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Article

Burner Design Using Used Oil Fuel Based on Water Vapor Pressure

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ABSTRACT

This research aims to design and build an environmentally friendly burner that integrates used oil as a fuel based on water vapor pressure and to test the waste combustion efficiency using the designed device. The design stage of the device uses the assistance of AutoCAD. This is followed by direct experimental testing to collect data on the performance and efficiency of waste combustion in the burner. Based on the results of the two burners that have been tested above, it can be concluded that the amount of shrinkage of 8 kg of waste burned in a used oil burner with water vapor pressure is more shrinkage than the used oil burner without water vapor with a difference of 1.1 kg. This can be proven in the best experimental results in the first experiment, namely to burn 8 kg of waste in 25 minutes experiencing a shrinkage of 7.1 kg, so that the efficiency of waste combustion reaches 88.75% in a used oil burner with water vapor pressure. While the used oil burner without water vapor obtained the best results for burning 8 kg of waste in 25 minutes experiencing a shrinkage of 6 kg, so that the efficiency is 75% lower than combustion using a used oil fuel burner using water vapor pressure.

1. BACKGROUND

1.1. Introduction

Among the environmental problems frequently encountered in everyday life is waste. Waste is a persistent problem, as its volume continues to grow with population growth. Household waste is the second largest source of waste after industrial waste (Yusnita et al., 2024).

Waste is the residual waste that comes from activities carried out by humans that can no longer be used, so it must be managed again. Waste can cause losses if it is not managed properly and correctly. Losses that can be caused by waste include flooding, changes in climate warming, causing unpleasant odours, damaging beauty, hampering environmental sanitation and the threat of causing various types of diseases because waste management is not done properly (Sulistyanto et al., 2020).

One way to address this waste problem is to incinerate it, but traditional incineration or open burning practices often produce harmful gas emissions that pollute the air. One promising approach is the use of alternative fuels. Used oil, often discarded carelessly, has the potential to be converted into an energy source.

Used motor vehicle oil is available in large quantities, making it suitable for use as fuel, either directly or through recycling, on both small and large industrial scales. Technologies range from inexpensive to expensive (Azzikri et al., 2024).

However, burning waste using used oil presents its own challenges. Used oil can produce pollutants in the form of black smoke and hazardous gases. Therefore, innovation is needed in designing incinerators that not only address the waste and oil waste problem but also reduce its negative impact on the environment. One way to do this is by using water vapor as a supporting medium in the combustion process.

Water vapour is the change from boiling water to water vapour by heating in a container. To produce steam, the process of boiling water uses heat energy that comes from fire sources, for example from fuel combustion, electric power and hot gas as the residue of chemical processes (Farid et al., 2020).

In addition to discussing environmental issues, the potential utilization of used oil, and

the role of water vapor in improving combustion quality, this research also needs to review manufacturing aspects so that the resulting burner design is truly applicable. The manufacturing aspect is very important because it determines whether the design produced is only limited to laboratory concepts or can be applied on a real scale in households and small industries.

First, material selection is a major factor in the success of the burner design. The materials used should have high temperature resistance, corrosion resistance due to exposure to used oil, and be relatively easy to obtain in the market. Proper material selection will increase reliability and tool life, while reducing long-term maintenance costs.

Secondly, the durability of the burner needs to be considered to ensure that it can be used repeatedly over a long period of time without significant damage. This includes the strength of the frame structure, the resistance of the combustion chamber to heat, and the stability of the connections between components. With good durability, the burner can provide optimal value for users.

Third, cost efficiency is an important consideration so that the designed burner can be produced at an affordable price. The use of materials that are easy to find locally, a simple assembly process, and maintenance that does not require high costs will make this tool more easily accepted by the wider community.

Fourth, ease of fabrication should also be considered in the design. The design of the burner should be simple, not requiring too sophisticated manufacturing equipment, and possible to be produced by small workshops or local craftsmen. Thus, this tool can be produced in large quantities and distributed to various areas in need.

