

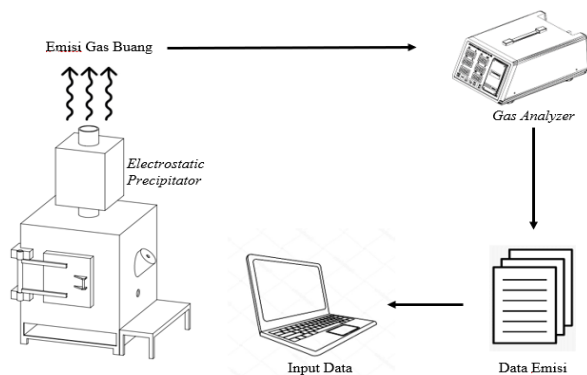
DECOMPOSITION OF EXHAUST EMISSIONS FROM THE PORTABLE INCINERATOR

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Graphical abstract



Schematic Diagram of Experimental

Abstract

Combustion is a chemical process called exothermic reaction, where all chemical reaction involves energy to break bonds in reactants, and energy is released when new bonds form in products. The combustion process that occurs in the incinerator is an exothermic reaction where hydrocarbon reacts with oxygen to produce heat, carbon dioxide (CO₂), and water vapor. However, in general combustion process that occurs is usually an imperfect reaction that creates harmful gas emissions. In this research, the author uses an electrostatic precipitator to filter emissions produced by the incinerator. An incinerator is a furnace used to treat solid waste, then turn it into gas, and ashes (fly ash and bottom ash). The experiment compares the combustion emission with the usage of ESP and without ESP. The experiment used a portable gas analyzer to gather emission data. The result of this research shows that ESP can reduce emissions from incinerator by 41% in filtering carbon monoxide (CO), 18% in filtering hydrocarbon (HC), and 11% in filtering carbon dioxide (CO₂). The oxygen value increases by 8% in ESP turned-on condition.

Keywords: exhaust emissions, combustion, electrostatic precipitator, incinerator

Abstrak

Pembakaran adalah proses kimia yang memiliki reaksi eksotermik, dimana semua reaksi kimia melibatkan energi untuk memutuskan ikatan dalam reaktan, dan energi dilepaskan ketika ikatan baru terbentuk dalam produk. Proses pembakaran yang terjadi pada insinerator merupakan reaksi eksotermik dimana hidrokarbon bereaksi dengan oksigen menghasilkan panas, karbon dioksida (CO₂), dan uap air. Namun pada umumnya proses pembakaran yang terjadi biasanya merupakan reaksi tidak sempurna sehingga menimbulkan emisi gas berbahaya. Pada penelitian ini penulis menggunakan alat electrostatic precipitator untuk menyaring emisi yang dihasilkan oleh insinerator. Insinerator adalah tungku yang digunakan untuk mengolah limbah padat, kemudian mengubahnya menjadi gas, dan abu (fly ash dan bottom ash). Eksperimen tersebut membandingkan emisi pembakaran dengan penggunaan ESP dan tanpa ESP.

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Ekspirimen tersebut menggunakan alat analisa gas portabel untuk mengumpulkan data emisi. Hasil penelitian menunjukkan bahwa ESP mampu menurunkan emisi dari insinerator sebesar 41% dalam menyaring karbon monoksida (CO), 18% dalam menyaring hidrokarbon (HC), dan 11% dalam menyaring karbon dioksida (CO₂). Nilai oksigen meningkat sebesar 8% dalam kondisi ESP dihidupkan

Kata kunci: Gelombang yang terhasil dari kapal; Tinggi gelombang; sudut gelombang

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1.0 INTRODUCTION

Combustion is a chemical process in exothermic reaction, where each chemical substance that reacts involves, energy used to break bonds in the reactants, and energy released when new chemical bonds are formed. However, a chemical reaction called endothermic reactions, that a less energy is released when new bonds are formed than the energy needed to break bonds in the reactants. The combustion process in an incinerator, an exothermic process occurs where hydrocarbons and oxygen combine to produce heat, carbon dioxide and water vapor. However, in general the combustion process that occurs is an incomplete combustion. The incomplete combustion will produce dangerous gases including carbon monoxide (CO), which occurs due to an imbalance in the reaction between hydrocarbons and oxygen.

The pollutants by combustion process such as carbon dioxide and carbon monoxide are very dangerous if released in large quantities into the atmosphere [1]. The one of research on reduce air pollution is using filter of exhaust gases through an ionization process. Ionization is the process of adding an electron to an atom or molecule to form an ion. In the ionization process involving carbon dioxide and carbon monoxide pollutants, the molecules will decrease or increase of electrons which causes a chemical reaction that forms new molecules that make carbon dioxide and carbon monoxide ionized [Melo, 2015]. The ionization can be developed by using an electrostatic precipitator. This research we installed an electrostatic precipitator technology into filter of the exhaust gas to ionized the molecules for reduce of exhaust gases in the Incinerator.

