International Journal of Energy Engineering 2020, 10(3): 90-94
DOI: 10.5923/j.ijee.20201003.03

Comparative Study of Coal Mixing Using *Chevron Stockpile* and *Windrow Stockpile Methods* in PT. Anugerah Bara Kaltim Kecamatan Loa Janan District Kutai Kartanegara Provinsi Kalimantan Timur, Indonesien

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Abstract Coal is still used in various industries with certain specifications, such as caloric value, ash content, sulfur content (Total Sulfur), flying substances (Volatile Matter) and water content (Total Moisture). Because the availability of coal with a variety of qualities is certainly not possible to meet the specification criteria that can be used by industry. Therefore we need a coal mixing system that can provide the quality desired by the industry or Market. In mixing coal there are several methods which are carried out and have different homogeneity. Coal blending using the chevron stockpile method and the windrow stockpile method were tested 5 times. Then the preparation of process was carried out using method of proximate analysis was carried out on the coal. The analysis results were then processed using the exel application. In the chevron stockpile method, the fluctuation value of coal quality analysis was as follows: total moisture had a range of 10.90, inherent moisture had a range of 14.58, ash content had a range of 39.76, votalite matter had a range of 4.71, fixed carbon had a range of 10.14, total sulfur had a range of 72.72 and calorie value had a range of 5.15. In the windrow stockpile method, coal quality fluctuation values were as follows: total moisture had a range of 6.84, inherent moisture had a range of 8.6, ash content had a range of 22.28, votalite matter had a range of 4.24, fixed carbon had a range of 8.18, total sulfur had a range of 31.82 and calorie value had a range of 1.61.

Keywords Coal mixing, Chevron stockpile method, Windrow stockpile method, Coal preparation, Coal analysis, Coal quality

1. Background

Coal is a very complex mixture of organic chemicals that contain carbon, oxygen and hydrogen in a carbon chain. Coal comes from plants that have died and are buried in a basin filled with water for a very long time, around millions of years to thousands of years. Coal is also one of the types and fuels for energy generation and is one alternative energy source that is currently increasing rapidly in the world market as an abundant and economical source of energy.

The increasing demand for coal in the world, makes Indonesia exploit this fuel on a large scale. Its greater availability and lower price compared to petroleum makes coal more economical when used in industry.

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Published online at http://journal.sapub.org/ijee

In its development, coal has now become one of the largest regional revenue contributors for the East Kalimantan region, one of which is a company that has contributed to the revenue, namely PT. Anugerah Bara Kaltim. Coal is still used in various industries with certain specifications, such as caloric value, ash content, sulfur content (Total Sulfur), flying substances (Volatile Matter) and water content (Total Moisture).

Because the availability of coal with a variety of qualities is certainly not possible to meet the specification criteria that can be used by industry. Therefore we need a coal mixing system that can provide the quality desired by the industry.

In mixing coal there are several methods of accumulation which are carried out and have different homogeneity. Therefore this research was conducted in order to find out the comparison of the level of homogeneity between methods.

2. Research Methodology

Data Collection Techniques.

This research was conducted in the area of the Coal Handling Facility (CHF) at PT. Anugerah Bara Kaltim. Some things that become a reference in taking data in this thesis include:

1. Taking Coal for Mixing Coal

Sampling is taking a small portion of material from a large pile of material to represent the overall quality of the large material. Sampling is done in ROM Stockpile.

2. Coal Blending

The method for mixing various kinds of coal and the mixing method used in this study were the chevron stockpile method and the windrow stockpile method.

3. Sampling for Analysis

This sample is taken after mixing the mixed coal and this sampling is done randomly.

4. Coal Sample Preparation

Preparation is a process of working the sample before it is analyzed by making the size and condition of the sample ready for analysis, the stages of which include drying if the coal is wet, reducing the size of the sample, mixing and reducing the weight of the sample by dividing it into two parts.

