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Potential of Rice Husk Brackets as A New Alternative Sea Water Distillation into Clean Water

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Kata Kunci:
Distillation, Briquette Absorber, Rice Husk, Clean Water

Abstrak: The need for clean water for people in Indonesia is increasing, especially in coastal areas, while the availability of clean water is very limited. One of the efforts made to anticipate is by utilizing sea water with a solar distillation system. In this study, the absorber used was rice husk briquettes. Various distillation technologies have been developed, but distillation technology with solar energy sources is still experiencing various obstacles so further technology and research are needed. To develop this technology, research was conducted with the aim of (1) producing a design of the thickness and density of rice husk briquettes in a seawater distillation system. (2) to produce clean water for each pair of thickness and density of rice husk briquettes through a seawater distillation system. (3) Knowing how much heat absorption efficiency is by using a rice husk briquette absorber. The research method used is a comparative method, which is a comparative study, where in this study the thickness and density of rice husk briquettes are compared. The data analysis method used the descriptive method. The parameters to be analyzed are plate temperature (Tp), glass temperature (Tg), water temperature (tw), basin room temperature (Tsv), ambient temperature (Ta) and distilled water (AT), area of absorbent plate (Ac), Collector and distillation efficiency. This research resulted in a design for the distillation of seawater into clean water using an absorber plate (absorber) of rice husk briquettes which can increase the production of clean water.

INTRODUCTIO N

Communities in several regions in Indonesia are still having difficulties in meeting their current needs for clean water, which is still an unsolved problem. Efforts that can be made to provide clean water are by utilizing existing water, one of which is seawater (Anggito Pangieo, 2012) To be used, seawater needs to be treated first. One of the practical and environmentally friendly processing methods is solar distillation. The utilization of solar power for the distillation of seawater into clean water is also a form of alternative energy utilization (Hasanuddin, et al., 2011). Water is one of the natural resources that are needed by living things to sustain their life. Water that fills more than two-thirds of the entire surface of the earth, provides a place to live that is 300 times wider than land, but most of the water cannot be directly used for the benefit of living things. Only 1% is beneficial to water that can be used as clean water, to be clean drinking water must undergo a technological process. (Anggito Pangieo, 2012)

Around 16.42% of the Indonesian population are people who live in coastal areas. The choice to live in coastal areas is certainly very relevant given the many potentials of biological and non-biological natural resources, artificial resources, and environmental services that are very important for people's lives. However, this does not become a fully prosperous coastal community. Their low productivity makes it difficult for them to get out of poverty (Mulyanef, et al.)

Another alternative to obtain clean water is the use of rice husks as an alternative energy source in Farmer's Households. Indonesia, which is an agrarian country, has most of the population as farmers. The husk is abundant in rural areas and is a waste that is used for alternative energy. (Ministry of Agriculture) The waste product from the husk furnace in the form of husk charcoal is very good to be used for plant-growing media and can be made of husk charcoal briquettes. The rice milling industry in Indonesia can process more than 40 million unground rice into rice with a yield approaching 60% - 80%. If this condition occurs sustainably as a capacity, then there will be 8 million tons of rice husks that will be produced, but on the other hand, this can disturb the environment. (Duffie, J. A. and B. William, 1980) Prediction rate (Aram II) from BPS in 2004. Assume that the total production of dry unground rice is 53.7 million tons which is equivalent to 33.92 million tons its rice. As it is well the l known that the husk is the outer part of rice that is not ground and is also a by-product of rice milling. Most of the content of the husk is crude fiber consisting of lemma and plea. The two fibers combine to envelop the caryopsis. For some time, it has been used for filling and incineration in the brick industry (farmers' industry during dry seasons/water shortages), while husk production is around 20% - 30% of the total, unground rice and unfortunately husks are still considered as waste. (Monintja NCV, 2004)

Rice husks are effluent hullersice mills (hullers) that mostly operate in rural areas. Because rice is the staple food of the Indonesian people. Waste in the form of rice husks by itself will never The time. The use of rice husks, is only limited to a mixture of organic fertilizers, horticultural plant media, broiler farming, and fuel bricks and ash. whereas rice husks can be used for the production of super carbon or charcoal briquettes. (Alpesh Mehta, Prof, et al, 2011)

Waste is often interpreted as waste material / residual material from the processing of agricultural products. The process of destroying waste naturally takes place slowly, so that waste not only disturbs the surrounding environment but also interferes with human health. At every rice mill, we will always see piles and even mountains of husks that are getting currently and higher. Currently, the use of rice husks is still little, so the husks remain a waste material that disturbs the environment.

