RICE HUSK AS AN ALTERNATIVE ENERGY FOR CEMENT PRODUCTION AND ITS EFFECT ON THE CHEMICAL PROPERTIES OF CEMENT

Agus Maryoto (√)
Gathot Heri Sudibyo

Universitas Jenderal Soedirman
Jl Mayjen Sungkono KM. 5, Purbalingga, Jawa Tengah, Indonesia

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OVERVIEW

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3. SPECIMENS
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   - Cement
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1. BACKGROUND

Rice Field

Indonesia, Rice production 75.397. 841 tonnes annually (BPS, 2016); Central Java : 11.301.422 tonnes

Rice Husk

Central Java = 2,825 Million tonnes per year

Alternative Fuel : Brick, roof tile and cement production

How the effect of rice husk ash in the chemical properties of cement

2. OBJECTIVES

This study aims to determine the effect of the rice husk usage in the cement industry on the chemical properties of cement.

3. SPECIMEN

Testing of rice husk

No	Type of Tests	Number of Sample
1	Percentage of rice husk	12
2	Calorific content	12
3	Density	12
4	Water content	12
5	Chemical content of rice husk ash	1
6	Chemical content of cement	12

4. Experimental Procedures

Testing of Rice Husk

Caloric Value

$$Hc = \frac{W.T - e_1 - e_2 - e_3}{m}$$

H_c is the gross heat of combustion, T is the temperature rise, W is the energy equivalent used, e_1 is the correction of HNO_3, e_2 is the heat correction of H_2SO_4, e_3 is the heat correction of the wire, and m is the weight of the sample.

$$\text{Density}\ (\text{kg}/m^3) = \frac{B - A}{V}$$

Containers with rice husk are weighed (B). The net weight of rice husk is obtained by subtracting the weight of the container (A) from the weight of B.

$$\text{Water content}\ (\%) = \frac{W_1 - W_2}{W_1} \times 100\%$$

The water content of rice husk can be analysed by weighing the rice husk (W_1). The rice husk is then dried in the oven until its moisture content is completely lost. The rice husk is weighed in dry conditions (W_2).

Chemical Content

X-Ray Diffraction

Testing for Cement

MgO Content

$$MgO\ (\%) = W \times 72.4$$

W is the weight of magnesium pyrophosphate (gram) and 72.4 is the 2 molecular of MgO to magnesium pyrophosphate ratio divided by the sample weight used (0.5 g) multiplied by 100.

$$\text{Loss on ignition / LoI (\%)} = \frac{Initial\ weight - Final\ weight\ after\ burning}{Initial\ weight} \times 100\%$$

$$\text{Insoluble Residue} = \frac{Precipitated\ product}{Weight\ of\ sample} \times 100\%$$

