15th NCB International Seminar on Cement, Concrete and Building Materials
05-08 DECEMBER 2017, NEW DELHI, INDIA
ORGANISED BY :
NATIONAL COUNCIL FOR CEMENT AND BUILDING MATERIALS
www.ncbindia.com

UPGRADATION OF EXISTING CEMENT GRINDING SYSTEMS WITH VRPM FOR CAPACITY ENHANCEMENT AND REDUCTION IN SPECIFIC POWER CONSUMPTION

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1. Introduction:

The Cement Industry is always looking forward to energy efficient solutions and are ready to upgrade their systems for higher production and lower power consumption. The adaptation with the available technologies is now the need of hour for staying competitive. One such attractive solution is offered by AMCL by using VRPM system for grinding cement and limestone. Recently, AMCL has undertaken up-gradation projects of cement mill circuits at M/s. Maihar Cement Ltd, Satna, M/s. Century Cement Ltd, Baikunth and M/s. BCL, Raebareli where the systems have been modified by replacing Mogensen Sizer with Static Separator which in turn has resulted in increase in Production of around 20 – 30% and savings in Specific power consumption around 3 kwh/t with reduced down time and smooth running operation. Many cement plants have VRPM installations with mogensen sizer operating at their plants experiencing high downtime and uneven feed distribution to ball mills. Such grinding systems need to be up-graded for better availability of VRPM, for higher production and reduced specific power consumption of the entire circuit.

2. Grinding System Description:

The earlier installations of VRPM systems were supplied in Pre-grinding mode with Mogensen sizer. In such system the ground material from VRPM is made to pass through the Mogensen sizer. The coarse material (+) 3mm is sent back to VRPM while the fine material (-) 3mm is sent to the inlet of Ball Mill for further grinding. The similar circuit is shown in figure 2.1.

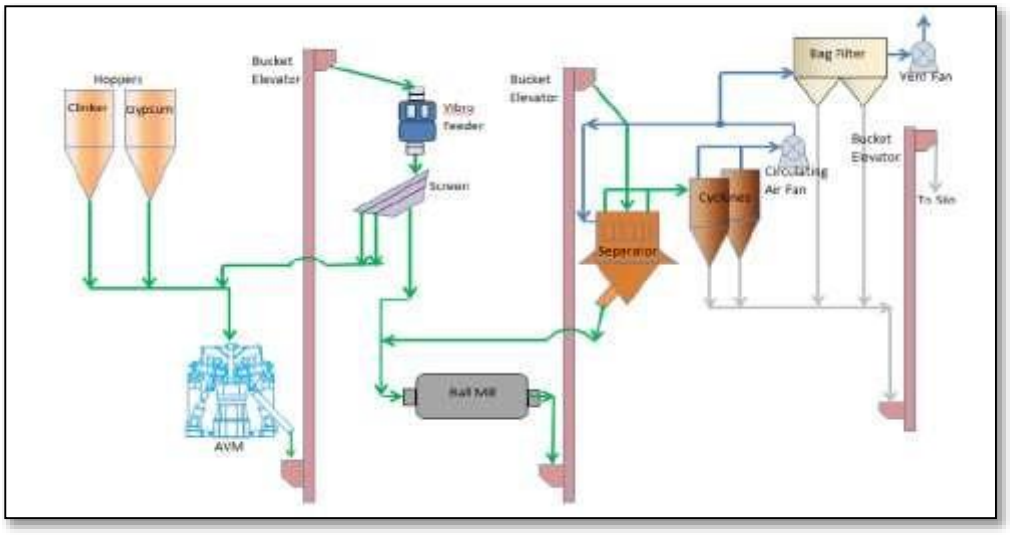


Figure 2.1

After a few years of operation, it was found that the mogensen sizer is prone to heavy maintenance thus requiring repetitive maintenance leading to high down time. The existing system with mogensen sizer has now been up-graded by converting the system from Pre-grinding mode to Semi-finish mode with static separator. The system is shown in the figure 2.2;

