Calcined lime is the second important input for steel making. Various factors like chemical, physical characteristics has an effect on quality of calcined lime. To produce a good quality lime from limestone, the process parameters of calcination have to be takencare of. Proper control of process parameters coupled with good quality limestone produces good lime. At Vizag Steel, lime is being produced in rotary kilns from SMS grade (low silica) limestone. The paper deals with the important parameters test methods as well as experience of Rashtriya Ispat Nigam Limited, Vizag steel while using low silica limestone. This paper also brings outsome details of the characteristics of low silica limestone from different sources which may help the BOF operators.

Usage of SMS Grade (Low Silica) Limestone

A RINL, Vizag Steel Experience

- Atanu Datta & A Majumder, RINL

Introduction

Present day steel making process demands for low lime consumption with effective dephosphorisation & other function of forming a good slag in converter. Any good product requires quality input materials as well as good process. Lime is not an exception. As the demand for ultra low phosphorous and low sulphur special steels is increasing, the requirement for superior quality lime is also becoming prominent. Limestone as a naturally occurring mineral exists nearly all over the world. The chemical composition of limestone varies greatly from region to region as well as between different deposits in the same region. Therefore, the final product from each natural deposit is different. In general, all limestone contains a mixture of carbonates and oxides such as CaCO3, MgCO3, CaO, Iron oxide, Silica, Alumina and other trace components.

Occurrence & Deposits

Presently in India the production of Limestone (state wise share in percent) is depicted in Fig 1.

Limestone Standard

Suitable limestone quality for different usage requirements are dealt in BIS 10345: 2004.

Table - 1 shows the guidelines for limestone usage in different industries.

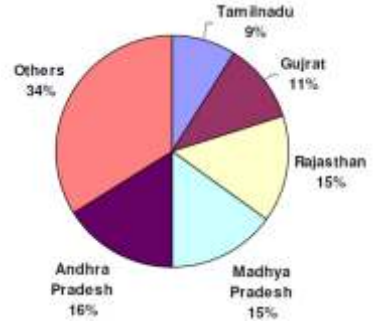

Fig 1: Limestone Production In India (State Wise Share In %)

Vizag Steel Experience

VSP presently requires around 4.5 lakh tons of high grade limestone for its steel melting shop producing about 5.3 Mt liquid steel. Presently VSP is totally importing the same from the Gulf Countries. After the expansion plan upto 7.3 M, VSP would be importing around 7 lakh tons of high grade limestone. In the last 20 years VSP has used the lime stone from different sources.

Limestone from the following sources which VSP has used over the period :

1) Dubai (UAE)

2) Oman

3) Thailand

4) Jaisalmer(Rajasthan-India)

Physical appearance of one of the source is shown in Fig 2.

Discussion

Limestone available in India contains a relatively high percentage of silica, which results in higher energy consumption. Lower silica also reduces the acidic nature of the molten slag, according to industry experts. Limestone from Katni, Madhya Pradesh, which is generally used for iron making in the blast furnace, contains Silica to the level of 5 to 6 percent and CaO of around 47

TABLE - 1

Characteristics	Grade-1 (Use in Steelmaking)	Grade-2 (Use in Ironmaking)
CaO	53% min.	44% min
MgO	1.5% max.	4% max.
SiO2	1.5% max.	6% max.
Total Acid Insoluble (TAI)	2% max.	10% max.
Alkali Content	0.2 Max	0.2 Max
Size	30-80 mm	15 to 75 mm
Undersize and Oversize	Not more than 5 %	Not more than 5 %

NOTE : The size ranges other than specified above shall be subject to agreement between the supplier and the purchaser.
The grade 1 and 2 limestones are also called as SMS grade / Low silica grade and BF grade limestone respectively.

Fig 2 : Typical Physical Appearance of Low Silica Limestone

percent. Similarly, limestone from Gotan, Jaisalmer district of Rajasthan, used in the steel melting shop, contains Silica around 1.5 percent and CaO around 53 percent. This level of SiO2 is far higher as compared to limestone imported from countries like Dubai, Oman, Iran and Indonesia where silica content is aslow as 0.5 to 1.0 percent. Sometimes, silica content from these places is even less than0.5 percent. CaO content of the imported limestone is little more than that obtained from Jaisalmer.

In converter, oxygen combines with the carbon and other unwanted elements to oxidize the impurities in the molten charge, and thereby converting the molten charge to steel. The lime and other fluxes help remove the oxidized impurities as a layer of slag.The refined steel is then poured into ladles. At this point ferro alloys, petroleum coke can be added to the steel to obtain the desired grade of steel.

Chemical analysis is essential to know the various components. The % SiO2, % CaO, %Al2O3 of limestone is very important parameters for judging its quality. The impurities P & S should be less than 0.005%. The Shatter and Tumbler index are important considering the strength properties at room temperature, where as Decrepitation index gives an idea how the material behaves (degrades) after calcinations at 1000 deg C.

VSP has maintained Low Silica Limestone two specifications to increase its supplier base as well as budgeted duty structure for import of low silica limestone. Some analysts also believe that imported limestone is expected to improve the yield of the steel melting shop and also reduce oxygen consumption. Presence of low silica is also expected to reduce the heat requirement of the converter.

The specific consumption of lime varies depending on the silicon content of the charge (i.e. Hot metal, recycled heat, scrap, pig iron) and also on the % SiO2 of Iron ore, dolomite . It will be low if the Silicon / Silica in the input is low.

Limestone at Kiln

Limestone from Source-1

This source is maximum used in VSP in different intervals with two varieties of silica % i.e. > 0.5% silica and Silica in between 0.50 to 0.65%.

- Limestone was supplied in the desired size range of 30-60 mm and almost free of dust.
- - 25 mm size after screening is gone as high as 20 % sometimes.
- Quality of lime is consistent with 3 to 7 % of LOI and 310 to 350 CC of 4 N HCL reactivity within 5 minutes.
- Total CaO + MgO for low silica limestone variety was 88 to 92 % and high silica variety which is used at present total CaO + MgO is 86 to 90 %.

Limestone from Source - 2

- Limestone was perfect in the desired size range of 30-60 mm and almost free ofdust.
- There was no coating piece formation inside the kiln as adherent dust is less.
- Lime quality consistent in the rotary kilns with LOI ranging 4 to 6.5%, reactivity in the range of 310 to 350 CC in 4N HCL for 5 minutes
- Chemical composition of the lime is well within the tolerable limit with total CaO+ MgO is in the range of 88 to 92 %, Silica was less than 1% in all the samples.

Limestone from Source - 3

- No visible oversize material is observed in the limestone and there are no chute jamming etc in receiving section.
- There is no noticeable change in - 25mm fraction in screening section where as very fine dust in the limestone which contributes to coating pieces in the kiln is less
- Consistent lime quality is observed in the rotary kilns with LOI ranging 3 to 6.5%,
- Reactivity in the range of 320 to 350 CC in 4N HCL for 5 minutes

Limestone from Source - 4

- Due to high decrepitation index in the limestone dust generation was very high
- Quality of lime was consistent with silica content less than 1%
- Huge over size observed in the limestone leading to chute jamming in different sections of Calcining plant.

Conclusion

The selection of Low silica lime stone depends on both physical and chemical parameters.

Depending on the calcinations process Rotary kiln or Shaft kiln the size of input material is decided. Of late the Indian steel makers are finding more value in importing limestone and the market is witnessing unprecedented growth in limestone import into the country. Exploration of the indigenous Low silica limestone in India needs to be enhanced.