COMMINUTION – THEORY AND PLANT PRACTICE

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INTRODUCTION

Comminution is a major unit operation in iron ore processing. In terms of global quantities of material reduced in size, it has been estimated that the annual tonnage is of the order of several thousand million, and in terms of the energy expended the yearly megawatt hours total several hundred million.

Top product size ranges from a few centimetres in crushing plants to a few microns in very fine grinding equipment, implying a 10,000 to 1 variation in product size. Mining is the only source for the iron ore minerals and metals that are required to maintain the high quality of life, we are now enjoying in this modern, high-tech world in which we live. Size reduction is essentially required in processing of iron ore minerals to (a) Liberate valuable minerals from the host ore (b) Expose to chemical reaction (c) Produce marketable product or a product for subsequent processing step. Size reduction is energy intensive and costly activity with high cost in iron ore processing operation as the efficiency of energy utilization during fragmentation of each solid particles is very low. During comminution the breakage of any individual particle is occurring simultaneously with that of many particles. The ore is made up of heterogeneous particles, normally flawed on both macro- and a micro- scale and behaves differently than a normal brittle materials which can be well explained by fracture physics and mechanics. Except at very fine sizes, all ore particles, in general, behave as brittle materials.

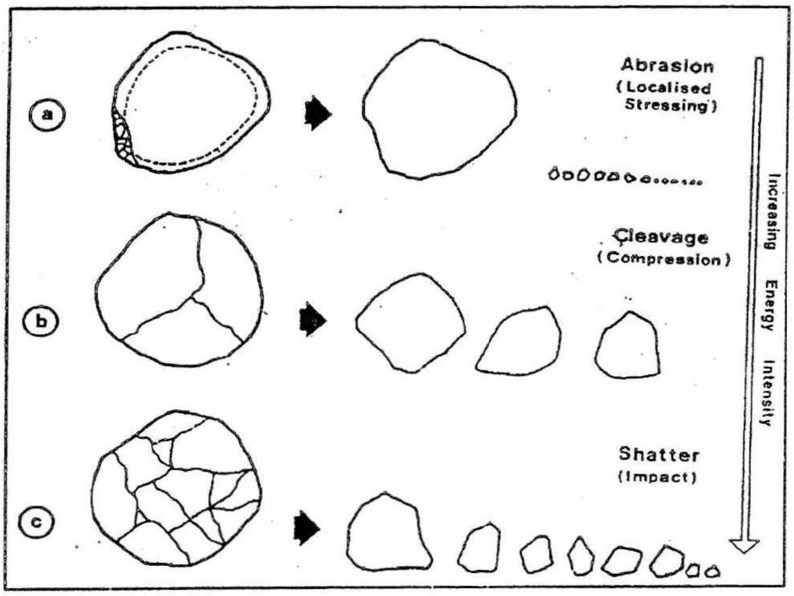

Fig-6.1: Particle breaking mechanism.

For a particle to fracture, a stress high enough to exceed the fracture strength of the particle is required. The manner in which the particles fracture depends on the nature of the particle and on the manner in which the force on the particle is applied. The force on the particle can be a compressive or shear force. This force could be applied at either a fast or a slow rate which affects further the nature of the fracture. The fracture may be by abrasion, cleavage (includes chipping), and shatter (Fig. 6.1). Accordingly, the product size distribution will vary. However, in practice, all these together contribute to result different product sizes. Traditionally crushing applies to size distributions with a top size greater than 5 mm (approximately passing 104 microns) and grinding to finer distributions.

CRUSHERS

The ones of main interest in recent times have been: jaw crushers, gyratory crushers, cone crushers. On increasing interest now are roll crushers of various types, especially the High Pressure Grinding Rolls. New variations on the traditional cone crusher design are also more in evidence, and a range' of impact crushers are also finding wide application, particularly in aggregate production.

Crushers may be used in many different roles in combination with screens of various kinds. In order of decreasing usage, these include:

- Maximum size reduction - often as feed preparation for a grinding circuit
- Maximum product of a specified size, for aggregates (particle shape is often important as well)
- Top size reduction for materials handling and conveyor design
- Top size control with minimum fines production - for commodities such as iron ore.

Crushers come in many varieties. The simplest is the jaw crusher, which is considered first in this discussion as it leads naturally to the widely-used Whiten modelling approach. Other types of crusher are then described in conjunction with how they are modelled.

A comminution process usually consists of many breakage events combined with a selection process. These processes may operate simultaneously, or consecutively, or both, ie. selection and breakage occur within each event. However, the process may also operate so that the product from each event is subject to some size-separation operation before some part of it is subjected to the next breakage event.

This concept is simple to grasp in the case of jaw crushers and is shown diagrammatically in Fig. 6.2. During the crushing stroke, a lump of ore is shattered and during the reverse (opening) stroke, those fragments which are larger than the discharge gap are retained within the jaws for further crushing. The same types of process also occurs within gyratory and roll crushers, and it is a particular feature of the operation of rod mills.

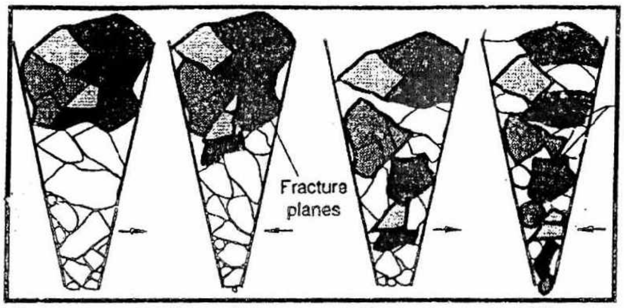

Fig. 6.2. Classification occurring in a jaw crusher.

