Sponge Iron Industry in India - An Overview

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Globally, iron ore is the major feedstock for BF-BOF route of iron and steelmaking which produced about 67 percent of world crude steel in 2016. But the process requires various types of raw materials, involving high capital costs and substantial investment on infrastructure. It also leads to environmental problems and has a long gestation period.

To find a way out of this shortcomings of BF-BOF Process, EAF steelmaking was introduced long ago. The share of EAF/IF (electric steelmaking) in the global output of crude steel has increased remarkably from 26.6 percent in 1988 to about 32 percent in 2016. The increasing trend in the prices of steel scrap and its short supply led the steel technologists to find a suitable charge-mix in the form of sponge iron or Direct Reduced Iron (DRI).

Sponge iron or DRI is obtained from the direct reduction of iron ore and has an iron content of about 88 percent. Reduction eliminates oxygen in the iron ore leaving behind a honey comb like porous structure that is “Spongy” in nature Hence the name 'sponge Iron'. It is usually produced in lumps or in pellet form and is also available in a compacted and briquetted form, called Hot Briquetted Iron (HBI) which is produced by compacting DRI at a temperature of about 650 degree centigrade. HBI is a denser and compacted from of DRI designed for ease of shipping, handling and storage. DRI can be used in steel plants/units where reduction is done in the reduction unit situated at the site of a steelmaking plant.

DRI has established itself as a high purity, high quality charge material the world over. As compared to scrap, the use of DRI/HBI offers more consistency in composition, low trace elements due to its porous nature and is environmentally friendly.

2. Various DRI Processes

Direct Reduction processes can be divided as follows.

- Those using non-coaking coal (such as rotary kiln and rotary hearth based processes) – coal – based processes.
- Those using natural gas/such as shaft furnace, fludized bed furnace based processes –Gas – based processes.
- A number of DRI processes which are available can be grouped as follows :
- Coal-based processes using, rotary kilns : SL/RN, Codir, Accr, DRC, TDR, SIIL, OSIL and Jindal
- Coal-based processes using rotary hearth furnaces: immetco, Fastmet, Cicofer, Sidcomet.
- l Batch type gas-based processes using

retarts : HYL 1

- Continuous processes in a shaft furnace using reformed natural gas as a reluctant : Midrox and HYL III.
- Gas – based processes using fluidized bed : FIOR, Finment, Circored
- Special processes for trating waste orides like PRIMUS using multi-health furnaces.

Globally, the MIDREX process accounts for about 64 percent of the world production of DRI followed by HYL III at about 18 percent by coal-based processes about 12 percent and the balance by other processes.

3. Advantages of using DRI over Scrap

Sponge Iron or DRI is a better substitute for sleep making through EAF/IF routes due to its homogenous nature, improved productivity and lower coke consumption.

Sponge iron can also replace ferrous scrap in a LD converter as a coolant.

Its is non-pyrophoric. It is free from tramp materials like copper, zinc, tin, chromium, tungsten, molybdenum etc. That are usually present in steel scrap.

- Continuous processes in a shaft furnace using reformed natural gas as a reluctant : Midroxand HYL III.
- Sponge iron has low sulphur and phosphorus contents.
- The DRI process has the ability to use low grade coal with good reactivity witch is unable for conventional steelmaking.
- The use of DRI permits application of low grade steel scrap as park of change material in electric steelmaking without affecting the quality of steel.
- Due to its known chemical composition DRI/HBI use enables accurate prediction of end-point analysis beginning with the continuous feeding of spange iron.
- Due to the uniform size of DRI, productivity is increased.
- The iron present as oxide in sponge iron reacts with the bath carbon resulting in vigorous boiling action promoting better heat transfer and accelerated slog/metal interactions during electric steelmaking, Due to this both homogeneity improves resulting in the achievement of lower hydrogen and nitrogen contents in steel.