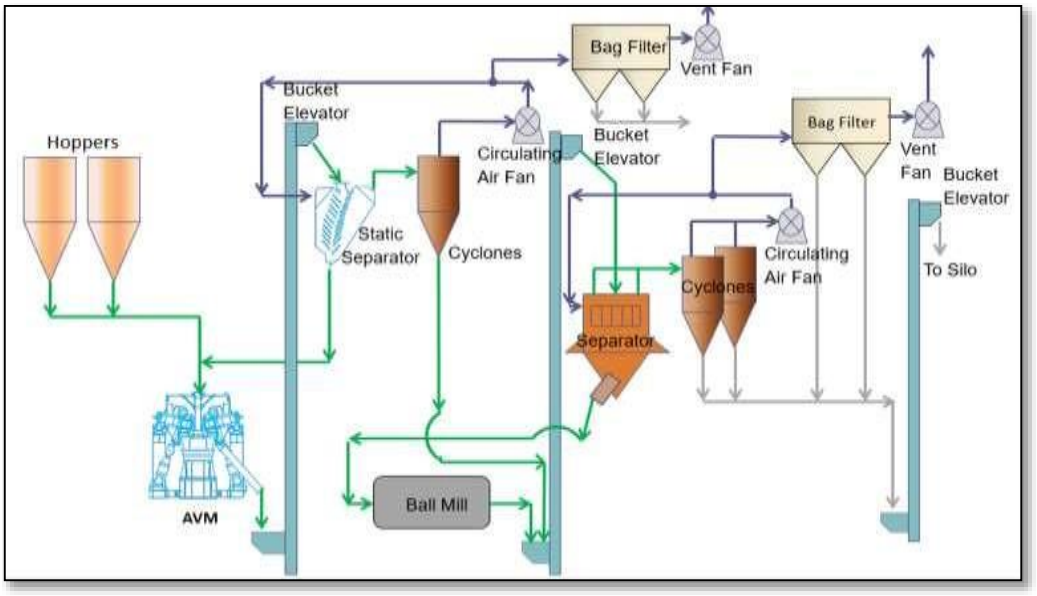


Figure 2.2

After up-gradation of the Ball Mill circuit with static separator has led to increased availability of VRPM and less down time. The production capacity has been increased by additional 25 – 30% and savings in the specific power consumption is around 3-4 units. Many cement plants are up-grading their system for better availability of plant and for smooth operation. The case studies of cement plants after up-gradation are explained below.

3. Up-gradation of VRPM Circuits:

M/s. Maihar Cement Limited, Satna

At Maihar Cement plant, the existing Ball Mill system was up-graded with VRPM in Pre-grinding mode along with Mogensen Sizer in the year 2004 resulting in 30 % increase in production capacity and savings of over 3 - 4 kwh/t. With a view to improve the existing grinding capacity and to increase the availability of plant later in the year 2014 the VRPM system has been changed to semi-finish mode by replacing mogensen sizer with static separator and by optimising the Ball Mill circuit which has resulted in further savings of 3 kwh/t and with 33 % increase in production capacity. The results are tabulated below;

Parameters	Unit	VRPM in Pre-grinding mode	VRPM in Semi-finish mode	% Increase in Capacity	Savings in power consumption
Product		PPC	PPC		
Output	TPH	170	226	**33 %**	
Sp. Power	kWh/t	31.09	27.92		**3.17**

Table 3.1(a)

After up-gradation the Mogensen sizer has been replaced with static separator.