By considering the four aspects of manufacturing, namely material selection, durability, cost efficiency, and ease of fabrication. This research not only produces a technically effective burner, but also presents a solution that is realistic, sustainable, and ready to be implemented in everyday life.

1.2. Research Objectives

a. To find out the design and construction process for a burner using used oil fuel based on water vapor pressure as an environmentally friendly alternative material.

b. To test the efficiency of waste combustion and the performance of the used oil-fueled burner with the designed water vapor pressure.

2. Literature review

2.1 Design.

Design is a series of procedures to obtain the results of analysis of a system into a

programming language to describe in detail how the system components are implemented and system development or construction is the activity of creating new tools/systems or replacing existing systems in whole or in part (Gunawan et al, 2021).

According to Bambang, as quoted by Ariansyah and Wijaya (2021), design is the process of creating a system to create a new system or improve an existing system, either completely or partially. Design is also the initial step of creating a picture or sketch of something that has never been created before, then processing it into a sketch/image that has the desired function.

Meanwhile, according to Taufik Ramadhan, as quoted by Sari et al., (2018), design is a series of processes in translating the results of a system analysis into a programming language, for the purpose of clearly describing how the system components will be used.

From the definition above, it can be concluded that design/construction is the planning, depiction, and sketching of several separate elements into a complete and functional unit. Therefore, the definition of design/construction is the activity of converting the results of analysis into software and then creating the system or improving an existing system.

2.2 Utilization of Used Oil and Water Vapor

Oil consumption continues to increase every year. This increase naturally leads to an increase in the amount of used oil waste produced. Used oil is classified as hazardous waste and therefore requires special handling.

One way to reduce environmental pollution is by utilizing used oil as an energy and fuel source. Furthermore, utilizing waste oil as fuel will minimize the use of other fuels, such as LPG and conventional fuels. The population and vehicle numbers continue to grow, and so does the amount of used oil waste and household hazardous and toxic waste. With

careful management, waste oil can be used as a fuel source (Mafruddin et al., 2022).

The combustion of used oil fuel involves the addition of water vapor from boiling water. In general, the working principle of water vapour is to convert water into pressurised steam, where the steam produced can be used for heat or pressure for industrial processes (Shahab & Sulton, 2023).

Previous research has shown that the hydrogen and oxygen content of the steam can increase the intensity of combustion, resulting in a stronger flame and a stronger flame color. The hydrogen and oxygen-containing water vapor can increase the size of the flame during combustion. The consistent flame output temperature and stable pressure in the water vapor system help reduce thick smoke and improve flame quality due to the hydrogen and oxygen content of the water vapor (Nugroho et al., 2021).

The flame temperature increases as the amount of steam increases, where this event is caused by the separation of hydrogen from its oxygen bonds during combustion (Siagian et al., 2018).

2.3 Burner

Burner A stove that produces a high-heat flame used to burn desired objects, such as trash. This device has a closed external space that holds fuel and provides a combustion chamber for items placed on it. Some examples of existing research designs:



Figure 1. PET Waste Melting Machine Using Used Oil Fuel

Source: (Hata et al, 2023)



Figure 2. Stove Using Used Oil and Water Steam as Fuel

Based on the image above, the design, design and dimensions of the burner above are quite large which is difficult to move and uses a blower as the air driving force which uses electric power.

2.4 Product Life Cycle

According to Levitt, quoted by Ria and Ningsih Anika (2022), the product life cycle is a graph that shows the history of a product from the time it is released on the market to the time it is withdrawn from the market. Meanwhile, according to Kotler and Armstrong, the product life cycle is the sales and profit journey of a product during its lifetime. The product life cycle is generally divided into four stages, namely the introduction, growth, maturity and decline stages.