Table 1. Analysis Results

NO	Variaty	Sample Code	TM % (ar)	IM % (adb)	Ash % (adb)	VM % (adb)	FC % (adb)	TS % (adb)	Gross Calorific Value (cal/gr)
EXPERIMENT 1									
1	*Raw Coal*	LJB	24.46	20.69	2.65	37.89	38.77	0.28	5,327
		LJD	33.42	26.85	5.98	34.73	32.44	0.16	4,499
	Plan	Blend Plan	28.94	23.77	4.32	36.31	35.61	0.22	4,913
	Analisis	Chevron	29.56	21.46	5.72	38.10	34.72	0.41	4,922
		Windrow	29.62	24.78	4.95	36.64	33.63	0.26	4,938
EXPERIMENT 2									
2	*Raw Coal*	LJB	25.22	20.37	3.49	37.80	38.34	0.28	5,253
		LJD	29.76	26.05	5.08	35.78	33.09	0.14	4,663
	Plan	Blend Plan	27.49	23.21	4.29	36.79	35.72	0.21	4,958
	Analisis	Chevron	28.83	21.52	5.37	38.24	34.87	0.32	4,856
		Windrow	28.36	24.35	4.29	37.10	34.26	0.20	4,973
EXPERIMENT 3									
3	*Raw Coal*	LJB	24.13	21.19	3.02	37.15	38.64	0.30	5,283
		LJD	33.87	29.74	4.70	37.05	28.51	0.16	4,393
	Plan	Blend Plan	29.00	25.47	3.86	37.10	33.58	0.23	4,838
	Analisis	Chevron	29.48	22.90	5.82	37.18	34.10	0.36	4,952
		Windrow	28.92	24.53	4.72	36.29	34.46	0.24	4,816
EXPERIMENT4									
4	*Raw Coal*	LJB	24.57	20.58	2.89	37.55	38.98	0.29	5,343
		LJD	32.72	26.51	4.80	35.42	33.27	0.14	4,611
	Plan	Blend Plan	28.65	23.55	3.85	36.49	36.13	0.22	4,977
	Analisis	Chevron	29.04	24.42	4.95	37.50	33.13	0.25	4,838
		Windrow	28.79	23.79	4.38	37.24	34.59	0.19	4,932
EXPERIMENT 5									
5	*Raw Coal*	LJB	25.46	21.37	4.75	37.42	36.46	0.31	5,116
		LJD	33.27	28.47	5.22	39.69	26.62	0.14	4,414
	Plan	Blend Plan	29.37	24.92	4.99	38.56	31.54	0.23	4,765
	Analisis	Chevron	27.60	26.04	5.54	39.59	28.83	0.32	4,662
		Windrow	28.29	25.76	4.99	39.34	29.91	0.24	4,799
Average									
6	*Plan*	Blend Plan	28.69	24.18	4.26	37.05	34.51	0.22	4890
	Analisis	Chevron	28.90	23.27	5.48	38.12	33.13	0.33	4846
		Windrow	28.80	24.64	4.67	37.32	33.37	0.23	4892

5. Analysis of Coal Quality

Analyzing the quality of mixing coal from samples that have been mixed with the chevron stockpile and windrow stockpile methods by conducting laboratory tests consisting of inherent moisture, total moisture, ash content, total sulfur, volatile matter, and caloric value (adb).

This research was conducted to determine differences in the accuracy of coal mixing using the chevron stockpile method and the windrow stockpile method. The data that has been obtained will then be processed and discussed to determine the differences in the quality parameters of the results of mixing coal and the processed data is presented using Microsoft Excel software.

In the above table, the analysis results were obtained to determine the comparison of the homogeneity of the chevron stockpile method with the windrow stockpile.

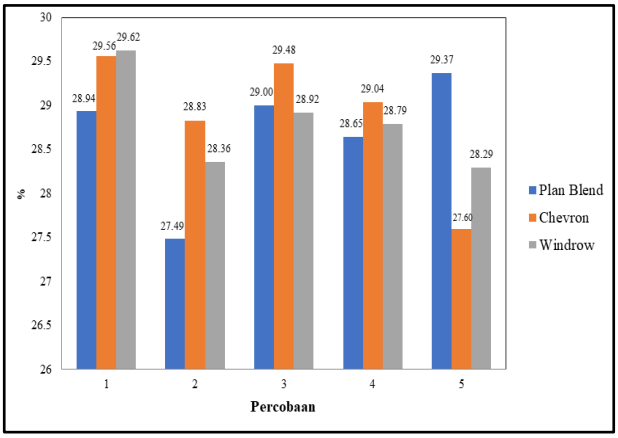

Figure 1. Total Moisture

In the table above, it was found that the total moisture value with a higher homogeneity level was found in the windrow stockpile method, which clearly shows that the value is very close to the desired target.

