Activity Based Costing Method for Analysing Asphalt Mixture Produced by Diesel and Palm Shell Fuel in Asphalt Mixing Plant

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Abstract. The purpose of this research is to calculate the price of basic production mixed asphalt with fuel shells palm oil and diesel fuel in blow dryer asphalt mixing plant. The research is quantitative descriptive that focuses on the subject of study by decomposing, analyzes, and collect data the subject of study by a process of interviews and data collection secondary to Asphalt Mixing Plant (AMP). The process of data analysis to determine prices basic production uses the activity based costing who reckoning based on activity his job. The result of this research is the price basic the production of mixed asphalt Rp 916.821,10 per 1000 kg mixed asphalt. While the difference between the price production basic mixed asphalt with fuel shell palm oil with diesel fuel is Rp 66.837,44 or the cost of goods production mixed asphalt with fuel palm shell 6,8 % for cheaper production of mixed asphalt use diesel fuel.

1. Introduction
The development of the world of infrastructure in the field of transportation, especially in terms of roads, has always been a priority for a country's development. Indonesia with thousands of islands and thousands of tribal needs of integration combined with transport. To balance the needs of road pavements, many companies are competing in terms of material effectiveness and economy, so that the goals achieved are expected to provide greater benefits through innovation and environmental friendliness.

Shell (Shells) palm-yield ber lignosefululosa materials including high carbon and has an density higher than the timber reached 1.4 g / ml so that these characteristics allow the material well as charcoal or fuel. The value of shell heat energy is also high at 20,093 kJ / kg [1]. Oil palm shell is an alternative material which is now being researched and developed to replace fuel oil whose supply is running low and prices are rising. The use of oil palm can be used in combustion in dryer Asphalt Mixing Plant. It is hoped that the selection of oil palm shells can save production costs and reduce waste from oil palm itself. Previous research on the comparison of AMP using coal fuel resulted in a more efficient cost of producing hot mix per ton 85,400 IDR or 9.75% compared to AMP using fuel oil [2]. This research explains that developments in the innovation of fuel substitute fuels in AMP dryers are continuously carried out to achieve the goal of reducing the waste that is around. Alfan has examined in his analysis determining the cost of production of hotmix asphalt using Activity Based...
Costing (ABC) which has proven to be quite effective and accurate compared to conventional methods used by companies [3]. This research was conducted to determine the cost of production using oil palm shell fuel as a substitute fuel for the AMP dryer using the Activity Based Costing (ABC) method.

The cost of products or services is the accumulation of costs charged to products or services produced by the company [4]. The cost of goods manufactured is the cost of goods purchased to be processed to completion, both before and during the current accounting period [5]. The cost of goods manufactured can also be defined in the form of production costs related to goods completed in one period. The cost of goods manufactured is divided into three main elements, namely raw material costs, direct labour costs, and factory overhead costs. The cost of production is calculated from the production costs from start to finish. To obtain the cost of goods manufactured, the method is to pay attention to goods in the initial process that are added to the production costs of that period and goods in the ending inventory of goods in process must be reduced. The Activity Based Costing (ABC) system is a method of calculating activities and assigning costs to cost objects such as products and services based on the activities needed to produce each product and service. The Activity Based Costing system can improve the cost calculation system by identifying individual activities as principal costs. These activities can take the form of events, tasks, or work units with specific goals such as product design, machine setup, machine operation and product distribution.

2. Experiments
This research is a descriptive quantitative research. The first step in this research is to collect all supporting data on the production process of asphalt using oil palm shell fuel and data on the production process of diesel fuel asphalt. Supporting data in the form of all costs of tools and materials used in the production process and all steps in the production process. The next step is to carry out an economic analysis calculating the cost of production of a mixture of asphalt with oil palm shell fuel and diesel fuel using the Activity Based Costing Method then the results of the analysis of these methods are compared with one another, namely between the cost of production of asphalt and oil palm shell fuel. diesel fuel. The conclusion of this study is expected to be used as a reference and consideration for starting asphalt production using oil palm shell fuel as a substitute for diesel fuel in dryer asphalt mixing plants in Indonesia as a solution to reduce palm oil waste and save from an economic perspective.

3. Results and Discussion
The production of a mixture of asphalt with oil palm shell fuel as a substitute for diesel fuel in dryers has been carried out at the Asphalt Mixing Plant. The process data is used to approach the production process of asphalt with oil palm shell fuel as a substitute for diesel fuel in the dryer Asphalt Mixing Plant. The duration of the total production time in one day is determined by the order placed by the customer. The production capacity of the AMP equipment is 1000 kg per batch with processing time per batch is + - 2 minutes.