2.5 circular economy

An alternative to the conventional linear economy that uses the make-use-dispose principle is the circular economy. Economic actors ensure that resources are used to the maximum extent possible, generate maximum value, and recover goods and materials at the end of each task. The basic principle of the circular economy is to reduce waste and maximise available resources. This circular economy method differs from the conventional linear economy that uses the take-use-dispose principle. A circular economy system minimises resource use, waste, emissions, and wasted energy by closing the production-consumption cycle. This is done by extending the life of products, creating new innovations, maintaining them, reusing them, producing them again, recycling them into their original products, and recycling them, into other products (Sarofah, 2022).

3. Research Methodology

Research into the manufacture of a burner using used oil and steam was conducted in stages. The research began with a literature review and simultaneous observations to identify the tools, materials, and manufacturing process for the burner. The design phase was completed using AutoCAD. The next stage involved manufacturing the burner using used oil and steam. This was followed by direct experimental testing to collect data on the performance and efficiency of the waste combustion in the burner.

The data analysis technique on the burner using used oil fuel with water vapor pressure is carried out by determining the performance results of flame temperature, flame duration, combustion speed, combustion residue (yield), and the effect of water vapor. Then, the efficiency of waste combustion with a load of 8 kg of waste was carried out using a used oil-fueled burner with water vapor pressure compared to a burner without water vapor.

3.1 Morphological Analysis of Research

Morphological analysis It's essential in burner design to achieve the desired results. Based on the description and explanation of the burner, the device's specifications can be divided into two categories: demands and wishes. The following is a list of burner specifications:

Table 1. Design Morphology

No	Design Consideration Demands	Condition	Level of Need
1.	Kinematics	1. The mechanism is easy to operate	D
2.	Geometry	1. Length around 35cm 2. width around 35 cm 3. Height around 35 cm 4. Dimensions can be reduced/enlarged	D D D W
3.	Energy	1. Using water vapor as air pressure 2. Can be replaced with other power	D W
4.	Material	1. Easy to get 2. Affordable prices 3. Good quality 4. Resistant to corrosion 5. According to quality standards 6. Has a long service life 7. Good mechanism	D W D D W D D
5.	Ergonomics	1. Comfortable to use 2. Not noisy 3. Easy to operate	D W D
6.	Signal	Easy to understand instructions	D
7.	Safety	1. The construction must be sturdy 2. Dangerous parts must be protected 3. Does not cause pollution that exceeds NAB	D D W
8.	Production	1. Can be produced in a workshop 2. Relative production costs 3. Can be developed further	D W W
9.	Maintenance	1. Affordable maintenance costs 2. Spare parts are easy to get 3. Easy maintenance	D D D
10.	Transportation	1. Easy to move 2. No need for other tools to move	D D

Information :

1. Requirement (Demand) "D" is the main requirement that must be present on the tool. If these are not met then the designed tool cannot be accepted.
2. Wishes "W" are conditions that are still being considered, if possible, that the tool can have.

3.2 Design Planning

This design uses more effective and efficient materials to simplify the combustion process and utilizes used oil and water vapor as

fuel. The dimensions of this design were calculated using AutoDisk Inventory (Auto CAD). The resulting design is as follows:

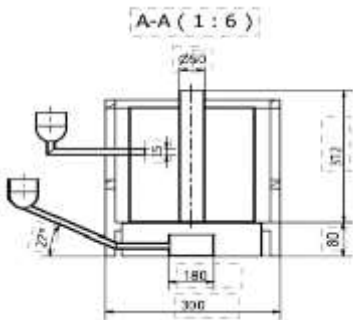


Figure 3.Right View Dimension

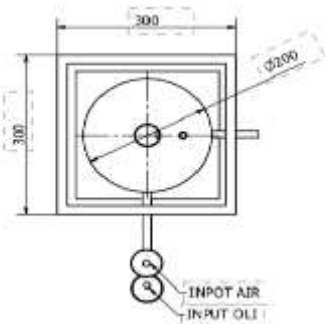


Figure 4.Top View Dimensions

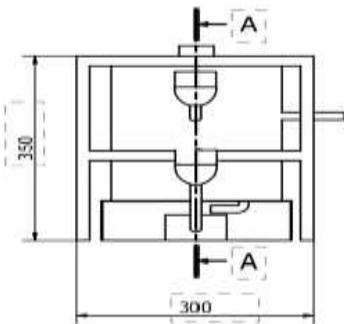


Figure 5. Left View Dimensions

3. 3 Materials and Tools for Making

Table 2.Materials and tools	
Material	Tool
1. Iron Plate	1. Welding machine
2. Galvanized Pipe	2. Ground cable
3. Hollow Iron	3. Mass clamp
4. Stop Faucet	4. Electrode cable
5. Sandpaper	5. Electrode
6. Bolt	6. Holder
	7. Welding Hammer
	8. Meter
	9. Grinder
	10. Electric Drill

4. Results and Discussion

4.1 Design Process

The design process for a used oil-fueled burner based on water vapor pressure was carried out systematically to produce an efficient, economical, and environmentally friendly device. This process included identifying needs, selecting materials, and developing technical specifications for determining dimensions.

1. Identify Needs

Based on the needs identification statement, several needs analysis steps were carried out to clarify the burner using used oil and water vapor. The stages of the needs analysis are as follows:

- Statement

Burner fueled by used oil with water vapor pressure to optimize waste oil as an alternative fuel and optimize the use of water as renewable energy and reduce the impact of waste pollution.
- Driving force

The propulsion uses water vapor as compressed air for energy-saving flame

- production without using electrical energy.
- Appearance dimensions

*Burner*This device has been designed to ensure user safety, comfort, and ease of operation. It's compact, making it easy to move from one location to another.

- Tool Excellence Target

The target or desired results that you want to achieve in making the granules produced by this burner are:

 - 1) Turning used oil and water vapor into potential energy as an alternative fuel.
 - 2) Fuel is easy to find.
 - 3) The cost of making this tool is affordable.
 - 4) Easy to use Burner, because the tool can be used by 1 person.
 - 5) The fire produced is quite good, without using electricity so it is easy to carry anywhere.
 - 6) The used oil combustion chamber and water tank can be removed and reassembled from the tool frame.

2. Burner Component Selection

Table 3.Component Material Selection

No.	Component	Choice of component/material variants	
		Variant A	Variant B
1	Burner Drive System	 (Water vapor)	 (220 V AC Blower)
2	Nozzle	 (Made from 1/2 inch galvanized pipe)	 (Brass Nozzle)
3	Oil Combustion Chamber	 (Type A Combustion Chamber)	 (Type B Combustion Chamber)
4	Fire Exhaust Pipe	 (3 inch stainless steel pipe)	 (Titanium Pipe)
5	Water Tank	 (Type A Tube)	 (Stainless Steel Tube)
6	Burner Frame	 (Iron aluminum)	 (4x6 Hollow Iron)

3. Component Specifications and Size Dimensions

This component and dimension specification describes the characteristics and dimensions of components used in the design process for a burner using used oil fuel with water vapor pressure. Dimensions are adjusted to meet operating time requirements, fuel consumption, combustion efficiency, and practicality in the field.

4.2 Burner Manufacturing Process

The burner manufacturing process involves several stages, including the manufacture of a water tube, fire outlet pipe, oil combustion chamber (tube base), nozzle, water input, water output, oil combustion chamber and frame.

1. Water Tank

In the process of making a cylindrical tube to create a water volume capacity of ≤ 6 liters, the resulting dimensions are 23 cm in diameter,

21.5 cm in height, and 1 mm in thickness. Inside, there is a 6 cm diameter flame outlet pipe, and inside the tube is a steam nozzle.