4. Raw Materials For DRI Production

The major raw material required for production of DRI are oxides of iron in the form of lump ore, pellets, non-coking coal with high reactivity and fluxing materials like lime and dolomite

Some precaution are necessary in selecting the iron oxide specially its phosphorous content and its reliability for easy reduction. Use of high purity pellets with low phosphorous contents at an economic price helps in the cost effective production of sponge iron of desired quality.

Use of pellets improves the performance of sponge iron plants Besides, pellet plants can fully utilise the micro fines plants. Besides, pellet plants can fully utilise the micro fines and slime available at iron are mimes. Use of pellets in place of sized iron are offer the following advantages in the manufacture of DRI/HBI.

- Specific iron consumption is reduced by about 20 percent or more.
- Production of DRI in rotary kilns can increase by about 15 percent.
- Specific coal consumption can be reduced by 10 to 15 percent.
- Specific power consumption can be reduced by about 10 percent.
- Metallisation will be higher.

Generation of fines will be reduced substantially.

Non-coking coal used should ensure ash softening temperature: 1200 degree centigrade, Calorific value - 5200 Keal / Kg and reactivity: 2.2 co/gm per degree centigrade.

Dolomite is used in sponge iron process as a de sulphuriser.

It removes sulphur from the feed – mix. Consumption of dolomite is about 50 kg per tonne of DRI.

5. Chemical Composition of Internationally trade HBI

The usual chemical composition of internationally traded HBI is given below:

For maximum yield, the metallic iron content should be at the highest possible level with sulphur and phosphorous as low as possible. The gangue content should preferably be within 2 percent and silica below 2 percent to ensure lower power consumption and far achieving higher productivity.

6. Three Forms of DRI

There are three farms of DRI as mentioned below:

- Cold DRI (CDRI)
- Hot DRI (HDRI)
- Hot Briquetted iron (HBI)

A. Cold DRI (CDRI)

After reduction, the DRI is cooled in the lower part of the shaft furnace (for gas-based) to about 50 degree centigrade or cooled in the other kiln (for coal-based) to about 80 degree centigrade. CDRI is typically used in a nearby EAF and must be kept dry to prevent re-oxidation and lossof metallisation, CDRI is ideal for continuous charging into the EAF.

Parameters	% of conent
Total Fe – Content	93-95
Metallic Fe – Content	85-92
Degree of Metalization	92-95
Carbon	1.0-1.5
Sulphur	0.02-015
Silica	1.00-2.00

B. Hot Dri (HDRI)

HDRI can be transported to an adjacent EAT (within the plant) at temperature up to 650 degree centigrade for taking the advantage of the sensible heat content of HDRI, which helps to increase productivity by reduction of electricity consumption and production cost. There are three methods used for the transportation of HDRI:

- Hot transport conveyor
- Hot transport Vessels
- HOTLINK

The heavy mass of HDRI easily penetrates the furnaces slag layer as its density which is over 5qm/cm 3 as compared to less that 3 gm/cm3 density of the furnace slag layer.

Major operational advantages of using HDRI are as follows:

- Well-defined, consistent chemistry with guaranteed specifications
- Lower residual content (Cu, ni, Cr, Mo, Sn, Pb and V)
- Dilutes impurities in lower quality scrap
- Promotes foamy slag and reduces nitrogen level in EAFs
- Shields refractory to reduce damage.
- Increases iron production in BOF, reduces Coke rate and CO2 emission.
- Metallic yield in BOF is similar to hot metal
- Higher thermal and electrical conductivity for faster melting
- Less fines generation gives added value to the customers
- It is 100 times more resistant to reoxidation than conventional DRI and picks up 75 percent less water

- It saves about 12 KWH of energy per tonne off DRI consumed by the EAF utilizing 650 degree centigrade heat contained in the iron.

