The prototype of characterization silica nano particle of rice husk using KOH based on artificial intelligence

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Abstract. One of the abundant sources of biomass is rice husk. Based on data from the Ministry of Agriculture of the Republic of Indonesia, dry grain production in Indonesia reached 83.037150 tons. About 20% of the dry grain is husk. As a result, 16.6 million tons of rice husks were produced in 2018 and their utilization has not been carried out optimally. This research will characterize rice husk silica particles using potassium hydroxide (KOH). The procedure of this research is pyrolysis with a high temperature of 800\textdegree C with a burning time of 4 hours and 6 hours. The next process is refining rice husk charcoal using High Energy Milling (HEM). The SEM and EDX test results show that the pyrolysis 800\textdegree C, 4 hours results in a higher% silica, namely 18.64% with 40.52% carbon. While the results of 800\textdegree C, 6 hours pyrolysis produced 35% silica with 28.04% carbon. The data obtained from this study became data in Artificial Intelligence (AI) software to determine the higher silica content of rice husks from several variations of pyrolysis. The results of this measurement, it becomes data for AI software to determine the higher % silica. From the experimental results of the two variations, 800\textdegree 6 hours pyrolysis resulted in higher silica.

Keyword: Silica, Silica extraction, Rice Husk, Artificial Intelligence

1. Introduction
One of the abundant sources of biomass is rice husk. Based on data from the Ministry of Agriculture of the Republic of Indonesia, dry grain production in Indonesia reached 83.037150 tons. About 20% of the dry grain is husk of 16.6 million tons of rice husks were produced in 2018 and their utilization has not been carried out optimally, even though the biomass contains organic materials and nutrients that are essential for plants. Management and utilization of agricultural biomass waste needs to be directed to be more integrated, which is expected to contribute to efforts to recycle organic matter in biomass for alternative energy generation (bioenergy) and efforts to recover nutrients to be returned to the land [1]. Figure 1 shows a recycling model for organic matter and nutrients from agricultural waste Utilization of rice husks to be converted into materials that have high added value is actually reflected in its composition consist of 38% cellulose, 22% lignin, 20% ash, 18% pentosane, and about 2% other organic compounds [2]. Rice husk ash has a high silica composition [3]. Silica can be simply extracted from rice husk in by a burning method. The controlled combustion process at high temperatures (500-600\textdegree C) will produce rice husk ash which is rich in silica content which can be used for various chemical processes. Research that has been done to produce rice husk nanoparticles with simple technology that relies on the role of residual stress and sodium hydroxide action on nano cracks. The material preparation procedure and XRD test results are as shown in Figure 2.
Research that has been done explains how to extract silica from rice husks with acids and bases, hydrochloric acid and sodium hydroxide to produce coagulation of silica. Since rice husks contain more than 80-90% silica when converted to ash, it is important to extract it. A simple non-conventional method for extracting silica in the amorphous using alkaline and acid solution [4].

Another study [4] extracted silica from rice husk to make charcoal by heating it under low oxygen conditions (pyrolysis), Charcoal is reduced in size by a steel ball collision process in 2 million cycles. Small carbon particles are separated by washing water. The mixture of water and charcoal is stirred until blended and let stand for 8 hours. The precipitated carbon particles are taken away and then removed and the rest contained in the water is dried. To obtain carbon nanoparticles, 1 gram of carbon particles is added 3 moles of sodium hydroxide in aqueous media. Then dried. SEM, TEM, and FTR test results show that the resulting nanoparticles are 25-50 nm [5].

Rice husks carbon are washed with distilled water and ring. They are dried in an oven for 24 hours. Next, the dry samples were crushed up to a mesh size 300μm. So we get is just rice husk ash. Really ashes now. The images of rice husk and rice husk ash are shown in Figures 3 (a) and (b) [6].

Galang conducted a study aimed to determine the effect of alkaline solution concentration and operation time on the yield of silica. The results showed that the largest silica yield was 50.49%, occurred at 10% KOH and the extraction time was 90 minutes [7]. Other studies have succeeded in extracting silica from rice husks by reflux method using alkaline NaOH and a variety of strong acids (HCl) and CH₃COOH. The rice husk ash used was the result of burning rice husk at a temperature of 700°C. The results showed that the largest percentage by weight of silica (SiO₂) was in the behavior of 5% NaOH and using 1 M strong acid HCl with a size of 84 wt.%. This research is useful in increasing the effectiveness of the silica extraction process from rice husks [8]. Over the past decade, ES expert systems have become a major practical application of AI research. Today there are many systems that
are useful in almost every discipline operating around the world. In this research, AI will be used to determine the highest silica content from several variations of pyrolysis [9].

