First Threshold Value of Minerals Workshop

by

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Background

- The threshold value is a component to mineral conservation as it decides the lower limit of sub grade in a mineral deposit and upper limit of mining waste as distinct from utilizable/ marketable fraction of ore zone.
- Last threshold value was revised by IBM in the year 2009 based on beneficiability/ marketability of minerals.
- Threshold values for Limestone were defined as under:

States	Threshold Values
Chhattisgarh, Gujarat, Himachal Pradesh, Madhya Pradesh, Maharashtra Rajasthan, Uttarakhand & Uttar Pradesh :	CaO – 34% (Min), MgO- 4% (Max)
Andhra Pradesh, Jharkhand Karnataka, Kerala, Orissa & Tamilnadu	CaO-35% (Min), MgO- 4% (Max), SiO2 – 18% (Max) & Alkalies-0.5%(Max)

Background

The implications for threshold value is:

1. That all non usable minerals above the threshold limit is required to be stacked separately within the mining lease hence blocks substantial area.
2. Overburden and waste material below threshold value during mining operations should not get mixed with the above material.

The Limestone production in India is as follows:

- Cement Grade: 97%
- Iron & Steel Grade: 2% &
- Chemical Grade: 1%

Hence major consumer for limestone is Cement Industry and present threshold value has been framed considering cement industry in mind. Requirement of CaO in Iron & Steel and Chemical Industry is much higher.

Considerations for Revision of Threshold Value of Limestone

1. **To be based on type of Limestone (sedimentary/ metamorphic) rather than on regional basis**.

- Sedimentary limestone is normally associated with soft deleterious components like clay and shale. Owing to difference in hardness these softer components become powdery on blasting and are segregable through beneficiation process like screening and washing.

- Metamorphic limestone on the other hand is normally associated with hard igneous intrusive like pegmatite, granite, amphibolite etc. and at times with dolomites/ dolomitic limestone which all are equally hard as metamorphosed limestone. On blasting, all these components along with limestone appear in almost the same fraction size and are therefore difficult to segregate in the course of beneficiation in mechanized mining.

2. Most of the Limestone Deposits Available for Cement Industry are Marginal Grade

- Many of the deposits that have come up or are likely to come up for auction are marginal grade having high silica and low to sub grade CaO (Rajasthan, Chhattisgarh and Maharashtra) content from cement manufacturing perspective which alone will not be able to sustain the process requirement for manufacture of clinker.
- Many of the deposits that have come up for auction were high in MgO content as well. These too will not be able to sustain the clinker manufacturing process owing to more than desirable limits of MgO in clinker manufacturing (Rajasthan).
- This will definitely require blending with high grade limestone whose availability is very limited.
- Deposits with inherent high silica cannot be utilized for cement manufacturing process without blending with high grade limestone.

3. National Council for Cement and Building Materials (NCCBM) norms for prospecting limestone suggest limiting value of CaO to be minimum 40%.

- The scope of beneficiation or addition of small quantity of sweetening material may make otherwise sub-grade limestone suitable for cement manufacture. The broad chemical specification is given below:

Oxide Component	Acceptable range for manufacture of OPC	Limiting values taking into consideration other type of cement, scope of beneficiation and blending
CaO	44 -52	40 (Min)
MgO	3.5 (Max)	5.0 (Max)
SiO_2, Al_2O_3 & Fe_2O_3	To satisfy Lime Saturation Factor (LSF), Silica Modulus and Alumina Modulus	
$Na_2O + K_2O$	<0.60	<1.0
Total S as SO_3	<0.60	<0.80
Cl	<0.015	<0.05

4. Role of Fuel in the Cut Off Limit of Limestone

- Fuel being used in the cement industry is Petcoke, Imported Coal and Indian Coal in this order. Each fuel plays an important role in clinker manufacturing process.
- Petcoke is the most preferred fuel due to its low ash and high calorific value (~8000 Kcal/ Kg) and also conserves limestone deposit. Even with this, it is difficult to blend limestone below 40% CaO. Availability of petcoke on regular basis is an issue. Further, high sulphur in petcoke put restrictions of its usage in some of the limestone deposits having inherent SO3.
- With the imported coal (ash ~16% & calorific value 5500- 6000 Kcal/ Kg) limestone cut off would be 42% CaO.
- Indian Coal available to cement industry today is high in ash (~38% to 45%) and low in calorific value (~3500 to 4000 Kcal/ Kg). With this quality of coal, the CaO value in limestone needs to be ~45%.
- Thus, industry uses Indian coal along with imported coal/ petcoke so that average run of mine is maintained at 43-45% CaO.

5. Role of Additives in the Cut Off Values of RoM Limestone

Besides Limestone, cement raw mix requires 8 to 10% additive material like laterite, bauxite, red ochre, iron ore etc.

Day by day quality and availability of these additives is deteriorating i.e. increase in silica which demands higher CaO content from run-off-mine limestone

Suggestion for Revision of Threshold Value of Limestone

Thus in practical consideration:

1. Even after use of petcoke available, screening of run-of-mine, the cut off limit of CaO is around 40% as against threshold value of 34%-35% for different regions.
2. Due to better process control limiting value of MgO usage can be enhanced from the present 4% to 5% (Max)
3. Deposits with high SO3 content restricts usage of petcoke as fuel resulting in consumption of limestone with high CaO only thus limiting the use of low grade limestone.
4. Coastal deposits having high SO3 and Cl content cannot be utilized fully even after having by-pass system. Present clinker manufacturing process restricts usage of SO3>0.8% and Cl>0.16% based on our experience of 20-25% by-pass system.
5. Further we do not see much technological development in beneficiation techniques for upgrading limestone quality that will bring down CaO usage at threshold value.
6. Resources should be considered upto a cut off of 38% CaO, 5% MgO, SO3<=0.80% and Cl<0.16% considering the scope of beneficiation. These limits can be reviewed again after a period of 5 years.

Thank You

LSF Sensitivity with Cut-off (CaO 34)													
Blended							Remaining (Not Blended)						
LSF	Tonnes (MiT)	CaO	SiO2	Al_2O_3	Fe2O3	MgO	LSF	Tonnes (MiT)	CaO	SiO2	Al_2O_3	Fe2O3	MgO
98.00	250	42.68	13.60	3.63	1.81	1.57	81.71	5.75	40.88	15.71	4.05	1.96	1.66
99.00	235	42.78	13.50	3.61	1.80	1.56	83.00	20.06	40.99	15.48	4.01	2.01	1.78
100.00	223	42.87	13.39	3.58	1.78	1.55	83.32	32.82	41.09	15.44	4.04	2.03	1.75
101.00	209	42.95	13.28	3.55	1.77	1.54	84.16	46.26	41.22	15.32	4.04	2.02	1.73
102.00	193	43.05	13.18	3.52	1.76	1.53	85.59	62.19	41.35	15.10	4.02	2.00	1.71
103.00	179	43.14	13.09	3.49	1.74	1.52	86.50	76.50	41.46	14.97	3.99	1.99	1.71
104.00	168	43.23	12.99	3.46	1.73	1.51	86.87	87.52	41.50	14.92	3.99	1.99	1.70
105.00	156	43.31	12.89	3.43	1.72	1.51	87.49	99.49	41.59	14.85	3.97	1.97	1.69
106.00	146	43.38	12.79	3.39	1.71	1.50	87.84	109.16	41.64	14.80	3.96	1.96	1.68
107.00	137	43.45	12.69	3.37	1.70	1.49	88.21	118.35	41.69	14.76	3.95	1.95	1.68
108.00	127	43.53	12.60	3.34	1.69	1.48	88.78	128.63	41.76	14.69	3.93	1.94	1.67
109.00	118	43.60	12.50	3.31	1.68	1.47	89.16	136.98	41.81	14.64	3.92	1.94	1.67
110.00	110	43.68	12.41	3.28	1.67	1.46	89.60	145.44	41.85	14.59	3.91	1.93	1.67