

# Design, Fabrication and Analysis to Reduce Carbon Monoxide Emission from Home generator set using coated stainless pipe.

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**ABSTRACT:** The emission from home generator set is becoming a serious problem to the environment. Hence, it is necessary to avoid the emission and accumulation of CO. In this research, an investigation of carbon monoxide (CO) from home generator set using coated stainless pipe has been performed, and there are many ways to reduce the pollution, by making advancement in engine configuration, using adsorbent materials in the exhaust manifold. In this regard the concentration of CO were measured. The research was carried out under five different load condition and the result has shown that during 0 load (idling) CO levels were drastically reduced by 0.12% using the absorber, it was also found that as the loading increases from 0.20KW, 0.30KW, 0.40KW and 0.50KW the absorption rate kept increasing by 0.14%, 0.19%, 0.24% and 0.31% respectively. The result shows that the amount of carbon monoxide (CO) emission reduced by 0.2%, after applying the material coating (cobalt metal). Hence using adsorbing materials in exhaust unit, emission of carbon monoxide clearly overcomes the drawbacks of the existing control techniques (post combustion). This assures the ideal operation of the absorber. The exhaust unit is cheap, effective way to lower idling CO emissions and loading conditions. It can be employed in any kind of home generator set irrespective of its engine.

**Keywords:** Carbon monoxide (CO), exhaust pipe, metal carbonyl, multi-gas analyser.

## I. INTRODUCTION:

Worldwide air pollution is caused due to the emission of harmful gases, Emission of these gases takes place mainly due to the incomplete

combustion of fuel and air mixture. The major emissions were carbon dioxide (CO<sub>2</sub>), carbon monoxide (CO), hydrocarbons (HC), oxides of nitrogen (NO<sub>x</sub>), oxides of sulphur (SO<sub>x</sub>) and particulate matter. NO<sub>x</sub> includes NO and NO<sub>2</sub> apart from CO, NO<sub>x</sub> and HC were known as the most likely harmful pollutants. Home generator sets and motor vehicles - cars, trucks, and buses are a major source of air pollution.

Gangadevi R, Vinayagam B. K., et al (2016). Developed a catalytic converter that reduces the exhaust emission into 90%. Narendran G. MusthaqAhamed P.A et al (2013) prevented the aggregation of CO around stationary vehicles. Hence, it is necessary to avoid the accumulation of CO around static vehicles in traffic signals, traffic jams and electrified parking spaces have a better reduction of fuel consumption and exhaust emissions compare with other technologies. NivedaLakshmanan (2015).

## II. MATERIALS AND METHODS

The research work aims to design a CO absorption mechanism inside stainless pipe attached to the exhaust pipe of home generator set. This absorption device is the CO scrubber (technical term for absorber). The scrubber will be used to capture the gaseous CO during different load conditions.

### Experimental Setup

#### • Exhaust Pipe Design

The exhaust pipe consists of a circular stainless steel pipe with inlet that is attached to the exhaust pipe and outlet.

• **Inlet pipe**

The inlet tube is a mild steel pipe with 38.3mm inner diameter (ID) and 40mm outer diameter (OD). The inlet pipe was coated with the absorbing/reducing material that will absorb/reduce the carbon content (carbon monoxide) from the exhaust. This contain absorbing material, which improves the rate of oxidation from the emissions released in the exhaust flow. Assembled exhaust unit absorbs the CO when flue gas is passed through it. The exhaust unit has to contain a sufficient amount of absorbing compound in order to effectively capture CO for a definite time. Based on extensive study and research, we came across several absorbents that have a high affinity to CO. These are inorganic chemicals that can capture several times its own volume of CO. The main necessity of these absorbents is the ability to withstand high temperature characteristic of the exhaust gases, and also have a high absorption capability.

$$A = \frac{\pi D^2}{4} \dots\dots\dots 1$$

Area of the inner and outer pipes  
 Wall thickness is 0.065” (1.7mm)

• **Metal Carbonyl**

The metal atom has the ability to absorb of 5 atoms of the carbon monoxide and forms a metal carbonyl. The good absorbing metals of CO are cobalt, iron and nickel, etc.