![Figure 3. Images of rice husk and rice husk ash](image)

**Figure 3.** Images of rice husk and rice husk ash [6]

![Figure 4. Alkaline solution: RHA + NaOH after heating (a) sodium silicate solution after filtration (b)](image)

**Figure 4.** Alkaline solution: RHA + NaOH after heating (a) sodium silicate solution after filtration (b) [6]

In this research, AI will be used to determine the highest silica content from several variations of pyrolysis.

2. **Method and Materials**
The material preparation procedure as shown in Figure 6. First process is pyrolysis of rice husks using a temperature above 800°C. Time variation of 4 hours and 6 hours. Pyrolysis to produce C-RHs rice...
husk charcoal. The next process is refining rice husk charcoal using HEM (High Energy Milling). The next step is dispersion with an acid-based solution. In this study, the acid-base solutions used were KOH and HCL. Therefore, it is filtered and dried to obtain silica in the form of nanoparticles.

2.1 Procedure Preparation of Rice Husk

![Diagram of Procedure Preparation of Rice Husk]

**Figure 6. Procedure Preparation of Rice Husk**

2.2 Software AI

Implementation of Artificial Intelligence in this research used Forward Chaining method as shown figure 7. An inference engine using forward chaining search with inference rules until it finds one IF clause is known to be true. When found it can infer and add new information to the dataset. In other words, start by a few facts and apply the rules to find all possible conclusions [6].

![Diagram of Forward Chaining method]

**Figure 7. Forward Chaining method [10]**

Variables used:
A = pyrolysis 800°C 4 hours
B = Pyrolysis 800°C 6 hours
C = has % silica
D = has % carbon
E = Highest % silica
F = Highest % carbon  
G = pyrolysis 800°C 4 hours the highest silica  
H = pyrolysis 800°C 6 hours the highest silica  
I = Highest % silica

Rule:
R1 = If 800°C 4 hours AND % silica is the highest THEN 800°C 4 hours% silica is the highest  
R2 = If 800°C 4 hours AND % of the highest carbon THEN pyrolysis 800°C 4 hours% lowest carbon  
R1 = If 800°C 6 hours AND % silica is the highest THEN 800°C 6 hours% silica is the highest  
R2 = If 800°C 6 hours AND% of the highest carbon THEN 800°C 6 hours% lowest carbon  
R5 = If R1 AND R2 THEN 800°C 4 hours the best% silica  
R6 = If R3 AND R4 THEN 800°C 4 hours the best% silica  
R7 = if R5 <R6 THEN R6 is best  
R8 = if R5> R6 THEN R5 is best

Simple Rule
R1: IF A AND C THEN E  
R2: IF A AND D THEN F  
R3: IF B AND C THEN G  
R4: IF B AND D THEN H  
R5: IF E AND F THEN I  
R6: IF I <| J THEN J  
R7: IF I >| J THEN I

3. Result and Discussion  
The results of the characteristics of the rice husk silica nanoparticles using SEM and EDX. Figure 8 SEM images of pyrolysis 800°C 4 hours. Figure 10 shows the EDX test results of 800°C 4 hours resulting in the amount of 18.64% silica with 40.52% carbon. While Figure 9 shows a silica rice husk image of pyrolysis 800°C 6 hours. The EDX test shows the amount of silica rice husk 35% with 28.04% carbon  
as shown in Figure 11.
The result of this research of the two variations, 800°C 6 hours has higher silica 35.17% than 800°C 4 hours has silica 18.64%. The results of this measurement, it becomes data for AI software to determine the best % silica rice husk from this research.

| Element | Line Type | Weight % | Weight % Sigma | Atomic % |
|---------|-----------|----------|----------------|----------|
| C       | K series  | 40.52    | 0.26           | 51.42    |
| O       | K series  | 40.07    | 0.21           | 38.17    |
| Si      | K series  | 18.64    | 0.12           | 10.12    |
| K       | K series  | 0.76     | 0.05           | 0.30     |
| Total   |           | 100.00   |                | 100.00   |

**Figure 10.** The result EDX of silica rice husk 800°C 4 hours

| Element | Line Type | Weight % | Weight % Sigma | Atomic % |
|---------|-----------|----------|----------------|----------|
| C       | K series  | 28.04    | 0.38           | 39.86    |
| O       | K series  | 35.97    | 0.25           | 38.39    |
| Si      | K series  | 35.17    | 0.23           | 21.38    |
| K       | K series  | 0.83     | 0.07           | 0.36     |
| Total   |           | 100.00   |                | 100.00   |

**Figure 11.** The result EDX of silica rice husk 800°C 6 hours

The result of this research of the two variations, 800°C 6 hours has higher silica 35.17% than 800°C 4 hours has silica 18.64%. The results of this measurement, it becomes data for AI software to determine the best % silica rice husk from this research.

4. **Conclusion**
From this research, it can be concluded that 800°C 6 hours has higher silica 35.17% than 800°C 4 hours has silica 18.64%. In other word, the higher the pyrolysis process of rice husks will produce higher % silica.

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