Some of the major steel producers in India are charging 80 percent of DRI in the charge – mix pf EAFS Benefits / savings of using Hot DRI are shown in Table – I

Source : JSPL

It is evident from the above table that use of HDRI in EAF reduces electrode consumption by 10 percent, saves energy consumption by 19 percent per tonne of DRI produced and productivity increases by more than 20 percent per tonne per hour.

C. Hot Briquetted Iron (HBI)

HBI is made by compressing hot DRI discharged from the shalt furnace at about 650 degree centigrade into PILLOW shaped briquettes.

HBI is a preferred DRI product because it is more denser than cold DTI and reduces reoxidation rate considerably. This enables HBI to be stored and transported without any special precaution. HBI is produced from natural iron are with no additives or binders. It is a source of clean metallized iron units.

7. Continuous Feeding of DRI

Table – 1: Benefits / Saving of Using HDRI vis – a vis cold DRI in an EAF

Parameters	Units	CDRI	HDRI
Electrode Consumption	Kg/t	2	1.8
Oxygen Consumption	NM3/T	32	32
Energy Consumption	KWH/t	640	520
Tap to Tap time	Minutes	82	68
Productivity	t/hr	184	221

Continuous feeding of DRI into an EAF results in achieving high power level than 100 percent scrap charge with similar selling's in the furnace.

Due to the heterogenous nature of steel scrap and the continuously varying are lengths between the electrode and scrap Leads to wide fluctuations in the melting scrap It has been found that such wide fluctuations reduce the effective power input. On the other hand, the melting of continuously fed DRI has been found to result in an increase of saving power up to 15kwh per tonne DRI produced with the use of UHP transformers. Ultra high

Power (UHP) transformers help to achieve better efficiency which facilitates fast melting of Hot DRI charge.

8. Use of DRI in BOFs

HBI in the form of DRI is best suited for use in BOFs because of its bulk density and physical strength. It is a preferred alternative to scrap due to the following reasons:

- Residual Levels are Low.
- Bulk density is higher.
- Mass and heat balances are more accurate.
- Steel chemistry is easier to control.
- Besides the above, other advantages of charging HBI in the BOF are as follows:
- It acts as a coolent
- There is no seulling on the lance
- HBI can be used for low sulphur steels
- HBI has much lover tramp materials. It is pyrophoric and free from tramp materials like copper, Zine, chromium, tungsten, moly hdlenum etc. That are usually present in steel scrap.

9. Use of DRI in Induction Furness (IFS)

The use of DRI in the charge – mix of Induction Melting Furance (IFs) commenced in early nineties of the last century. Sponge iron manufactures in India trained steel technologists about the proper use of DRI in the IFs. Many sponge iron manufactuers have installed IFs and are using over 60percent DRI in the charge – mix.

Technologically for good quality steel production through the IF route, emphasis should be given on?

- Good Weldability
- Proper balancing of the charge – mix for controlling the tramp materials.

mechanical properties.

- Sulphur and phosphorous should be controlled as per IS : 1786.

10. Use of DRI in EAFs

Due to low availability of indigenous steel scrap and its high price, DRI is being used as a supplement in the one charge – mix in EASs during the last few decades.

Initially, DRI was being used for producing low cost carbon steel products where scrap supplies were limited. However, during the last two decades or more, EAF steel makers have experienced the true value of DRI as a scrap supplement that dilutes the undesirable contaminants in the EAF when used to make high quality that products and low nitrogen steels.

DRI is ideally suited for either as a replacement or a supplement for in the EAF. DRI enables EAF operators to regulate their furnace charges to achieve the desired product quality at a low per tonne of liquid steel. There are two major benefits of charging Hot DRI into an EAF which are mentioned below:

(I) Lower specific electricity consumption.

(ii) Increased productivity up to 15-20 percent.

The energy savings Occur as less energy is required to heat the DRI to melting temperature which shortens the melting time with the utilisation of 650 degree centigrade heat contained in the HDRI. Benefits/Savings of using HDRI vis-a-vis CDRI in EAFs have been discussed earlier.

