



# Jaw Crusher Destroyer Design Capacity Ton of Coal

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**Abstract:** Coal is an energy source that has long been used mainly for power generation, steelmaking, and others, with the rise in world oil prices which have an impact on the increase in domestic oil prices, coal into alternative energy sources that can be used as fuel for home stairs in the packaging in the form of briquettes. Before the use of coal, coal needs to be destroyed first become smaller chunks which are then processed into powder coal and packaged in various sizes briket. The coal crushing process is to use a jaw crusher, in this destruction process chunks of coal inserted between the movable jaw which is driven by the connecting rod and fixed jaw which is set movements.

**Keywords:** Jaw crusher & coal.

## 1. PRELIMINARY

Coal is an energy source that has long been used mainly for power generation, steel manufacturing and others. Along with the rise in world oil prices which have an impact on the domestic oil price increases, then the coal into alternative energy sources that can be used as household fuel. Before coal can be used by consumers, coal needs to be destroyed first become smaller chunks which are then processed into powder coal and packaged in the form of briquettes.



Figure 1. Coal Briquette

To achieve the desired size of the coal before it is processed into briquettes, it takes a machine destroyer and one destroyer machines are jaw crusher. In this research, a design and analysis of jaw crusher machine that can be used to crush coal capacity of one ton / hour. The results of this analysis are expected to design and can be applied to several industrial briquettes that can reduce engine components that have to come from outside.

**Coal**

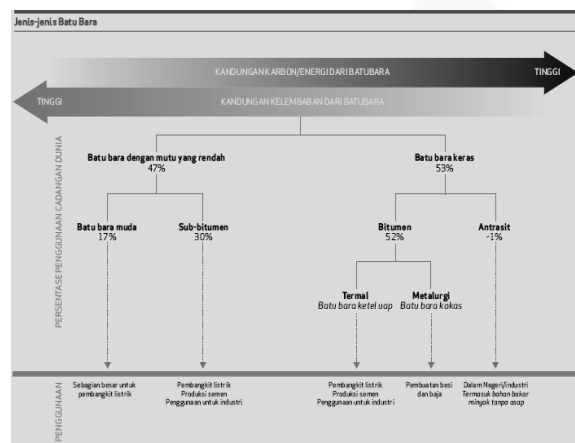
Coal is the remains of prehistoric vegetation that originally accumulated deformed and peatlands which are then deposited into stone.

**Types of Coal**

The degree of change experienced by coal from peat to anthracite known as coalification and have an important relationship is referred to as coal quality level.

Coal with a low quality, such as lignite and sub-bituminous typically softer, friable materials with a dull, earthy appearance. Lignite has a high moisture levels and low carbon content and thus low energy content.

Coal with higher quality is generally harder and stronger and often have a black vitreous luster. Coal with higher quality has much carbon content, low moisture levels and produce more energy. Anthracite is coal with the most excellent quality and thus has a carbon content and higher energy and lower humidity levels.



**Figure 2. Classification of Coal**

**Use of Coal**

Coal has many important uses worldwide. The most significant uses are in electricity generation, steel production, cement manufacturing and other industrial processes as well as liquid fuels. Coal is also an essential ingredient in the manufacture of certain products:

- Silicon metal used to produce silicones and silanes which in turn is used to make lubricants, water repellents, resins, cosmetics, shampoo and toothpaste.
- Activated carbon is used in filters for water and air purification and kidney dialysis machines.
- A carbon fiber reinforcement material is very strong but light used in the construction of mountain bikes and tennis rackets.

**Method of Destruction of material**

Some types of material crusher working principle commonly used in industry, such as shown in Table 1 below:

**Table 1. The working principle and the shredder material**

No.	Style	Work principle	Engine type
1	suppression (Compressive)	be pressed (Compression)	Doble Roll Crusher
2	Blow (Impact)	beaten (Impact)	Hammer mill impactor
3	Friction (Shear / Attrition)	swiped (Attrition)	Disc attrition mill
4	Mix of style suppression force, beatings and friction	The union of the working principle is pressed, beaten and swiped.	Single Roll Crusher Jaw Crusher

*crushing* is the processing of the solid material the first level is done mechanically by reducing the size of the material through several processes, including: pressed (compression), hit (impact), swiped (shearing / attrition), cut (cutting) etc.