Before up-gradation (Mogensen Sizer)

After up-gradation (Static Separator)

Particle Size analysis for fresh clinker and material feeding from Static Separator to Ball Mill is shown in the table below;

Fresh clinker to VRPM	
seive (mm)	Cum. Wt % (Retained)
40	2
25	9
20	23
16.3	49
12.5	65
6.3	90

Product from Static Separator to Ball Mill outlet	
sieve (mm)	Cum. Wt % (Retained)
2	2
1	8
0.5	22
0.212	40
0.09	67
0.045	90

The feed to the VRPM and the product material from VRPM feeding to the Ball Mill is shown below;

Fresh feed to VRPM

VRPM Product

Grinding Media loading pattern

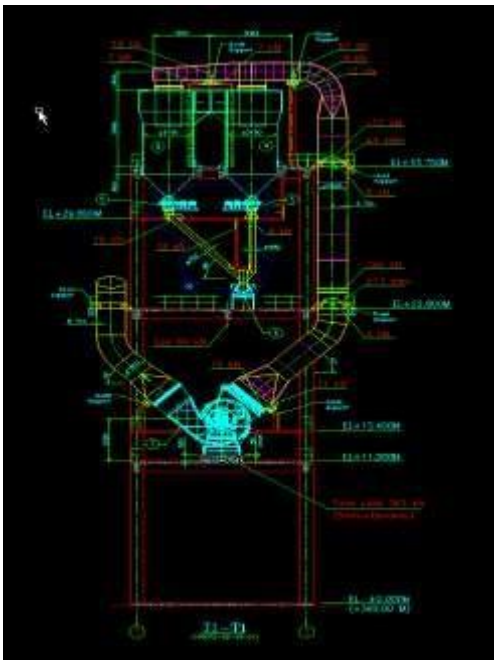
The grinding media pattern has also been changed based on the particle size of material feeding to the Ball Mill inlet. The revised grinding media pattern before up-gradation and after up-gradation is shown in the table below;

Cement Mill Grinding Media (Before Up-gradation)					Cement Mill Grinding Media (After Up-gradation)		
Ball Size, mm	CM 1		CM 2		Ball Size, mm	CM – 1 / 2	
	1st Chamber	2nd Chamber	1st Chamber	2nd Chamber		1st Chamber	2nd Chamber
50 mm	6	-	18	-	50 mm	17	-
40 mm	24	-	14	-	40 mm	26	-
30 mm	15	-	10	-	30 mm	10	13
25 mm	5	53	8	53	25 mm	-	21
20 mm	-	47	-	45	20 mm	-	29
17 mm	-	-	-	-	17 mm	-	25
15 mm	-	-	-	-	15 mm	-	8
Total	50 TON	100 TON	50 TON	98 TON	Total	53 TON	96 TON

3.1 (b)

Engineering and layout

With the efforts of both M/s. Maihar Cement Ltd and AMCL the layout was developed wherein it was possible to fit new Static Separator in the existing building. Whereas for Cyclone Separator and Circulating Fan a new civil structure was made near the existing building. The layout drawing is shown below;



Layout for VRPM Circuit

4. M/s. Century Cement Limited, Baikunth

At Century Cement plant, the existing Ball Mill system was upgraded with VRPM in Pre-grinding mode along with vibrating screen in 2004 resulting in 30 - 40 % increase in production capacity and savings of over 3 - 4 kwh/t. Later in the year 2014 the VRPM system has been changed to semi-finish mode by installing static separator which has resulted in further savings of over 4 kwh/t and with 16.6 % increase in production capacity. The results are tabulated below;

Performance of Cement Mill at M/s Century Cement Limited									
Param -eters	**Unit**	**VRPM in Pre-grinding mode**			**VRPM in semi-finish mode**			**% Increase in capacity**	**Savings in Sp. Power consum**
		CM 4	CM 5	Total	CM 4	CM 5	Total		
Product		PPC	PPC	PPC	PPC	PPC	PPC		
Output	TPH	108	108	216	129.5	123	252	**16.6 %**	
Sp. Power	kWh/t	29.5	29.5	29.5	25.06	25.5	25.3		**4.2**
Fineness	Blaine	3500	3500	3500	3600	3600	3600		

Table 4.1(a)

*CM-5 is with old grinding pattern of grinding media. Further improvement expected after new grinding media pattern.