2.0 METHODOLOGY

The research was conducted an incinerator capacity 25 kg at the Untirta Sindangsari campus and equipped with an ESP system. The waste used is plastic waste, leaves and paper from campus waste. The voltage 5 until 35 kV (DC) from a DC power supply high-voltage is supplied to the plate and wire rod. The high voltage is required to produce a corona discharge which is caused by ionization of the aerosol particles surrounding a conductor. The

corona power is a result from the current and voltage applied to produce an electric field. Particles through an electrode wire with a high negative charge will be negatively charged (carry negative charge) and will be attracted to another electrode plat with a positive charge. ferries and sampans.

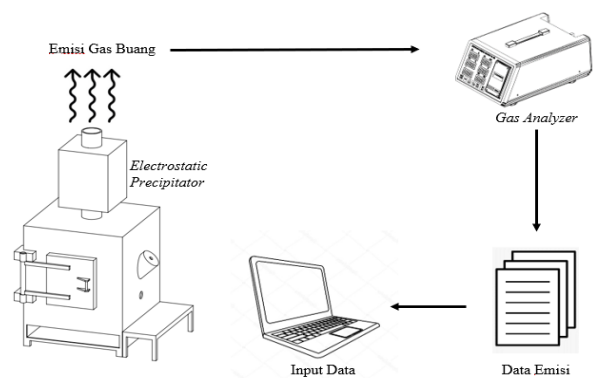


Figure 1. Schematic Diagram of Experimental

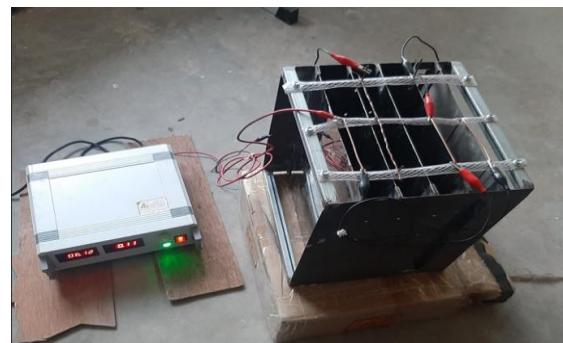


Figure 2. ESP Filter

ESP comprises of five units plat, each having eight vertical wires (stainless steel, length 30cm and diameter 0.1mm) connected to a DC high voltage supply and connected to the ground. The plate electrodes for collection are made of stainless steel due to the aggressive gases and fumes, and also to avoid oxidation which will be caused by the use of water for washing.

3.0 RESULTS AND DISCUSSION

Analysis of Carbon Monoxide (CO)

The experimental results show in table below. The data was compared between using ESP and without ESP. The results shows that the using ESP the CO emissions was significantly reduce by 43%. This is because of Carbon Monoxide inside the exhaust gas destructing into other gases caused by electrostatics effect

Analysis of HC Emissions

The experimental results of HC emissions is shown in table and figure below. The data was compared between using ESP and without ESP. The results shows that the using ESP the HC emissions was decrease by 18% in average for the three of experiments.

Analysis of CO₂ Emissions

The experimental results of CO₂ emissions is shown in table and figure below. The data was compared between using ESP and without ESP. The results shows that the using ESP the CO₂ emissions was decrease by 10% in average for the three of experiments.

During the ionization processed by electrostatic precipitator, an electroreduction phenomenon occurs in carbon dioxide (CO₂). The molecules of CO₂ will split into new molecules, namely; formic acid, carbon monoxide (CO), methanol (CH₂OH), methane (CH₄), ethylene (C₂H₂), and ethanol (C₂H₅OH), an illustration of the electroreduction process can be seen in the following picture [3].

Analysis of Filter Plat of ESP

The plate filter for the ESP used is a stainless steel because it has good durability at high temperatures and good electrical conductivity [4]. The experimental data shows the temperature inside the ESP reaches 400⁰ C. Figure 6. shows one of the ESP filter plates in the condition before burning.



(a)



(b)

Figure 3. The Visualization of Filter ESP (a) before experiment and (b) after experiment

4.0 CONCLUSION

The research on reduces of exhaust emissions of incinerator using electrostatics precipitator is examined. The research experimental consist of three combustion experiment with and without ESP filter. The results show that using ESP filter the CO, HC and CO₂ emissions were reduces at 43%, 18% and 10% respectively compare without ESP. The ESP filter can be implemented on incinerator for ensure the environmental sustainability.

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