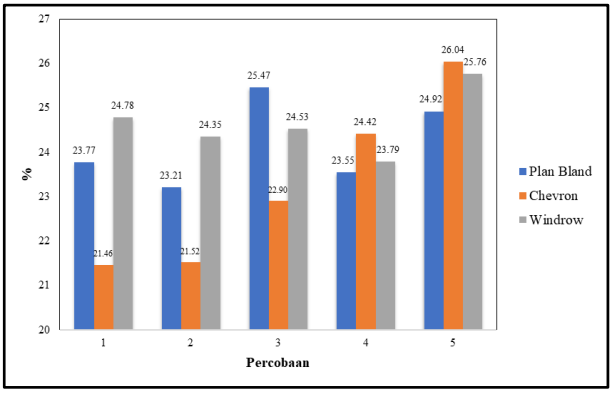

Figure 2. Ash Content Graph

In the ash content value, the homogeneous level was higher in the windrow stockpile method which has a value closer to the target.

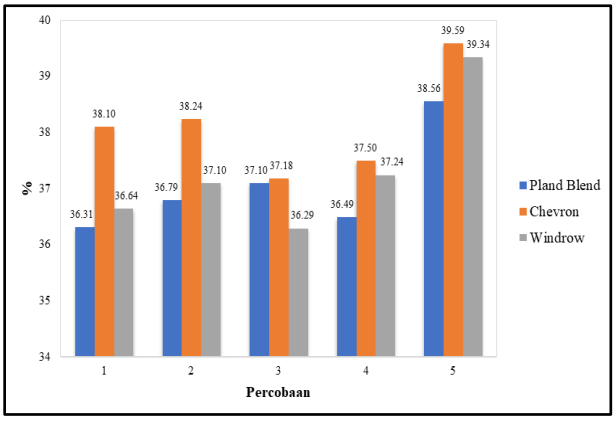

Figure 3. Volatile Matter Graph

For the value of volatile metter the level of homogeneity was higher in the windrow stockpile method with a value approaching the target in all experiments.

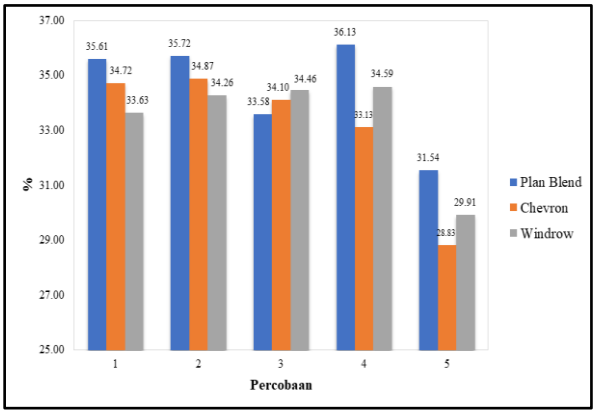

Figure 4. Fixed Carbon Graph

The highest homogeneous level of fixed carbon value in the chevron stockpile method with a ratio of 3: 2 with the windrow stockpile method.

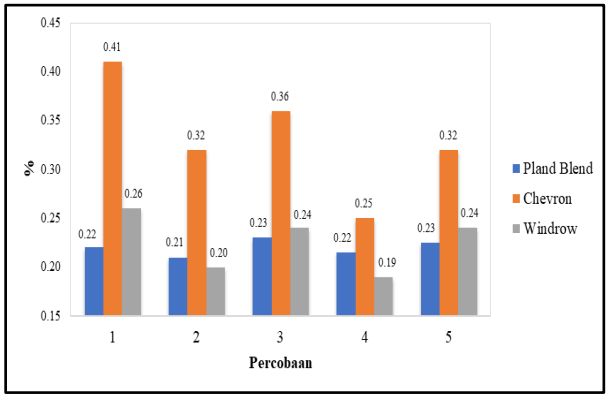

Figure 5. Total Sulfur Graph

In the total value of sulfur the level of homogeneity was found in the windrow stockpile method with a value that approaches the target.

