ISSN (online): 2250-141X
Vol. 6 Issue 3, July 2016

EFFECT OF COMMINUTION DEVICES ON THE GRINDABILITY CHARACTERISTICS OF HEMATITE ORES

J.L. Gumaste, B. Das, R. Bhima Rao. V.N. Misra, and B.K.Mishra.,
IMMT, [Formerly Known as RRL,(CSIR)],Bhubaneswar, 751 013,Orissa, India.

ABSTRACT:

The present investigations deal with the study the effectiveness of crushing of five different types of iron ore samples employing hydraulic press and mechanical roll crusher. The crushing of 250.g of the each iron ore sample of -18+10 mm size in a hydraulic press for 2 minutes duration resulted in the liberation of fine sized particles of average size ranging from 0.2 to 0.4 mm and the size reduction ratio of crushed particles varied from 28.0 to 67.8. Whereas crushing of the same quantity of the same iron ore samples in a roll crusher for10 minutes resulted in the liberation of coarse sized particles with an average size ranging from 1.1 to 2.3 mm and the size reduction ratio of crushed particles varied from 5.0 to 12.0 only. The effectiveness of ball mill grinding on the hydraulically and roll crushed powder product on the duration of grinding for obtaining 80% passing of 180µm sized particles is also studied. The studies reveal that crushing by hydraulic press liberates high fraction of fine sized particles.

Key words: Hydraulic press, roll crusher, grinding and reduction ratio

Introduction:

In recent years much attention is paid to the development of energy efficient and economical ore grinding processes for the extraction of metallic values from mined ores. But in the traditional mineral beneficiation processes, comminuting of ores alone accounts for 60-70% of the total energy requirements. The unit operations such as crushing, grinding are energy intensive and energy efficiencies of these processes are rather low (restricting only to 2to 30%).Because in the existing processes of crushing, the application of grinding energy is not uniform and definitive. i.e. crushing of large size lumps to fine size powder would depend on the area of lump surface area and number of stress concentration points, hence it would be very difficult to get uniformly sized lumps and apply uniform crushing energy. Secondly in the existing crushing processes the application of crushing force is though repetitive but it is only for short duration. The new hydraulic crushing method, due to uniform application of pressure for desired duration results in rapid crushing of ore particles and re-arrangement of crushed

ISSN (online): 2250-141X
Vol. 6 Issue 3, July 2016

particles with in the die cavity. Hence higher energy efficiency during hydraulic crushing operation is expected. The kinetics of crushing can be enhanced by the application of a stress of magnitude slightly larger than the breaking strength of the ores. This can be implemented by the application of unidirectional stress over the ore body in a steel die using hydraulic press (fig-1a) with appropriate lower and top punches(fig1b). The application of such critical stress on to the ore body results in cracking and shearing of particles under the constant action of stress field.

Ores are most often associated with siliceous gangue materials and inclusions which occur at the grain boundaries and in the bulk respectively. The mineral matter needs to be liberated from ores before it is being sent for recovery of valuables. The liberation of mineral matter can't be done without grinding the same to fine size for some ores. The grinding characteristics of ore bodies depend on its hardness, strength and presence of porosity present in it etc, (1-6). As the strength and hardness of ores increases, the energy needed for crushing and grinding the coarse feed to required size also increases.

In the classical ball mill grinding operations only a fraction of input energy is transmitted to grinding media, while the remaining energy goes as waste. The kinetics of grinding in this device depends on the critical speed, ball: charge ratio etc. Beside these parameters, the kinetics also depends on the level of cleavage stress that is being transmitted to ore bodies and subsequent generation of cracks of critical length and their concentration. It is rather difficult to maximize these operative stresses within the scope of parameters set in the above equipment for maximization of the grinding efficiency. The kinetics of grinding can be enhanced by the application of a stress of magnitude slightly larger than the breaking strength of the ores. This can be implemented in crushing operation by the application of unidirectional stress over the ore body in a steel die using hydraulic press with appropriate lower and top punches. This work gives an account of studies on the crushing and grinding of five different types of hematite ores using hydraulic press, roll crusher and ball mill.

EXPERIMENTAL:

Five different iron ore lumps of size -18 +10 mm, designated as sample-1, 2, 3, 4 and 5 were taken as starting materials for crushing and grinding studies. Carver hydraulic press of 15.ton capacity (Fig1a), laboratory roll crusher and rotary ball mill of 1.5 liter capacity were utilized for crushing and grinding operations respectively.