This research is motivated by the increasing need for clean water, particularly in coastal areas. Therefore, this study aims to evaluate the potential of seawater distillation by utilizing heat absorption from rice husk briquettes. The problems addressed in this research are, first, how much clean water can be produced through the seawater distillation process using rice husk briquettes as heat absorbers, and second, how efficient the heat absorption from rice husk briquettes is in the seawater distillation system to produce clean water.

The main objectives of this research are to produce clean water from the seawater distillation process by utilizing rice husk briquettes as heat absorbers and to determine the heat absorption efficiency of rice husk briquettes in the distillation process. Therefore, it is expected that this research will provide significant benefits, such as helping to meet the growing demand for clean water, especially in coastal areas, and supporting the national development program focused on the efficient, affordable, and environmentally friendly use of energy to meet household water needs. Furthermore, this research is also expected to assist the government in reducing rice husk waste, which increases in production every year, by using it as a raw material for briquettes that are beneficial in the seawater distillation process.

LITERATURE REVIEW

It is known that the husk is the outer part of the unground rice and is also a by-product of rice milling. Most of the content of the husk is crude fiber consisting of *lemma* and *plea.* The two fibers combine to cover *the caryopsis* and are used for fires in the brick industry (farmers' industry during the dry season/water shortage). Husk production is about 20% - 30% of the total unground rice and unfortunately husks as still considered waste. (W.T Chess, 2002)

Various distillation technologies have been developed, but the distillation technology with solar energy sources is still experiencing various obstacles so further technology and research are needed. To develop this technology, research was carried out to obtain a technology model for processing seawater into clean water by a distillation process that has a higher efficiency value and produces clean water that can be consumed directly (Rahmad S., 2001).

An Air heating system with solar energy is the utilization of solar radiation energy that is widely used by people. One of the stages of developing this system is to increase the efficiency of the collector. For this reason, it is necessary to measure the parameters that affect the thermal efficiency of the collector, for example, the temperature of the air inlet and the temperature of the air leaving the collector, the intensity of solar radiation, the rate of airflow through the collector and the temperature of the surrounding air. In carrying out this research, collector

testing was carried out according to the ASHRAE 93-77 standard and the measurement system was using a personal computer. (Ashrae, 1977).

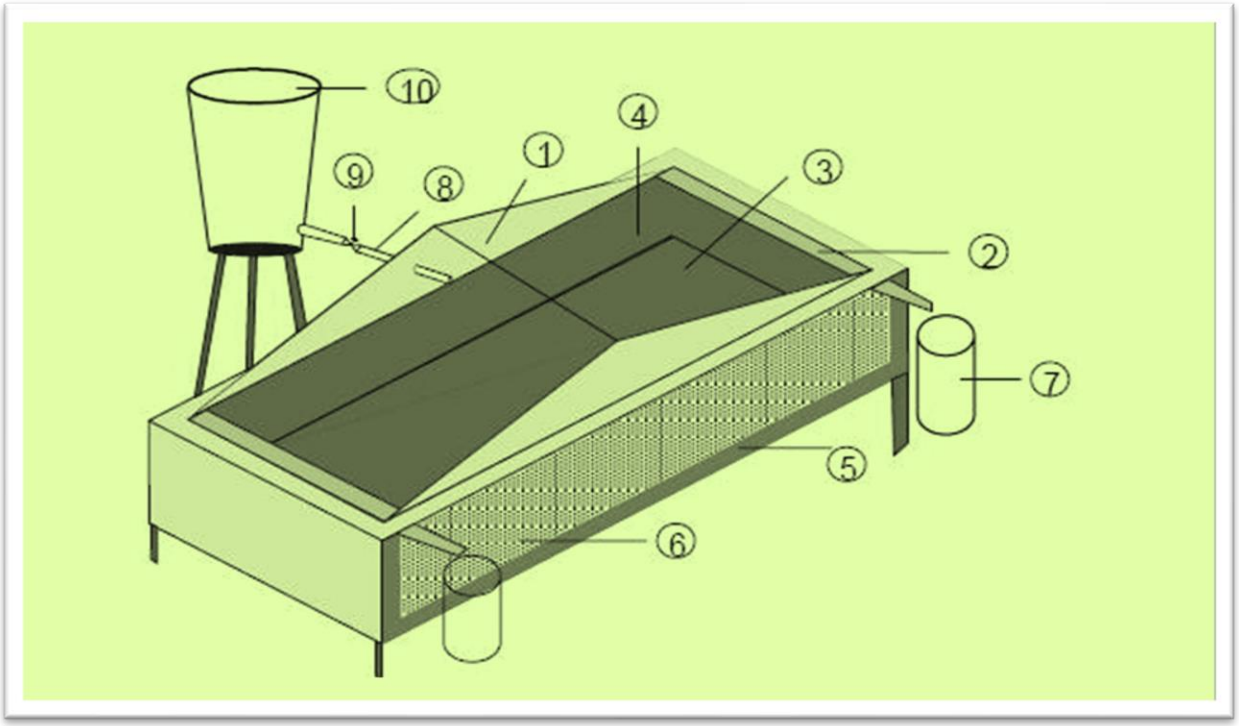
Efforts to increase the efficiency and productivity of *solar stills* by providing variations on the absorbent plate that produce condensate water productivity and efficiency using absorbent plates from concrete castings are more than using absorbent plates from copper, and the addition of gravel with a diameter of 1 cm produces more condensate water. compared to no gravel. (Ketut Astawa, et al., 2011)