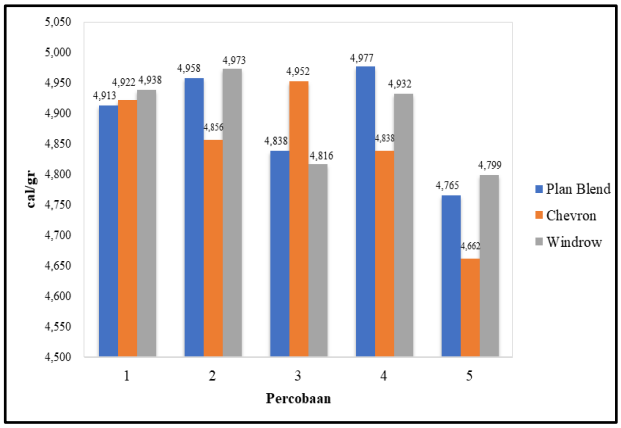

Figure 6. Calorific Value Graph

The highest level of calorific value of homogeneity was found in the windrow stockpile method with the value approaching the target more than the chevron stockpile method.

With this it can be proven that the windrow stockpile method had a higher homogeneity compared to the chevron stockpile method, although the fixed carbon value was closer to the chevron stockpile method. This happens because in the first experiment, the second experiment and the third experiment the chevron stockpile method had inherent moisture, ash content and votalite matter values higher or lower than the value of the windrow stockpile method.

3. Error Factors in Research

Based on my research, there were factors that cause imperfections in this research, namely the treatment of sampling that will be used in analyzing my research. In this study I conducted vertical sampling using a shovel and should had taken horizontal sampling using a pipe to match the rules of taking at the stockpile using a drill tool. Due to the limited use of sampling tools in the company, this study uses a shovel tool that did not use pipes and horizontal sampling was more difficult to use a shovel than a pipe.

4. Conclusions

1. The process of coal mixing is done by 2 methods, namely the chevron stockpile method and the windrow stockpile method.

a. In the chevron stockpile method the coal piling process is in the first stage with LJB quality with a weight of ± 30 kg, then in the second stage LJD quality coal weighing ± 30 kg is stacked on top of the first pile, after that it is piled back with LJB quality with a weight of ± 30 kg kg for the third and fourth stages are stacked on top of the third stack with LJD quality with a weight of ± 30 kg to form a pyramid.

b. In the windrow stockpile method, the process of coal stacking in the first stage is by stacking 3 adjacent piles of coal with a quality of LJB weighing ± 10 kg, then the second stage between the LJB stacks is stacked with coal quality LJD weighing ± 20 kg, after that the third stage is stacked back at on the LJD pile, LJB quality coal weighing ± 10 kg, and in the fourth stage there is a stacking of LJB piles with LJD quality coal pile of ± 20 kg, and the last stage is the LJB quality coal stacking ± 10 kg as much as above the LJD pile thus forming a pyramid.

2. Differences in the quality of mixing coal with the chevron stockpile method and the windrow stockpile method in 5 trials include:

a. Chevron Stockpile Method

i. Total moisture has a range of 10.90
ii. Inherent moisture has a range of 14.58
iii. Ash content has a range of 39.76
iv. Votalite matter has a range of 4.71
v. Fixed carbon has a range of 10.14
vi. Total sulfur has a range of 72.72
vii. Calorie value has a range of 5.15

b. Windrow stockpile method

i. Total moisture has a range of 6.84
ii. Inherent moisture has a range of 8.6
iii. Ash content has a range of 22.28
iv. Votalite matter has a range of 4.24
v. Fixed carbon has a range of 8.18
vi. Total sulfur has a range of 31.82
vii. Calorie value has a range of 1.61

3. Based on my research, there are factors that cause imperfections in this research, namely in the treatment of sampling that will be used in analyzing my research. In this study I conducted vertical sampling using a shovel and should have taken horizontal sampling using a pipe to match the rules of taking at the stockpile using a drill tool. Due to the limited use of sampling tools in the company, this study uses a shovel tool that does not use pipes and horizontal sampling is more difficult to use a shovel than a pipe.

5. Suggestion

It is better to do the combustion wire installation more carefully to avoid *miss fire* and the installation of *a bomb calorimeter* must be tight and be careful because there can be an explosion when the analysis process is going on.

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