Crushing experiments were carried out in batches of 250 gm of hematite ores in a hydraulic press (Fig-1a). In a typical crushing experiment 50.gm of -18 +10 mm sized iron ore bodies were put into stainless steel die of 50.mm O.D, 100 .mm ht with through bore of 45.mm dia and 100.mm ht, the lower punch of 50 mm greater OD 44.5 mm smaller OD and 30.0 mm over all ht as shown in Fig-1b and the load transmitting upper plunger having a diameter of 44. 0 mm and 30 mm ht with load transmitting s s rod 25 mm dia 150 mm ht welded to the base as shown in Fig-1b was inserted into

ISSN (online): 2250-141X
Vol. 6 Issue 3, July 2016

the bore previously charged with iron ore over the lumps. The cup with loading plunger was placed on the lower platen of hydraulic press and a pressure of 3.ton, was loaded on to the plunger for the duration of 2.minutes. After crushing operation the fractured powder was poured out of the s. s die.

The above-designated samples were also crushed in a roll crusher at 5.0 mm gap. The product obtained after crushing in a hydraulic press and roll crusher were used as feed material for ball mill grinding.

RESULTS AND DISCUSSION:

The sieve analyses of hydraulic and roll crushed products are presented in Tables- 1 to 5. Table-1a. Shows the effect of crushing of sample-1 by hydraulic press. The sieve analysis of liberated powder product depicts interesting size distribution of particles starting from -10+5.613 ,crushed down to -0.15 +0.1 mm. Relatively high weight fraction of (0.2495) fine particles are liberated in the size range of 0.71 +0.18 mm. Lower weight fraction of product powder in the size range of 10+5.0.and 3.96 +2.4 mm is also observed. The sieve analysis of the product particles evinces an average size of 0.4985 mm and an overall size reduction ratio of 28.082.

Table-1b shows effects of roll crusher on the size reduction of sample-1. The sieve analysis of the liberated product shows high weight fraction (0.5510) of coarse size particles with 10.+5.6 mm size and weight fraction of 0.71 +0.18 mm sized product is only (0.04).The sieve analysis of the product particles evinces an average size of 2.378 mm and size reduction ratio of 5.865.

Table-2a shows effect of crushing of iron ore sample by hydraulic press on the size reduction of hematite ore lumps (sample-2). The sieve analysis of crushed product shows high weight fraction of (0.252) particles with the size range of -0.71 +0.18 mm. The variation in quantities of differently sized particle is observed in the sieve analysis. The quantity of particle having size less than 1.0.mm is more than that having an average size greater than 10.mm. The product particles show an average size of 0.36 mm and a size reduction ratio of 36.63.

Table-2b shows effect of crushing by roll crusher of hematite sample-2 on the size reduction. The size distribution pattern exhibits relatively large weight fraction (0.399) with the size range of 10+5.6 mm and second large weight fraction (0.219) with the size range of-5.613 +3.92 mm. The crushed product particles show an average size of 1.2504 mm and size reduction ratio of 11.1964.

Tables -3a, 4a and 5a show sieve analyses of hydraulically crushed iron ore product particles from sample 3,4 and 5. The size distribution pattern in these samples shows large fraction of- 0.71 +0.18 mm particles with weight fraction of 0.36, 0.35 and 0.32 respectively. These samples show average product particle size of 0.3258, 0.208 and 0.28 mm and the size reduction ratio of 42.97, 67.307 and 49.5, respectively.

Tables - 3b, 4b and 5b show sieve

ISSN (online): 2250-141X
Vol. 6 Issue 3, July 2016

analyses of roll crushed product particles from sample 3, 4 and 5. The sample-3 shows diminishing crushing effect in size reduction of particles, the maximum weight fraction of crushed powder (0.312) is in the size range of 10. +5.6 mm. The sieve analysis shows an average size of 1.06 mm for the product particles and a size reduction ratio of 12.88.

Table 4b shows sieve analysis of sample-4 crushed in roll crusher. The reduction in size shows diminishing crushing effect when particle size decreases. The maximum weight fraction is in the size range of 3.962 +2.4 mm. The average size of the product particle is 0.971mm and the product shows a size reduction ratio of 14.44. The sieve analysis of product particle of sample-5 crushed in roll crusher is shown in Table-5b. The size distribution pattern of crushed particle shows that the maximum weight fraction (0.288) is in the size range of -3.96 +2.4mm. The powder product shows, an average particle size of 1.125 mm and size reduction ratio of 12.437.