This size reduction process does not alter the chemical properties of the material produced with a smaller size than previous materials. The process of downsizing (size reduction) was very helpful and even bring many advantages for a variety of processes, such as:

- Can increase the drying rate, the rate of combustion and cooling rate.
- When combined with the sorting process (screening), we can determine the size of the desired product.

Crushing process usually consists of three levels, namely:

**Primary crushing**

Primary Crushing is used to reduce the solid material two inches up to ninety-six inches or more into becoming the desired size or for further processing by the secondary crusher.

**secondary crushing**

Secondary Crushing usually used for input distance (gap) 15 cm and reducing the size of the mineral stones that will be used in tertiary crushing.

**tertiary crushing**

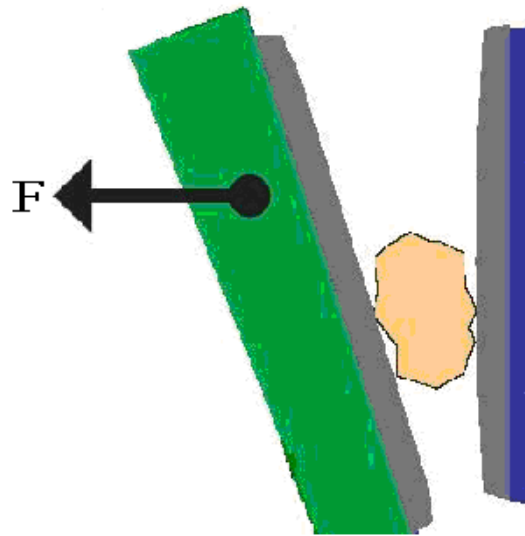
Tertiary Crushing is used for the finishing process mineral stone processing.

**2. PROCESS OF DESTRUCTION OF COAL WITH MACHINE Jaw Crusher**

The destruction of the material by using a shredder type of jaw crusher is conducted by an emphasis on the material between the fixed jaw and a moving jaw.

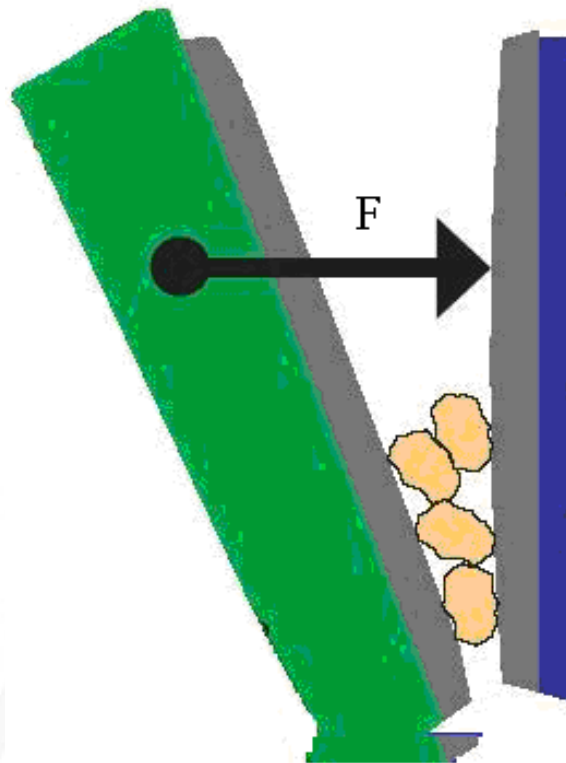
Jaw motion in motion by connecting rod that is connected to the rotating crank shaft that is connected to the pulley, while the pulley driven by an electric motor through V-belt. Changes crank shaft rotational motion into a translational motion in the connecting rod is used to push or pull the jaw motion.

At the time of the connecting rod pull jaw motion, the space between the fixed jaw and jaw motion extends and material with large dimensions can enter the space between the jaw and jaw movement remains up stuck on both sides of the jaw.



**Figure 3 Jaw When Drawn by Connecting Rod**

At the time of the connecting rod pushing jaw movement, jaw movement and the space between the fixed jaw and resulting narrowing material that are in between the two jaw is suppressed, because the material is not able to withstand the pressure, the material crushed by the pressure that is given by the second jaw.



