ISSN 2277–5528
Impact Factor- 4.015

INTERNATIONAL JOURNAL OF ENGINEERING SCIENCES & MANAGEMENT

TECHNICAL REPORT ONIMPACT OF IMPORTED COAL IN SPONGE IRON MAKING WITH HIS ASPECT

Pradeep Kumar*[1], Atish Goswami[2], Jaideep Sinha[2] and Uzma Qureshi[1]
[1]Sri SatyaSai College of Engineering, RKDF University Bhopal, (M.P.)
[2]Jindal Steel & Power Ltd, Angul (OD)
pradeep.kumar@angul.jspl.com

Abstract

In the present time diversified use of available energy resources other than the conventional, the use of imported coal which is have high calorific value and low ash coal may serve the purpose of long kiln campaign life of the Sponge iron Plant. The use of imported coal may not only be beneficial for the effective utilization of carbon in the kiln but also to increase productivity of the DRI Kiln as well. Such high Carbon coal's char can be effectively used in the kiln as well in order to reduce the specific consumption of the coal.
Due to scarcity of none coking coal and that too available for the power plant operations in India in order to cater the power requirement of the nation, use of such imported coal may be boon for the DRI industries.

Keyword: Coal, Sponge Iron

Introduction

The blast furnace is the dominant reactor for iron making.Alternative iron making processes that do not use the blast furnace and not dependent on coke as the primary reductant, currently account for about 8% of total global iron production. These alternative processes may be broadly classified into two categories:

1. Processes in which iron is produced as a solid,by solid state reduction
2. Processes producing liquid iron by a combination of solid and liquid State reduction.

Direct reduction (DR) includes a family of processes in which iron by(in the form of fines, Lumps or pellets) is reduced is reduced to the solid state either by solid or gaseous reducing Agents. Depending on the type of the reductant employed,DR processes can be classified into two categories,viz coal based processes and gas based processes.
The above experiments were done on both the types of coal i.e.Domestic Washed Coal and Imported South African Coal and the results were found as under:-
Proximate analysis of washed coal from JOCCM.

Sample No	%Moisture	% VM	% ASH	% FC	GCV
1	19.2	31.8	35.44	32.76	3898
2	18.8	30.52	34.7	34.78	4138
3	18.2	30.12	33.82	36.06	4252
4	16.6	32.63	33.63	33.74	4223

Size analysis of washed coal.

Screen Size	+20 mm	+15 mm	+10mm	+8mm	+5mm	+3mm	-3mm
Sample 1	3.2	15.3	43.58	8.95	15.62	7.32	6.04
Sample 2	2.1	13.7	49.78	10.75	14.67	5.08	3.92
Sample 3	2.7	14.2	43.08	7.51	14.92	8.01	9.54
Sample 4	3.3	16.3	30.19	12.61	18.6	9.31	9.69

Proximate analysis of imported coal.

Sample No	%Moisture	% VM	% ASH	% FC	GCV
1	11.8	20.24	25.12	54.64	5615
2	12.6	20.14	26.38	53.48	5590
3	12.2	20.69	24.25	55.06	5607
4	12.6	21.9	23.25	54.85	5596

Size analysis of imported coal.

ISSN 2277–5528
Impact Factor- 4.015

Screen Size	+20mm	+15mm	+10mm	+8mm	+5mm	+3mm	3mm
Sample 1	15.2	4.8	12.3	22.8	9.4	10.3	25.2
Sample 2	14.8	4.9	12.2	23.8	9.7	10.9	23.7
Sample 3	16.7	5.3	12.1	20.6	9.5	11.6	24.2
Sample 4	15.3	4.5	11.7	24.2	8.8	11.3	23.4

Above analysis clearly show that chemical properties of coal is far better than wash coal but the physical properties are not as per required.

As per size analysis we have some major challenges

1) Our limitationthat we have no provision of crusher so the feeding of +20 mm inside the kilnhas to be done.
2) Feeding of fines coal inside the Kiln.
3) Proper coal distribution for no coal starvation.
4) Proper air distribution for the maintaining temperature inside kiln.

Above all are directly related to product quality as well as campaign life of kiln. So thefollowing steps are taken for betterment.

1) As per discussion the final decision made that +20mm sized coal is to be fed from feed end and fines coal -3mmto be injected from discharge end.
2) Gap between pocket and body of rotary feeder is decreased from 3mm to 1mm.
3) Rotary feeder pressure reduced from 6000mmwc to 4000mmwc.
4) Air reduced from 2250 Nm3/hr/ton of ore to 2000 Nm3/hr/ton of ore.
5)Air distribution change are as under:-Preheating zones air increased, mid zone air are minimized as low as possible, Reduction zone and secondary air are maintain as per QRT sample observation.
6) For more utilization of coal,retention time for solid-solid reaction is increased by decreasing the kiln rpm.
7) Use of dryer is one of the good options for imported coal before charge

Results and Discussion

It was observed that as the ash handling is higher side when JOCCM washed coal is fed through the kiln and hence formation of accretion found on higher side even in early days of kiln campaign.