Fig-2 shows effect of crushing by hydraulic press on five different iron ore samples. The data is extrapolated from sieve analysis. The percent passing is plotted against size of the product particles. The percent passing curve differs from one sample another due to the differing physical and mechanical properties of ores. The morphological features, grain size and concentration of porosity may also differ from one sample to another. Sample-4 shows higher percent passing than the remaining samples.

Fig-3, shows effect of crushing of five different types of ores obtained by roll crusher. Percent passing distribution in this case also differs from one sample to another for reasons mentioned above. Percent passing for the lower size range of 0 to 4 mm is much lower than hydraulically crushed product. In this case also sample-4 shows better percent passing than the remaining samples. Hydraulically crushed samples show high percent passing for the initial size of 1to 4 mm than roll crushed product.

Fig-4 shows effect ball mill grinding of hydraulically crushed product from all the five different iron ore samples. Sample - 4 shows higher grind ability than the remaining samples. The 80% passing of 180 m particles takes 7.5 minutes of grinding duration for sample - 4. The 80% passing of 180 m sized particles in case of Sample 2 3and 5 takes 15 minutes of grinding duration.. The sample - 1 takes 3minutes of grinding duration for attaining 80% passing, thus showing lowest grind ability of all the samples.

Fig. - 5, shows effect of grinding on 80% passing of 180 µm particles for all the five samples crushed in roll crusher... Sample numbers 2, 3 and 4 show 40-50 minutes of grinding duration for attaining 80% passing of 180µ. Sized particles. Whereas sample-1 does not attain 80% passing of 180 µm particles even after grinding roll crushed product for 60 minutes. The product obtained from hydraulic press shows better grind ability and lower grinding time than the product obtained from roll crusher. The increased grind ability in the case of hydraulically

ISSN (online): 2250-141X
Vol. 6 Issue 3, July 2016

crushed product may be attributed to development of high concentration of cracks and pressure –induced defects because of the high loading of grinding stresses. .

From Figs. 4 and 5 it is observed that higher weight fraction of 180 µm sized product is liberated after ball milling of the hydraulically crushed product which may also be attributed to lower average size of feed particles obtained after hydraulic crushing.

From the considerations of surface area liberated during crushing by hydraulic press and roll crusher, it can be observed that hydraulic crushing liberates large surface area of product particles for same crushing duration with lower energy input.

CONCLUSIONS:

For a given crushing time use of hydraulic pressure crushing gives lower average particle size (0.2 to 0.4 mm) and higher reduction ratio 28.0-67.8, where as roll crushed product gives an average particle size of (1.1 to 2.3 mm) and lower reduction ratio of 5 to 12.0.

Because of the effective application of grinding stress on the ore bodies, crushing by hydraulic press liberates large fraction of fine size particles for the same grinding duration.

The studies on ball mill grinding of hydraulically and roll crushed products, show that hydraulically pressed product is more amenable to grinding than roll crushed product. The percent passing of 180 micro meter size particles is more for given duration of 15 minutes for hydraulically crushed product than roll crushed product.

From the consideration of generation of large fraction of fine particles it is evident that crushing by hydraulic press is more energy efficient than roll crushing.

ACKNOWLEDGEMENTS

Authors express their deep sense of gratitude to Dr. B.K. Mishra. Director IMMT (RRL)-Bhubaneswar for his permission to publish this paper in and they are also grateful to Dr. R.K. Galgali, HOD, AMT and Mr. P.S.R Reddy, HOD, MPT RRL-BBSR for their kind encouragement given during this exploratory work..

REFERENCES:

I. J.L.Gumaste , B Dash, R Bhimarao and V.N.Mishra, Proc, of all India Seminar on Technology Update in mineral and chemical Based Industries Instituteof Engineers, Bhubaneswar(2005), 34-47

II. Trucker, P., International Journal of Mineral Processing, 12, 273-284 (1984)

III. Banerjee, G, N and Bhima Rao, R., Metal, Material and Process, 12,1,81- 86 (200).

IV. Bhima Rao, R, Veeresh, M.B and Banerjee, G.N., Light Metals.

V. Binns, D.G., M . Phil Thesis, Cambrone School of Mines (1984)
VI. Fitzgibbon, K.E and Veasey, J.T, Minerals Engineering 181-185, (1990)

ISSN (online): 2250-141X
Vol. 6 Issue 3, July 2016

TABLES AND FIGURES:

Table 1a. Effect of use of hydraulic press for crushing ore on size reduction of hematite SampleSample1,Feed size , - 18 + 1mm , Average size= 14 mm

Size, mm	Average size, (di), dia	Amount retained, gms	Fraction retained, (Xi), gms	Xi/di	Average product dia, ,ܲp 1/ ∑ (xi/di	Reduction ratio ܲ f / ܲ (p
-10.+ 5.613	7.81	31.0 0.	0.1345	0.0172		
-5.613 + 3.962	4.79	15.5	0.0672	0.0140		
-3.962 + 2.400	3.18	39.5 0	0.1714	0.0539		
-2.40+ 1.680	2.04	13.5	0.0586	0.0287		
-1.68+ 1.405	1.54	20.5	0.0889	0.0577		
-1.405 + 1.204	1.30	9.0	0.0390	0.0300		
-1.204 + 0.850	1.03	11.0	0.0477	0.0463		
-0.85+ 0.710	0.78	12.0	0.0521	0.0463		
-0.71+ 0.180	0.44	57.5	0.2495	0.5670		
-0.18+ 0.150	0.17 5	12.0	0.0521	0.0668		
-0.71+ 0.180	0.44	57.5	0.2495	0.5670		
-0.150	0.07	16.0	0.0694	0.9914		
Total		230.5	1.0000	2.0006	0.4985	28.0842

Table 1b. Effect of roll crusher on size reduction of hematite SampleSample1
Feed size,- 18 + 10mm , Average size= 14 mm

Size, mm	Average size, (di), dia	Amount retained ,gms	Fraction retained, (Xi), gms	Xi/di	Average product dia, ,ܲp 1/ ∑ (xi/di	Reduction ratio ܲ f / ܲ (p
-10.+ 5.613	7.81	166	0.5510	0.0706		
-5.613+3.962	4.79	60	0.199	0.0415		
-3.962+2.40	3.18	36	0.12	0.0377		
-2.40+1.680	2.04	6	0.02	0.0098		
-1..68+1.405	1.54	6	0.02	0.0130		
-1.405+1.204	1.3	4	0.013	0.010		
-1..204+0.85	1.03	4	0.013	0.0126		
-0.85+0.71	0.78	4	0.013	0.0167		
-71+0.18	0.44	12	0.040	0.0.909		
-0.18+0.15	0.17	1	0.0030	0.0176		
-0.150	0.07	2	0.007	0.1000		
Total		301	1.000	0.4204	2.3787	5.8866

ISSN (online): 2250-141X
Vol. 6 Issue 3, July 2016

Table 2a. Effect of hydraulic press on size reduction of hematite

SampleSample2
Feed size, - 18 + 10mm, Average size = 14 mm

Size, mm	Average size, (di), dia	Amount retained ,gms	Fraction retained, (Xi), gms	Xi/di	Average product dia, ,ےp 1/ ∑ (xi/di	Reduction ratio ے f / ے (p
-10+5.613	7.81	35.5	0.149	0.0191		
-5.613+3.962	4.79	31.5	0133	0.278		
-3.962+2.400	3.18	31.0	0.130	0.0409		
-2.400+1.68	2.04	7.0	0.29	00142		
-1.68+1.405	1.54	12	0.05	0.0324		
-1.401.5+1.204	1.30	8.0	0.034	0.0261		
-1.204+0.85	1.03	6.0	0.025	0.0243		
-0.85+0710	078	12	0.050	0.0641		
-0.71+0.18	0.44	60.0	0.0252	0.5727		
-0.18+0.15	0.17	5.0	0.021	0.1235		
-o.150	0.07	30.0	0.127	1.8143		
Total		238	1.0000	2.7595	0.3624	38.6313

Table 2b. Effect of roll crusher on size reduction of hematite Sample
Sample2
Feed size ,-18 + 10mm , Average size= 14 mm

Size, mm	Average size, (di), dia	Amount retained,gms	Fraction retained, (Xi), gms	Xi/di	Average product dia, ,ےp 1/ ∑ (xi/di	Reduction ratio ے f / ے (p
-10+5.61	7.81	120	0.3990	0.0511		
-5.613+3.962	4.79	66	0.2190	0.0457		
-3.962+2.400	3.18	48	0.1590	0.0500		
-2.4+1.680	2.04	10	0.033	0.0162		
-1.680+1.450	1.54	8	0.027	0.0175		
-!.450+1.204	1.3	8	0.027	0.0200		
-1.204+0.85	1.03	6	0.0200	0.0194		
-0.85+0.71	0.78	6	0.0200	0.0256		
-0.71+0.18	0.44	20	0.0660	0.1500		
-0.18+0.150	0.17	1	0.00030	0.0176		
-0.150	0.07	8	0.027	0.3857		
Total		301	1.0000	0.7997	1.2504	11.1964