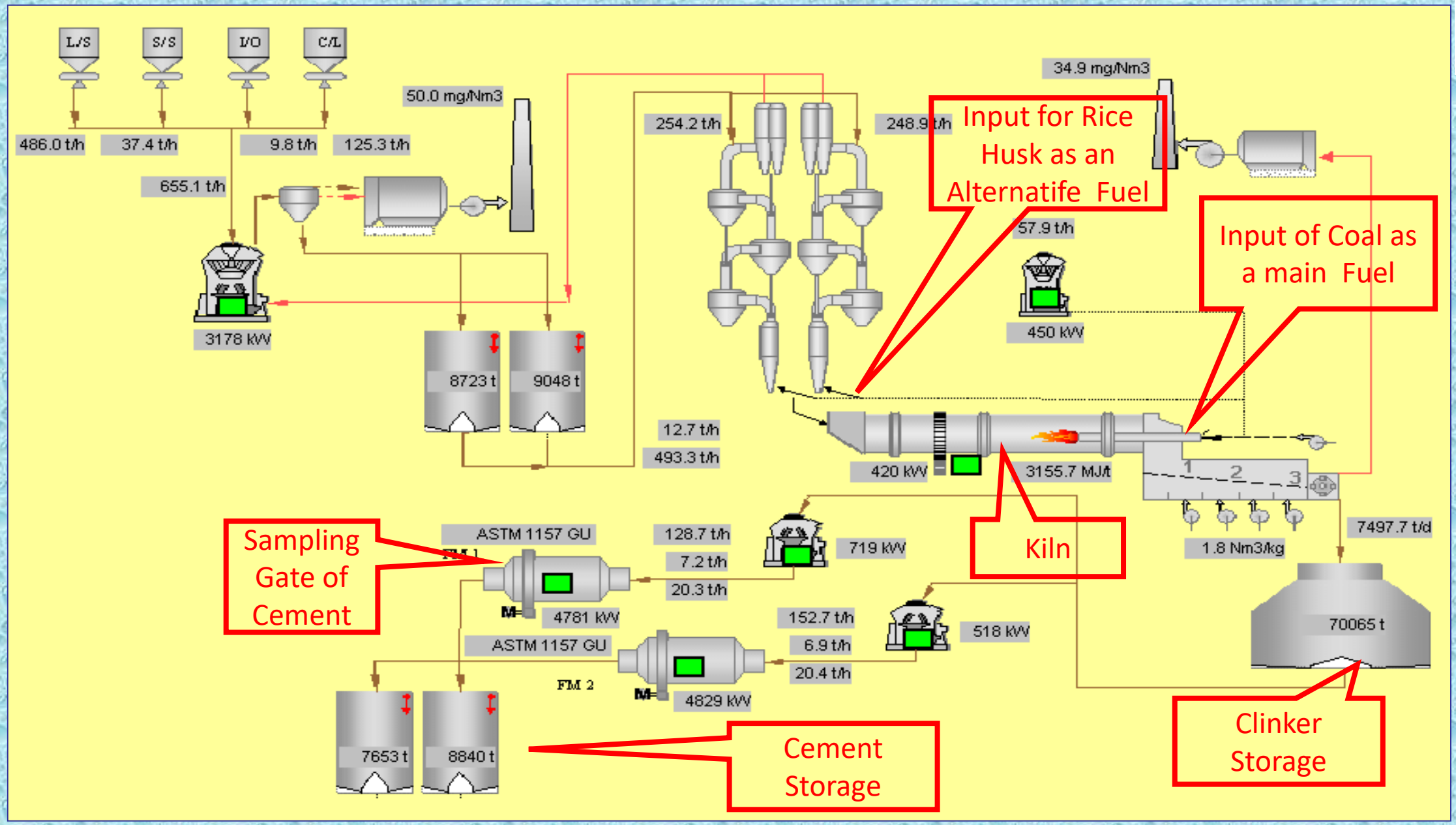
$$SO_3\ (\%) = W \times 34.3$$

w is the weight of $BaSO_4$ (g) and 34.3 is the ratio of SO_3 molecules to $BaSO_4$ (0.343) multiplied by 100