The shortcomings of JOCCM washed coal is taken over by the imported South African Coal.

The Impact of the Imported Coal is as under:-

1. Due to low moisture content (11-12%), the amount of moisture to be handled is less and hence less fuel is lost for the conversion of the moisture in the form of steam form coal feed in the Kiln.
2. As the Fixed Carbon content of the imported coal is higher side (54-55%) and hence the Gross Calorific Value of the coal (5500-5600 K Cal/Kg of the coal) too, less specific coal 0.78 to 0.80 is needed.
3. As the Ash Content (in the range 24-26%) which is less as compared with JOCCM washed Coal plays a vital role in DRI kiln campaign life. The rate of formation of low melting complex formation is observed very little at the outlet of Kiln hence throughout kiln volume is available for the further feeding of iron ore.
4. Heat losses through the kiln decreased as the lower handling of ash and kiln can operate at optimum temperature.
5. Less char generation not only allows easy separation of DRI from non magnetic char but also concept of Hot DRI for direct charging to Basic Oxygen Furnace from kiln outlet discharge at a temp of 1000*C through hot charging Car can be done.
6. Due to less char the lesser quantity of water required for controlling of discharge temperature decreased from 950 m3/hr to 600 m3/hr.
7. The char generated contains higher amount of fixed Carbon @ 38-40 % hence it is reutilized in the kiln from outlet with injection coal in proper proportion. Thus the utilization of unburn coal in the form of char can be used effectively,which has reduced the specific coal consumption from 0.78 -0.80 to 0.74-0.76.
8. Unburn carbon in WHRB is also reduced from 16-18% to 9-10%.
9. In over all the wastage from ABC & DSC are reduced.
10. Rate of formation of accretion is very low so that iron wastage fromT.C. gate and Over size gate are minimized.
11. This coal composition is best for kiln but the steam generation is reduced from 60 ton/hr to 35ton/hr because of flue gas are reduced.
12. Wide variation in product quality due variation in Coal MPS.

The impact of JOCCM washed coal on the Sponge Iron kiln operation is as under:-

1. Due to higher Moisture content (16-19 %) there is a need of extraneous fuel (coal) to remove moisture from the system in the form of steam. For one kg of moisture need 604 Kcal heat.
2. As the Fixed Carbon and hence the Gross Calorific value of the Coal is low(FC:-31.5-36%) (GCV:- 3750-4250 Kcal/Kg of coal) , the Specific coal required for the production of Sponge iron is high (1.3 to 1.35 Tons/ton of DRI) and

ISSN 2277–5528
Impact Factor- 4.015

impair the productivity as the volume available for the kiln is fixed(DRI production in the range of 450-460 t/day in the 500tpd capacity kiln.)

3. As the Ash content of the washed coal is higher side(33-35%) it not only forms low melting complex in the kiln in the form of accretion but also takes heat from the combustion of coal in order to remain at the operating temperature of the kiln. As the ash burden gains the volume in the kiln, the effective volume available for the charge (iron Ore) gets reduced.

As discussed earlier the Chemical analysis of accretion (low melting tertiary complex of SiO2-Mno-Al2O3-FeO) formed in the kiln in a Campaign is as follows:-

Sample ID	FeO%	SiO2%	Al2O3%	CaO%	MgO%	C%	S%
Lower layer*	33.24	28.74	18.94	2.28	0.48	0.32	0.14
Upper Layer *	10.20	32.5	23.92	3.48	0.78	0.08	0.26
Air Tube No. 3 & 4	36.74	24.98	20.78	2.56	0.88	0.54	0.33
Air Tube No. 6 & 7	10.64	19.48	14.26	3.16	1.18	0.37	0.22
Mid Zone Area	37.10	22.02	17.85	2.96	0.78	0.035	0.56
Out let & Cone Area	5.7	46.10	26.48	3.90	1.14	0.075	0.18

Conclusion

It is clearly seen on the above test & observation imported coal is the other optionto survive the DRI process, in future aspect imported coal is used in place of non coking coal, but that time process observation required more keenly because using the imported coalaccretionaggregation is low but when ever formed metallic ring chances increased so that why need to be more attention during using imported coal.

References

1. Ahindra Ghosh and Amit Chatterjee: Iron making & steel making theory and practice,PHI Learning private limited new Delhi 2nd printing September 2008, p-11,225-228
2. Fuel ,furnace & refractories by O.P. Gupta