# Energy Consumption Characteristics of Disc Mill to Produce Cob Flour.pdf

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# Energy Consumption Characteristics of Disc Mill to Produce Cob Flour

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Specific fuel consumption characteristics of disc mill to produce cob flour was investigated. The disc mill was modified to serve centrifugal force effect to push out cob flour through 20-mesh, 25-mesh and 80-mesh shieve. Cob fed into disc mill with moisture content about 22% and 33%. Shieve was installed in 3 variation size of 20, 25, and 80-mesh for each run of experiments. The performance of the equipment was termed in specific fuel consumption (sfc), that is a ratio between fuel consumption needed and flour product (litre/kg). The best specific fuel consumption was at milling process with 25-mesh. The value of specific fuel consumption at the 25-mesh were 0.1 l/kg for mc 22 and 0.07 l/kg for mc 33.

**Keywords:** Cob, Disc Mill, Specific Fuel Consumption.



## 1. INTRODUCTION

Cob are waste that can be used as fiber-addition of a feed ration. The original size of cob needs to be reduced to a smaller size level to meet feed size standard. This size reduction is one of predigestion treatment of fibrous-feed that could increase digestibility.[7] The complete-feed in pellet ease to handle and feed.[6]

Currently, mill technology is based on collission principle (hammer mill) and friction principle from two corrugated-plate.[1] There are some kinds of milling machine with difference technology such as hammer mill, roller mill, and disc mill. Hammer mill is an impact type milling used to break solid materials. The material is broken smaller by hammering between hammer and wall and then force them out through perforated plate. This process lead to generate heat. The heat cause product is heated and lost its water content.[5] Generally, power needed in medium mill is one kilowatt for a kilogram product.[2] On the other hand, roller mill works by applying roller force to product to be deformed and broken into smaller size. Disc mill is a mill that use combination principle of hammer mill and roller mill to reduce product size. Energy consumption for milling process is related to product hardness and its moisture content.

Disc mill is widely commercially fabricated. To widen research domain, disc mill characteristic related to fuel consumption for a cob flour needs to be investigated.

## 2. EXPERIMENTAL DETAILS

In this study, modified disc mill type FFC-XX that consists of 2 main parts[4] namely static disc and rotating pin was proposed as shown in Figure 1. The proposed design of the disc mill was a distance between outer rotating part and shieve that was precisely set in 2 mm. The rotating part was connected to 6,5 hp engine by v-belt. The rotation of the part was measured by tachometer, while moisture content was determined by oven method. Fuel consumption was calculated from difference of initial level and end level of fuel indicator. Cob fed into disc mill with moisture content about 22% and 33%. Shieve was installed in 3 variation size of 20, 25, and 80-mesh for each run of experiments.

The experiment had 3 runs which each run execute a batch of ten kilograms cob. The batch of cob was continuously fed into hopper, flow downward by gravitation into milling chamber, broken into small size and flow out from shieve as flour. The rotation of rotating part was 3960 cycle per minute. Parameter measured for every batch were processing time and fuel consumption. The experiment data were analyzed in anlysis of variance with one factor and drawn in graphs. The analysis of variance was excecuted by using microsoft excel software. Specific fuel consumption (sfc) is a ratio between fuel consumption and flour production in litre/kg flour.

## 3. RESULTS AND DISCUSSION

Capacity and calculation of specific fuel consumption were plotted as shown in Figures 2 and 3. While the result of analysis of variance of capacity and fuel consumption were shown in

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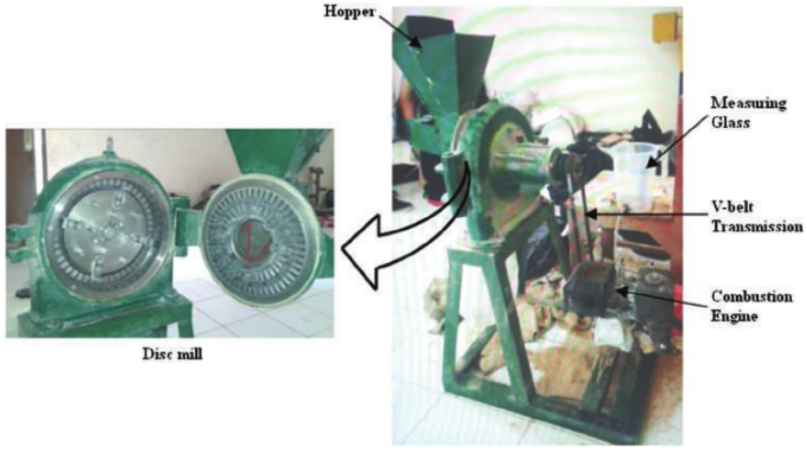


**Fig. 1.** Proposed modified disc mill used in experiment.

Figure 4. Figure 2 shows that moisture content decreased during milling process. The milling process generates heat caused by friction dan pressure force. This heat causes surface tension of water occurs and lead molecules of water penetrates in fibre, flows to surface and diffuses into atmosphere in milling chamber. This mist in milling chamber flows out through hopper and oulet nozzle among with flour. Therefore, the milling chamber could not be saturated so that could not affect to flour wet. The similar phenomena of heat generation in flour milling process is occured in hammer mill.[5] Figure 2 also shows that there is an optimum capacity at disc mill when mill was operated with shieve 25-mesh. In the optimum point, avarage capacity reaches the highest value in mc 33 and mc 22 namely 11.98 kg/hr and 10.36 kg/hr subsequently. Milling capacity of machine operating in 20-mesh was lower than those in 25-mesh. The lowest capacity was in 80-mesh.