ISSN (online): 2250-141X
Vol. 6 Issue 3, July 2016

Table 3a. Effect of hydraulic press on size reduction of hematite Sample

Sample 3
Feed size -18 + 10mm , Average size=14 mm

Size, mm	Average size, (di), dia	Amount retained ,gms	Fraction retained, (Xi), gms	Xi/di	Average product dia, ,ےp 1/ ∑ (xi/di	Reduction ratio ے f / ے (p
-10+5.613	7.81	9.5	0.0476	0.0061		
-5.613+3.962	4.79	8.0	0.0401	0.0084		
_3.962+2.400	3.18	24.5	0.1228	0.0386		
-2.400+1.680	2.04	8.0	0.0401	0.0197		
-1.680+1.405	1.54	13.0	0.0652	0.0423		
-1.405+1.204	1.3	10.5	0.0526	0.0405		
-1.204+0.85	1.03	13.5	0.0677	0.0657		
-0.85+0.71	0.78	10.0	0.0501	0.0-642		
-0.710+0.180	0.44	72.5	0.3635	0.8261		
-0.180+0.150	0.17	4.5	0.0225	0.1323		
-0.150	0.07	25.5	0.127	1.8257		
Total		199.5	1.0000	3.0697	0.3258	42.9711

Table 3b. Effect of roll crusher on size reduction of hematite
SampleSample 3
Feed size ,-18 + 10mm, Average size = 14 mm

Size, mm	Average size, (di), dia	Amount retained, gms	Fraction retained, (Xi), gms	Xi/di	Average product dia, ,ےp 1/ ∑ (xi/di	Reduction ratio ے f / ے (p
-10+5.613	7.81	88	0.312	0.0399		
-5.613+3.962	4.79	64	0.2250	0.0470		
-3.962+2.400	3.18	62	0.2180	0.0680		
-2.400+1.68	2.04	12	0.0420	0.0206		
-1.68+1.405	1.54	12	0.0420	0.0273		
-1.405+1.204	1.3	2	0.0070	0.0054		
-1.204+0.85	1.03	6	0.0210	0.0204		
-0.85+0.71	0.78	4	0.0140	0.0179		
-0.71+0.18	0.44	24	0.0840	0.1909		
-0.18+0.150	0.17	2	0.007	0.0412		
-0.150	0.07	8	0.0280	0.4000		
Total			1.0000	0.9203	1.0866	12.8842

ISSN (online): 2250-141X
Vol. 6 Issue 3, July 2016

Table 4a. Effect of hydraulic press on size reduction of hematite
SampleSample 4
Feed size, -18 + 10mm , Average size= 14 mm

Size, mm	Average size, (di), dia	Amount retained, gms	Fraction retained, (Xi), gms	Xi/di	Average product dia, ,ےp 1/ ∑ (xi/di	Reduction ratio ے f / ے (p
-10+5.613	7.81	5.5	0.0328	0.0042		
-5.613+3.962	4.79	2.5	0.0149	0.0031		
-3.962+2.400	3.18	17.5	0.1045	0.0329		
-2.400+1.680	2.04	5.5	0.0328	0.0160		
-1.680+1.405	1.54	6.5	0.0388	0.0252		
-1.405+1.204	1.3	7.5	0.0448	0.0345		
-1.204+0.85	1.03	4.5	0.0269	0.0261		
-0.85+0.710	0.78	10.5	0.0627	0.0804		
-0.71+0.18	0.44	59.0	0.3522	0.8004		
-180+0.150	0.17	7.0	0.0418	0.2459		
-0.150	0.07	41.5	0.2478	3.5400		
Total		167.5	1.0000	4.8087	0.2080	67.3077

Table 4b. Effect of roll crusher on size reduction of hematite
SampleSample 4
Feed size ,-18 + 10 mm, Average size = 14 mm