Chemical Content

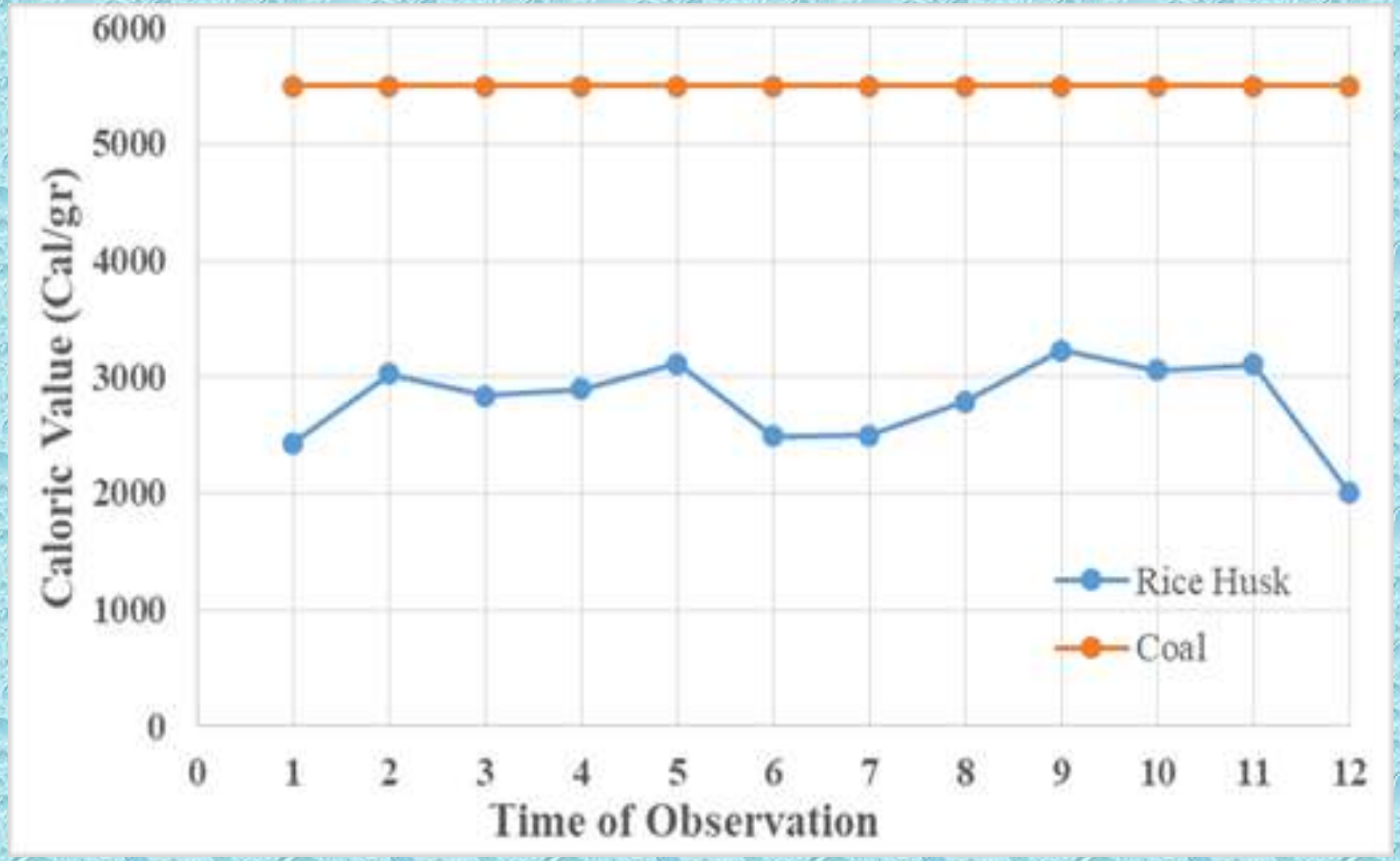
X-Ray Diffraction

Processes of Cement Production



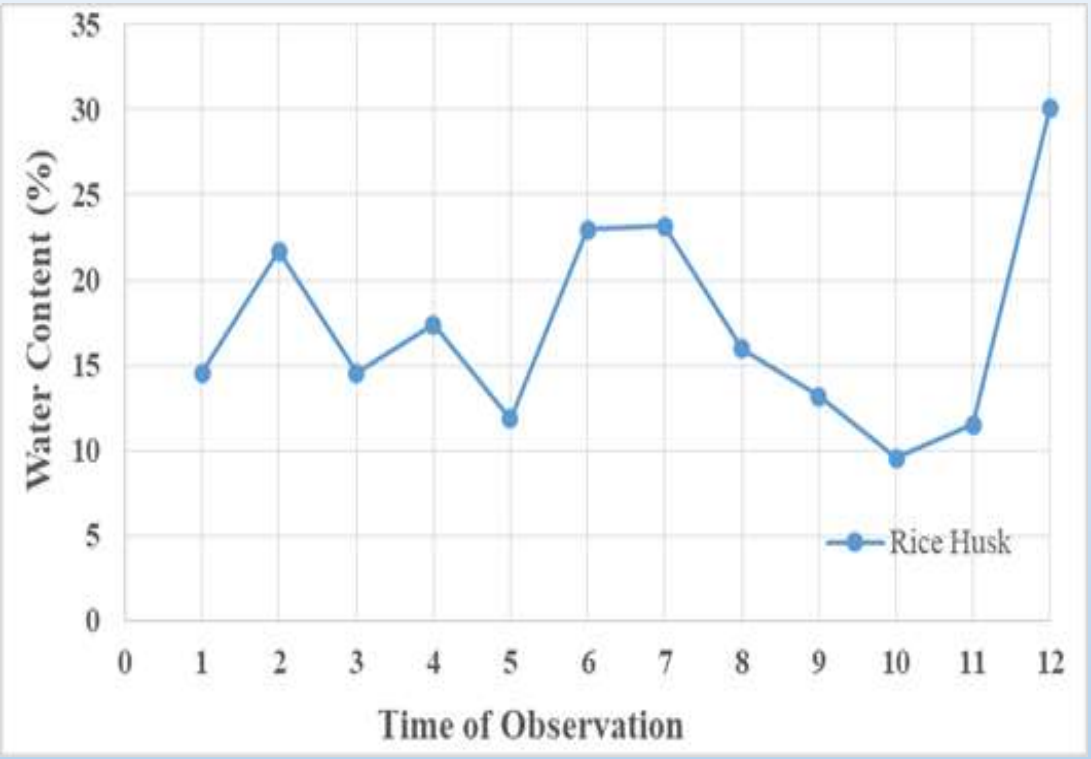
5. RESULT AND DISCUSSIONS
Rice Husk

Caloric Value



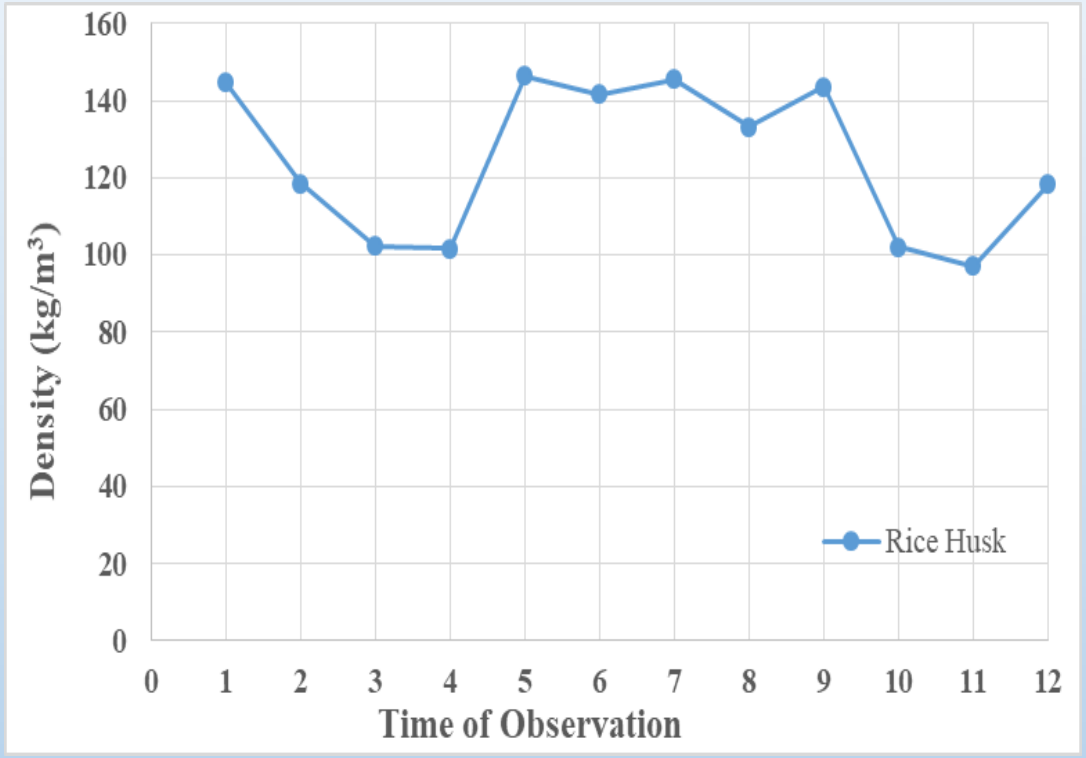
The figure describes the sampling time and the calorific value of rice husk. The average calorific value of rice husk is 2790 calories per gram. When compared to the calorific value of coal, the calorific value of rice husk is half that of coal. The low calorific value of rice husk is affected by the high water content

Water Content of rice husk



The water content of rice husk is very large. The maximum value of water content reaches 30%. This will decrease the calorific value generated by burning rice husk. The average water content of rice husk is 17.20%.