Particle Size analysis for fresh clinker and material feeding from Static Separator to the outlet of Ball Mill is shown in the table below;

Fresh clinker to VRPM	
sieve (mm)	Cum. Wt. % Retained)
50	3
25	16
20	24
12.5	48
6.3	75
3	93

Product from Static Separator to Ball Mill outlet	
sieve (mm)	Cum. Wt. % Retained)
2	2
1	9
0.3	20
0.2	38
0.09	59
0.045	71

Fresh feed to VRPM

VRPM product

Grinding Media loading pattern

The revised grinding media pattern before up-gradation and after up-gradation is shown in the table 4.1 (b) below;

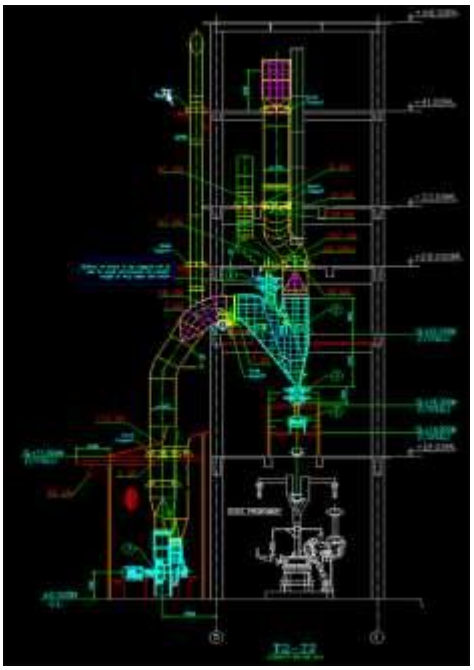
Cement Mill Grinding Media (Before Up-gradation) , CM – 4 / 5			Cement Mill Grinding Media (After Up-gradation), CM – 4		
Ball Size, mm	1st Chamber	2nd Chamber	Ball Size, mm	1st Chamber	2nd Chamber
90 mm	15	-			
80 mm	14	-			
70 mm	13	-			
60 mm	13	-			
50 mm	-	-	50 mm	20	-
40 mm	-	2	40 mm	30	-
30 mm	-	20	30 mm	10	15
25 mm	-	26	25 mm	-	25
20 mm	-	48	20 mm	-	35
17 mm	-	10	17 mm	-	30
15 mm	-	-	15 mm	-	10
Total	55 TON	106 TON	Total	60 TON	115 TON

Table 4.1(b)

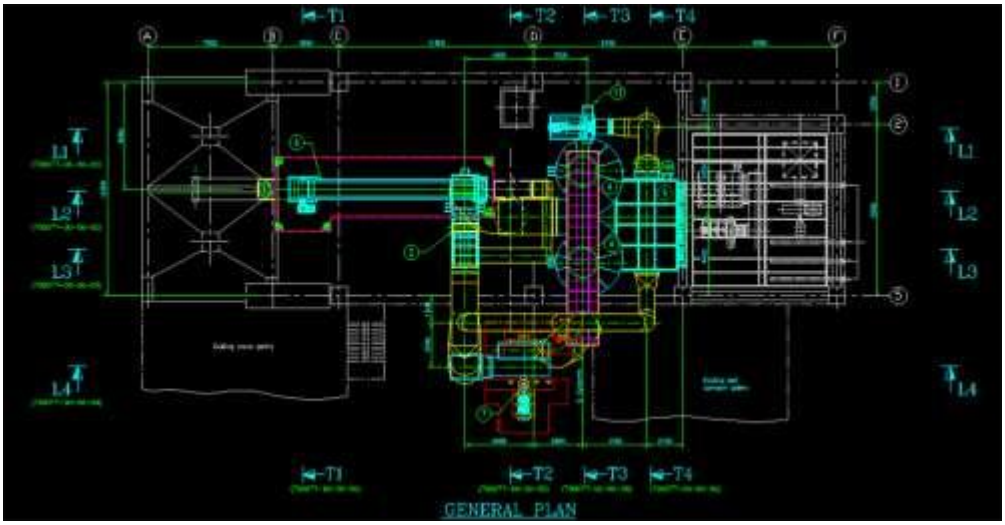
*Grinding media pattern for CM-5 is yet to be changed to suit AMCL recommendation.