While the jaw crusher is relatively simple to engineer, it has inherent limitations in terms of capacity and size reduction. When a particle is broken, its products will occupy more space. This swell factor is typically 30 - 40% of the original volume. The jaw crusher offers less cross sectional area as the gap decreases. Therefore throughput is limited by the smallest cross sectional area. Further, as soon as a particle is generated which is smaller than the closed side setting, it will certainly fall through, that is, there is no opportunity for further breakage.
Gyratory and cone crushers provide an elegant geometrical solution to this problem by wrapping the jaw crusher profile around a central axis. The extra dimension allows the available cross sectional area to increase at finer gaps by making the cone flatter. This shallow cone also offers opportunities for multiple impacts.
There are further benefits from particle-particle interactions. As the crushing objective is to reduce particle size, there is substantial benefit in using particles to break each other instead of abrading expensive alloy steel. This condition is called choke feeding. Choke feeding decreases the product size which can escape and increases severity of breakage.

Jaw Crushers:

A Jaw Crusher is one of the main types of primary crushers in iron ore processing plant. The rectangular or square opening at the top of the jaws (feed opening) designates the size of a jaw crusher. For instance, a 24 x 36 jaw crusher has a opening of 24" by 36", a 56 x 56 jaw crusher has a opening of 56" square. Primary jaw crushers are typically of the square opening design, and secondary jaw crushers are of the rectangular opening design. However, there are many exceptions to this general rule.

A Jaw Crusher reduces large size rocks or ore by placing the rock into compression. A fixed jaw, mounted in a "V" alignment is the stationary breaking surface, while the movable jaw exerts force on the rock by forcing it against the stationary plate. The space at the bottom of the "V" aligned jaw plates is the crusher product size gap, or the size of the crushed product from the jaw crusher. The rock remains in the jaws until it is small enough to pass through the gap at the bottom of the jaws.

Cone Crushers:

A Gyratory Cone Crusher is one of the main types of primary crushers in iron ore processing plant. Gyratory cone crushers are designated in size either by the gape and mantle diameter or by the size of the receiving opening. Gyratory cone crushers can be used for primary or secondary crushing. The crushing action is caused by the closing of the gap between the mantle line (movable) mounted on the central vertical spindle and the concave liners (fixed) mounted on the main frame of the crusher. The gap is opened and closed by an eccentric on the bottom of the spindle that causes the central vertical spindle to gyrate. The vertical spindle is free to rotate around its own axis. The crusher illustrated is a short-shaft suspended spindle type, meaning that the main shaft is suspended at the top and that the eccentric is mounted above the gear. The short-shaft design has superceded the long-shaft design in which the eccentric is mounted below the gear.

Tumbling mills

Grinding is the last stage in the process of iron ore comminution; in this stage the particles are reduced in size by a combination of impact and abrasion, either dry or in suspension in water. It is performed in rotating cylindrical steel vessels known as tumbling mills. These contain a charge of loose crushing bodies-the grinding medium-which is free to move inside the mill, thus comminuting the ore particles. The grinding medium may be steel rods, or balls, hard rock, or, in some cases, the ore itself. In the grinding process, particles between 5 and 250 mm are reduced in size to between 10 and 300 μm.

All ores have an economic optimum mesh of grind which will depend on many factors, including the extent to which the values are dispersed in the gangue, and the subsequent separation process to be used. It is the purpose of the grinding section to exercise close control on this product size and, for this reason, correct grinding is often said to be the key to good iron ore processing. Under grinding of the ore will, of course, result in a product which is too coarse, with a degree of liberation too low for economic separation; poor recovery and enrichment ratio will be achieved in the concentration stage. Overgrinding needlessly reduces the particle size of the substantially liberated major constituent (usually the gangue) and may reduce the particle size of the minor constituent (usually the mineral value) below the size required for most efficient separation. Since the energy required for grinding is directly proportional to the amount of new surfaces produced, the fine grinding which produces greater amount of new surfaces, will require more energy than coarse crushing and will therefore be more expensive. It is important to realise that grinding is the most energy intensive operation in iron ore processing. The main purposes of fine grinding in ore dressing are as following:

- Liberation of valuable minerals from waste minerals of the ore prior to subsequent tabling, flotation, amalgamation etc.

- Grinding to a size meeting specific process requirements viz. flotation requires a feed largely under 0.1 to 0.2 mm size

The principal draw backs of the grinding mills are as follows:-

- Fine grinding is a relatively expensive operation, frequently accounting for one-half or more of total milling cost.

- Fine grinding machines are inherently inefficient, since they utilize in actual useful crushing only a fraction of the total power input. Most of the power consumed is utilized in lifting the balls to the necessary height.

- The production of excessive quantity of material finer than necessary, in the form of slimes of colloidal material, is a waste both of energy and of ore values, as concentration efficiency, even in flotation, falls off in extremely fine sizes

Tumbling mills are of three basic types: rod, ball, and autogenous (figure-3). Structurally, each type of mill consists of a horizontal cylindrical shell, provided with renewable wearing liners and a charge of grinding medium. The drum is supported so as to rotate on its axis on hollow *trunnions* attached to the end walls. The diameter of the mill determines the pressure that can be exerted by the medium on the ore particles and, in general, the larger the feed size the larger needs to be the mill diameter. The length of the mill, in conjunction with the diameter, determines the volume, and hence the capacity of the mill. The feed material is usually fed to the mill continuously through one end trunnion, the ground product leaving via the other trunnion. Although in certain applications the product may leave the mill through a number of ports spaced around the periphery of the shell. All types of mill can be used for wet or dry grinding by modification of feed and discharge equipment.