3.1 The Production Process of Mixing Asphalt with Oil Palm Shell as a Substitute for Diesel Fuel in the Dryer
1. Prepare asphalt mix production equipment; AMP, aggregate carrier wheel loader, asphalt storing boiler, gasifier.
2. Feeding the palm shells to the gasifier using a wheel loader with a capacity of 1.5 m³ per load. The temperature of the oil palm shell is the temperature of the air (transfer process + - 2 minutes)
3. Loading aggregate from stock to cold bin using wheel loaders with a capacity of 1.5 m³ per load, the aggregate temperature is the air temperature. (transfer process + - 2.5 minutes).
4. Inside the cold bin is divided into four fractions;
5. Fraction I is an aggregate measuring 10 - 20 mm.
6. Fraction II is an aggregate with a size of 5 - 10 mm.
7. Fraction III is the aggregate size <5 mm.
8. Fraction IV is filler, namely cement and sand.
9. Put the aggregate from the cold bin using a conveyor into the dryer to be heated to a temperature of 160 °C (conveyor process + 2 minutes)
10. Enter the dust collector to remove dust carried from the aggregate stock to the cold bin.
11. Using the elevator, the aggregate then enters the Hot Screen for sieving, the aggregate temperature is 160 °C (elevator process + 2 minutes)
12. After sieving, the aggregate enters the Hot Bin which is also divided into four fractions, the aggregate temperature decreases to 155 °C, (process in hot bin + 2 minutes)
13. Prepare filler from a special container (silo).
14. Prepare 60/70 pen asphalt from the storing kettle which has been heated two days before the mixing process is carried out in AMP, (heated to 130°C)
15. The aggregate from the Hot Bin is weighed per fraction according to the design proportion of the AC mixture. (weighing process + 1 minute)
16. The weighed aggregate is put into a mixer, after being evenly mixed, then sprayed with liquid 60/70 pen asphalt at a temperature of 130°C, (process in the mixer +1.75 minutes)
17. Pour the asphalt mixture into the dump truck.

3.2 Estimated Cost of Production of Mixture of Asphalt with Oil Palm Shell as a Substitute for Diesel Fuel in the Dryer

A) Cost of Using Raw Materials

| No. | Raw material               | Price / 1000 kg |
|-----|----------------------------|-----------------|
| 1   | Aggregate:                |                 |
|     | BIN I                      | IDR 34,111.93   |
|     | BIN II                     | IDR 76,233.87   |
|     | BIN III                    | IDR 32,407.90   |
|     | BIN IV                     | 0               |
| 2   | Filler:                    |                 |
|     | Cement                     | IDR 20,680      |
| 3   | Bulk Asphalt 60/70         | IDR 477,400     |
| 4   | Palm shells                | IDR 33,250      |
| 5   | Solar (Genset, boiler heater, Loader) | IDR 46,200.00 |
| 6   | Total                      | IDR 720,283.70  |

B) Direct Labor Usage Costs

| No. | Direct labor costs        | Cost (Rp)   |
|-----|----------------------------|-------------|
| 1   | Basic salary              | Rp. 252.60, - |
| 2   | Medicine and Care         | Rp. 77.12   |
| 3   | Personal protective equipment | Rp. 9,58    |

C) Indirect Costs

| No. | Miscellaneous expense     | Cost (Rp)   |
|-----|----------------------------|-------------|
| 1   | AMP Usage Fee             | Rp. 138,250, - |
| 2   | Cost of Using Wheel Loaders | Rp. 10,412.50 |
| 3   | Biomass Gasifier Cost     | Rp. 4,809.95 |
4 Equipment Depreciation Cost Rp. 1996.95
5 Equipment Maintenance Costs Rp. 1996.95
6 Transportation costs Rp. 36,458.33

B) First Stage Calculation Procedure
1) Identifying and classifying activities

Table 4. Activity Classification Details

| Activity Level | Overhead Cost Components | Amount (Rp) |
|----------------|--------------------------|-------------|
| Unit Level Activity | Direct labor costs | 2,612.72 |
| | Machine and Equipment Costs | 153,472.45 |
| | Depreciation Cost of Equipment and Machines | 1996.95 |
| Batch Level Activity | Equipment and Machinery Maintenance Costs | 1996.95 |
| Product Level Activity | Transportation costs | 36,548.33 |

2) Associating various costs with various activities
3) Determine the appropriate Cost Driver for each activity

Table 5. List of Cost Drivers in AC-WC Production Process with Oil Palm Shell Fuel.

| No. | Cost Driver | total |
|-----|-------------|-------|
| 1   | Number of units | 1 unit |
| 2   | Total AMP Capacity | 1000 Kg |
| 3   | Total Biomass Gasifier Capacity | 100 kg |
| 4   | Total Wheel Loader Capacity | 0.875 m³ |
| 5   | Inspection Hours | 1.75 Minutes |

4) Determination of homogeneous cost groups.