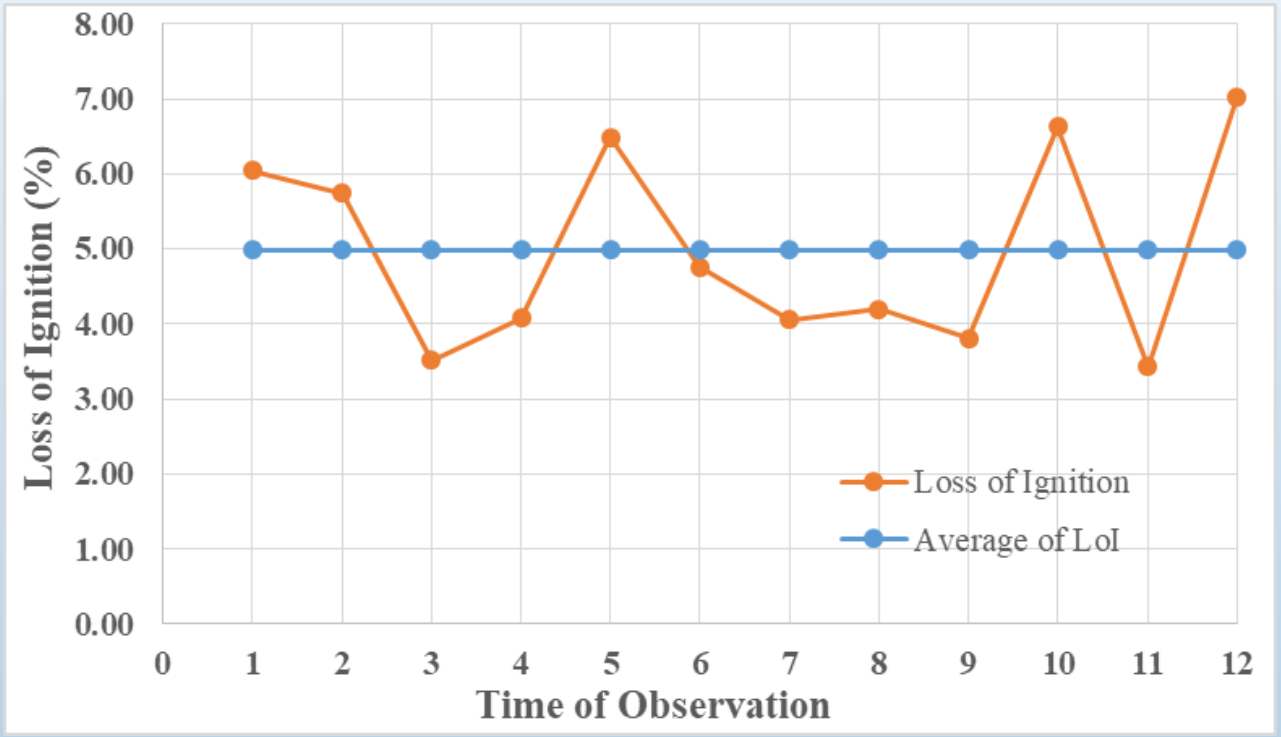
Density of rice husk



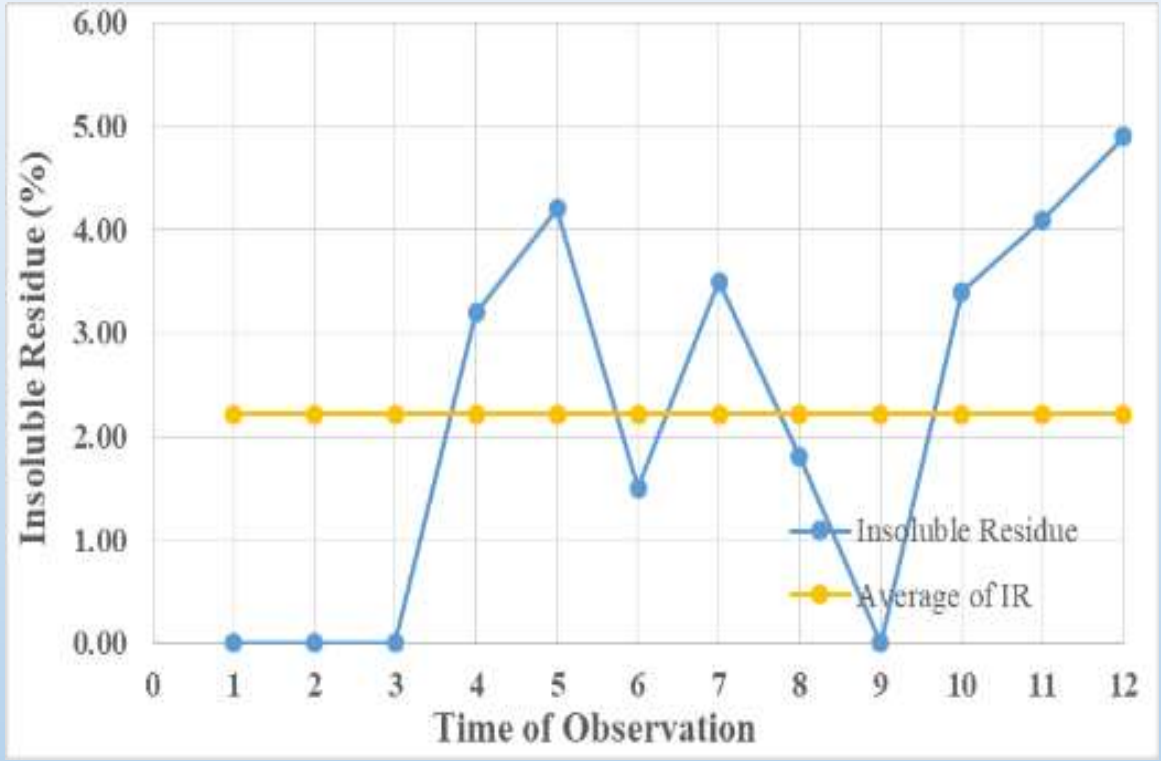
The average density of rice husk is 124 kg/m^3. The low density, in addition to its physical nature consisting of small grains, makes it easy to pump rice husk into the inlet burner of a rotary kiln.