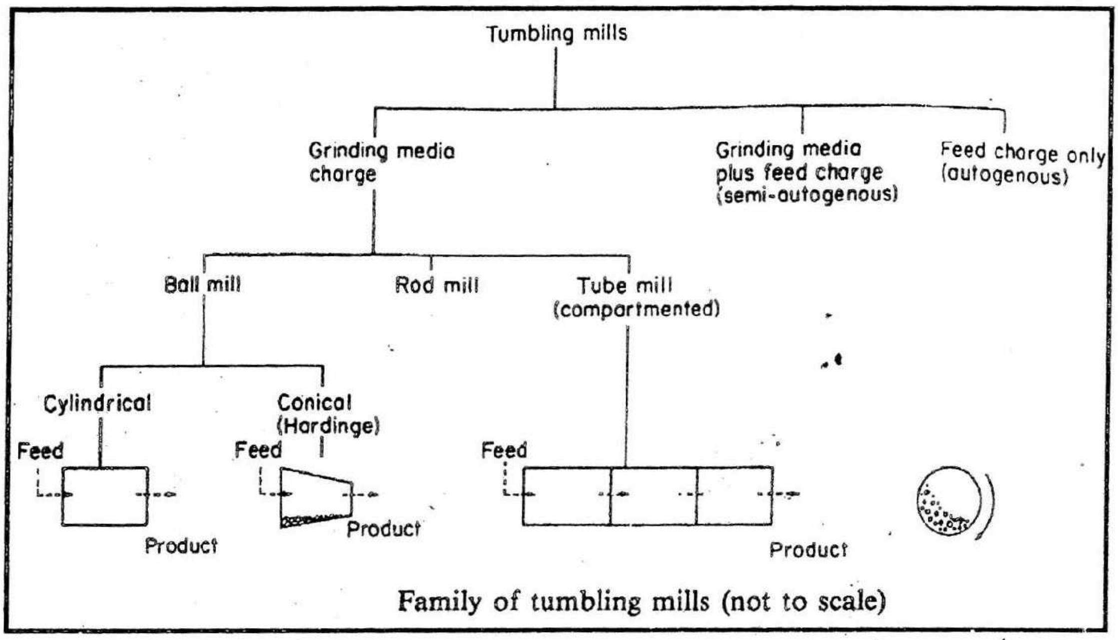

Fig. 6.3. Different type of tumbling mills

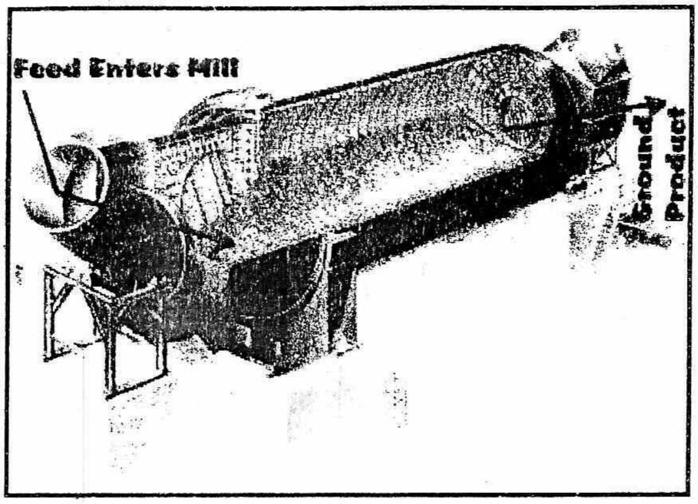

Fig. 6.4. Image of cut away ball mill, showing material flow through the mill

Rod Mills

Rod mills are very similar to ball mills, except they use long rods for grinding media. The rods grind the ore by tumbling within the the mill, similar to the grinding balls in a ball mill. To prevent the conditions leading to rod charge tangling, the length to diameter ratio is maintained at 1.4 to 1.6. Rod mills accept feed up to about 50 mm (2 in.) and produce a product in the size range of 3000 to 270 mm (–4 to –35 mesh). Grinding action is by line contact between the rods extending the length of the mill. Rods tumble and spin in roughly parallel alignment simulating a series of roll crushers. This results in preferential grinding of coarse material and minimizes production of slimes.

Of the three main types of rod mill, overflow, end peripheral discharge, and center peripheral discharge only the overflow mill is in common usage. Wet grinding rod mills are normally used in the iron ore processing industry. Dry grinding is used in some areas; however, it is confronted with problems and should be avoided except where absolutely necessary. Rod mills operate at lower speed than ball mills since the rods are rolled and not cascaded. For an equivalent grind, a rod mill uses less steel than a ball mill because of the lower speed and better contact between the media and ore. The rod charge must be maintained in good working condition, and broken and worn rods must be removed. Rod mills usually require greater operator attention. It is important that the rods stay essentially parallel to one another. If rods become misaligned, grinding action is lost and, more importantly, rod tangles occur. Maximum rod length is limited to about 6.1 m (20 ft). This in turn limits the length, diameter, and capacity of rod mills. The heavier rods acting upon the lifters and liners result in greater wear on the mill liners.
Rod mills normally carry 35 to 65% rod charge by volume. The limits on charge level are (1) keeping the feed end trunnion open so that feed will get into the mill, and (2) keeping the rod charge low so rods will not work their way into discharge openings where they can cause rod tangling.

Critical Speed(C_S) of mill $= \frac{76.63}{\sqrt{D}}$; where D is Inside mill diameter in feet

The Critical Speed is used for the determination of ball mill ideal operating speed. But for comparison, rod mills would operate between 50% to 95% of the critical speed. The faster the mill speed, the greater the wear on the rods and liners. So, the general rule of thumb for rod mills is to operate no faster than the speed that will obtain the desired product size.