Table 6. Homogeneous Cost Groups for AC-WC Production Using Oil Palm Shell Fuel.

| Homogeneous Cost Group | BOP activity | Cost Driver | Activity Level |
|------------------------|--------------|-------------|----------------|
| Pool 1                 | Machine and Tool Activity | Number of units | Unit Level |
|                        | Machine and Equipment Depreciation Activities | Number of units | Unit Level |
| Pool 2                 | Direct Labor Activities | Inspection Hours | Unit Level |
| Pool 3                 | Maintenance Activities | Inspection Hours | Batch Level |
| Pool 3                 | Transportation Activities | Product Unit | Product Level |

Determination of the group rate (Pool Rate)

Table 7. Pool Rate of Activity Level of AC-WC Production Unit Using Oil Palm Shell Fuel

| Cast Pool | BOP elements | Amount (Rp) |
|-----------|--------------|-------------|
| Cast Pool 1 | Machine and Equipment Costs | 153,472.45 |
|           | Depreciation Cost of Machinery and Equipment | 1996.95 |
|           | The amount of costs | 155,469.40 |
|           | Number of Production Units | 1000 Kg |
|           | Pool Rate 1 | Rp. 155.47 |

Source: Primary data that has been processed
The amount of costs 2,612.72
Number of Inspection Hours 0.029 Hours
Pool Rate 2 Rp. 90,093.79

Source: Source: Primary data that has been processed

| Cast Pool 3 | BOP elements          | Amount (Rp) |
|-------------|-----------------------|-------------|
| Cast Pool   | Maintenance cost      | 1996.95     |

The amount of costs 1996.95
Number of Inspection Hours 0.029 Hours
Pool Rate 3 Rp. 68,860.38

y data that has been processed.

| Cast Pool 4 | BOP elements          | Amount (Rp) |
|-------------|-----------------------|-------------|
| Cast Pool   | Transportation costs  | 36,458.33   |

The amount of costs 36,458.33
Number of Production Units 1000 Kg
Pool Rate 4 Rp. 36.46

B) Second Stage Calculation Procedure

**Table 8.** The imposition of BOP with an *Activity Based Costing System* in the AC-WC Production process using Oil Palm Shell Fuel

| Activity Level | Cost Driver | Loading Process | Amount (Rp) |
|----------------|-------------|-----------------|-------------|
| Unit           | Product Units 155.47 x 1000 | 155,469.40 |
| Inspection Hours 90.093.7931 x 0.029 | 2,612.72 |
| Total Unit Level Activity | | 158,082.12 |
| Batch          | Inspection Hours 68,860.38 x 0.029 | 1996.95 |
| Total Batch Level Activity | | 1,995.95 |
| Product        | Product Units 36.46 x 1000 | 36,458.33 |
| Total Product Level Activity | | 36,458.33 |
| Total BOP      | | 196,537.40 |

Based on the imposition of *Overhead Costs* that have been carried out, the calculation of the Cost of Production per unit using the *Activity-Based Costing System* for AC-WC production using oil palm shell fuel can be presented in **Table 9.**

**Table 9.** Cost of Production per unit of production of AC-WC using Oil Palm Shell Fuel (1000 Kg)

| No. | Information              | Amount (Rp) | Percentage of Cost |
|-----|--------------------------|-------------|--------------------|
| 1   | Raw Material Costs       | 720,283.70  | 78.56%             |
| 2   | Production Overhead Costs| 196,537.40  | 21.44%             |
|     | **Cost of goods sold**   | 916,821.10  | 100%               |
3.3 Comparison of the Estimated Cost of Production of AC-WC Using Oil Palm Shell Fuel with Solar Fuel

Based on the calculation of the estimated cost of production of AC-WC using oil palm shell fuel, the comparison of the estimated cost of production of each asphalt product as of July 2019 is shown in Table 10.

Table 10. Comparison of production cost per unit of production AC-WC Shells Using Palm Oil Fuel with Fuel Solar on Dryer Asphalt Mixing Plant (1000 Kg)

| No. | Type of Fuel  | Cost of goods sold |
|-----|--------------|--------------------|
| 1   | Oil Palm Shell | Rp. 916,821.10     |
| 2   | Solar         | Rp. 983,658.54     |
|     | Difference    | Rp. 66,837.44      |

The explanation of Table 10 above is that the replacement of oil palm shell fuel from diesel fuel in the dryer asphalt mixing plant can affect the amount of production cost of Rp. 66,837.44 is cheaper than the cost of producing diesel fuel in general. It can be concluded that the use of oil palm shell fuel as a substitute for diesel fuel in AMP dryers can save 6.795% of the production price of asphalt fuel asphalt mixture.

4. Conclusion

The conclusion of this research is that to produce asphalt mixture weighing 130,640 tons requires diesel fuel of 1477.25 liters which is equivalent to the fuel consumption of oil palm shell waste of 6.009,44 kg and also which is equivalent to energy consumption of 52,974.2 MJ. Where to produce 1 ton of asphalt mixture requires diesel fuel of 11.31 liters and to increase 1°C requires energy of 290.16 MJ or equivalent to the use of diesel fuel of 8.09 liters.

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