11. Indian Sponge iron Industry.

Unlike the Indian steel industry, Indian sponge iron industry is of comparative recent origin. It is about 35 years old. It started in the eighties of the last century with the setting up of first generation SL/RN technology based plant developed by Lurgi Metallurgia. In fact, the first 30,000 fonmes coal-based demonstration plant was set up at Polancha in Andhra Pradesh with UNDP support to find out the suitability of Indian iron are and non-coking coal for producing the required grade of sponge iron. Driving thus period other smelting reduction technologies like CODIR serviced KRUPP, DRC serviced by DAVY and ACCR SERVICED BY Allis chalmers and OSIL PROCESS also came into existence in india. Between 1980 and 1985, the growth of the sector was slow owing to regulatory bottle neck of restrictive licensing. In 1985, the

Government of India de-licensed the sponge iron industry. During this period, government also encouraged setting up of gas-based sponge iron plants at there was surplus natural gas. Between 1985 to 1995, apart from a few coal-based plants, there natural gas based plants were commissioned.

The first gas-based sponge iron plant wasbuilt by Essay Steel ltd at Hazira in Gujarat in 1990 with an initial capacity of 3.60 Mtpa. Essay has the worlds largest HBI plant with its present capacity of 6.8 mtpa. The first MIDREX MEDGAMOD plant was installed by Ispat Industries at Dalvi in Maharashtra with an initial capacity 1.60 mtpa in 1994. At present it have been taken over JSW Ltd. Grashims Vikram Ispat set up a gas-based plant with an initial capacity of 0.9 Mtpa in 1993 at salav in Maharashtra. It was globally the first sponge plant to install HYL III technology. According to HYLSA, this was the first zero KwH plant in the world. At present the is owned by Welspun Maxsteel Ltd (JSWL) AND HAS A CAPACITY OF 1.2 Mtpa. Between 1985 and 1988, only three coal-based sponge iron plants were set up. These were Orissa sponge Iron Ltd. With an initial capacity of 0.1 Mtps. Its present capacity 25000 tpa, Ipitata sponge Iron Ltd. (now Tata Sponge Iron Ltd.) with an initial capacity of 0.9 Mtpa (present capacity is 390000 tpa) and Suntlag Iron & steel Ltd. With an intial capacity of 0.15 mtpa. Its present capacity is 262000 tpa.

12. Structure of The Indian sponge Iron Industry

According to industry sources, there are about 455 sponge Iron plants at present.

Out of the above, five are gas-based, three of them use use natural gas, one synthesis gas and the other COREX off gases.

Coal-based sponge iron units are located in clusters. The major clusters are siltara (Chhattisgarh, kazvmunda in Odisha), Sarikela-kharswan (Jharkhand), Jharsuguda (Odisha), west Medinipur and Bankura (Well Bengal) and Bellary (Karnataka).

Approximate capacity wise distribution of coal-based plants are as under.

Capacity Range	% Share In Capacity
Up to 30,000 TPA	18
30,000 – 60,000 TPA	5
60,000-100,000 TPA	2
1,00,000 -1,50,000 TPA	9
OVER 1,50,000 TPA	66

The above coal-based sponge iron plants and units together have a share of about 27.5 percent of all coal based plant/unit capacity in the country.

13. India's Production of DRI

India was the highest global producer of DRI between 2003 and 2015. But Iron outstripped India from its top position in 2016. India's DRI production from 2007 to 2016 are Shown in Table – 2

Table – 2 : India's Production of DRI : 2007 to 2016 (Mt)

Source : Worldskeel, MIDREX

In 2016, Iran's production of DRI went up by 10 percent at 16.01 Mt while Indias output declined by 11.73 percent at 14.3 Mt.

14. Comparative Analysis of Various Parameters of DRI Production By Gas-Based And Coal-Based Routes

A Comparative analysis of the various parmeters of Gas - based and Coal - based production routes is shown in Table – 3.

