

Design Environmentally-Friendly Incinerator and Hybrid Smokeless Incinerator Sorong of Merchant Marine Polytechnic

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ABSTRACT

The problem of waste is the subject of discussion from time to time, waste that is not managed properly has a negative impact on the environment. There needs to be a waste management system so that waste problems can be suppressed and overcome, the most effective method of overcoming waste is burning but the results of burning will cause pollution that can pollute the air and can affect the environment. In an effort to overcome the problem of environmentally friendly waste, the Sorong of Merchant Marine Polytechnic designed a waste handling system through the Design of Environmentally-Friendly and Hybrid smokeless incinerators whose work system uses smokeless combustion using "hybrid power" sources, solar cell and power plant company. This research uses qualitative methods referring to previous research. The Incinerator working system is to process waste in an environmentally friendly process using the automatic combustion method to turn waste into residue through several levels of filtering in the "incinerator chamber". The combustion of waste will also cause smoke and gas which will be flowed by the "blower" then suppressed and eliminated using the "smoke and gas remover" system by isolating it in a room with a spray and sprinkle device that is driven by high-pressure water power from the "water pump". There are two filtration systems in this incinerator system, first "gas filtration" which is used to capture and trap harmful gases, second water filtration is used to filter waste water (aerosols) from the smoke and gas remover process, clean water filtering results will be accommodated and recirculated to the "smoke and gas remover" using a "water pump". The "Hybrid power" source in this tool is used to drive the "conveyor", "automatic waste door", "automatic lighter", "blower" and "water pump".

INTRODUCTION

Higher education contributes directly to the development, application and sustainable initiatives and is able to reflect knowledge and social relations, as well as enabling a change of perspective, understanding and production beyond the present, with new visions of the future and new actions. (Berchin et al., 2021).

Municipal waste includes a large proportion of food waste, paper, plastic, wood, textiles, etc. (Brunner and Rechberger, 2015; Sun et al., 2016). Currently it is 2.01 billion tons per year, and the amount is expected to increase to 3.40 billion tons by 2050 (Kaza et al., 2018). With incineration, waste volume can be substantially limited to approximately 85-90%, mass to 60-90%, and organic matter to almost 100% (Fruegaard and Astrup, 2011; Leckner, 2015). From 2006 to 2018, the amount of waste treated by incineration jumped rapidly from 11.4 to 101.8 million tons, which replaced a near nine-fold increase. (European Union, 2020; Zhang et al., 2021).

Combustion is the process of solving waste that is easy to implement. This system is one of the reasons why many decide to utilize the combustion process as a solution to solid waste problems, especially hazardous waste. Combustion is the process of recombination between fuel (biomass, oil, etc.) and oxygen or also known as oxidation (Adia Nuraga G.P, 2011). Incineration is a waste treatment mechanism that can destroy hazardous components, reduce the volume of waste by 5-15% to ash and can produce energy (Chandra et al. 2021; wang et al., 2022) Incinerator is a combustion furnace that is used as a solid waste processor that turns into gas and ash material (bottom ash and fly ash). The treatment of waste through the incineration process can reduce the volume and mass and reduce hazardous waste that is infectious. The aspects that play an important role in incineration are the combustion temperature and the duration of the combustion process. Incinerator instruments in combustion activities that occur can produce temperatures of 815oC to 1095oC (Latief, 2012). In an effort to handle waste, Sorong of Merchant Marine Polytechnic seeks to realize the development of waste treatment using an environmentally friendly incineration process without smoke through research on the design of environmentally-friendly and hybrid smokeless incinerators.



LITERATURE REVIEW

From previous research, the Incinerator Working Principle has 4 (four) stages. First, the waste enters the furnace as fuel for the combustion process. Second, the combustion smoke stream from the furnace enters the filter and exits the gas filter. Third, water from the tube is pumped into the spray or rotary sprinkle, then the water condenses the smoke so that it becomes dirty. Fourth, it means that electricity flows from the solar panel to the battery. The power socket flows from the socket to the blower and pump. If using electricity from a power plant, the electricity flows to the socket and continues to the blower and pump. (Riyadi S. et al., 2019).