CEMENT

Loss of Ignition



Insoluble Residue



The average test result for loss on ignition of cement after the use of rice husk as substitute fuel is 4.98%. This result is slightly lower than that given by the SNI 12049-2015 standard, which is 5%. Meanwhile, the result of the insoluble residue test shows an average value of 2.40%. This value of insoluble residue is better than the minimum required by the SNI, which is 3%.

Chemical Content

No	Compound	SNI	Time of Observation											
			1	2	3	4	5	6	7	8	9	10	11	12
1	SiO_2, min.	–	18	18	18	18	19	20	18	18	19	18	18	17
2	Al_2O_3, max.	–	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0
3	Fe_2O_3, max.	–	3.0	2.9	2.9	3.0	3.0	2.9	2.9	3.0	3.3	2.9	3.0	3.3
4	MgO, max.	6	1.5	1.4	1.4	1.6	1.4	1.4	1.5	1.6	1.6	1.6	1.5	1.5
5	SO_3, max. If $C_3A \leq 8$ If $C_3A > 8$	 3.0 3.5	2.2	2.1	2.1	2.1	2.2	2.3	2.2	1.6	1.8	2.3	2.0	2.1
6	Alkali eq.	0.6	0.3	0.3	0.3	0.4	0.4	0.5	0.3	0.3	0.3	0.5	0.4	0.5
7	IR, max.	3.0	0.0	0.0	0	3.2	4.2	1.5	3.5	1.8	0.0	3.4	4.1	4.9
8	C_3S, max.	–	58	68	70	58	46	43	67	66	60	59	57	58
9	C_2S, min.	–	9.0	8.0	0.9	8.6	21	24	0.8	2.0	8.9	6.5	8.2	5.9
10	C_3A, min.	–	8.0	8.5	8.1	8.9	8.5	9.0	8.0	8.1	7.8	8.5	8.5	8.7
11	$C_4AF + 2C_3A$, max.	–	9.7	8.7	8.7	9.1	9.1	8.7	9	9.2	10	8.8	9.3	10.2

The MgO content of cement based on SNI-2049-2015 is 6%, while the MgO content of the cement sample is 1.5% according to the test result. This means that the MgO content of the cement meets the requirements of SNI.

SNI-2049-2015 requires an SO_3 content of 3% if $C_3A \leq 8\%$ and 3.5% if $C_3A > 8\%$. The SO_3 content of the cement is 2.08% according to the test result. This means that the content of SO_3 in the cement meets the requirements of SNI-2049-2015.

Also, Average of alkali equivalen and insoluble Residue meet to SNI-2049-2015.

6. Conclusions

According to the above discussions, the following conclusions are summarized.

1. Rice husk can replace coal used in the cement industry as the ratio of the calorific value of rice husk to the calorific value of coal is 1 to 2.
2. The use of rice husk as a fuel in the cement-making process has a good effect on the chemical content of cement produced in the cement industry.

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THANK YOU