Table – 3: Comparative Analysis of Various Parameters of Gas-based and coal-based Production Routes of DRI

15. Innovations In DRI Production through Gas Based Route

Production of DRI through bas based route without using natural gas has been a unique and outstanding development in India's DRI production history **.**

Two of such developments are mentioned below:

(A) JSPL'S DRI plant at Angul, Odisha is a designed MIDDREX DRI plant with a capcity of 1.8 MTPA. This is the first DRI plant in the world paired with commercially available technology coal gasification to produce DRI with synthesis gas.

THE Syn Gas technology has been claimed as the future of Coal-based DRI production because it allows all the benefits like quality and reliability & the DRI process by using coal as the primary energy source rather than natural gas.

In case rise in energy costs, coal gasification also enables the lower quality or waste product to produce energy. The shaft furnace at JSPL's Angul plant is almost identical to the one used natural gas based MIDREX PLANTS. The main difference between the traditional MIDREX flow sheet and new combination is that it uses a coal-based synthesis gas source rather than an natural gas reformer. JSPL's Angul plant is designed with greater flexibility for production of Hot and Cold DRI. The plant produced about 1.78 Mt of DRI in 2016-17.

Advantages of Syn Gas Based DRI Process

(I) The SynGas based DRI Process is an inherently high metallization process due to the following reasons :

- The Counter-flow of reducing gas and iron oxide in the reduction furnace.
- A furnace burden residence time of 4-6

Names of the Five Gas-Based Plants, with Location and capacity are furnished below:

Name of The Company / Plant	Location	Capacity (2000 tonnes)
1. Essar Steel Ltd.	Hazira, Gujarat	6,000
2. JSW Steel (formerly Ispat Ints.)	Dolvi, Maharashtra	1,600
3. Welspan Maxsteel Ltd. (JSWL)	Salav, Maharashtra	1,200
4. Jindal Steel & Power Ltd.	Angul, Odisha	1,800
5. JSWL Steel Ltd.	Vijiynagar, Karnataka	1,200

Names of Major Coal-based sponge Iron Plants/Units with Location and Capacity are shown below :

Name of The Company / Plant	Location	Capacity (2000 tonnes)
1. Jindal Steel & Power Ltd.	Raigarh, Chhattisgarh	1,300
2. Bhushan Steel Ltd.	Meramandali, Odisha	1,500
3. Bhushan Power & Steel Ltd.	Ihrasguds, Odisha	1,200
4. Monnet Ispat & Energy Ltd.	Chhattisgarh	

(Table Contd. Next page)

5. Prakash Industries Ltd.	Chhattisgarh	750
6. BMM Ispat Ltd.	Hospet, Karnataka	660
7. Tata Sponge Iron Ltd.	Odisha	390
8. Sarada Energy & Minerals	Chhattisgarh	360
9. Lloyds Metal & Energy Ltd.	Maharashtra	270
10. Godwari Power & Ispat Ltd.	Chattisgarh	555
11. Jai Balaji Industries Ltd.	West Bengal	345
12. Adhunik Metallics Ltd.	Odisha	300
13. Jaiswal Neco Industries Ltd.	Chattisgarh	255
14. Rungta Mines Ltd.	Odisha	330
15. SKS Ispat Ltd.	Odisha	270
16. Sunflag Iron & Steel Ltd.	Maharashtra	262
17. Visa Steel Ltd.	Odisha	300

hours in the reduction zone.

- The uniform distribution of reducing gas.
- The uniform decent of burden in the reducing zone.

(ii) Lower metallisation and reduced fuel and power consumption can be achieved, it required, by increasing the production rate relative to the below of reducing gas to the furnace bustle.

(iii) The plant can belled for extended period and returned to full production in a few hours.