Engineering and layout

With the efforts of both M/s. Century Cement and AMCL the layout was developed wherein it was possible to fit new equipment's i.e. Static Separator, Cyclone Separator, Circulating Fan etc. in the existing building itself. The layout drawing is shown below;



Layout for VRPM Circuit



Plot plan for VRPM Circuit

5. <u>M/s. Birla corporation Limited, Raebareli</u>

At M/s. BCL, Raebareli the VRPM system was commissioned in the year 2003 in pre-grinding mode along with mogensen sizer. Later due to repetitive maintenance requirement of Mogensen sizer and high down time, the need of up-gradation of grinding circuit was felt and in the year 2016 the system has been up-graded by replacing mogensen sizer with static separator. The up-graded system is shown in the figure below;

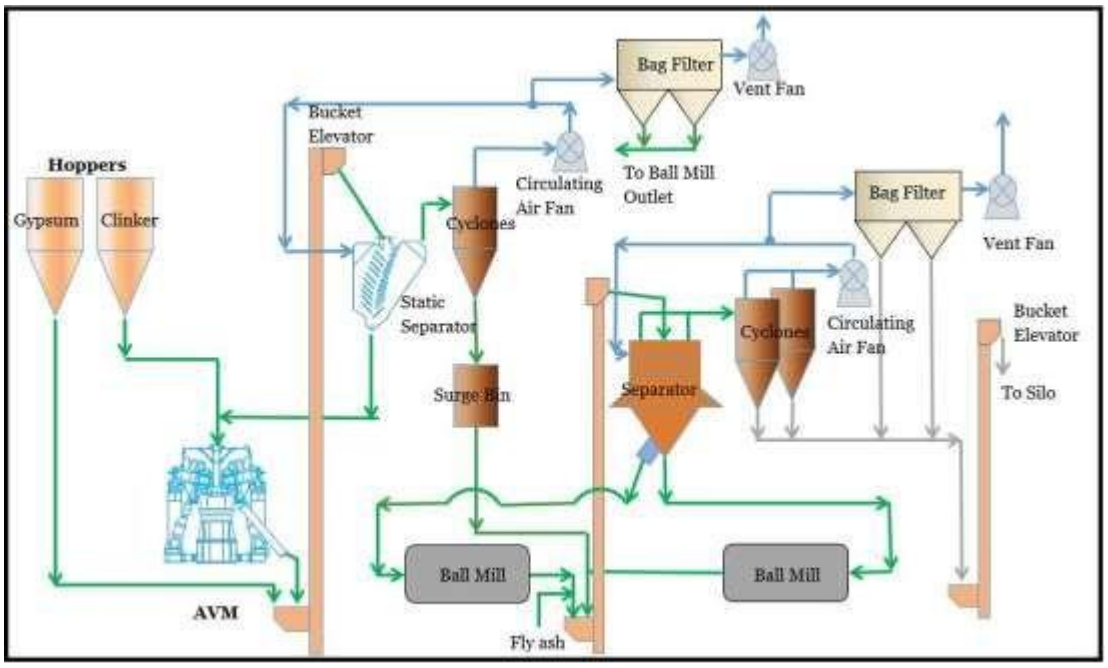


Figure 5.1

After up-gradation of system with static separator the system availability has been increased considerably and the additional increase in the production capacity is around 22 % and savings in specific power consumption is around 5 units.

The performance of the circuit is tabulated below;

Parameters	Unit	VRPM along with screen	VRPM along with static separator	% Increase in Capacity	Savings in power consumption
Product		PPC	PPC		
Output	TPH	90	110	**22%**	
Sp. Power	kWh/t	35.7	29.85		**5.35**
Fineness	Blaine	3300	3300		

Table 5.1 (a)

Fresh Feed to VRPM

VRPM product

After up-gradation the feed input to Ball Mill has been uniform. The below table is showing the feed distribution to Ball Mil before and after up-gradation.