To determine the effect of the type of absorbent plate and water flow rate on the performance of a simple *solar heater* with the addition of a storage plate. The highest type of absorbent plate is the copper type, while the stable heat absorption efficiency is the cast concrete type. At high water flow rates, the trend of heat absorption efficiency decreases, and vice versa. In a simple *solar heater system*, the performance of a device that can absorb and store heat well is needed, so it can be concluded that the best type is the type of cast concrete absorbent plate with a slow flow rate. (Irfan, et al., 2011)

To determine the effect of the surface shape and thickness of the *absorber* on the production capacity of fresh water, it is carried out by testing the effect of the surface forms of the *absorber* made of zinc (flat, wavy, and jagged) on the temperature rise in the *solar still*. then tested the effect of the thickness of the *absorber* made of zinc on the temperature increase in the *solar still*, using each form of the above surface being layered according to the desired thickness. In each of the above tests, the temperature outside and inside the *solar still,* as well as the volume of distilled fresh water are measured. Furthermore, the freshwater obtained was tested for pH and salinity to determine its quality. (Jansen, Ted. J., 1995)

Research on absorbent plates for seawater distillation, copper material coated with black doff paint has a good heat absorption coefficient of 0.96 BTU (Rizki Rizaldi Hidayat, 2011). Calculating thermal planning and laboratory tests for seawater distillation. Observations were made with an area of 1 m^2 with east and west orientation Total sun (G_t) and freshwater productivity ($Q_{at)}$ (Holman, JP., 1997). To determine the effect of the shape and cooling medium with the Principle of capillary film on the productivity and efficiency of solar stills using the experimental method (Arif, et al, 2007). The wave absorber with the addition of a reflector can increase the productivity of condensate water and the efficiency of solar still is higher than that of a wave absorbing plate without a reflector (Jansen, Ted. J., 1995).

In principle, distillation is a way to get clean water through the process of distilling dirty water. In the distillation process, there are processes of heat transfer, evaporation, and condensation. Heat transfer occurs from the heat source to the dirty water. If the water is continuously heated, the evaporation process will occur. If this vapor comes in contact with a cold surface, a condensation process will occur on the cold surface. In the distillation process b, only the condensate water is taken, and germs and bacteria will die by the heating process (La Aba, 2007).



Description of the picture:

1. Cover Glass	6. frame
2. Canal	7. Tube, water container
3. Absorbent plate	8. Pipe
4. Basin	9. Valve
5. Insulation	10. Seawater reservoir

Figure 1. Two-Slope Surface Type Solar Distillation

In the design of this distillation, absorbent plate material from rice husks has been made into briquettes (H.U Syarif, 2014).

Thermal Overview of the Distillation Equipment

Heat transfer by conduction, the rate of heat transfer is expressed by Fourier's law,

$$qkond. = -kA\left(\frac{dT}{dx}\right)W(watt)$$

where: $q_{cond.}$ = Conduction Heat Transfer Rate (W)

k = thermal conductivity. W/(mK)

A = Cross-sectional area perpendicular to the heat flow, m^2

dT/dx = temperature difference d in the direction of heat flow. K/m

The sign (-) in the above equation is written to fulfill the second law of thermodynamics.