These may be considered as either fine crushers or coarse grinding machines. They are capable of taking feed as large as 50 mm and making a product as fine as 300 μm, reduction ratios normally being in the range 15-20: 1. They are often preferred to fine crushing machines when the ore is "clayey" or damp, thus tending to choke crushers. The distinctive feature of a rod mill is that the length of the cylindrical shell is between 1.5 and 2.5 times its diameter. This ratio is important because the rods, which are only a few centimetres shorter than the length of the shell, must be prevented from turning so that they become wedged across the diameter of the cylinder. The ratio must not, however, be so large for the maximum diameter of shell in use that the rods deform and break. Rod mills are generally run at between 50-65% of the critical speed, so that the rods cascade rather than cataract.
The power required for a certain required capacity may be estimated by the use of Bond's equation:

$$W = \frac{10W_i}{\sqrt{P}} - \frac{10W_i}{\sqrt{F}}$$

The feed pulp density is usually between 65 and 85% solids by weight, finer feeds requiring lower pulp densities. The grinding action results from line contact of the rods on the ore particles; the rods tumble in essentially a parallel alignment, and also spin, thus acting rather like a series of crushing rolls.

The operation speed of rod mills is generally determined by the Peripheral Speed (3.14D and generally between 280-480 Feet/Minute) of the Inside of the mill. Generally, rod mills operate between 280 feet per minute and 480 feet per minute at the periphery of the mill.

Ball Mills

Ball mills are the most common form of tumbling mill, probably because they work effectively from laboratory units of a few watts to huge industrial units drawing 10-12 MW. They dominate mineral comminution over a wide size range, from a few millimetres to a few tens of microns. Ball mills are used as primary grinding mills with feed up to 20 mm, as well as secondary/tertiary and regrinding operations with fine feed and products.

In this century ball mills have grown steadily larger, driven by cost and scale factors. During the 1950s and 60s large diameter ball mills dominated high capacity primary grinding. However since the mid 1970s, multi-stage crusher and coarse primary grind ball mill circuits have been almost completely supplanted by AG/SAG circuits. Ball mills still dominate secondary grinding but are in serious competition with closed circuit AG/SAG and a range of stirred mills. Stirred mills, such as tower mills, are also finding application in fine grinding tasks, especially those with feed sizing of more than 80% passing 50microns.

Ball mills are usually the largest consumers of energy within a mineral concentrator. Therefore, their efficient use has important performance and cost implications.

Ball mills are cylinders rotated around their longitudinal axes. A figure of the ball mill is given in Fig. 6.4. Ore and (usually) water are fed in at one end and discharged from the other. The second common fluid for ball mills is air. Air-swept mills are common in cement grinding for example. Many other fluids are used in ball mills which are also chemical process reactors.

Ball mills can be used over a remarkable size range, from laboratory mills of 200 mm x 200 mm - drawing a few watts - to giant industrial units 6 m in diameter by 9 m long (20' x 30') drawing 10 -12 MW. Very few process units can cover more than six orders of magnitude of scale!

A Ball Mill grinds material by rotating a cylinder with steel grinding balls, causing the balls to fall back into the cylinder and onto the material to be ground. The rotation is usually between 4 to 20 revolutions per minute, depending upon the diameter of the mill. The larger the diameter, the slower the rotation. If the peripheral speed of the mill is too great, it begins to act like a centrifuge and the balls do not fall back, but stay on the perimeter of the mill.

The point where the mill becomes a centrifuge is called the "Critical Speed", and ball mills usually operate at 65% to 75% of the critical speed.

Ball Mills are generally used to grind material 1/4 inch and finer, down to the particle size of 20 to 75 microns. To achieve a reasonable efficiency with ball mills, they must be operated in a closed system, with oversize material continuously being recirculated back into the mill to be reduced. Various classifiers, such as screens, spiral classifiers, cyclones and air classifiers are used for classifying the discharge from ball mills.

The critical speed is calculated by using formula of any ball mill. Most ball mills operate most efficiently between 65% and 75% of their critical speed.

The final stages of comminution are performed in tumbling mills using steel balls as the grinding medium and so designated ball mills.

Since balls have a greater surface area per unit weight than rods, they are better suited for fine finishing. The term ball mill is restricted to those having a length to diameter ratio of 1.5 to 1 and less. Ball mills in which the length to diameter ratio is between 3 and 5 are designated *tube mills*. These are sometimes divided into several longitudinal compartments, each having a different charge composition; the charges can be steel balls or rods, or pebbles, and they are often used dry to grind cement clinker, gypsum, and phosphate.

The power input in ball mill is directly proportional to the volume weight of the grinding medium, the power input and capacity of pebble mills are correspondingly lower than that of ball mill. Thus in a given grinding circuit, for a certain feed rate, a pebble mill would be much larger than a ball mill, with correspondingly higher capital cost.

The efficiency of grinding depends on the surfac4e area of the grinding medium. Thus balls should be as small as possible. Ball mill usually consist of charge having a wide range of ball sizes to attain desired grinding fineness. The grinding efficiency can be summarized as :

$$d = KD^{0.5-1}$$

Where, d is the ball diameter, d is the feed size and K is a constant varying on type of ore. The charge volume of the mill is usually 40-50% of the internal volume of the mill, about 40% of this being the void space. Ball load should be such that it occupies just more than half of the mill during stoppage.

