



BALL MILLS



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The ball mill is a key equipment to grind the crushed materials in to fine powder or fine paste by grinding in a wet way. Ball mill is widely for grinding materials like ores, chemicals, ceramic raw materials, cement, paints etc. ore dressing of ferrous metal and non-ferrous metal, glass ceramics, etc.

WORKING PRINCIPLE

The Ball Mill is a horizontal rotating device transmitted by the outer gear. The materials are transferred to the grinding chamber through the quill shaft uniformly or through opening manhole on the cylinder shell. Ball Mill rotates on horizontal axis partially filled with raw material to be ground plus the grinding medium. Material fed through the mill is crushed by impact and grounded by attrition between the balls and also the internal cascading effect reduces the material in to a fine powder. Ball Mills usually have replaceable liners inside suitable to the product and these liners are replaced when they wear out. These liners will be of wave shape which key the ball charge in to the shell and prevent the slippage. Grinding media is usually of metallic balls or other media like porcelain, pebble suitable to the product. The ground material is discharged through the other end of the hollow shaft or through opening manhole and thus the grinding process is finished. Ultimate particle size depends entirely on how hard the ground material is and how long the ball mill runs.

To achieve reasonable efficiency the ball mills are to be operated in a closed circuit system where the over size particles are continuously being re-circulated back to the mill and to be reduced.

TYPES

Cylindrical single / multi compartment with and without classifier. Conical cylindrical with classifier. Jacketed cylinder.

Single / Multi Compartment Cylindrical Ball Mill

Single compartment mill is conventional type of batch mill, consists of cylindrical shell with flat steel ends welded to the shell. The material and the grinding medium are fed in to the opening manhole and the grounded material is discharged through the opening

manhole. As the barrel rotates the material is crushed between the individual piece of grinding media that mix and crush the product in to fine powder. The manhole has grate which serves to retain balls, tramp and coarse material. Mill is suitable for dry and wet grinding. The length to diameter ratio cylindrical mills range from 1 to 1 through 3 to 1. When the L/D ratio is 2 to 1 or greater the mill is referred as tube mill.

Normal feed sizes :

- 80% passing 6 mm or finer for hard ores.
- 80% passing 25 mm or finer for softer ores.

Multi Compartment Cylindrical Ball Mill

Multi compartment Cylindrical Ball Mill Ball mills operate either in open or closed circuit. Open circuit operation is best utilized when :

- Another stage of grinding follows the mill " Reduction ratio is small
- Feed material is already fine and one pass through the mill produces the desired results
- Product size control is not critical and oversize material can be tolerated in the product.



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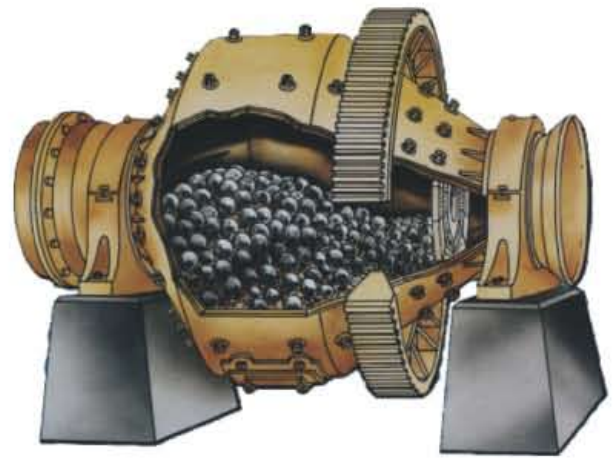
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This ball mill is horizontal type and tubular running device, has two or more compartments. The material enters spirally and evenly the first compartment of the milling machine along the input material hollow axis for

coarse grinding. After grinded coarsely in the first warehouse, the material then enters into the second compartment through grated partisan for regrinding with the steel ball and to the other compartment. In the end, the powder is discharged by output material board and the end products are completed. Where size control of the final product is important, closed circuit grinding is the most efficient method of operation. To achieve reasonable efficiency with Ball Mills, they must be operated in closed circuit system with over size material continuously being re-circulated back in to the mill to be reduced. Various classifiers such as screen, spiral classifier, cyclone, air classifiers are used for classifying the discharge from ball mills.