METHOD

Research carried out in the laboratory and workshop Mechanical Engineering and Conversion Energy State Polytechnic campus Makassar. The dimension and materials used in the third collectors who use adsorbents from coal briquettes and rice husks are: (9)

1. Collectors distillation Surya made a collector plate flat that forms the installation methods operations have much in common with collectors heating and water. Collectors distillation is fitted with a slope of 30^{o}. Made from transparent glass with 1 cm.
2. A very precise braking performance because the material used in this research is plate briquette rice husks that aim to speed up steam because coal briquettes rice husks have thermal conductivity, with the water bait is very thin. With this very precise braking performance because we are aiming for the operation collect continuously and only needed simple steps to reduce the crystals salt remains distillation drainage of water in such ways bait.
3. The bases and finding from concrete with thick 5 cm and covered with insulation fiber pages 2 mm.
4. Long size Dimension wide 100 cm, wide 100 cm, and was 20 cm.
5. *Heat adsorbents* using coal briquettes rice husks with 8 cm, 10 cm, and 12 cm and widespread 1 m^2.
6. Water pipe raw materials and water pipes condensate.
7. Gallon 20 liters to retain water raw materials are sea water, and aqua bottle measuring 1.5 liters to accommodate clean water.
8. Glass measure, to measure water from the result condensation.
9. Pyranometer to measure the intense radiation of the sun.
10. Anemometer to find a wind speed.
11. The computer used to run the application measures the temperature is happening in a container distillation example briquette temperature and temperatures of the glass lid.
12. Thermocouple linked to a computer to see the resulting temperature on the instruments collector.

Trial implementation will be done from 07.00 to 17.00 AM, decision-making time test is to find out the influence of the intensity of solar radiation in one day on performance summary distillation by using adsorbents from coal briquettes rice.

Equipment Set-Up

The equipment set up is as follows: [Hasanuddin, et al., 2011]

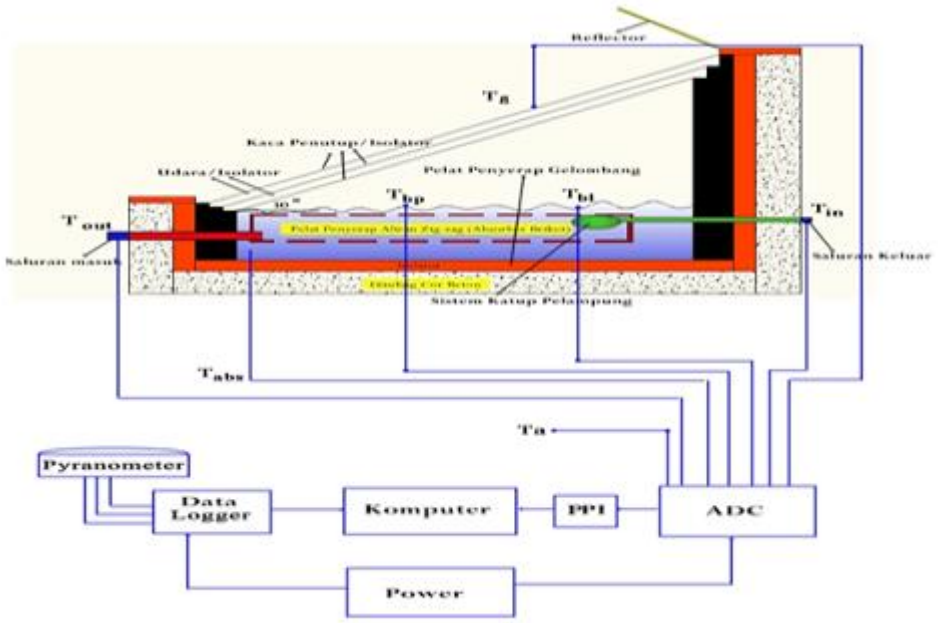


Figure 2. The research uses an experimental method by testing simple

The research uses an experimental method by testing simple *solar energy distillation* of briquette absorbent plates from wave model rice husks with the addition of a *reflector* on the performance of solar energy distillation. (H.U Syarif, 2014)

The design of the tool is based on the collector's innovations and the use of easily available materials. Collector innovation can be seen in the following collector designs:

1. The solar distillation collector made is a transverse house shape collector whose installation method of operation has many similarities with the water-heating collector. This distillation collector is installed with a slope above 30^o.
2. The absorber material used in this study is briquettes (rice husk) which aims to accelerate evaporation because briquettes have a high conductivity level with a very thin layer of feed water. With this absorber, it is desirable to operate the collector continuously and only a simple step is needed for the reduction of the residual salt crystals from the distillation, namely by flowing feed water.
3. The research method used is a comparative method, which is a comparative study, where in this study the thickness and density of rice husk briquettes are compared. The data analysis method used is the descriptive method. The parameters to be analyzed are plate temperature (T_p), glass temperature (T_g), water temperature (t_w), basin room temperature (T_{sv}), ambient temperature (T_a) and distilled water (AT), area of absorbent plate (Ac), Collector and distillation efficiency.