2. Fire Exhaust Pipe

After making the water tube, the next part is making the fire outlet pipe which is in the water tube with a diameter of 6 cm, a height of 35 cm, and a thickness of 1 mm, this size is made so that the resulting fire is denser coming out of the fire tube and also adjusts the size of the Nozzle so that the pipe hole is not blocked. The fire enters from the bottom of the pipe which is assisted by steam thrust as fire pressure into the pipe and the fire exits from the end of the pipe.

3. Tube Base

The base of the tube that is made is square and is located under the tube with each having a length of 29 cm with a height of 10 cm made of iron plate as a closed space and the size of the base of the tube is made to adjust the place to place the oil combustion chamber.

4. Nozzle

The steam outlet pipe, also known as the nozzle, is shaped like a pipe with a diameter of 1.2 cm and a length of 18 cm in an L-shape with a nozzle tip hole size of 5 mm. This size is made to adjust the nozzle height to be higher than the water volume limit in the tube. The nozzle tip size is made 5 mm so that the resulting steam pressure is greater out. This pipe is located directly below the center of the pipe where the fire enters and is inside the water tube for steam channeling out.

5. Water Input and Output

The water input pipe is made of 1.2 cm diameter, 20 cm long, glazing pipe. It has a funnel for water inlet and a valve to prevent steam from escaping. The water output pipe is a tube with a diameter of 1.2 cm and a length of 15 cm. It has a valve to prevent steam and water from escaping, and also to act as a water barrier.

6. Oil Burning Place

The oil burner is in the form of a round bowl to make the oil volume capacity ≤ 2 liters, so the size made is 21 cm in diameter and 6 cm in height and an oil input place is added along

with a 35 cm long handle stick to make it easier to add oil.

7. Framework

The burner frame serves as a supporting structure, providing strength, stability, and protection for the appliance's components. It's made of 4 cm x 6 cm hollow iron, measuring 30 cm wide, 32 cm long, and 32 cm high, to accommodate the burner's dimensions.

4.3 Design Results

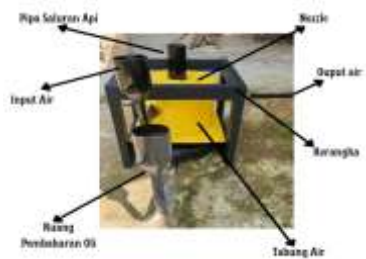


Figure 6. Used Oil Fuel Burner with Water Vapor Pressure

Component Description:

- 1. Water Tube
- 2. Fire Line Pipe
- 3. Nozzle
- 4. Water Output and Input
- 5. Oil Combustion Chamber
- 6. Framework

4.4 How the Burner Works

The way this burner works starts from inserting used fuel oil into the combustion place through the oil input and entering water in the tube through the water input. Then initial heating is carried out in the combustion chamber using used fuel oil to heat the water in the tube to produce water vapor. The steam released from boiling water will flow out of the tube through a nozzle to the fire pipe. Then the fire resulting from burning used oil comes out through the fire pipe with steam pressure and pressure so that the fire increases.

4.5 Burner Results and Testing

Results and testing are the final stage of the burner research process, where the collected data is analyzed and entered to obtain accurate conclusions.

1. Burner Testing Process

The purpose of this study was to determine the performance and efficiency of household waste burning using a used oil-fueled burner with water

vapor pressure on the burned waste weighing 8 kg and the used oil fuel capacity used was 0.3 liters and 3 liters of water. At the stage of testing the performance of this burner, the aim was to determine the results of the flame temperature, the length of time the flame burned, the combustion speed, the remaining waste combustion (yield) and the effect of steam on increasing the flame intensity and reducing exhaust gas emissions.



Figure 7.Testing Process

The flame temperature performance test was carried out for 25 minutes using a digital infrared thermometer temperature measuring tool by pointing it at the end of the flame outlet pipe and the combustion speed test was carried out using a stopwatch when the fuel flame was extinguished. Meanwhile, the efficiency testing phase is conducted to determine how efficiently the fire burns waste. This allows for a comparison of the initial input waste with the remaining waste output.