(iv) EAF steelmakers wants carbon at 1.4 to 1.8 percent, with the Sym Gas DRI process, carbon can be controlled at 1-2 percent

(v) The quality of DRI produced by the Syn Gas process has the Quality comparable to that of natural gas based DRI plant.

(vi) The process has the protection to use coal Sym Gas from other Soirees such as Coke oven Gas or BOF gas.

Energiron

The Energiron Direct Reduction Technology, jointly developed and marketed by Daniela and Tenova HYL, provides gas based process that convert iron oxide pellets, hump are or pellet /lump mixtures into a highly metallised product (DRI) with controlled carbon content from 1.5 to 4 percent.

The Engergiron Direct Reduction Plan can be designed to be fed with all of the following reducing gas sources :

- Natural Gas : In this Case the hydrocarbons are converted through external or "in situ" reforming to the required reducing gases hydrogen and carbon monoxide.
- Syn Gas from coal gasification or from other iron making plants (e.g. COREX, FINEX) : coal is gasified to produce the same reducing gase (Co, h2 and Ch4)
- COKE OVEN Gas (COG) :

Engeriron plant can be equipped with Hytemp system t send hot discharged high quality DRI directly to EAF, leading to an increased production and lowering of electric consumption in the melt shop. JSPL is planning to set up a 2.5 MTPA capacity DRI plant based on Energiron technology.

(B) JWSL uses coke Over Gas To Supplement natural Gas for DRI Production MIDREX Technologies and JSW Steel have announced Successful Completion and modification of the existing MIDREX DRI plant at Dolvi, Maharashtra to utilize coke oven gas (COG) to partially replace natural gas for production of DRI. This is the first time that COG has been commercially used in a

Year	Production	% change	Rank In World of DRI
2007	20.1	-	1
2008	20.9	3.90	1
2009	23.4	11.96	1
2010	24.8	5.98	1
2011	21.3	(-) 14.11	1
2012	19.7	(-) 7.51	1
2013	17.8	(-) 9.64	1
2014	17.3	(-) 2.81	1
2015	16.2	(-) 6.36	1
2016 (P)	14.3	(-)11.73	2

- Ensure correct carbon equivalent.
- Correct addition of alloying elements to achieve the desired

Parameters	Gas-based DRI/HBI	Coal – based DRI
Metallisation (%)	up to 93	92 (max)
Carbon (%)	1.2 to 2.5	0.2 to 2.5
Size of the product	Mostly Uniform	Wide Variation
Stability	Resistant to Degradation	Easily degradable
Bulk Density, T/M3	1.6 to 2.0	1.8 to 2.5
Recitation	Prone to re-oxidation Unless briquetted	Relalively more Stable
Melting In EAF	High Carbon is advantageous for reducing residual from Oxide in HBI/DRI	Extra Carbon is required for reducing FeO in DRI
Melting In BOF	Carton Content will be high	Carbon in Liquid metal is reduced EeO indri

(Table Contd. Next page)

Non-Magnetic materials (%)	NIL	1-2
Yield of liquid steel	1-2 percent more than coal-based DRI	'i-2 percent less than gas-based DRI/HBI
usage In EAFs(%)	up to 80	30-60

MIDREX shaft furnace to replace natural gas consumption

The vision of the Joint CEO of the Dolvi plant to use "chemical energy of COG for production of DRI instead of the thermal energy" has given new dimensions for starting the use of COG in a DRI plant.