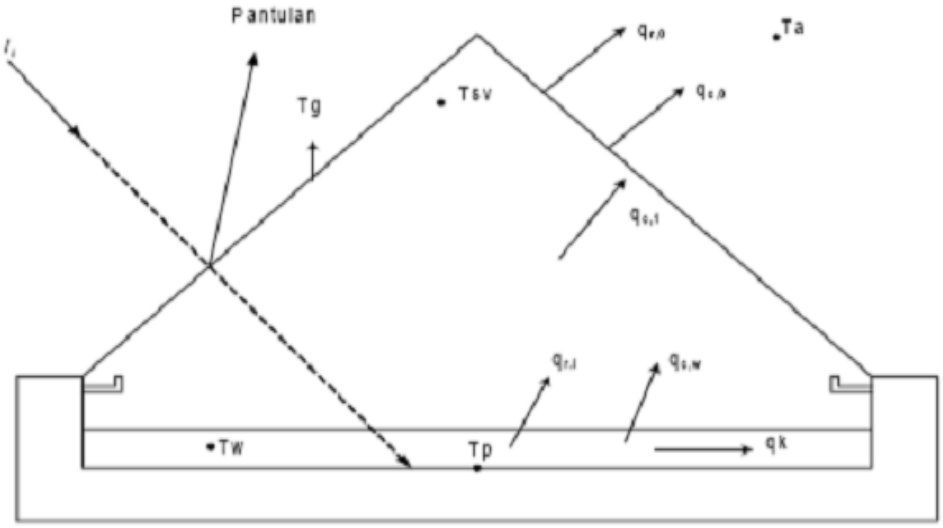
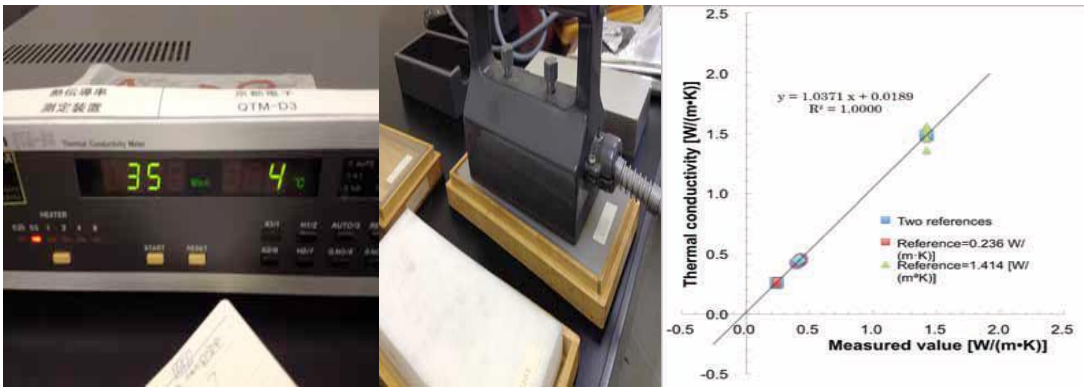


Figure 3. Energy flow diagram

Source and The Potential for Rice Husks

Measurements of thermal conductivity of briquette rice husks will be done in a laboratory at the University of Miyazaki, under the coordination of K. Shiomori. Thermal Conductivity briquette rice husks measured by Kemtherm TQM - D3 (*Electronics Kyoto Manufacturing Co., Ltd.*, Figure 4-a Autodetection equipped with thermal Figure 4-b. Two types of capital, are used to make the curve calibration rubber: 0.236 W/m•K and glass: 1.414 W m•K. (Syarif, Humayatul U, et. al.,)

The values thermal conductivity that comes from samples Inward at the reference to the values that are shown in the measurement, and links linear. A sample that is used to measure is shown in Picture 5 thermal conductivity of briquette rice husks is evaluated at 0.42 W/m•K. (Alpesh Mehta, Prof, et al, 2011)



(a) Kemthem QTM-D3 (b) Autodetection thermal (c) Conductivity result

Figure 4. Tools measurements thermal conductivity

According to Katsuki et al (2005) Rice husk now, it has been developed as a material for ash, which was known in the world as RHA (*rice husk ash*). Ash rice husks that were produced from burning rice husks at a high temperature of 400^{o} - 500^{o}C will be silica amorphous and the temperature of more than 1,000^{o}C will be silica Crystalline. Silica amorphous which is produced from ash rice husks was suspected to be an as important source producing silicon pure, Carbide silicon, and flour nitric silicone.