A single gram of the salt has the ability to absorb 19 grams of carbon monoxide. This absorbent is used in water-gas treatment and for industrial purposes. The cuprous ammonium salt may be acetate, formate, carbonate, nitrate, or ethanolamine nitrate. After considering all these parameters, the best CO absorbent was found to be pure cobalt metal. Normally metals have π-ligand bond, so another 2 electrons are needed. Most of transitional element(metals) combine with CO to form a metal carbonyl at a specified conditions. The compound formed by cobalt with CO is called Dicobaltoctocarbonyl. The conditions such as required pressure and temperature keenly affect the absorption of CO. Cobalt has melting of 1480°C. Moreover, it forms carbonyl only at a pressure of 20-60000 KPa, and the temperature at which it occurs is around 200-400°C. Hence, cobalt can sufficiently react with CO in the exhaust, which may range from 200-500°C on the test generator. Lastly, the carbonyl compound is said to be pyrophoric, which means it instantly disintegrates under room conditions. The setup will be devised

by taking this factor into account. To enables better utilization of metal for flexible purposes, the cobalt metal was purchased in the form of fine powder.

• **Test Generator set**

The test was carried out on the generator set, it was chosen with respect to ease of implementation and practicality. The generator set used was a 6.5 Hp Tiger model which has a 4-stroke single cylinder engine with a displacement of 74.6cc and an idling speed of 1400±100rpm.

• **Multi-Gas Analyzer:**

The scrubber (CO absorber/exhaust unit) is going to be fitted to the generator set using a flange and secured. The generator set was operated under different load conditions to test the absorber’s effect on the performance.

It was found that during idling, the CO levels were drastically reduced by 0.12%. Now the reading recorded was 4784 ppm of the engine exhaust. This is considerably lower than the previous reading of 4800 ppm taken without the absorber. This assures the ideal operation of the exhaust unit. The tests clearly indicate the reduction in CO emissions after the usage of absorber in the home generator set. This authenticates the viability of the exhaust unit and the absorption capability of cobalt metal. Hence, the absorber’s functionality is confirmed. It was noted that there was no abnormal emission characteristics while the absorber was under operation during idling.

**III. RESULTS**

**Table 4.1:** CO Emission under normal condition (without absorber)

LOAD(KW)	CO(PPM)
0	4800
0.20	5539
0.30	5900
0.40	6200
0.50	6800

**Table 4.2:** CO Emission under coated pipe (with absorber) condition

LOAD(K W)	CO(PP M)	%CO(PPM)ABSORBED
0	4784	0.12
0.20	5520	0.14
0.30	5873	0.19
0.40	6166	0.24
0.50	6757	0.31

### III. DISCUSSION OF RESULT

The exhaust emission system (Absorber) was tested with two different conditions (Table 4.1 and Table 4.2 above) in which the coated pipe was designed to reduce the emission of CO by some percentage from the home generator set. The result has shown that during 0 load (idling) CO levels were drastically reduced by 0.12% using the absorber, it was also found that as the loading increases from 0.20KW, 0.30KW, 0.40KW and 0.50KW the absorption rate kept increasing by 0.14%, 0.19%, 0.24% and 0.31% respectively. This assures the ideal operation of the absorber.

### IV. CONCLUSION

The research was carried out under five different load condition. The result shows that the amount of carbon monoxide (CO) emission reduced by 0.2%, after applying the material coating (cobalt metal). Hence using adsorbing materials in exhaust unit, emission of carbon monoxide clearly overcomes the drawbacks of the existing control techniques (post combustion). The exhaust unit is cheap, effective way to lower idling CO emissions and loading conditions. It can be employed in any kind of home generator set irrespective of its engine. Further, we desire to improve the absorption of CO by utilizing nickel or iron.

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