Size, mm	Average size, (di), dia	Amount retained, gms	Fraction retained, (Xi), gms	Xi/di	Average product dia, ,ےp 1/ ∑ (xi/di	Reduction ratio ے f / ے (p
-10+5.613	7.81	42	0.1450	0.0186		
-5.613+3.962	4.79	66	0.0228	0.0047		
-3.962+2.400	3.18	84	0.2900	0.0912		
-2.400+1.680	2.04	20	0.0690	0.0338		
-1.680+1.405	1.54	14	0.0480	0.0312		
-1.405+1.204	1.3	6	0.0210	0.0162		
-1.204+0.85	1.03	6	0.0210	0.0204		
-0.85+0.71	0.78	8	0.0280	0.0359		
-.0.71+0.18	0.44	32	0.1100	0.2500		
-0.180+0.15	0.17	2	0.0070	0.0412		
-0.150	0.07	10	0.0340	0.4857		
Total		290	1.0000	1.0289	0.9719	14.0448

-

ISSN (online): 2250-141X
Vol. 6 Issue 3, July 2016

Table 5a. Effect of hydraulic press on size reduction of hematite Sample
Sample 5 -Feed size,- 18 + 10 mm , Average size = 14 mm

Size, mm	Average size, (di), dia	Amount retained, gms	Fraction retained, (Xi), gms	Xi/di	Average product dia, ,ےp 1/ ∑ (xi/di	Reduction ratio ے f / ے (p
-10.0+5.613	7.81	13.5	0.0543	0.0070		
-5.613+3.962	4.79	17.0	0.0684	0.0143		
-3.962+2.400	3.18	31.0	0.1247	0.0392		
-2.400+1.680	2.04	10.5	0.0422	0.0207		
-1.680+1.405	1.54	12.0	0.0483	0.0313		
-1.405+1.204	1.3	10.5	0.0423	0.0325		
-1.204+0.850	1.03	13.5	0.0543	0.0527		
-0.85+0.710	0.78	11.5	0,0463	0.0594		
-0.710+0.1800	0.44	80.0	0.3220	0.7318		
-0.180+0.1500	0.17	8.0	0.3220	0.1800		
-0.1500	0.07	41.0	0.1550	2.3571		
Total		248.5	1.0000	3.5355	0.2828	49.5050

Table 5b. Effect of roll crusher on size reduction of hematite Sample
Sample 5
Feed size, -18 + 10,mm, Average size = 14 mm

Size, mm	Average size, (di), dia	Amount retained, gms	Fraction retained, (Xi), gms	Xi/di	Average product dia, ,ےp 1/ ∑ (xi/di	Reduction ratio ے f / ے (p
-10.0+5.613	7.81	48	0.1680	0.0215		
-5.613+3.962	4.79	64	0.2240	0.04676		
-3.962+2.400	3.18	80	0.2800	0.0880		
-2.400+1.680	2.04	20	0.0700	0.0343		
-1.680+1.405	1.54	12	0.042	0.0273		
-1.405+1.204	1.30	6	0.0210	0.01620		
-1.204+0.850	1.03	10	0.03510	0.0340		
-0.850+0.710	0.78	6	0.0210	0.02690		
-0.710+0.180	0.44	32	0.1110	0.2523		
-.180+0.150	0.17	2	0.0070	0.0412		
-0.1500	0.07	6	0.0210	0.3000		
Total		286	1.0000	0.8884	1.1256	12.4376

ISSN (online): 2250-141X
Vol. 6 Issue 3, July 2016

FIG-1 a) CARVER HAND OPERATED HYDRAULIC PRESS 12 TON CAPACITY

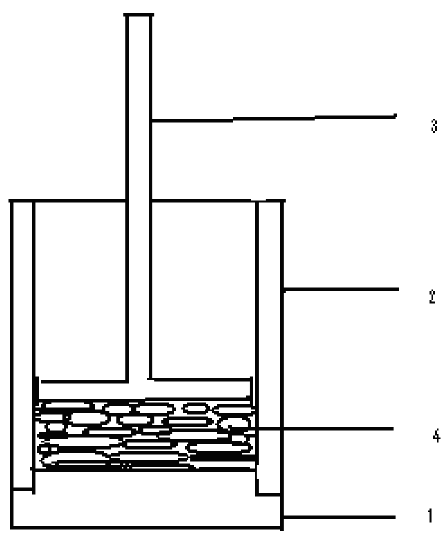


FIG--1(b) Die Assembly, 1) Lower punch,2) Die Body, 3) Upper punch
4) Iron ore lumps