Testing and The count

1. Testing with the method of *Scanning Electron Microscopy* (SEM)

Scanning Electron Microscope (SEM) as can be seen in picture 12 is an electron microscope one of the kinds using the electrons to show from the surface of the material that is analyzed. Electrons are fired and interact with materials to produce signals that contain information on the surface materials on topography, morphology, composition, and information kristalografi. Elements of a material can be seen by enlargement of 5 m, 10 m, 20 m, 40 m, 50 m, 100 m, and 200 m. (H.U Syarif, 2014)

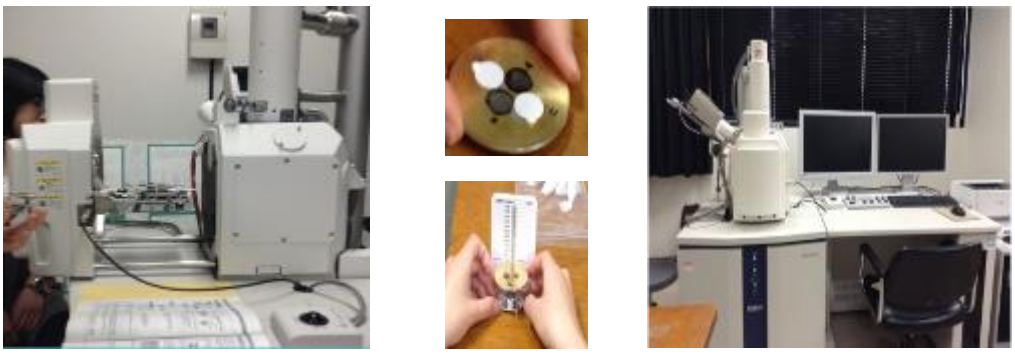


Figure 5. Process or use any means SEM

SEM (*Scanning Electron Microscope*) is an electron microscope used to analyze the surface material. SEM can also be used to analyze data crystallography, so it could be developed to determine the compound or element. In principle work SEM, two saner electrons are used simultaneously. The strike specimens used to test the compound or element and the other CRT (*Cathode Ray Tube*) give it looks like a picture, so have two monitor screens, Figure 6 shows that SEM uses the principles scanning, meaning the sheaf electrons directed from point to point on the object. The Movement sheaf electrical engineering from a point to the point where there are in a region object is a movement to read. The main components of SEM consist of two units the *electron column* and *display console* (H.U Syarif, 2014).

2. Testing with the method of *X-ray Fluorescence* (XRF)

X-ray is part of the electromagnetic spectrum and revealed in the energy department (kilo electron volt - Kev would still be) or wavelength large-scale nanometer (nm), XRF (*X-ray Fluorescence*) is the consequence of the changes that took place in a single atom. A single atom

stable consists of a nucleus and the electrons that an area unobservable. Electrons will be arranged in a cloud: every shell consists of electrons to the energy of that period. When the incident high energy (primary) X-ray collides with atoms, the atom would experience a disturbance from the condition stability. An excited electron from the low level of energy (e.g., K shell: see diagram) fill a room that is made. As a result, a higher energy level (for example L shell) falls into this space. The difference energy produced as electrons move between this level X-ray emissions released a secondary that is characteristic of the elements. This process is called XRF. XRF is a technique that is proven to be able for analysis of material in various industries and appapplicationsrom Material identification, memos division volume, measured sulfur in the oil, analyze the thickness finishing layer refined tin, and quality control blend and consumptions in electronic industry. According to Gosseau 2009.

Benefit analysis with XRF includes:

1. Convenience without preparation samples.
2. Analysis of non - destructive.
3. Na11 analysis of U92, ppm range for high concentrations percent.
4. Does not contain chemical wet - not acidic, and does not involve Reagan
5. Can analyze solid, balance, powder, film, a small object, etc.
6. A quick analysis of - minutes in the unit minutes.
7. Qualitative, semi-quantitatively, quantitative analysis is complete.
8. Quality control routine analysis instrument can 'be used by anyone.

XRF is easy to use a quality control method quick and accurate for various industries and applications.

3. Testing with *different methods Thermal Analyzer* (DTA)

The method of diffraction is commonly used to identify the compound contained in a solid with how to compare the data diffraction with the database issued by the International *Center for Diffraction* Data PDF (*Power Diffraction file*). Light, where they are refracted will be caught by the detector and then rendered as top diffraction. More and more crystal field that was found in samples, and the more powerful diffusion intensity that it produces. The top Each that appeared in the pattern DTA represents the crystal that has a certain orientation in a three-dimensional (H.U Syarif, 2014).