Conveyor

Conveyors are mechanical hardware that acts as a cargo transportation instrument that processes systematically, efficiently and effectively to send material from one place to another intended place (Reddy, 2018).

In this incinerator design using a roller conveyor where the motion path consists of several rolls with a flat plate placed on the frame to hold the load with the direction of movement in the direction of rotation of the roller. The load capacity is around 350 N per roll conveyor. The material chosen can be made of stainless steel. (Siahaan et al., 2022). Automatic incinerator door, the door for the incinerator will open and close automatically if there is garbage rising on the conveyor then the door will automatically open and after the garbage enters the door will automatically close through the sensor on the conveyor.

Burner Incinerator

The incinerator burner is a device that has a high temperature to burn waste, the combustion process is called incineration. Incineration is a combustion process at temperatures between 800 ° C and 1,000 ° C which is used to treat solid waste in order to reduce the amount of waste that can no longer be recycled and is flammable and can eliminate viruses and bacteria. (Pungut et al., 2022).

Automatic combustion incinerator compartment, where the compartment contains an igniter with electrodes that produce sparks. Sensors that detect waste and fall into the incinerator box with the help of a DC motor and when it is fully charged, it automatically generates sparks and burns the waste completely inside the box and turns it into ash. The spark is generated only once, when the bin is fully filled. (Leninpugalhanthi et al., 2021).

Blower

A blower is a device that functions to increase or increase the pressure of air or gas that will be flowed in a certain room and suck certain air or gas where the blower manifests a relatively high pressure ratio along with a larger volume of gas flow. The blower is used as an oxygen supply in the combustion chamber. (Umurani et al., 2020)

Filtration

The basic view of filtration is to sort solid molecules that combine in solution, so the level of purity of the filtrate obtained from filtration depends on the quality of the filter pores used. (Parahita, 2018). Filtration in this research is used to filter gas and water.

Solar Cell Power

Photovoltaic is an event due to the electric voltage caused by the relationship between two electrodes with a solid or liquid system due to light energy. Based on the working process of solar cells, people call solar cells the photovoltaic effect. Photovoltaic power generation systems have cell components, mechanical connections, electrical connections and means of regulating and/or changing the electrical output. This system is calculated in units of kilowatt peak (kWp) which describes the desired amount of electrical power that can be obtained from the solar system when in sunny conditions directly overhead. (Parida et al., 2011).

Simply explained, solar cells on solar panels will absorb sunlight and convert it to DC current electricity. Then, the inverter on the solar panel part will convert the DC current into AC current and create an electric current. then the electricity generated is stored in the battery. Listrik is then channeled through cables to the desired electrical appliances.

METHOD

The research method used in this research is qualitative referring to previous research. Qualitative research methods are research methods based on the philosophy of positivism or interpretive for natural object conditions, where the researcher is the key instrument, data collection uses triangulation (combined) techniques, data analysis is qualitative and research results focus more on meaning than generalization. (Sugiyono et al, 2019). Previous research in this study was used as a reference for researchers in conducting this research, reviewing and developing data and previous research results. the final results in this study are used to determine the design and working system of the environmentally-friendly and hybrid smokeless incinerator tool at the Sorong of Merchant Marine Polytechnic which further aims to solve waste problems and also waste management efforts through the incineration process where the



process of burning waste which causes air pollution in survival can be suppressed and overcome.

RESULT

The waste process enters the incinerator chamber through a conveyor and automatic waste door. The combustion process is carried out automatically with an automatic lighter and the results of combustion in the form of residue will be filtered using residue filtration and accommodated into the residue tank. The combustion results will also produce smoke which is flowed using a blower to the smoke and gas remover tool. Harmful gases from the results of the tool will be filtered using gas filtration.