Before Up-gradation	
Vibrating Screen Product	
sieve (mm)	Cum. Wt. % (Retained)
+5.60 mm	2.1
+4.75 mm	3.04
+3 mm	7.46
+212 µ	58.06
+90 µ	70.80
+45 µ	81.31
-45 µ	18.69

After Up-gradation	
Static Separator Product	
sieve (mm)	Cum. Wt. % (Retained)
+5.60 mm	0.0
+4.75 mm	0.0
+3 mm	0.05
+212 µ	43.03
+90 µ	60.27
+45 µ	75.26
-45 µ	24.74

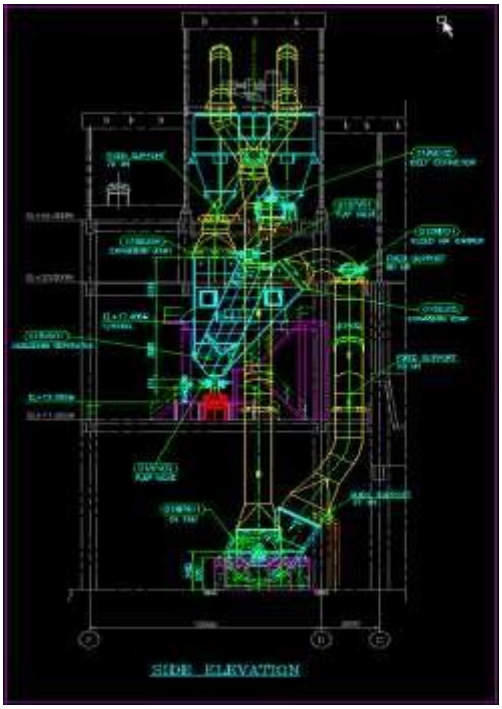
Grinding Media loading pattern

The revised grinding media pattern before up-gradation and after up-gradation is shown in the table below;

Cement Mill Grinding Media (Before Up-gradation)			Cement Mill Grinding Media (After Up-gradation)		
Ball Size, mm	CM 1 & CM 2		Ball Size, mm	CM 1 & CM 2	
	1st Chamber (Tons)	2nd Chamber (Tons)		1st Chamber (Tons)	2nd Chamber (Tons)
80 mm	2	-			
70 mm	3.5	-			
60 mm	8.5	-			
50 mm	6.1	-			
40 mm	2.12	-	40 mm	9	-
30 mm	-	6.46	30 mm	9	
25 mm	-	7.06	25 mm	6	5
20 mm	-	16.94	20 mm	-	25
17 mm	-	19.21	17 mm	-	15
Total	22.2 TON	49.67 TON	Total	24 TON	45 TON

Table 5.1 (b)

Engineering and layout



Layout for VRPM circuit

Static Separator

Downtime for hook-up:

Downtime is the important aspect and all efforts have made to minimise the same. The downtime for up-gradation project at M/s. Maihar Cement Ltd was curtailed to maximum of 14 days with the hook up activities, for M/s. Century Cement Ltd the downtime was 15 days while to carry out up-gradation at M/s. Birla Corporation Limited, Raebareli the downtime was of 16 days. It is important to study all aspects of hook up activities and ensure smooth operation.

Feasibility studies, System Engineering and after sales services:

The proper balancing of equipment is more crucial aspect in retrofit jobs. Many a times the real benefit cannot be derived due to mismatch in capacity of downstream equipment which needs to be set right subsequently. AMCL now is fully equipped to carry out feasibility studies, process engineering, system design and layout preparation for projects related to both Clinker grinding as well as Raw material grinding.

AMCL has given due importance to prompt after sales services to ensure customers satisfaction. A team of Engineers has been developed for deputation on short notices.

Conclusion:

After up-gradation i.e. changing the circuit to Semi-finish mode the cement grinding units have achieved the encouraging results. It has been clearly demonstrated that by the proper coordination between the user and the supplier it is possible to make best use of existing equipment and to achieve substantial savings in power consumption and higher production. Increased Plant availability is an added advantage.

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