Trial DTA in this research is aimed to know that is formed due to chemical process hydration in rice husks among others: *profiles*, *smoothing profiles* rice husks, *B. G subtracts profiles*, Ka 1 *profiles*, *peak*.

4. Testing Conductivity

Measurements of thermal conductivity of briquette rice husks will be done in a laboratory at Miyazaki University, under the coordination of Koichiro Shiomori. Thermal Conductivity briquette rice husks measured by Kemtherm QTM - D3 (*Electronics Kyoto Manufacturing Co., Ltd.*, Picture 13 shows measuring result thermal conductivity briquette rice husks. D ua types of capital that are used to make the curve calibration rubber: 0.236 W/m•K and glass: 1.414 W m•K

(Alpesh Mehta, Prof, et al, 2011).

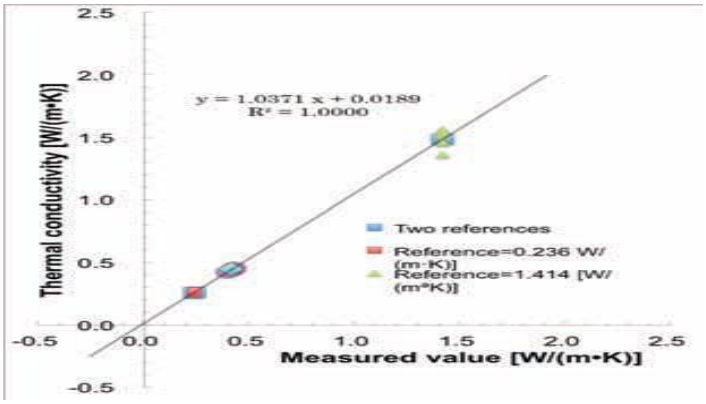


Figure 6. The result measurements thermal conductivity

The Flash sea water solar energy will be done to get raw water level was above adsorbents still and continuous. *Flash distillation is a type in which the raw ingredients* are water marine on an ongoing basis, and ensure continuity materials sea water and production will continue for a long time. Analysis flows of energy in solar collectors with license plate absorbent (*adsorbents t*) brackets rice husks.

RESULTS AND DISCUSSION

The charcoal rice husks that are taken from the briquette thickness rice husks are below 90 percent. In due with a mixture of clay and glue of sago to produce an additional compound is SO3, foes, Fluor, and Chrome. Samples of charcoal rice husks that have been contaminated by the four compounds mentioned above are not dangerous, because they would evaporate and will disappear in the process of distillation. (Humayatul Ummah, at.al., 2015)

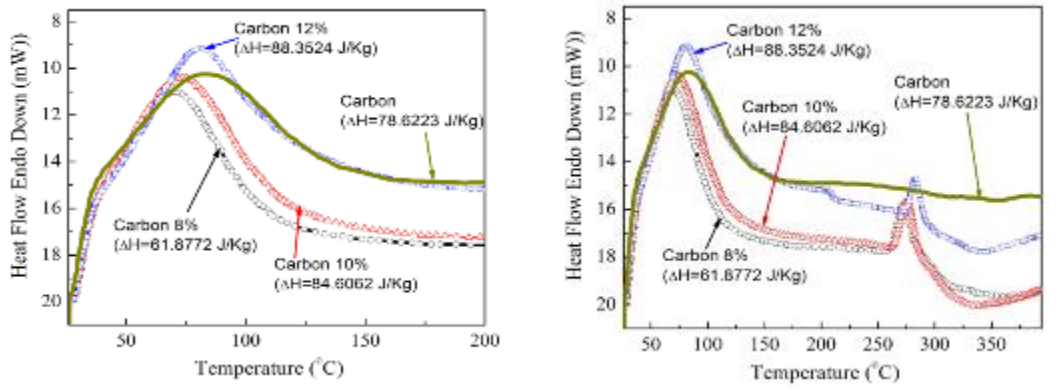


Figure 7. Numbers of the energy produced

Figure 7. shows the conductivity of summer with the temperature early average 26.1^{o} C have values conductivity hot almost the same briquette where rice husks with 12 cm obtained the most of it, which is 20.58 MW, the thickness 10 cm with the 20.48 MW, charcoal rice husks pure advanced 20.46 MW coal briquette thickness rice husks 8 cm namely 20.43 MW. (Syarif, Humayatul U, et. al., 2015)

The process that takes place in the system distillation is a process exothermal is a process that could deliver energy in the temperature change during a continuous process. The great energy that moved during the process hot happen such as the results obtained is conductivity heat. The great energy that, for the carbon pure or charcoal rice husks that ΔH worth -78.6223 J/g. Coal briquette rice husks thickness 8 cm worth -61.8772 J/g to -7.4439 J/g. Coal briquette rice husks thickness 10 cm worth -84.6062 J/g to -8.8479 J/g. Coal briquette rice husks with 12 cm worth -88.3524 J/g to -5.4490 J/g.

