domestic demands worked out on the basis of past growth rate as well as by econometric modeling are furnished in table-7 and illustrated graphically in fig-2.

Table-7 : Projected Demand for Pig Iron

Year	Domestic Demand	
	Past Growth Basis	Econometric Modeling
2011-12	6060	5968
2016-17	7740	6857

Export Potential

Japan, Republic of Korea, Taiwan, Thailand, and Malaysia are major importers of pig iron. Beside these countries, Indonesia also imports pig iron in good quantity.

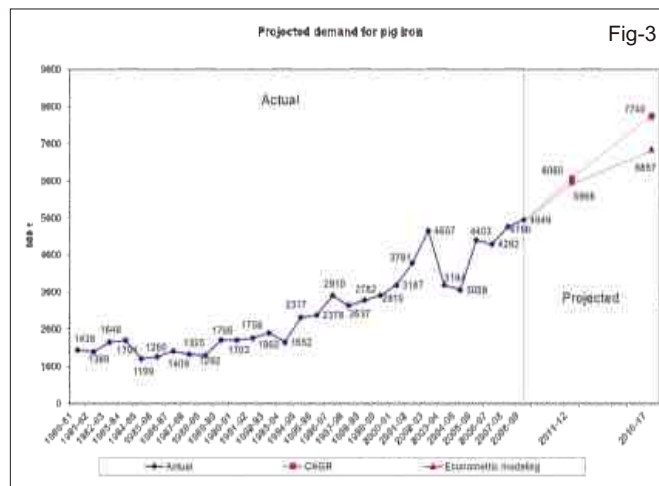
The trend of imports of pig iron by selected Asian countries during the period 2001 to 2007 is shown in table-8.

Table-8 : Import of Pig Iron by selected Asian countries

('000 tons)

Country	2001	2002	2003	2004	2005	2006	2007
Indonesia	63	70	232	280	125	17	15
Japan	181	185	559	599	1039	1425	1309
Republic of Korea	1446	1365	1575	1751	1508	850	1166
Malaysia	186	215	409	464	595	330	195
Taiwan (ROC)	448	940	991	967	863	683	846
Thailand	113	204	369	918	969	559	850
Total	2450	3003	4160	4992	5118	3865	4381

Source : Steel Statistical Yearbook, World Steel Association



Under the present global scenario, there exists potential for pig iron export opportunity from India. Exports of pig iron from India have been ranging from about 6 percent to 18 percent of apparent consumption during the recent past, as revealed from table-03.

Exports have been utmost important for a developing economy. Government of India is making all efforts to enhance the exports after meeting its domestic demand.

Under the circumstances, it is expected that there will be a substantial potential for exports of pig iron in the coming years. As such, there will be further increase in demand export provision in the future years.

Region-wise Demand Distribution

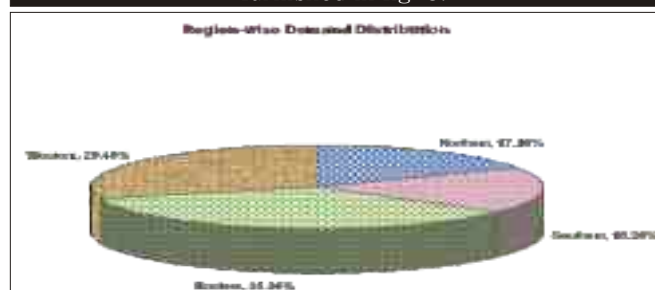
With a view to assess region wise demand for pig iron, the state wise consumption of the same has been collected for past three years (2006-07 to 2008-09). The average

distribution of consumption of pig iron during these years for all the states has been derived. For arriving at the region wise distribution of pig iron consumption, all the states are clubbed in to the respective regions according to their location. The states under the four regions are furnished below.

Regions			
North	East	West	South
Delhi, Haryana, Jammu & Kashmir, Punjab, Chandigarh, Himachal Pradesh	Bihar, Jharkhand, Orissa, U.P, Uttarakhand, West Bengal, Assam, Other North Eastern States	Chhattisgarh, Gujarat, Madhya Pradesh, Maharashtra, Goa, Rajasthan	Andhra Pradesh, Karnataka, Kerala, Tamilnadu

The region-wise demand for pig iron is governed by the presence of foundry industry and their operating capacity in these regions. Foundry units are developed in clusters in various states since inception in India and the demand for pig iron in these regions is attributed to these clusters of foundries.

