

Vehicle Exhaust Purification by Chemical Process

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ABSTRACT

Pollution has always been a menace to our environment. Air is the most susceptible to pollution. A major part of air pollutants consist of the exhaust of vehicles. While measures have been taken to suppress the amount of these pollutants entering the atmosphere, it is either ineffective or too expensive. An alternate solution to this problem can be the chemical purification of the exhaust gases. The setup described here has a 4-stage filtering mechanism for utmost reduction of harmful particles present in the exhaust. The first stage involves bubbling of the exhaust through water to remove any particulate matter. In the second phase, the moist gas is passed through sulphuric acid, resulting in the elimination of any bacteria and oxidation of harmful chemicals like Carbon monoxide. The third stage involves the subsequent conversion of these oxides to their respective bases with the help of sodium hydroxide. In the last step, neutralization of carbon dioxide is ensured by passing the gas through lime water. This is a cost effective solution to the increasing amount of pollutants in the atmosphere due to motor exhausts. If implemented, we can ensure a more sustainable and breathable air for the years to come.

Keywords: Environmental issues, Air pollution, Solar Energy, Chemical process.

I. INTRODUCTION

The release of **air pollutants** into the atmosphere is called air pollution. These **pollutants** mainly consists of gases or particulate matter and can they can be obtained from various sources. It occurs when harmful or excessive quantities of substances including harmful gases, particulates and biological molecules are introduced to earth's atmosphere. Carbon monoxide, sulphur dioxide, nitrogen oxides, ozone, particulate matter and lead are some of the major contributors of air pollution.

A major pollution contributor, Passenger vehicles produces significant amounts of nitrogen oxides, carbon monoxide, and other pollutant. Out of all the

major contributors Seventy-five percent of carbon monoxide is produced by the emissions of automobiles. In urban areas, harmful emissions produced from automotive are responsible for anywhere between 50 and 90 percent of **air pollution**. That's quite a lot of polluted air coming from our vehicles. By reducing vehicular emissions, we can cut down more than half of the pollutants in air.

Our implementation uses a passive and self-efficient way to reduce the emissions. Vehicular exhaust consists mainly of carbon components. Out of these Carbon dioxide, released as a consequence of fuel combustion along with water, is a passive component. However this happens only when the efficiency of the engine is 100% i.e. an ideal engine. In non-ideal

engines, however, in addition to CO_2 , active components like Carbon monoxide are released. This is due to the incomplete combustion of the fuel in the engine.

II. METHODS AND MATERIAL

For the experimental setup, the following components were used:

- Airtight containers
- Intake fan (Voltage rating=12V)
- Transmission pipe
- Solar panel (Output Voltage=12V)

The following chemicals were utilised for the purification of the exhaust gas:

- Water
- Sulphuric acid- H_2SO_4 (98%)
- Sodium Hydroxide AR grade - NaOH (5%)
- Lime Water- CaOH (5%)

III. DISCUSSION

Initially, the exhaust is taken through the intake fan. The exhaust is then passed through a 4-stage purification process. The processes are as follows.

A. Stage-1

The raw exhaust is taken through the transmission pipe submerged in water. This exhaust is bubbled through water. Due to this, particulate matter present in the exhaust is removed and these form a sediment.



Figure 1. The air is sucked through intake fan.

B. Stage-2

The particulate-free gas is then passed through concentrated sulphuric acid. In this stage microorganisms and other harmful gas molecules are removed. In addition to this sulphuric acid also removes the moisture content present in the gas.



Figure2. The intake air is passed through water and H_2SO_4 .

C. Stage-3

The dry gas is then passed through Sodium Hydroxide (NaOH). NaOH is a strong base which facilitates conversion of carbon molecules into their respective carbonates. These carbonates thus formed are salts and are stable.



Figure 3. This air is then bubbled through NaOH.

D. Stage-4

The gas is then bubbled through Lime Water (CaOH) which turns milky indicating that Carbon Dioxide (CO_2) is converted into Calcium Carbonate (CaCO_3). Thus the exhaust is purified by 4-stage chemical process.



Figure 4. This air is finally passed through lime water which turns milky and the bag which was filled with air is completely transparent.

IV. OBSERVATION

For this experiment the fumes produced by burning paper was passed through the setup.

A transparent plastic bag was attached to the outlet. It was observed that the gas filling the bag was completely transparent unlike the blackish fumes of the burnt paper.



Figure 5. Experiment setup.

V. CONCLUSION

This experiment demonstrates the purification of exhaust by chemical process. The transparent air filled in the bag indicates that the impure air is purified to a high degree. Hence it can be inferred that the exhaust gas of vehicles can be purified in a cost effective and efficient way through chemicals and this method can be used to purify the air to high degree.

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