This data proves that coal briquettes rice husks with 10 cm had heat energy that doesn't change and still has had much energy -8.8479 J/g. In the process of adiabatic, even though the heat can be passed system, the temperature can change due to such interaction energy in the system itself. Thus, even though at night is not the sun, is still process evaporation occurs at night, causing system distillation is still produce clean water. (H.U Syarif, 2014).

The Potential Rice Husks as Adsorbents in Process Distillation

Result research showed that chemical composition and physics briquette rice husks, in general, the elements Pereiro silika ($_2$) 94-96 percent, while research results in table 8 increased by 96.74 percent. This could that rice husks when burned in the initial phase amorphous will produce charcoal rice husk's critical market as adsorbents in the process of distillation of seawater to clean water. Silika elements that are in disappearing rice husks have functions binding heavy metals. Silica in rice husks also is an organic matter that works to improve the land and help bind elements nitrogen, sulfur, and potassium (NPK).

Chemical composition and physics briquette rice husks before and after used as adsorbents in process distillation sea water to clean water, changes. This can be based on the results of research that chemical elements Silica (The) charcoal rice husks as adsorbents have-experienced where it is used as the adsorbents weighs 42.23 percent and then used as the adsorbents weighing up to 35.23 percent. There is also the area, the results of the research showed that the oxygen, the increase, this shows that elements oxygen dissolved not participate in the process evaporation of water sea to clean water. Metal ions whose existence in seawater are sodium chloride, magnesium, sulfide, and calcium, which will be done, and metal ions before being used as adsorbents have a value of 5 percent while after being used as adsorbents briquette rice husks, a decline of 4 percent. While the elements silica experienced a decline from 45.5 percent to 33.3 percent. Elements of silica are potentially used in seawater to clean water through the process of distillation. Clean Water, acquired through this process, is examined in the laboratory producing water that can be consumed according to the standard regulation PERMENKES RI No. 492/MEN.KES / PER/IX/2010. (Disclosure)

Results of research by using SEM (S*canning Electron Microscope*), show that some briquette charcoal rice husks (a) before undergoing a process distillation density of coal briquettes solid and rice husks can be seen not spongy and (b) after being used as adsorber in process

distillation density, changes you can see some briquette rice husks seen its surface is porous. The temperature rise usually will reduce the density of a material.

Efficiency collectors distillation theoretically is a tool distillation ability to produce products in the form of distillation kindest (water). With the rising sun radiation intensity was so high-temperature cover also increased. In late afternoon where more intensity radiation also decreased so that the process condensation at that time will be increased. Efficiency distillation in absorbing the plate briquette rice husks theoretically reached 24.85 percent and efficiency actual, reached 13.49 percent with average freshwater productivity, reaching 1250 ml. Daily efficiency, reached 46.66 percent.

CONCLUSION

The seawater distillation system, using rice husk coal briquette absorbents with thicknesses of 8 cm, 10 cm, and 12 cm, and a thermal conductivity value of 0.42 W/m°C, produced similar amounts of water condensate across the different thicknesses. The distillation process using rice husk briquettes with a thickness of 10 cm yielded 1.25 liters of clean water per day. Laboratory tests on the distilled water confirmed that it met the drinking water standards set by Indonesia's Ministry of Health Regulation No. 492/MEN.KES/PER/IX/2010, making it suitable for consumption.

The effectiveness of rice husk briquettes was further assessed using Differential Temperature Analyzer (DTA) tests, which showed that briquettes with a thickness of 10 cm achieved peak values ranging from -5.9453 MW to -2.2381 MW, with an area measurement of -846.062 MJ to -88.479 MJ and Delta H values between -84.6062 J/g to -8.8479 J/g. Solar radiation intensity had a significant impact on energy input into the collectors (Qin) and useful energy output (Qout or S). The highest solar radiation intensity occurred between 11:30 AM and 1:00 PM. The system achieved an efficiency of 13.49 percent, with a daily efficiency of 46.66 percent.

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