According to JSW Dolvi Sources about 20,000 M3 of COG is being used in the DRI plant on an hourly basis allowing it to offset natural gas equal to half of the COG consumption and produce DRI at a steady rate with the same product quality–

Gas-based	2011-12	2012-13	2013-14	2014-15	2015-16
Production (Mt)	5-15	3.93	2.61	3.14	3.92
Installed Capacity (Mt)	9.6	9.6	12.6	12.6	12.6
Capacity Utilisation (%)	53.6	40.9	24.92	31.1	
Coal-based					
Production (Mt)	15.41	14.74	15.49	14.32	13.95
Installed Capacity (Mt)	25.71	27.71	28.06	36.03	36.03
Capacity Utilisation (%)	59.9	53.2	55.2	39.7	38.7
Total (All- India)					
Production (Mt)	2056	18.67	18.10	17.46	17.87
Installed Capacity (Mt)	35.31	37.31	37.66	48.63	48.63
Capacity utilisation (%)	58.2	50.0	48.1	35.9	36.7

16. Production, Installed Capacity And Capacity utilisation of Gas-based and Coal-based plants / units in India are shown, in Table – 4

Table 4: Production, Installed Capacity And Capacity Utilisation of Gas based & Coal-based DRI Plants/Units In India Between 2011-12 and 2015-16

Source : SIMA

According to SIMA, in 2016-17, India produced about 90 Mt of finished carbon steel. DRI, an important to this steel making, accounted 21 Mt, 7Mt from Gas-based and 14 Mt form coal – based DRI plants / units

It is evident from the above table that India's production of DRI declined from 20.56 mt in 2011-12 to 17.87 in 2015- 16- a drop of 13.1 percent in four year Capacity utilisation in the above period come down from 58-2 percent to 36.7 percent

In case of gas-based plants production of DRI saw a decline of 23.9 percent from 5-15 Mt in 2011-12 to 3.92 Mt in 2015-16. Capacity utilisation come down shortly from 53.6 percent to 31.1 per during the above period.

Coal-based DRI production came down from 15.41 Mt in 2011-12 to 13.95 Mt in 2015-16 while there capacity utilisation declined from 59.9 percent to 38.7 percent the priod.

Major resaons for the decline in production of DRI and its capacity utilisation are as follows:

Shortage and high price of iron are due to the ban on iron are mining in Karnataka and Goa and restriction on odisha and Jharkhand Shortage of coal for coal- based. CIL and SCCL are not able to supply the required quality. CIL supplied only 2Mt of Coal in 2013 – 14 against a demand of 50 Mt. Shortage of raw materials and environmental problems have compelled many coal based units to shut down.

Shortage of natural gas for gas-based DRI plants Against a requirement of 7.4 mm scmd, allocation is 5.36 mm scmd and availability is 1.14 mm semd or only 15.41 percent of requirement.

17. Views of Sponge Iron Manufacturers Association (SIMA)

The National Steel Policy, 2017 aims at 300 Mt steel production capacity by 2030 SIMA maintains that the intrinsic and relative ease by which the secondary sector shall grow as compared to ISPs, augurs well for the DRI industry. NSP hob envisaged the steel production through DRI-FAF and IF routs at 35-40 percent. This means a DRI capacity of 114Mtpaand DRI demand / production at 80 Mt by 2030 -31.

Pellets Reduce dependability of DRI plants on sized ore and enlarging the basket of inputs materials, reducing raw material risk of the industry SIMA a opines that pellets can be tailor made to improve the effectiveness & DRI process. Pellets of high purity can cause improvement in the DRI Kiln productivity. One of the biggest advantages of the DRI industry is that it has three standard modules : 100TPD, 350 TPD and 500 TPD, making it easier and less expensive to commission a few improvement project.

18. Conclusion :

A marked slowdown is noticed in DRI industry recently. The future of gas-based plants lies in the development of coal gasification and COREX/FINEX off gases or coke oven gas. The technology in coal-based plants needs much upgradation to control pollution and raise the productivity. The use of high grade pellets can improve the productivity and Quality of DRI. The estimated DRI production of 80Mt by 2030-31 seam to be an over estimation.

Acknowledgments :

1. Articles by NMRao, Consultant (IFS)
PUBLISHED IN JPC Bulletin Steel world.
2. Articles By Dr. Amit Chatterjee. For merely Advisor, Tata Steel.
3. Daniel Technology Book.