2. Performance Test Results

The results of this burner's performance aim to determine the results of the flame temperature, the length of time the flame burns, the combustion speed, the remaining waste

combustion (yield) and the effect of steam on increasing the flame intensity and reducing exhaust gas emissions.

a. Fire Temperature Measurement

1) Burner Temperature Testing with Steam

Table 4.Burner Temperature With Water Steam

Test	Time (Minutes)	Burner Temperature (C)
1	5	186
2	10	207
3	15	216
4	20	263
5	25	268

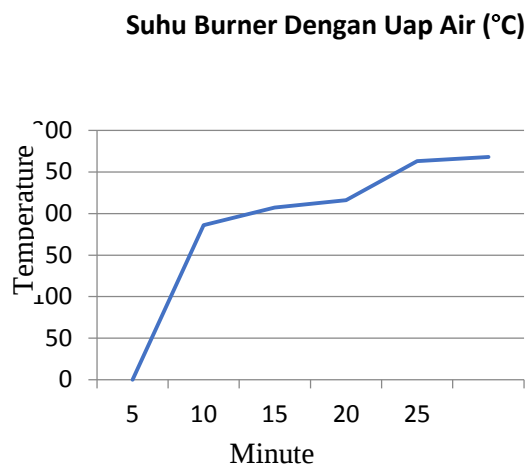


Figure 7.Burner Temperature Graph With Water Steam

The flame temperature, generated from the combustion of used fuel oil with water vapor pressure, was measured using an infrared thermometer at the flame outlet. Tests were conducted every 5 minutes over a 25-minute experiment with 0.3 liters of fuel oil. Results showed a continuous increase in flame temperature from 186°C at the 5th minute to 268°C at the 25th minute, exceeding 200°C and indicating a positive rate of increase

2) Burner Temperature Testing Without Steam

Table 5.Burner Flame Temperature Without Steam

Test	Time (Minutes)	Burner Temperature (C)
1	5	151
2	10	157
3	15	151
4	20	173
5	25	188

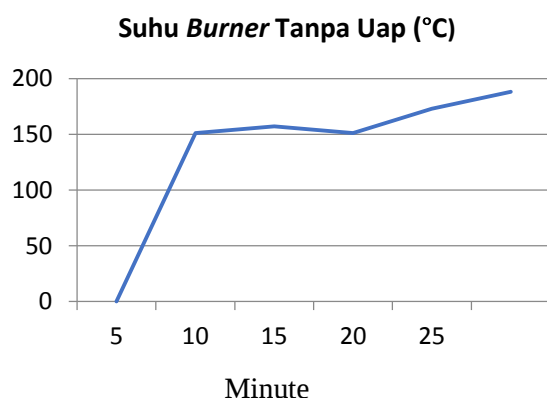


Figure 8.Burner Temperature Graph Without Steam

This test was conducted every 5 minutes in a 25-minute experiment with 0.3 liters of used oil used. From the performance test data conducted on the burner without water vapor, the results obtained in the 5th to 10th minute, the flame temperature increased continuously from 151°C to 157°C, indicating a positive rate of flame temperature increase. In the 10th to 15th minute, the flame temperature decreased to 151°C, indicating a negative temperature increase. In the 15th to 25th minute, the temperature increased from 157°C to 188°C. During the 25 minutes of the flame burning using the burner without water vapor, the measured flame temperature only reached 188°C lower than the burner using water vapor which exceeded the temperature above 200°C.

b. Length of Time the Fire Burns



Figure 9.Length of time the fire burns

The duration of the flame burning is the duration of the flame burning in the test of a used oil burner with water vapor pressure and without water vapor in waste combustion.