Smoke and gas remover works using water media that is pumped from the water tank and flowed to the spray and rotary sprinkle located in this tool. The resulting waste water will be filtered using a water filtration device and flowed back into the water tank. The mechanism of hybrid power Enviromentally-Friendly Incinerator And Hybrid Smokeless Incinerator Sorong of Merchant Marine Polytechnic is to drain electricity from the solar panel to the battery and flow to the socket or electricity from the power plant company is flowed to the socket. The electricity is flowed to drive the water pump, blower, automatic lighter, automatic waste door and conveyor.

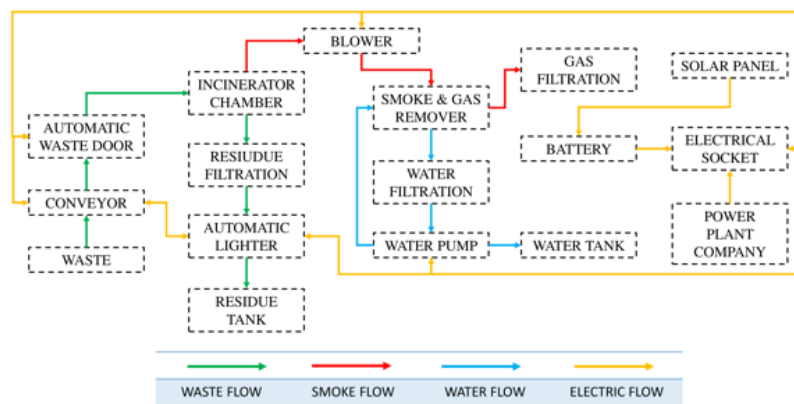


Fig. 1 The Incinerator Working Mechanisme

DISCUSSION

The final design Enviromentally-Friendly Incinerator And Hybrid Smokeless Incinerator Sorong of Merchant Marine Polytechnic can be seen in Fig. 2 below:

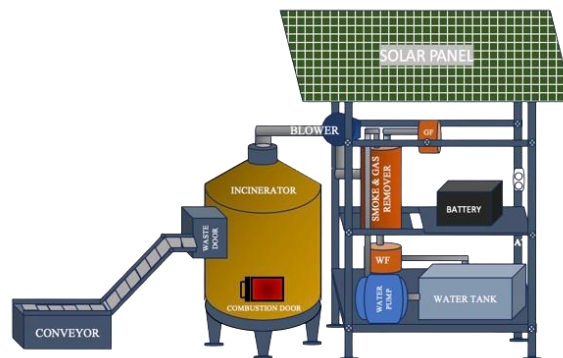


Fig. 2 Final Design

The main instruments in the working principle of this incinerator design are:

Incinerator Chamber

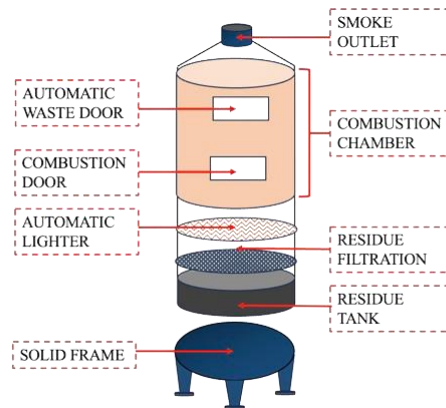


Fig. 3 Incinerator Chamber Design

Incinerator Chamber Design In Fig. 3, describes several components of the incinerator chamber, namely the automatic waste door which is used as a place for the entry of waste that has been transported by the conveyor, with a door that can open and close automatically. Combustion Chamber is used as a waste combustion chamber. Automatic lighter is used to automatically light a fire to burn waste. Combustion Door is used to monitor the combustion process. Residue Filtration is used to filter between waste and residue, residue tank is used as a place to accommodate residue from burning waste that is filtered before and smoke outlet is used as a place to release smoke from burning.

