MINERAL DRESSING

Semester: 6th

STUDY MATERIAL

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INTRODUCTION

MINERAL DRESSING/MINERAL PROCESSING:It is commonly regarded as the processing of raw mineral to yield marketable products and waste by means that donot destroy the physical and chemical identity of the minerals.

Primary objectives of coal crushing and screening, also known as size reduction and size separation, respectively are to reduce the run-of-mine coal to a size suitable for subsequent requirement, e.g., washing or transportation or general market or specific client specification. Crushing and screening are together commonly referred to as size preparation. Irrespective of coal qualities coal crushing is guided by certain general principles. Notables among those are as follows:

1. A particular type of crusher is most efficient in acting on a certain size range of feed.
2. Crushing is performed most efficiently in a series of stages; no one machine efficiently reduces large sizes to small sizes by repeated breakage.
3. For rapid and efficient size reduction, finer material should be scalped as quickly as possible from the crusher feed.
4. A crusher design should be chosen to handle the hardest material in the coal, but should not be of heavier (more costly) construction than needed.
5. Any crusher can be used at any stage, provided that is the most cost effective choice.

There is a rough distinction between breaking and crushing. Breaking as a term is usually applied to size reduction operations on large materials where coal is broken along natural cleavage lines. Crushing generally refers to size reduction of material below 300/ 500mm. The term “grinding” covers the size reduction of material of about 25 mm in size to micron sizes, as in the production of pulverized fuel for use in a power plant.

Before we move further, some of the terminology used in coal crushing needs clarification.

- ✓ Top size: the largest allowable particle size in a feed or product (d_{100})
- ✓ Nominal size: at least 90% of the material passes through this size (d_{90})
- ✓ Oversize: material too large to pass through a specific screen aperture or grizzly opening; alternately material larger than the crusher discharge setting (set) size
- ✓ Closed Side Setting: This is the minimum gap between the two opposing crushing faces of a reciprocating crusher, e.g. bowl and mantle liners on a cone crusher when

the eccentric is at its closest limit. This term is used when setting the size at which the crusher will crush. Normally a crusher with new liners will pass 80% below this size (d_{80}) and 20% above

- ✓ Open Side Setting: This is the maximum gap between the two opposing crushing faces of a reciprocating crusher
- ✓ Choked Feed: operating the crusher with a completely filled crusher chamber
- ✓ Closed Circuit Crushing: a system in which oversize material is screened from the crusher product and returned for another pass through the crusher; usually carried out at the final stage of crushing
- ✓ Circulating Load: The amount of oversize returned to the crusher after screening the crusher product, usually expressed either in tph or in % of the crusher feed
- ✓ Friable: material that breaks easily
- ✓ Reduction Ratio: usually the ratio of the top size of feed material to the top size of crusher discharge ($RR = d_{100F}/ d_{100P}$), but could be expressed in terms of any other characteristic size, e.g. d_{80}; a ratio of less than 4:1 or 3:1 is desirable in coal crushing to avoid excessive fines generation
- ✓ Scalping: removing all sizes smaller than product top size from the crusher feed
- ✓ Tramp Material: Bolts, shovel teeth, picks, iron pieces, timber supports and other foreign material that may be present in a crusher feed

ROM coal obtained from the mines generally shows a top-size of 300-2000 mm. Top-size is smaller for coal obtained from underground pits, whereas comparatively larger for coal obtained from surface mines. Following factors affect the top-size and size distribution of ROM coal.

- ➢ Underground or surface mining
- ➢ Mechanised, semi-mechanised or manual mining
- ➢ Method and intensity of blasting
- ➢ Presence or absence of in-pit crushing
- ➢ Material handling system used to transport the coal from mine to plant

Subsequent to mining, ROM coal is subjected to crushing in stages. The types, sizes and number of crushers employed in a complete size reduction system would vary with such factors as the volume or tonnage of coal to be crushed, top-size and size distribution of ROM coal, the hardness of coal and the size and dimension required for the final product. Rotary breakers, recently sizers and single roll crushers are commonly used as primary crushers, whereas double roll and impact group of crushers are usually applied in secondary and

tertiary crushing. Reciprocating crushers, such as jaw, gyratory and cone crushers are also sometimes used to crush hard to very hard coal in large capacity operations, e.g. in coal handling plants of large capacity mines.