1) Flame Burning Time in Used Oil Burner with Water Vapor Pressure

The flame burning time in the used oil burner test with water vapor pressure was measured using a stopwatch, starting at the five-minute mark, when steam began to emit after preheating to boil the water in the cylinder. The resulting time was 25 minutes using the same 0.3 liters of used oil.

2) How long the flame burns on a burner without steam

The flame burning time in a test burner using used oil without vapor pressure was measured every 5 minutes using a stopwatch until the fuel ran out and the flame went out. The resulting time was 25 minutes using the same 0.3 liters of used oil.

C. Burning Speed

The rate of waste incineration can be calculated by comparing the weight of the waste incinerated with the burning time, multiplied by the number of hours. In this performance test using a used oil burner with water vapor pressure, the waste used was 8 kg of household waste, which burned in 25 minutes, resulting in a rate of 19.2 kg/hour.

$$KP = \frac{\text{Bobot Sampah Rumah Tangga}}{\text{Waktu Pembakaran}} \times 60 \text{ Minutes} \\ = 19.2 \text{ kg/Hour}$$

d. Combustion Residue



Figure 10. Combustion Residue

The residual yield is used to determine the perfection of the waste incineration process. The parameters measured to obtain the residual yield are the mass of ash/charcoal from the combustion and the mass of the waste burned. The value of the residual yield is calculated by comparing the total mass of waste minus the mass of the waste combustion residue. In this performance test, the mass of waste burned was 8 kg with the resulting combustion residue of 0.9 kg. So the shrinkage resulting from burning waste using a used oil-fueled burner with water vapor pressure is 7.1 kg with a waste combustion efficiency of 88.75%.

- 1) Efficiency of Waste Combustion Using Used Oil Burner with Water Vapor Pressure.

Waste Incineration Efficiency:

$$\times 100\% \frac{\text{Jumlah Penyusutan}}{\text{Bobot Sampah}} = \frac{7,1}{8} \times 100\% \\ = 88.75\%$$

Meanwhile, the shrinkage resulting from burning waste using a used oil-fueled burner without water vapor pressure is 6 kg with waste burning efficiency reaching 75%.

- 2) Efficiency of Waste Combustion Using Used Oil Burner Without Water Vapor.

Waste Burning Efficiency:

$$\times 100\% \frac{\text{Jumlah Penyusutan}}{\text{Bobot Sampah}} = \frac{6}{8} \times 100\% = 75\%$$

e. Effect of Water Vapor



Figure 11. Changes in Fire Quality

Based on the data analysis in Figure 4.17 above, water vapor can affect burner performance, such as increasing flame intensity along with the released steam pressure. Furthermore, water vapor can also reduce thick smoke emissions resulting from the combustion of used oil. The oxygen and hydrogen content in the water vapor can improve the quality of the resulting flame. The results of the tests conducted on the effect of water vapor on the flame are consistent with previous research conducted by Nugroho et al.

2. Comparison of Burner Tests Fueled by Waste Oil and Water Steam with Burner Without Steam

Comparison of the two burners to determine which burner is more efficient in reducing the volume of waste burned by knowing the shrinkage of waste produced with the same burning time.

Burner Fueled by used oil with water vapor pressure

The comparative test of the used oil burner and water vapor with the burner without water vapor begins by first lighting the burner flame until the burner is fully lit with the help of 100°C water vapor pressure. Then the waste is put into the waste combustion chamber with a capacity of 8 kg of waste in the use of 0.3 liters of used oil fuel using 3 liters of water as a steam generator, so that the efficiency of the waste reduction results is obtained from the initial amount of waste entered minus the remaining waste combustion results. The results of the used oil fuel burner test with additional water vapor pressure were carried out 2 times

and the experimental results can be seen in the table below.