The low capacity in 80-mesh was logic because the milling process was done repeatedly to achieve small product size. Higher amount of heat was also generated in the repeated processes so that lowering the moisture content to 4–6%. The highest capacity that reached in 25-mesh was influenced by disc and design factors that have good characteristics to mill cob either in mc-22 or mc-33. The factors need to further investigation. Figure 3 is a specific fuel consumption versus mesh. Figure 3 shows that minimum point occurs at 25-mesh. This point is an optimum point either for capacity or spesific fuel consumption.

Figures 2 and 3 shows there are difference value of capacity and spesific fuel consumption. Analysis of variance for capacity and specific fuel consumption was conducted in significant level of 95%. The analysis of variance shows that moisture content influences in capacity difference either at 20-mesh or 25-mesh. Capacities of 20-mesh at mc 22 and mc 33 were 8.44 kg/hr and

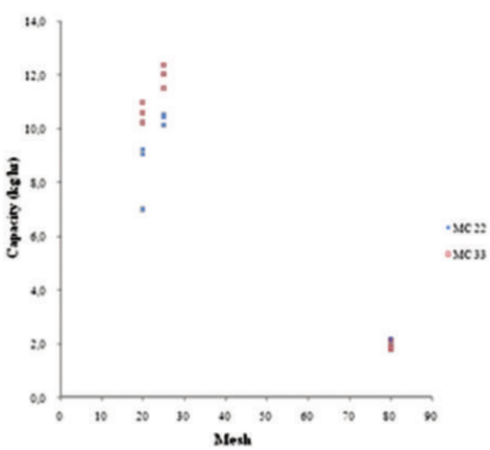


**Fig. 2.** Plotted data in capacity versus mesh.

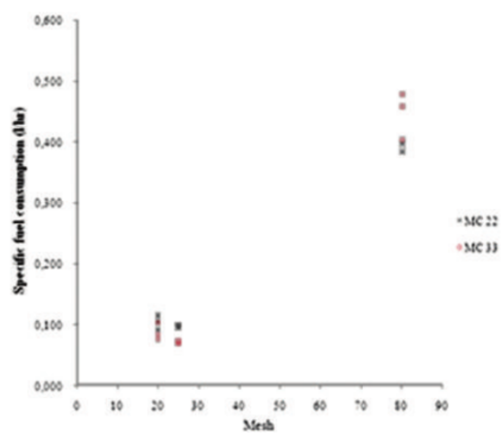


**Fig. 3.** Plotted data in specific fuel consumption versus mesh.

(a)

| | | MESH-20 | | MESH-25 | |
|---|---|---|---|---|---|
| | | MC 22 | MC 33 | MC 22 | MC 33 |
| MESH-20 | MC 22 | - | 10,61 / 8,44 | 10,36 / 8,44 | - |
| | MC 33 | 8,44 / 10,61 | - | - | 11,98 / 10,61 |
| MESH-25 | MC 22 | 8,44 / 10,36 | - | - | 11,98 / 10,36 |
| | MC 33 | - | 10,61 / 11,98 | 10,36 / 11,98 | - |

(b)

| | | MESH-20 | | MESH-25 | |
|---|---|---|---|---|---|
| | | MC 22 | MC 33 | MC 22 | MC 33 |
| MESH-20 | MC 22 | - | 0,087'- 0,104 | 0,097'- 0,104 | |
| | MC 33 | 0,087'- 0,104 | - | - | 0,070'- 0,087 |
| MESH-25 | MC 22 | 0,097'- 0,104 | - | - | 0,07 / 0,10 |
| | MC 33 | - | 0,070'- 0,087 | 0,10 / 0,07 | - |

**Fig. 4.** Matrix result of analysis of variance.

10.61 kg/hr subsequently. Capacities of 25-mesh at mc 22 and mc 33 were 10.36 kg/hr and 11.98 kg/hr subsequently. Whereas at 80-mesh, there is no effect of moisture content to capacity difference. Production capacity at 80-mesh was in the range of 1.95 kg/hr to 2.15 kg/hr.

The analysis of variance of specific fuel consumption (l/kg) shows that the best specific fuel consumption was at milling process with 25-mesh. The value of specific fuel consumption at the 25-mesh were 0.1 l/kg for mc 22 and 0.07 l/kg for mc 33.

## 4. CONCLUSION

The conclusion of the research is that the optimum condition for capacity and specific fuel consumption occurs at 25-mesh operation, with its value at mc 22 and mc 33 were 0.1 l/kg and 0.07 l/kg, subsequently.

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