CONICAL BALL MILL

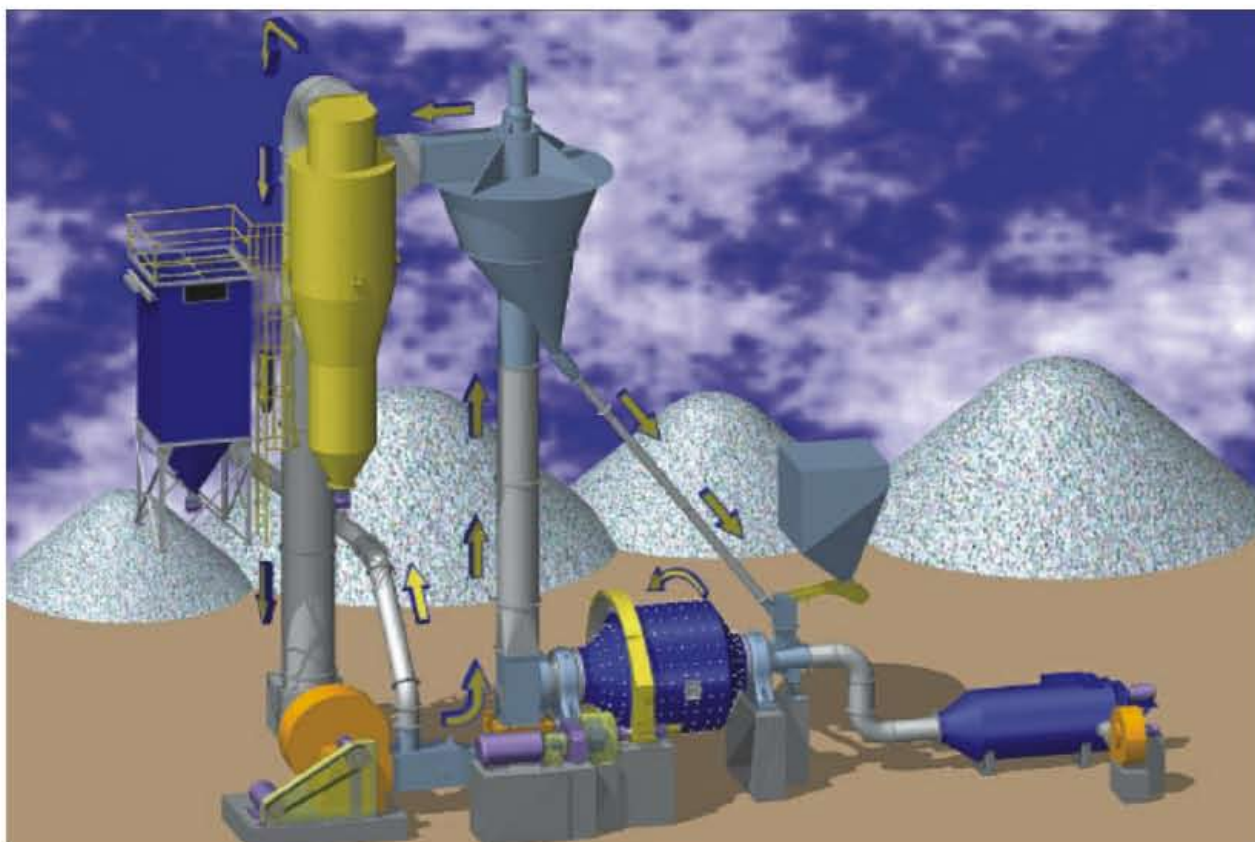
Conical Ball Mill is most efficient when compare with cylindrical mill. Classification and circulation within the mill is the principle of operation for the conical ball mill. In a cylindrical mill most of the work is accomplished in only a portion of the mill cylinder length and the end corners are ineffective. In conical ball mill it is maximum utilization. Moreover the structural advantage of a cone is well known. The truss is the strongest type of structure. The conical ball mill is built on this structurally sound



principle. Minimum shell surface per unit of grinding volume, less liner weight and thereby reduced dead weight load of the mill, less bearing friction loss and over all power consumption, classification are added advantages. Conical Ball Mill is a closed circuit system incorporate the classification system comprising the Rotary Classifier, Dynamic Classifier, Multi Cyclone and Bag Filter.

MOC

Mostly MS construction with manganese steel / steel casted / ceramic lined and SS.



Layout of Continuous Conical Ball Mill

TECHNICAL DATA

For Cylindrical Grate Type Ball Mills in Dry Grinding

Size, diam. x length ft.	Max. ball load, lb.	Motor, hp.	Normal R.P.M.	Cement clinker from 97% <200-m. to 95% <100-m. bbl. per hr.	Limestone from <12-m. to 95% <100-m. t.p.h.	Calcined gypsum to 95% <100-m. t.p.h.
4 x 10	8,500	50	28 to 30	9	2	2
4 x 18	15,300	100	28 to 30	17	5	4
5 x 22	36,000	200	25 to 27	37	10	9
6 x 24	70,000	350	22 to 24	65	17	16
7 x 26	102,000	500	20 to 22	95	25	23
8 x 30	180,000	900	18 to 20	170	45	42
9 x 30	223,000	1,200	16 to 18	235	65	60
10 x 30	278,000	1,500	15 to 17	280	80	74

NOTE : Barrel weight : 376 lb.

For Conical Ball Mills in Dry Grinding

Mill, diam. ft. x cylinder length, in.	Ball Load lb.	R.P.M.	Motor, h.p.	Capacity, t.p.h.						Anthracite, from <3/16-in. to 85% <200-m.	Chrome ore, from <3/4-in. to 97% <200-m.	Illeminite sand from <1-in. to 90% <200-m.
				Limestone		Cement clinker		Bituminous coal				
				From <3/4-in. to 99% <20-m.	From <3/8-in. to 90% <200-m.	From <1-in. to 99% <20-m.	From <20-in. to 95% <325-m.	From <1-in. to 70% <200-m.	From <1-in. to 90% <200-m.			
2x8	500	38	2	0.12	0.08	0.55	0.3	0.08	0.06	0.04	0.04	0.03
3x8	1,000	32	7.5	0.5	0.3	2.2	1.2	0.3	0.23	0.17	0.18	0.14
4½x16	3,800	30	20	1.6	1.0	7	3.1	1.0	0.7	0.5	0.67	0.44
5x22	6,700	28	40	3.3	2.0	1.5	7.3	2.0	1.4	1.0	1.1	0.9
6x22	11,100	26	60	5.7	3.5	2.8	13	3.4	2.5	1.8	1.9	1.5
7x22	17,000	24	100	9	5.2	43	18	5.0	3.5	2.7	2.8	2.2
8x36	32,000	21	150	15	9.7	80	35	9.0	6.4	5.0	5.2	4.1
9x48	50,000	19	300	30	19	150	68	18	12.5	10.0	10.5	8.0
10x66	65,000	18	400	43	26	215	94	25	17	13	14	11
12x60	105,000	17	700	70	43	360	150	40	30	22	23	19
12x120	170,000	16	1,200	120	80	650	270	70	52	40	40	38



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