There are two main forms of ball mill, depending on how the slurry is discharged. The *overflow* mill has an exit hole at the discharge trunnion which is larger than the inlet; this generates a hydraulic gradient which drives the slurry through the mill. The *grate discharge* mill has an internal grate and slurry lifters at the discharge end, much the same as AG/SAG mills; such mills run with a lower internal slurry level than overflow mills.

A cylindrical trommel screen axially mounted on the mill end is often used to remove ball or ore scats. However, for large primary mills with large pumps and classifiers, a ball return spiral in the discharge end of the mill is often adequate and a trommel is not necessary. Occasionally an ore will have a harder component, and small pieces (scats or chats) survive the grinding processes and are rejected along with tramp steel. If these rejects are barren of valuable mineral, this can provide some degree of preconcentration. Ball mills will work effectively over a very wide range of length to diameter aspect ratios, with 1 - 1.5 ratios being most common; ratios of 1:3 to 3:1 are also encountered.

Autogenous Mills

There has been increasing tendency seen in the mineral industry is migrating towards autogenous and semi-autogenous mills over ball mill. This mills have an advantages over conventional circuits include lower capital cost, the ability to handle wet & sticky material, relatively simple flow sheets, etc. The autogenous mill uses tumbling to effect comminution instead of using media such as steel rods or balls. It uses action of ore particles on each other to achieve comminution.

Autogenous Mills operate, mechanically, similar to the ball mill. They differ in the media they use to break or grind the ore. Autogenous Mills use large particles of ore instead of steel or other balls for grinding media. Autogenous mills use large pieces of ore as grinding media. The grinding is facilitated in autogenous mills by attrition with limited grinding by impact.

For an ore to successfully grind autogenously, the ore must be competent, and it must break along grain boundaries at the desired product size. Another requirement is that the finer sizes should break easily and should be removed from the mill, otherwise, there will be a critical size buildup. Autogenous grinding has two advantages, (1) it reduces metal wear and (2) eliminates secondary and tertiary crushing stages.

Thus it offers a savings in capital and operating costs. Autogenous mills are available for both wet and dry grinding. The diameter of autogenous mills is normally two to three times the length. The ore charge is usually 25 to 35% of the mill volume.Autogenous mills have grate discharges to retain the coarse grinding media in the mill.

COMMINUTION CIRCUITS

Three basic types of size reduction circuit used to produce a fine product are shown in Fig. 6.5. The notable feature of the conventional circuit (Fig. 6.5) is that size reduction is carried out in a number of stages. There are three major factors contributing to this. First, most size reduction equipment performs more efficiently when the reduction ratio is limited. This is especially true for the compression crushers where the crushing chamber is designed to handle the larger particles rather than the smaller. Hence, once a particle has been broken once, twice, or three times, it is too small to be efficiently broken further in the same chamber. The relationship between media and particle size in tumbling mills has already been considered, and this again limits the reduction ratio that should be attempted in a given mill. In practice, ball mills in particular can have large reduction ratios, but to achieve this most efficiently requires decreasing media size along the mill. The second reason for limiting the reduction in a given machine applies mainly to the final stages of grinding and concerns the desirability of preventing.

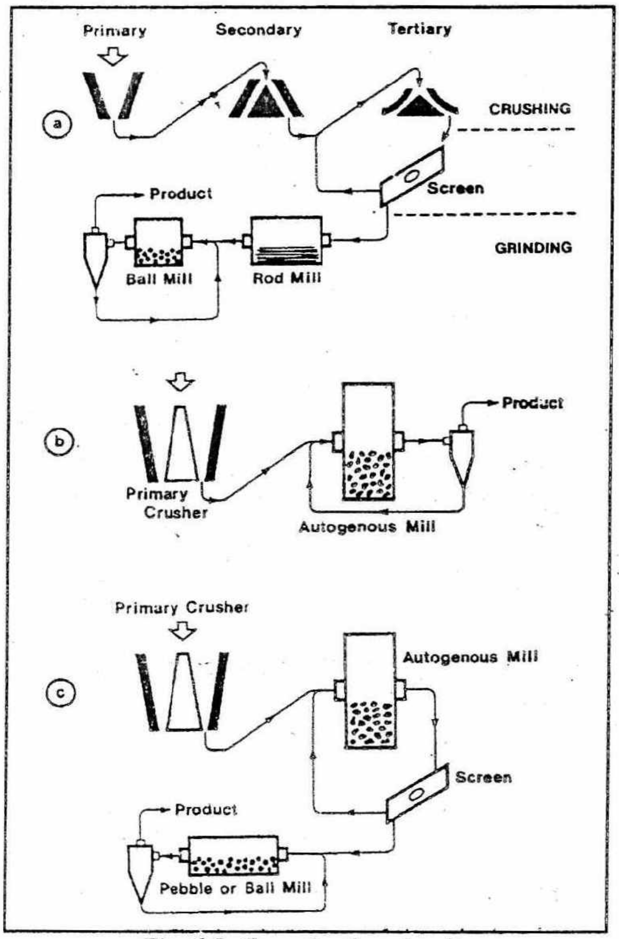

Fig. 6.5: Comminution circuits

COMMINUTION OF IRON ORE - PLANT PRACTICE

Generally, crushing of iron ore is carried out in two stages, namely, primary and secondary crushing. Jaw and Gyratory type crushers are used mostly for primary crushing. They can handle large tonnage of material. Jaw crushers produce a reduction ratio of 4:1 to 9:1 while gyratory crushers produce a somewhat larger range of 3:1 to 10:1. The reduction ratio is defined as the representative feed size by representative product size.

A typical circuit for comminution of iron ore in a plant is shown in Fig. 6.6. In case of iron ores, the ROM ore is transported by the rear dump trucks and directly dumped into the Primary Crusher through fixed inclined Grizzly having an opening of 200 mm. The crushed ore along with the Grizzly undersize is conveyed to the Primary Surge Pile through 1200 mm wide 800 t/h conveyor.

The crushed ROM is reclaimed from the surge pile through a 2000 mm x 200 mm, 700 t/h Apron Feeder and a 1200 mm wide 500 t/h conveyor to the Secondary Crushing, Washing and Screening Plant. The ore is received on a 2100 mm x 6000 mm Scalper Screen which screens at 40 mm. The +40 mm from this scalper is fed to the 2100 mm Hydraulic Cone Crusher and crushed.

The secondary crushed ore along with the -40 mm ore from scalper is fed through a 1000 mm wide 500 t/h conveyor on to a 2400 mm x 6000 mm Rinsing screen with 40 mm square aperture. The +40 mm from the Rinsing Screen is conveyed to the Tertiary Crusher house which has a 2100 mm Cone Crusher where it is crushed and conveyed to the Rinsing Screen in a closed circuit loop. The -40 mm ore is fed to a 2400 mm x 8700 mm scrubber which discharges the same onto another 2400 mm x 6000 mm Rinsing Screen having 10 mm square aperture. The -40+10 mm designated as sized ore is conveyed over a set of conveyors and a travelling tripper to the Sized ore surge pile. This fraction is the feed to the blast furnace.

The -10 mm material from the Rinsing Screen flows into two 1650 mm Triple Pitch Screw Sizing Classifiers where the -10+0.15 mm material, designated as Classifier fines, is separated. The classifier fines are fed to a 2400 mm x 6000 mm Dewatering Screen and conveyed through a set of conveyors and a travelling tripper to the Classifier Fines Surge Pile.

The -0.15 material along with the water is known as slime and is transported through a pipeline to thickeners where approximately 80% of the water is recovered for reuse and circulated back to the water storage tanks. The thickened material is pumped through a 25 km pipeline to the Tailings Pond from where water is recovered and circulated back to the water storage tanks.

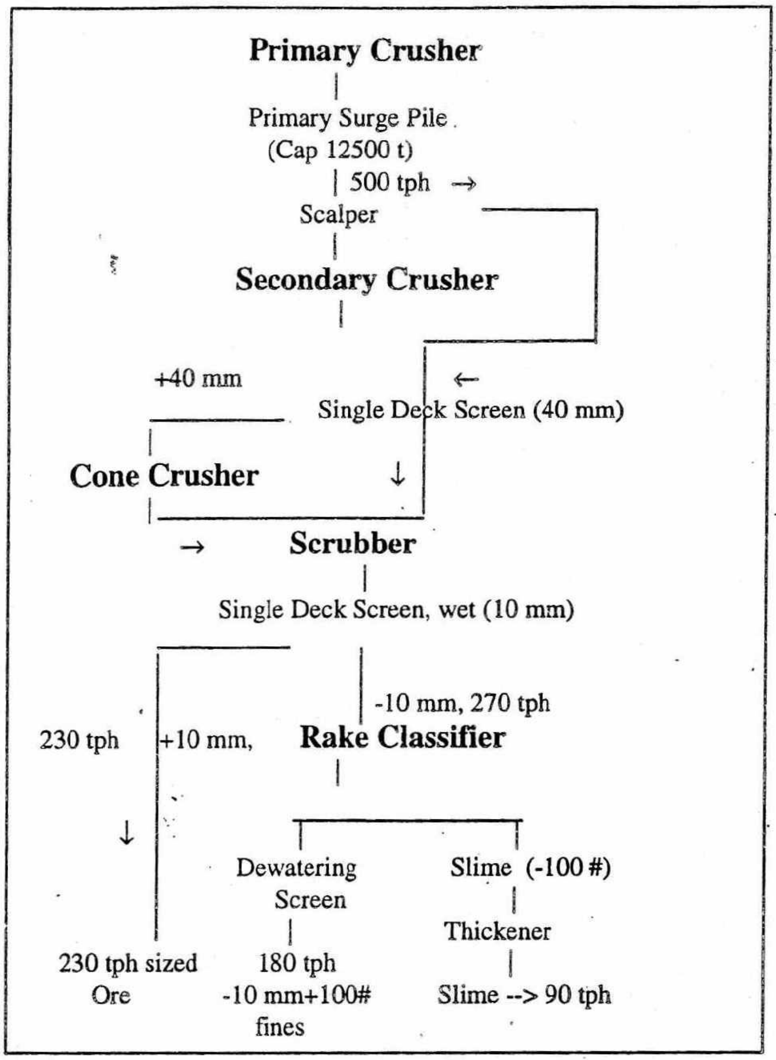

Fig. 6.6. A typical comminution circuit in an iron ore processing plant.

COMMINUTION AND PROCESSING OF BARSUA IRON ORE – A CASE STUDY

The ore body constitutes the Southern Tip of Bonai Iron Ore range. The ore processing plant consists of two sections viz., washing section at the top and jigging section at the bottom connected by two parallel lines of launders. The washing section consists of two parallel circuits comprising Drum scrubbers and DD screen. The washed lump is a final product and is delivered to the downhill conveyors system for despatch. Fines are delivered in a slurry form through the launders to a tank located in the jigging section. The slurry is put on a DD screen +8mm is dewatered and sent through a fine ore belt conveyor. -2 mm fractions in slurry form is classified in two spiral classifiers. The classifier sand of -2 mm and +65 mesh join the -8=2 mm portion and fed to the Remer jigs for further upgradation. Jigs are not in use for the last several years due to certain problems such as high loss of products to rejects, poor stratification and mechanical problems. The classifier overflow is hydrocycloned. The overflow of the hydrocyclone is put in a thickener and the underflow taken to the tailing pond. The flow diagram is given in Fig. 6.7.