FIG-1b) DIE ASSEMBLY, 1) LOWER PUNCH,2) DIE BODY, 3)UPPER PUNCH,4) IRON ORE LUMPS

ISSN (online): 2250-141X
Vol. 6 Issue 3, July 2016

Fig.1. Effect of hydraulic press on different iron ores

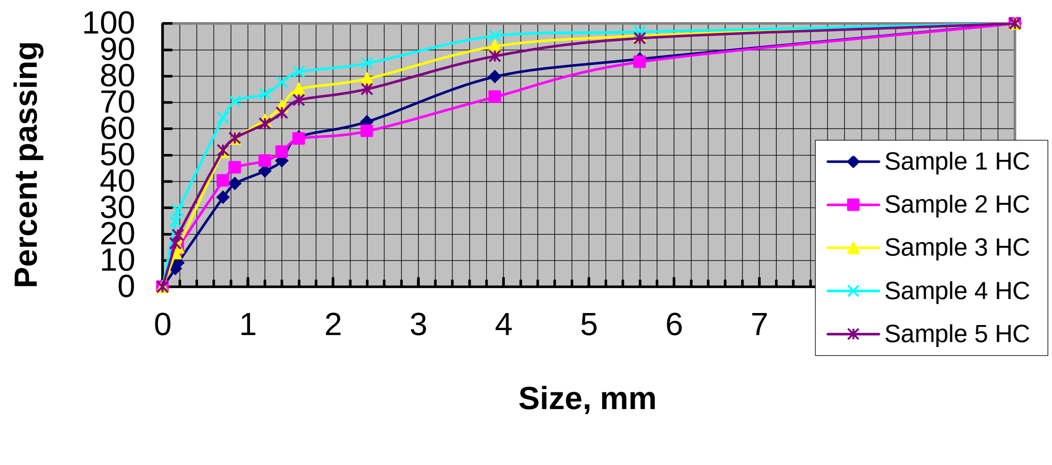


Fig.2. Effect of roll-crusher on different iron ores

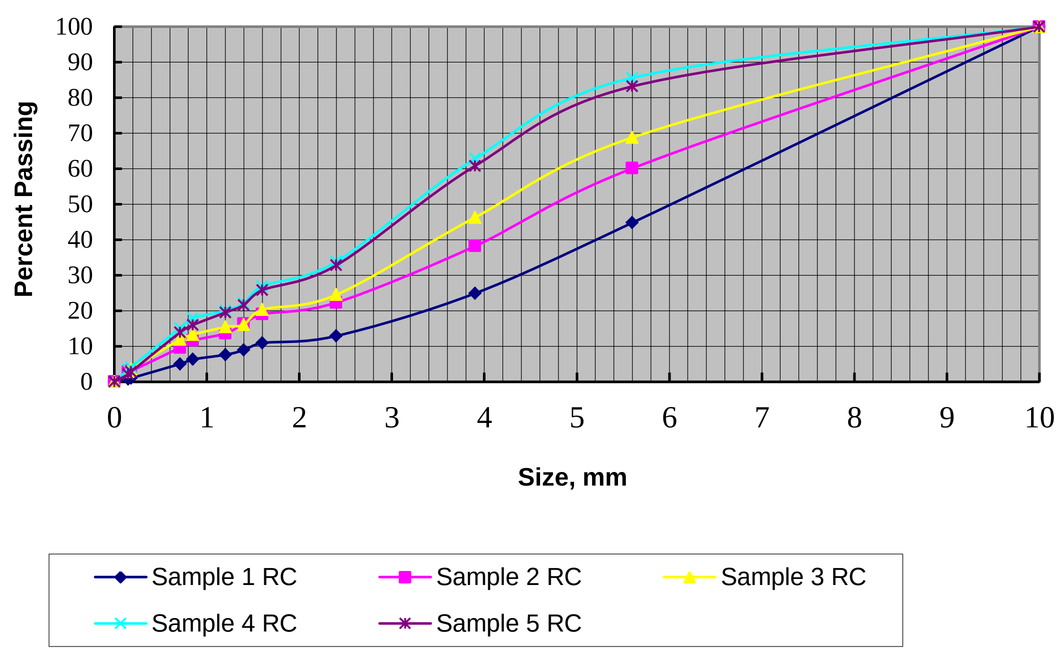
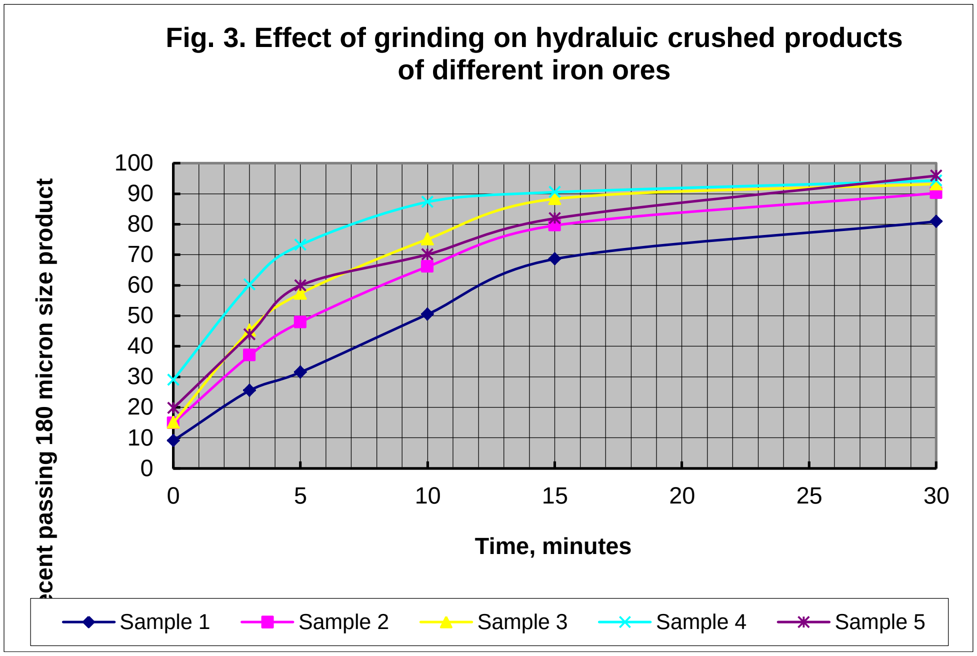