**Figure 4. Jaw when Driven by Connecting Rod**

According to Kirk - Kirvichev [1], the max volume of the crushing zone are:

$$V_{max} = L(G + s + D) \cdot \frac{H}{2} \quad (1)$$

Where:

L = width of the plate jaw crusher (m)

G = Clearance Input jaw crusher (m)

S = Clearance out put jaw crusher (m)

I = Step Stroke (m)  
 H = High-plate jaw crusher (m)

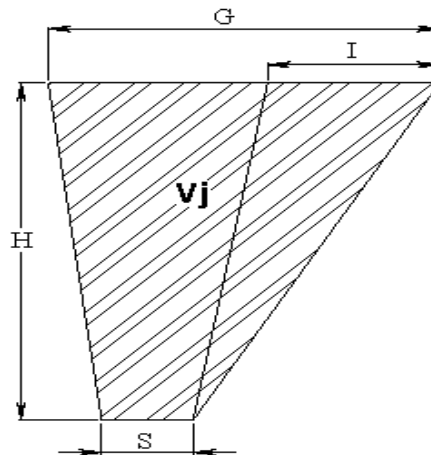


Figure 5. Regional cross-section Crushing Zone

In fact the only material that is greater than the (s + I) are destroyed, so that the large volume of material to be destroyed to be multiplied by a constant K which costs about 0, 2-0, 4 [1].

$$v_j = KV \quad \max \quad (2)$$

$$v_j = KL (G + s + I) \cdot \frac{H}{2} \quad (3)$$

The energy required to destroy the material volume crushing zone areas are:

$$W = \frac{\sigma^2}{2E} \cdot V_j \quad (4)$$

is the compressive strength of the material to be crushed, E modulus of elasticity of the material to be destroyed.

The force required to crush material in the crushing zone are:

$$F = K \cdot L \cdot (G + S + I) \cdot h \cdot \frac{\sigma^2}{2 \cdot E \cdot I} \quad (5)$$

Power is required to destroy the material in the crushing zone is

$$P = W \cdot \frac{2 \pi \cdot n}{60} \quad (6)$$

Transimisi system on engine power jaw crusher

The transmission system is part of an engine system that serves as a carrier, transfer, liaison and continues this movement as well as a load.

The transmission system of jaw crusher machine is as follows:

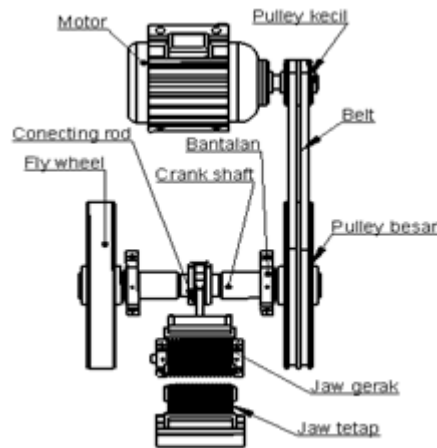


Figure 6. Transmission System Engineering Jaw Crusher

Rotation of the motor is connected to the small pulley is transmitted to the large pulley through the belt. Displacement rounds of small pulley to the large pulley This resulted in the decline in the round. Round of large pulley passed through the crank shaft used to move the connecting rod. Forward or backward translational motion of the connecting rod is used to move the jaw motion to suppress material that is diruang between jaw.

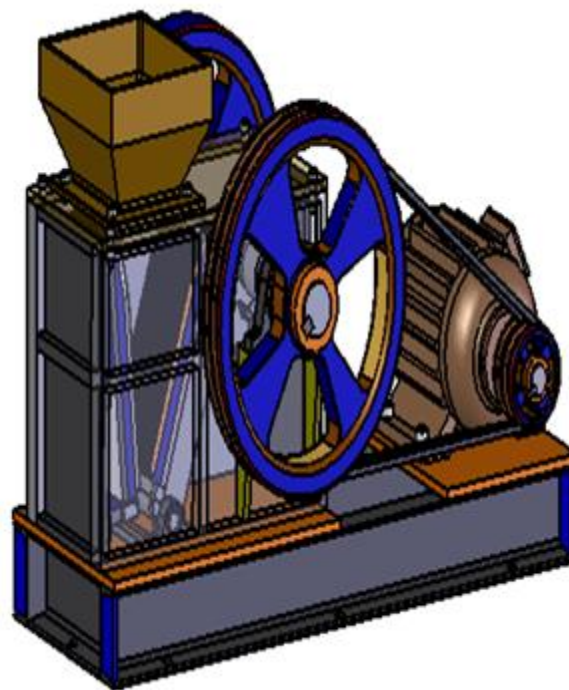


Figure 7. Machinery Jaw Crusher

### 3. Jaw Crusher COAL CAPACITY 1 TON/ HOUR

Analysis of the energy required to break material crushing zone area. Jaw crusher known dimension data is  $L = 160 \text{ mm}$ ,  $G = 237 \text{ mm}$ ,  $h = 300 \text{ mm}$ ,  $I = 134 \text{ mm}$ ,  $S = 20 \text{ mm}$