The mine was developed for a production level of 2.01 Mt/yr lump and fines to supply to Rourkela Steel Plant in the year 1961. The quality requirement was 62 +/- 0.5 % Fe. Since the ore deposit at Barsua is having lean grade ore, the mine has been provided with fairly advanced type of ore beneficiation plant. Though the plant is designed to produce 1.5 Mt/yr (out of 2.5 Mt/yr ROM Beneficiable ore) through the wet circuit and 1 MT through Dry Circuit, it seldom utilises the beneficiation facilities to treat more than 1 Mt/yr. This is primarily due to huge loss of fines through slimes as well as leakage in launders. The reported slime loss through process and leakages was 27% of ROM beneficiable grade ore as against the design norm of 15-20%. A good amount of iron values are lost in the process.

The loss of excessive quantity of fines were due to corrosion of launder lining and junction box. Most of the process equipment were not performing well due to some reason or other and some were bypassed altogether such as jigs, secondary spiral classifier, hydrocyclones and thickener. Recommendations were given viz., insertion of baffle boxes, change of launder lining, replacement of 10x10 mm bottom deck screen of washing plant by 6x6 mm square opening etc. Most of the recommendations have been implemented and a full scale trial has shown that the slime losses could be reduced to 21%.

COMMINUTION CIRCUIT AT MEGHATABURU IRON ORE MINES- A CASE STUDY

Meghataburu Iron Ore Mine of SAIL has been designed to supply the requirement of iron ore to Bokaro Steel Plant to meet its requirement at 4.75 MT stage. It was commissioned in June 1985. The mine has a design capacity of 6 MT excavation, 5 MT ROM generation and 4.3 MT finished product consisting 1.3 MT of lump and 2.96 MT of fines after beneficiation. The deposit of mine was estimated to be 133 MT. The comminution circuit is given in Fig. 6.8.

The plant has got two divisions viz., Ore processing plant consisting of Crushing Plant, Down hill section and Screening Plant. The Ore Handling plant consists of stacking and wagon loading system. The ROM ore fed into the crushing plant is crushed in two stages and brought to the size of -40 mm and is stacked in the secondary stockpile through downhill conveyor system. The screening plant is designed to operate in both dry and wet mode operation. In the dry process the high grade ore is screened separating out lump and fine. In the wet process the entire ore is washed in the double deck screen and the -40+10 mm is stacked through conveyor system into lump ore stockpile. The -10 mm product is processed through duplex rake classifier, the raked sand is dewatered through dewatering screen to reduce the moisture whereas the overflow from the rake classifier, underflow of the dewatering screen containing less than -65 mesh is mixed in the slime distributor and the slurry is fed to hydrocyclone through slime pump. The underflow of the hydrocyclone containing coarser sand was designed to be fed into disc filter. However, after commissioning the screening plant, the disc filter could not be operated commercially on a sustained basis and recovery of fine ore as per design parameters could not be made.