The region-wise pig iron consumption, thus, estimated is furnished in fig-3.



Supply Scenario

Presently, there are numbers of pig iron producers in the secondary sector in the country. A few of these secondary units are not operating due to various reasons whereas a few pig iron producing units are under execution. The producer like NINL and a few small pig iron producers are planning to install downstream facilities to produce steel products. Further, Integrated Steel Plants viz. BSP, DSP, RSP, BSL, ISP and RINL in primary sector also produce pig iron for sale after meeting their captive requirement of hot metal for steel making. However, presently the integrated steel plants are left with only a small quantum of pig iron for sale.

The past production of pig iron by main and secondary producers during 2001-02 to 2008-09 is furnished below in table- 9.

Producers	2001-02	2002-03	2003-04	2004-05	2005-06	2006-07	2007-08	2008-09
SAIL								
- BSP	88	77	121	10	128	40	136	61
- DSP	23	47	51	52	26	38	57	62
- RSP	11	19	17	10	22	44	27	1
- BSL	214	145	89	75	167	161	98	79
- ISP (IISCO)	288	283	222	184	213	177	93	97
-VISL	21	19	31	21	21	50	31	9
Total (SAIL)	642	590	527	352	577	510	442	269
RINL	374	517	439	273	439	352	495	322
Total (Main Producers)	1016	1107	966	625	1016	862	937	591
Contribution of Main Producers	25%	21%	26%	20%	22%	17%	18%	11%
Secondary Producers	3055	4178	2798	2603	3688	4133	4378	4700
Grand Total	4071	5285	3764	3228	4704	4995	5315	5291

Source: Steel Scenario Yearbooks

Analysis

In the recent years, share of secondary producers in production of pig iron has increased and has already achieved more than 85 percent during 2008-09 while that



of primary producers has been declining.

The major contributor towards production of pig iron in India in the secondary sector are Nilanchal Ispat Nigam Ltd., Jayaswal Nicco Ltd., Usha Martin Ltd., Tata Metallics Ltd., Sesa Industries Ltd., Southern Iron & Steel

Company Ltd., Kirlosar Ferrous Industries Ltd., Kalyani Ferrous Industries Ltd., Electrosteel Castings Ltd. among others. Presently, total installed capacity of pig iron from secondary sector is assessed as about 6.5Mt. Capacity utilization of secondary producers of pig iron is estimated as about 72 percent during 2008-09. Most of the merchant pig iron producers do not have captive coke ovens and as such they have to depend on the metallurgical coke available in the open market. Thus the availability of metallurgical coke is a major constraint in the utilization of their full capacity.

For projecting the future availability of pig iron from secondary producers a capacity utilization of 75 percent and 80 percent has been considered the milestone years 2011-12 and 2016-17 respectively. Though, the integrated steel plants viz. SAIL and RINL envisaged converting its hot metal into steel to the extent possible, a small fraction of hot metal is converted into cold pigs due to mismatch in production schedule of blast furnace and downstream facilities. The availability of pig iron from Integrated Steel Plant of SAIL and RINL are arrived at from various documents/ publications related to their expansion programmes which have been estimated as about 1.0 Mt. per year and are also furnished in table-10.

Table-10 : Projected Availability of Pig Iron

(In '000 tons)

Year	Availability		
	Primary Producers	Secondary Producers	Total
2011-12	1000	4880	5880
2016-17	1000	5200	6200

The projected availability of pig iron for the milestone years 2011-12 and 2016-17 are of the order of 5.9 Mt and 6.2 Mt respectively.

The projected demand and the availability of pig iron are depicted graphically in fig-4.



In view of the expected growth potential of capital goods and automotive industry in India, the demand is expected to surpass the supply of pig iron as revealed by fig-4. Under the circumstance, the merchant pig iron producers have to review their production capacity and production plan to bridge the gap between demand and supply.

Further the Indian foundry industry is geared up to utilize the immense opportunity of becoming an Asian hub for supply of high quality castings for automotive, auto ancillary and other capital goods industries. The quality of castings mainly depends upon the pig iron quality, therefore the pig iron producers need to pay attention on supply of suitable foundry grade pig iron to ensure that the foundry products are globally competitive with respect to quality and cost.