FIG-2, EFFECT OF USE OF HYRAULIC PRESS ON IRON ORE CRUSHING
FIG-3,EFFECT OF USE OF ROLL CRUSHER ON DIFFERENT IRON ORE CRUSING

ISSN (online): 2250-141X
Vol. 6 Issue 3, July 2016



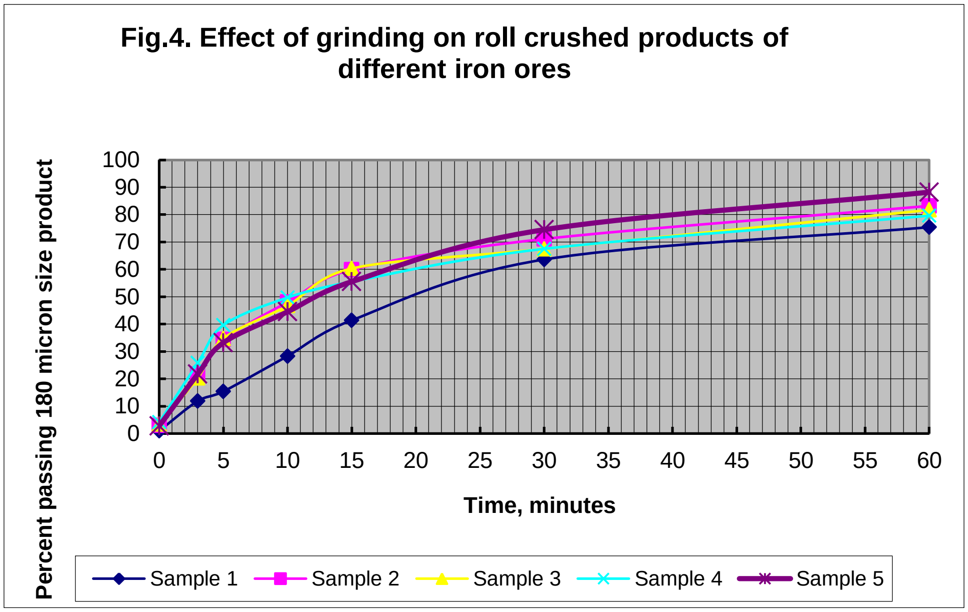


FIG-4, EFFECT OF GRINDING OF HYDRAULICALLY CRUSHED PRODUCTS OF DIFFERENT IRONORES.

FIG -5,EFFECT OF GRINDING OF ROLLCRUSHED PRODUCTS OF DIFFERENTIRON IRON ORES