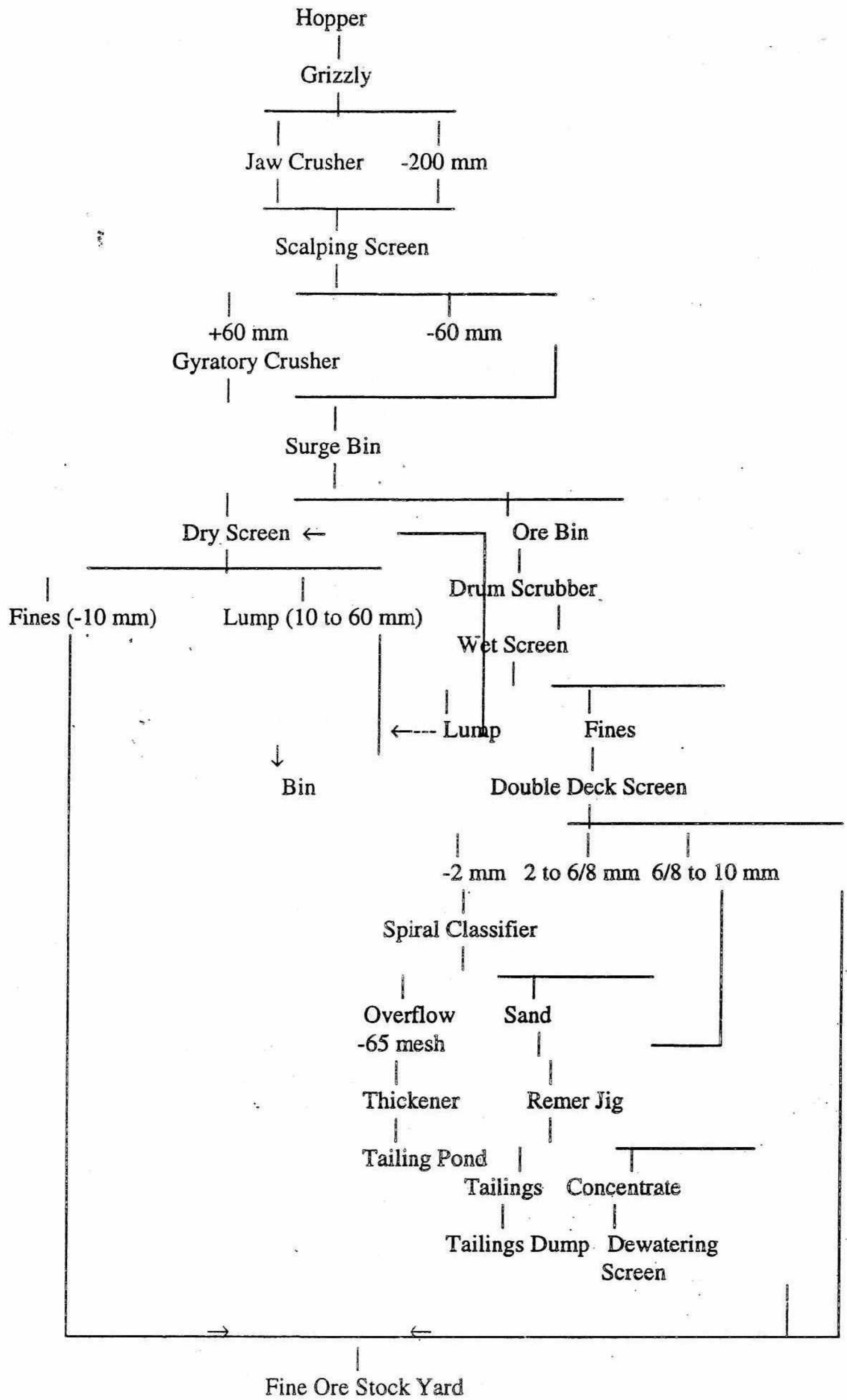

Fig 6.7 : Flowsheet of iron ore processing at Barsua

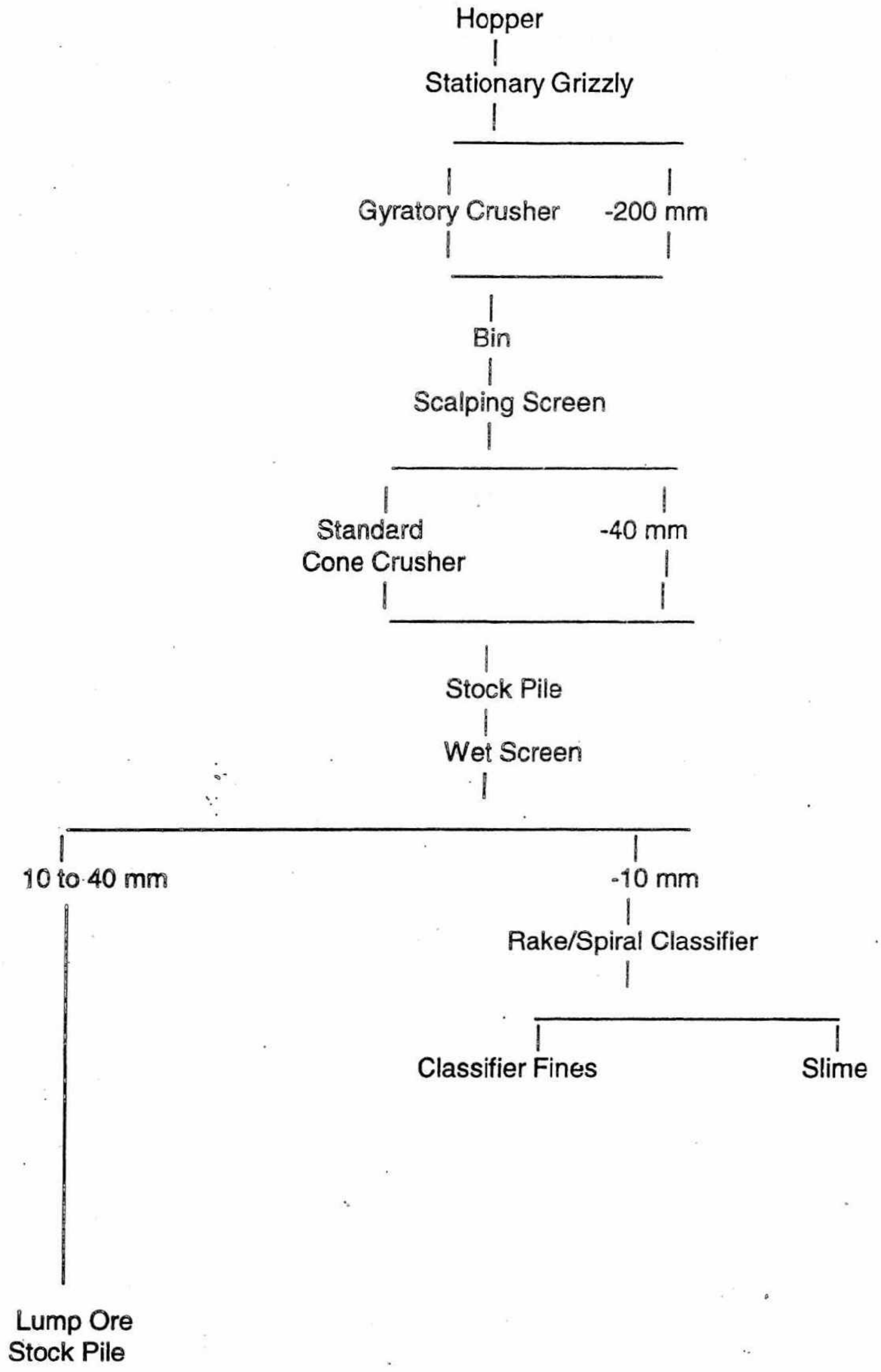

Fig. 6.8. Comminution circuit at Meghataburu

To overcome this situation, it was recommended that instead of a disc filter the fines could be reclaimed with a variable speed classifier. To recover this high grade ore a Slow Speed Classifier was put in operation which removed substantial quantity of good quality material.

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