Smoke and Gas Remover

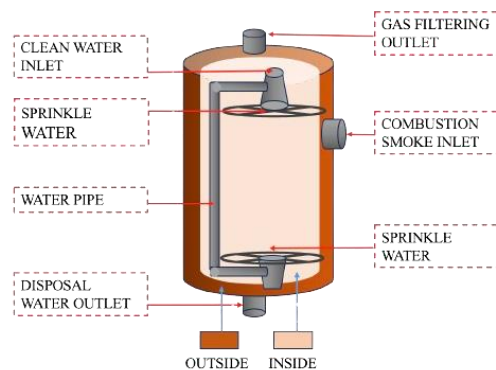


Fig. 4 Smoke and Gas Remover Design

Smoke and Gas Remover in Fig. 4 is used to remove smoke and gas using water media. When smoke and combustion gas are flowed into this tool, two sprinkle rotors driven by water pressure coming from the water pump will then spray water from the upper and lower sides. Furthermore, the smoke will condense because of the water. This process causes the water to become dirty because it is mixed with smoke particles (aerosols), besides that it also causes a change in the color of the water to yellow-black. The environmentally friendly mechanism results in the smoke coming out as fresh air.

Gas Filtration

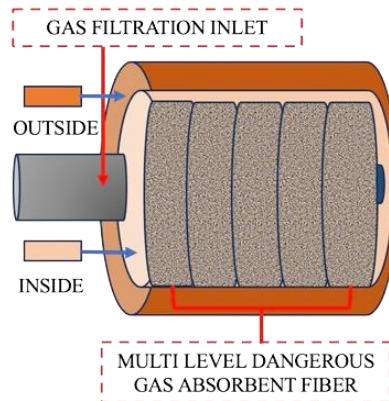


Fig. 5 Gas Filtration Design

Gas Filtration in figure 5. Describes the gas filtration system. Fiber filtration is arranged in several levels so that it can absorb, trap and filter harmful gases resulting from smoke and gas remover.

Water Filtration

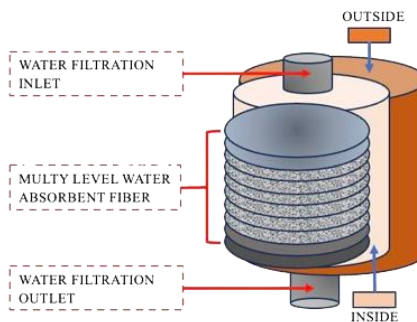


Fig. 5 Water Filtratin Design

Water filtration in figure 5. explains the water filtration system, processing waste water (aerosols) from the gas and smoke remover system into clean water and then accommodated in a water tank and circulated using a pump to the Smoke and Gas Remover tool so that water usage can be efficient.

Hybrid Power

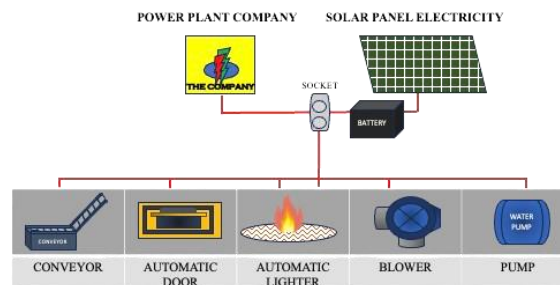


Fig. 6 Hybrid Power Design

Hybrid power in figure 6. is used as a power source to power the conveyor, automatic waste door, automatic lighter, blower water pump. The main source of electricity is obtained from solar panels and secondly from the power plant company. When solar cells on solar panels absorb solar heat, the heat is converted into electricity, then the electricity is stored in batteries. In addition, electricity is sourced from the power plant company. The two electrical systems will be used separately. The electricity from the power plant company will be used when weather conditions

are unfavorable (cloudy, rainy, stormy, etc.). Therefore, this mechanism will save the operational cost of the electricity used.

CONCLUSION

This research is based on the role of Sorong of Merchant Marine Polytechnic as a university that supports environmentally friendly waste treatment mechanisms and sustainable technology development.

Design Environmentally-Friendly and Hybrid Smokeless Incinerator Sorong of Merchant Marine Polytechnic uses hybrid power by utilizing electricity from solar panels and also Power plant Company.

The main electricity in this incinerator design uses solar panels and the second uses a power plant company and not all tools in this incinerator use electricity. The use of water media serves as a means of removing smoke and gas that circulates continuously. There are two filtration systems in the incinerator design gas filtration and water filtration.

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