Table 6. Experimental Test 1 on Used Oil & Steam Burner

No	Observed Performance	Used Oil Test Results With Steam
1	Flame temperature (°C)	286
2	Amount of waste reduction (Kg)	8-0.9= 7.1
3	Boiling temperature of water/steam (°C)	100
4	How long the fire burns (Minutes)	25
5	Fuel capacity (Liters)	0.3

Table 7. Experimental Test 2 on Used Oil & Steam Burners

No	Observed Performance	Used Oil Test Results With Steam
1	Flame temperature (°C)	216
2	Amount of waste reduction (Kg)	8-1.4= 6.6
3	Boiling temperature of water/steam (°C)	100
4	How long the fire burns (Minutes)	25
5	Fuel capacity (Liters)	0.3

Burner Fueled by Used Oil Without Water Vapor

The comparison test of the used oil burner and water vapor with the burner without water vapor begins by first lighting the burner flame until the burner is fully lit. Then the waste is put into the combustion chamber with a capacity of 8 kg of waste in the use of 0.3 liters of used oil fuel, so that the results of the waste shrinkage are obtained from the initial amount of waste entered minus the remaining results of the waste combustion. The results of the used oil fuel burner test without water vapor pressure were carried out 2 times, the test results can be seen in the table below.

Table 8. Experimental Test 1 of Used Oil Burner Without Water Vapor

No	Observed Performance	Test Results of Used Oil Without Steam
1	Flame temperature (°C)	157
2	Amount of waste reduction (Kg)	8-2 = 6
4	How long the fire burns (Minutes)	25
5	Fuel capacity (Liters)	0.3

Table 9. Experimental Test of the 2nd Used Oil Burner Without Water Vapor

No	Observed Performance	Test Results of Used Oil Without Steam
1	Flame temperature (°C)	188
2	Amount of waste reduction (Kg)	8-2.5 = 5.5
4	How long the fire burns (Minutes)	25
5	Fuel capacity (Liters)	0.3

It can be concluded that from table 8 and table 9 that the test results on the burner fueled by used oil with water vapor pressure can be seen that the burning of waste achieved a shrinkage of 7.1 kg and 6.6 kg with a burning time of 25 minutes and a flame temperature of 286°C and 216 °C.

After testing the results on a used oil-fueled burner with water vapor pressure, then testing was carried out on a used oil burner without steam. It can be concluded that table 4.4 and table 4.5 of the test results on a used oil-fueled burner without water vapor pressure can be seen, that the combustion of waste achieved a shrinkage of 6 kg and 5.5 kg with a burning time of 25 minutes with a flame temperature reaching 157 °C and 188 °C.

Based on the results of the two burners that have been tested above, it can be concluded that the amount of shrinkage of 8 kg of waste burned in a used oil burner with water vapor pressure is more shrinkage than the used oil burner without water vapor with a difference of 1.1 kg. This can be proven in the best experimental results in the first experiment, namely to burn 8 kg of waste in 25 minutes experiencing a shrinkage of 7.1 kg, so that the efficiency of waste combustion reaches 88.75% in a used oil burner with water vapor

pressure. While the used oil burner without water vapor obtained the best results for burning 8 kg of waste in 25 minutes experiencing a shrinkage of 6 kg, so that the efficiency is 75% lower than combustion using a used oil fuel burner using water vapor pressure. So a comparison was obtained on the two burners to find out which burner is more efficient in reducing the volume of waste burned by knowing the shrinkage of waste produced with the same combustion time.

5. Conclusion

1. This study shows that the use of used oil-fired burners with added water vapour increases the efficiency of waste combustion to 88.75%, higher than burners without water vapour.
2. The application of water vapour was shown to reduce flue gas emissions, increase flame temperature, and reduce the volume of waste remaining at the same combustion time.
3. The novelty of this research lies in the design of a portable burner without a blower that utilises water vapour as a medium to increase flame intensity. This is different from previous studies that still rely on blowers as an additional oxygen supply.
4. Thus, this research provides an alternative tool technology for waste burners that is more environmentally friendly, simple, and energy efficient, and can be the basis for the development of small-scale waste burner stoves in the future.

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