Volume crushing zone according to equation 3. the price of  $K$  is used is equal to 0.4 are:

$$v_j = 0,4 \times 160 \times (237 + 20 + 134) \times \frac{300}{2}$$

$$= 3.75 \times 10^{-3} \text{ m}^3$$



The energy required to crush material in the crushing zone by equation 4. if known:  
The compressive strength of coal, = 18.9 MPa, a Young's modulus, E = 2, 6 GPa [2].

$$W = \frac{18,9 \cdot 10^6 \cdot \epsilon^2}{\epsilon} \times 3,75 \times 10^{-3}$$

$$= 257,6 \text{ joules}$$

The force required to crush material in the crushing zone with equation 5

$$F = K \cdot L \cdot (G + S + I) \cdot H \cdot \frac{\sigma^2}{2 \cdot E \cdot \epsilon \cdot I}$$

$$= 0,4 \cdot 0,16 \cdot (0,237 + 0,02 + 0,134) \cdot 0,3 \cdot \frac{18,9 \cdot 10^6 \cdot \epsilon^2}{\epsilon}$$

$$= 3,85 \text{ kN}$$

Motor power required to crush coal menghancurkan untuk if a round jaw crusher is 135 rpm and the energy required to crush coal by Equation 4 is 257.6 joules, then the motor power required is:

$$P = \frac{257,6 \cdot \frac{2 \cdot 3,14 \cdot 153}{60}}{60}$$

$$= 4,125 \text{ Watt}$$

$$= 5,5 \text{ HP}$$

### 3.1 Design of Transmission Belts

Design belt transmission for jaw crusher machine based on the input rotation (n1) at 1400 rpm, Round output (n2) = 524 rpm, Power (P) = 6 HP, for the purposes of Crushing Machinery and distance between centers of pulleys, C = 25 in

From the calculation of the belt transmission system design, data design:

Puli small diameter = 6 in

Puli large diameter = 16 in

Standard belt type = B85

The length of the belt = 84.57 in

Distance between centers of pulleys, = 25.38 in

Total belt = 3 pieces

The diameter of the shaft to the pedestal jaw motion by moments of 3245 kg.mm deflection and torque of 31,327 kg.mm, minimum shaft diameter based on the equation:

$$d_s = \sqrt[3]{\frac{K_t T \cdot \epsilon^2}{K_M M \cdot \epsilon^2 + \epsilon} \cdot \left(\frac{0,1}{\tau_a}\right) \cdot \epsilon}$$

If KM is used by 2 and then the diameter of 1.5 Kt minimum is 37.5 mm.

### 3.2 Ratio of material destruction.

Coal crushing ratio is the ratio between the dimension of the input coal with coal output dimensions. Penhancuran coal ratio may be determined by the ratio between the inlet area with jaw jaw outlet. If the inlet area known jaw jaw outlet 37 920 mm<sup>2</sup> area of 3,200 mm<sup>2</sup>, then:

$$i = \frac{37.920}{3.200} = 11.85$$

#### 4. CONCLUSION

From the results obtained design specifications jaw crusher coal engine capacity of 1 ton / hour are:

Length: 1,177 m

Width: 0.65 m

Height: 0.728 m

Mobilization: The electric motor 6 hp

Work Capacity: 1000 kg / hour

The standard components used are small pulley diameters 6 in Alta, Alta large pulley diameter 16 in, the type of standard belt Mitsubishi B85, capacity electric motor 6HP, SKF Bearings Ball bearings 6208 and 6214. Automotive components are used for the jaw crusher machine is a crank shaft and the crank shaft connecting rod GAZ car. To achieve the destruction capacity of one ton per hour the speed of movement of the jaw is 16 rad / s and the amount of energy required to crush coal crushing zone area amounted to 257.6 Joules and the force needed to crush the coal in the crushing zone of 3, 85 kN. Parameters that influence the magnitude of the destruction capacity of coal is the angular velocity of the jaw crusher, crushing local volume zone and compressive strength of coal.

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