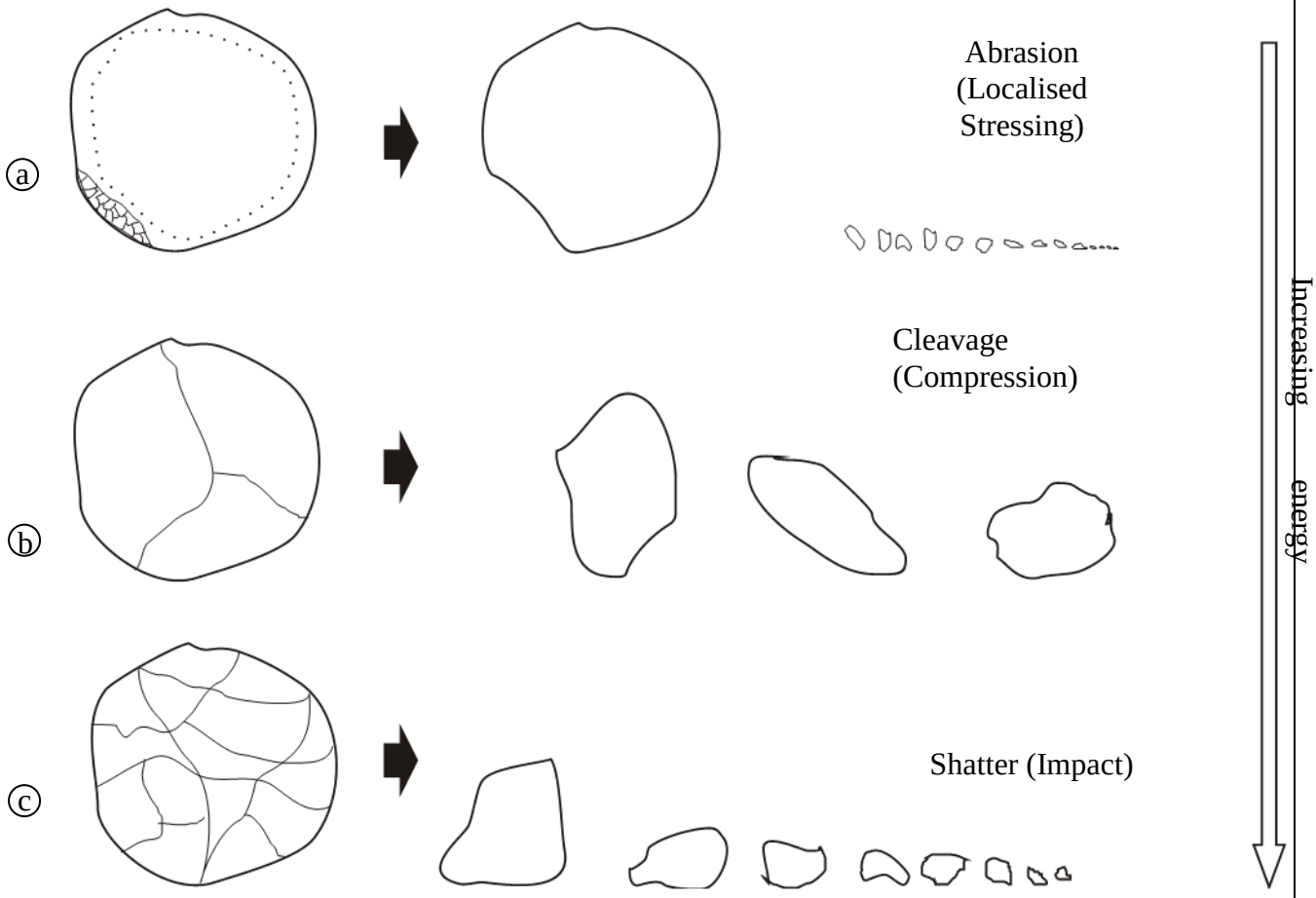

Figure 1 Typical Mechanisms of Fracture

When coal is crushed for the purpose of washing, it is important to remember that based on US practices, relationship of coal washing costs, coarse to fines, generally is given as 1:3 or 1:4, whereas in India it is estimated to be around 1:5 – 1.6. Therefore, as and when washing is required, as far as liberation permits, generation of fines in coal crushing should be bare minimum. Otherwise also fines pose a major problem in handling, transportation and utilization of coal. Therefore, a major restriction imposed on coal crushing is minimum generation of fines.

Fundamentals of Breakage

There are four basic actions by which coal is reduced in size. These are Compression, Shear, Impact and Attrition. Most crushers employ a combination of these crushing “methods”. For

a particle to fracture, a stress high enough to exceed the fracture strength of the particle is required.