Experiment 2

Aim: To study and determine crushing efficiency, reduction ratio, and power required.

Theory and principle:

Crushing is the process of reducing the size of solid particles into definite smaller sizes. Jaw crushers are major size reduction machines used in mechanical, metallurgical and allied industries. The crusher crushes the feed by some moving units against a stationary unit or against another moving unit by the applied pressure, impact, and shearing or combine action on them. They are available in various sizes and capacities ranging from 0.3 ton/hr to 50 ton/hr. They are classified based on different factors like product size and mechanism used. Based on the mechanism used crushers are of three types namely (i) Cone crusher (ii) Jaw crusher, and (iii) Impact crusher.

Fracture occurs in the feed material when the strain developed in it due to sufficiently applied impact forces, pressure or shearing effect exceeds the elastic limit. Generally crushers are very rugged, massive and heavy in design. The contact surfaces are equipped with replaceable liners made from high tensile manganese or other alloy steel sheet having either flat or corrugated surfaces. Shearing pins or nest in heavy coiled springs are provided in the crusher to guard against shock and over load.

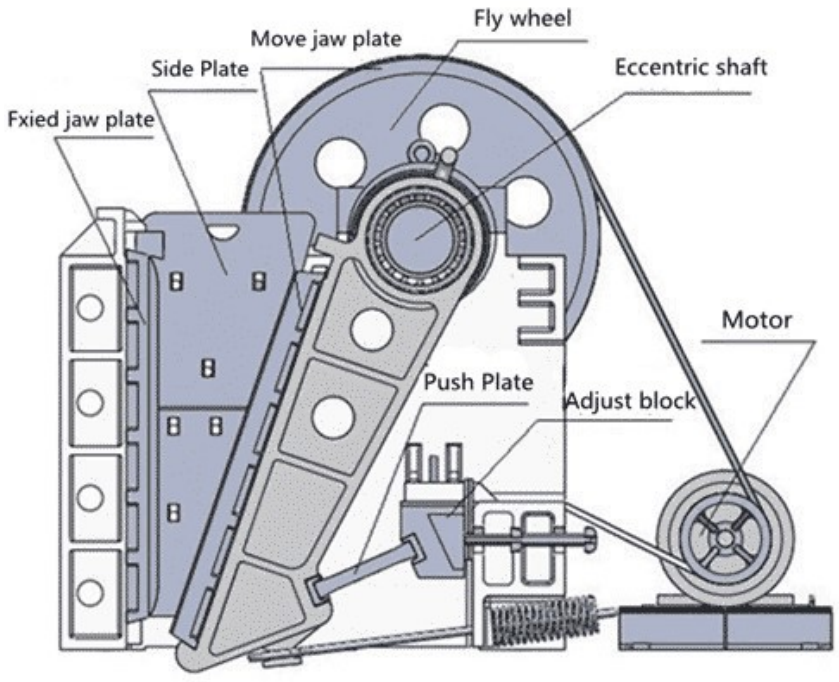

Figure: Jaw Crusher

A crusher may be considered as primary, secondary or fine crusher depending on the size reduction factor:

(a) Primary crusher: The raw material from mines is processed first in primary crushers. The input of such crushers is relatively wider and the output products are coarser in size.
Examples: Jaw crusher, Gyratory crusher.

(b) Secondary crusher: The crushed rocks from primary crusher are sent to secondary crusher for further size reduction. Examples: Cone crusher, reduction gyratory crusher, spring rolls, disk crushers etc.

(c) Fine crushers: Fine crushers have relatively small openings, and are used to crush the feed material into more uniform and finer product. Examples: Gravity stamp.

Working: The material to be crushed is dropped between two rigid pieces of metal, one of which then move inwards towards the rock, and the rock is crushed as it has a lower breaking point than the opposing metal piece. Jaw crusher movement is guided by pivoting one end of the swinging jaw and an eccentric motion located at the opposite end. The size of a jaw crusher is designated by the rectangular or square opening at the top of the jaws . For example, a 22 x 30 jaw crusher has an opening of 22" by 30", a 46 x 46 jaw crusher has a opening of 46 square inch. Generally primary jaw crushers have the square opening design, and secondary jaw crushers have rectangular opening design. Jaw crushers are used as primary crushers in a mine or ore processing plant or the first step in the process of reducing rock. They follow “crush using compression” mechanism.

Procedure:

1. Take 5-6 pieces of brick.

2. Note the weight of each piece and the corresponding equivalent diameter.

3. Feed the brick piece one by one to the jaw crusher and collect the total material.

4. Note the total time of crushing.

5. Subject the crushed material to sieve analysis.

6. Take weight of material retained on each screen.

Observation table:

(a) For Feed:

SN	Mesh number	Mesh opening	Mass retained	Mass fraction	nd^3	nd^4

(b) For Product:

SN	Mesh number	Mesh opening	Mass retained	Mass fraction	nd^3	nd^4

Calculations:

(a) For feed:

$$\sum nd^3 = ...$$

$$\sum nd^4 = ...$$

(b) For product:

$$volume\ mean\ diameter = \frac{D_{P,feed}}{D_{P,product}}$$

$$P = 0.3162 \times W_i \times M \times \left[\frac{1}{\sqrt{D_{P,product}}} - \frac{1}{\sqrt{D_{P,feed}}} \right]$$

Where,

P = Power required
M= Mass of feed to be crushed tons per hr.
W_i= Working index of brick.
$D_{P,\ product}$ = Volume mean diameter of the product

$$D_{P,product} = \frac{\sum nd^4}{\sum nd^3}$$

$D_{P,\ feed}$ = Volume mean diameter of the feed

$$D_{P,feed} = \frac{\sum nd^4}{\sum nd^3}$$

Results: