Investigation on emission characteristics of a hot-dip galvanizing 4-stroke single cylinder SI engine

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***Abstract*—The major pollutants emitted from spark ignition engine are carbon monoxide (CO) and unburnt hydrocarbons (UHC). These are hazardous and cause health problems to human beings, and hence control of these pollutants calls for immediate attention. It has been identified from the literature review that zinc coating inside the cylinder head and over the piston crown will reduce the emission and increase the overall performance. Hence, in this work piston is coated using zinc and experiment conducted. The vehicle engine is used for conducting experiment. The zinc coated engine is used to improve the engine, fuel consumption and emission (HC, CO,). The performance characteristics of the zinc coated engine also been studied.**

***IndexTerms*—100cc SI engine, zinc coating, 5 gas analyzer ,emission.**

INTRODUCTION

The engine manufacturer as well as automobile industry is facing a serious challenge to improve engine efficiency. Governments are legislating stricter fuel consumption regulations and consumers are purchasing more fuel efficient models to reduce their environmental impact and spending on dearer fuel. The major pollutants emitted from spark ignition engine are carbon monoxide (CO) and unburnt hydrocarbons (UHC). These are hazardous and cause health problems to human beings, and hence control of these pollutants calls for immediate attention. In internal combustion engines, the chemical energy of the fuel is converted to thermal energy during combustion. The losses are-loss through the engine exhaust, to the coolant and due to radiation. When fuel is supplied to the engine, heat is liberated and 30% of the heat supplied is lost through the engine exhaust, 30% of the heat supplied is lost to coolant. Zinc, which has thickness of 300 microns, is coated over piston crown and inside portion of the cylinder head of the spark ignition engine. A microprocessor-based analyzer is used for the measurement of CO/UHC in the exhaust of the engine. Hot-dip galvanization is a form of galvanization. It is the process of coating iron and steel with a layer of zinc by immersing the metal in a bath of molten zinc at a temperature of around 840 °F (449 °C)The hot-dip galvanizing is regularly done at over 450 °C ensuring that the zinc is in a molten state. This provides a durable, tough, corrosion-resistant and abrasion-resistant coating with even a cathodic (sacrificial) protection if by any reason the surface is scratched.

LITERATURE REVIEW

D. Jedrzejczyk et al (2010) decided to look at the high- temperature oxidation process from the point of view its influence on effects got during cast iron coating with Zn. The investigations of high-temperature corrosive resistance of cast iron have been led for ten years and they concern different aspects of this problem. The presented in literature results usually describe the structure of cast iron scale layer or analyze the influence of different factors (the chemical composition of cast iron, shape of graphite, etc.) on oxidation mechanism. The investigation of different grades of cast iron: with flake graphite, white, nodular and ductile showed that the oxidation kinetics and the scale layer morphology depend closely on size and distribution of flake graphite. With temperature increasing the process of oxidation accelerate, the scale layer porosity enlarges and the scale layer adhesiveness to metal core gets smaller. Hot dip galvanizing process is the most often used in industrial application to protect Fe-C alloys against corrosion influence of aggressive environment. [1]

Sepper, P. et al (2011) in this work hot dip galvanizing have improved significantly over the years, it is still a challenge to produce high-quality coatings for decorative and constructional applications. Different applications require specific appearance of galvanized coatings (e.g. dull appearance in roof construction). The appearance of the coatings depends on processing properties, steel content, and substrate surface conditions. The purpose of this study is to work out a technique how to evaluate the appearance of hot dip galvanized coatings. Under observation are substrate steel parameters (chemical composition, surface conditions e.g. roughness), which affect the appearance of hot dip galvanized coatings. Based on this research appearance classifications have been established. Hot dip galvanizing is used as a very effective steel corrosion protection method, providing a long service- life. [2]

Grayson K Dixon et al (2006) in this work galvanizing on steel surface provides excellent protection to the base metal. The life of galvanized coatings is directly proportional to the thickness of the coatings. Barrier protection plays a vital role in improving the life of the coated substrate. To improve the quality and the nature of galvanized coating of Zn on steel minor alloying elements such as lead, aluminum, surface passivators are added or gal annealing and other treatments are carried out. Zn, Zn-Pb, Zn-Al and interface Zn-Fe alloys are widely used to improve the quality of protective coatings. In the present work the effect of lead has been

studied using potentiodynamics. The quality of the Zn-Pb coating formed is also studied in terms of its adherence and other mechanical properties. Hot -dipped galvanizing sheet is produced commercially using galvanizing baths having a range of compositions. In general, most baths contain Al to minimize the thickness of the Fe/Zn alloy layer at the interface of the sheet and the galvanized layer and Pb to produce spangles and a better quality surface. [3]

EXPERIMENT

The experimental setups were carried out on single cylinder four stroke petrol engine (Hero Honda 100cc) as shown in fig.1. The Exhaust emission such as (HC, CO, CO2& O2) was measured by using Automotive Emission Gas analyzer. The specification of the engine used for conducting the experiments is tabulated in table 4.1.

Table 1 Specification of engine

Engine	Hero Honda
Displacement	100CC
Fuel	Petrol

The main pollutants which are objectionable and are to be reduced are HC, CO, CO2 and NOX by using catalytic coating as one of the techniques widely used to reduce emission and improve performance. 5 gas analyzer is used for measurement of HC, CO, CO_2, NO_X.

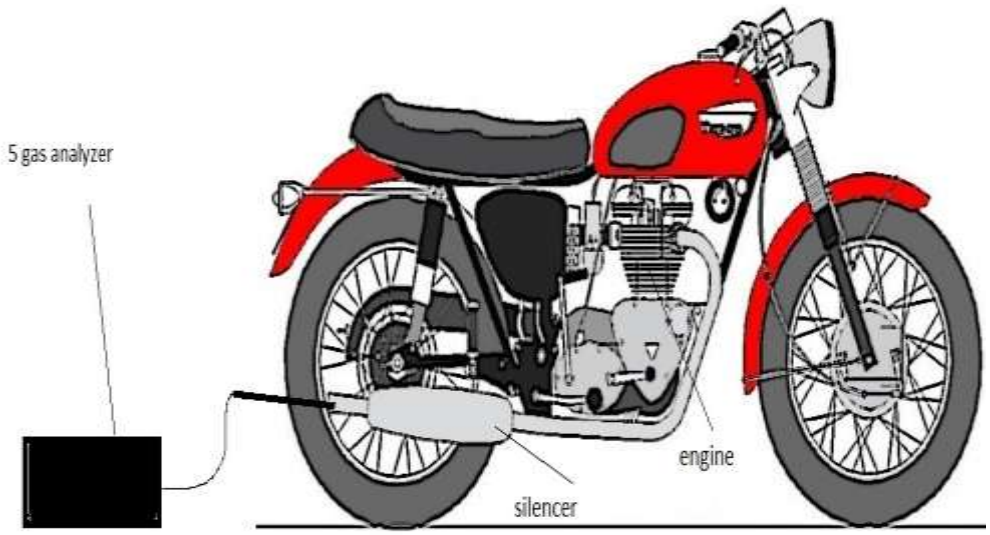

Fig.1 Experiment set up

3 Hot dip galvanizing process

The hot dip galvanizing process starts by suspending steel articles and dipping them into a series of cleaning baths as shown in fig.3. Once cleaned, the steel is lowered at an angle into a bath of molten zinc. Immersing the steel on an angle allows air to escape from vented tubular shapes or pockets that may be within the design and permits the molten zinc to displace the air. The steel reacts with the molten zinc to form the galvanized coating. After being withdrawn from the zinc, the final step in most hot dip galvanizing processes is a quench to promote passivation of the zinc surface as shown in fig.4.

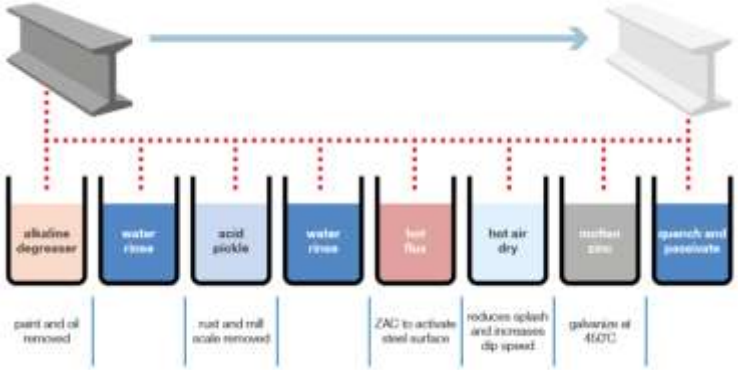

Fig.2 Hot dip galvanizing process

Fig.3 Hot dip galvanizing process on piston and cylinder head

Fig.4 Piston Crown and Cylinder Head with zinc coating

5 GAS ANALYZER

5 GAS analyzer measures five emission gases, including Hydrocarbons (HC), Carbon Monoxide (CO), Carbon Dioxide (CO2), Oxygen (O2) and Oxides of Nitrogen (NOX). Based on gas concentrations

Fig.5 Gas analyzer

RESULT

Two comparative results of CO and HC level in emission of engine by using 5 gas analyzer shown below in table 5.1.

Table 2 Result of emission

	Before coating	After coating
CO level in %volume	2.20	2.15
HC level in ppm	3362	2414

There is a reduction of HC and CO level after zinc coating as shown in fig.5 and fig.6.

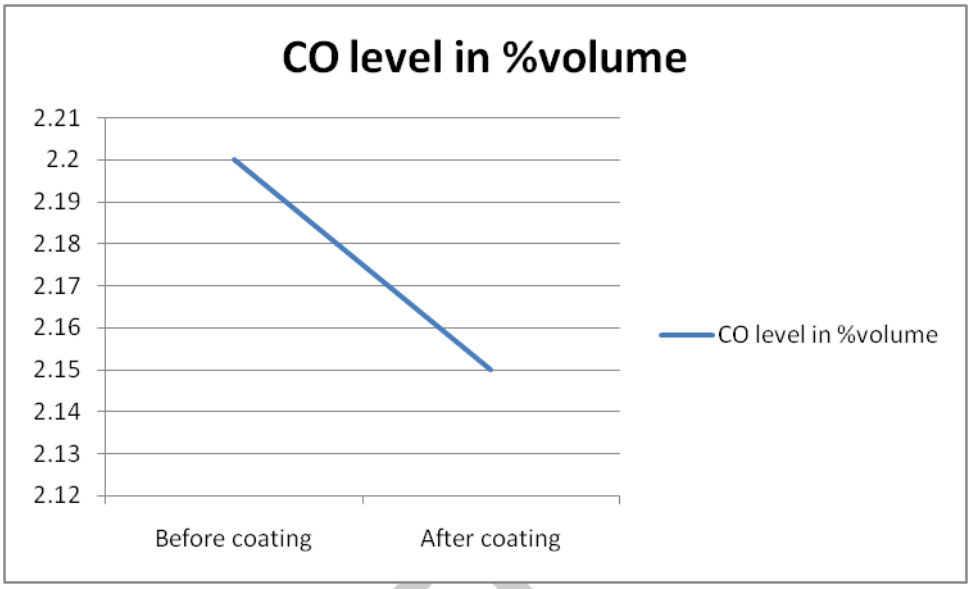

Fig.6 CO level in % Volume

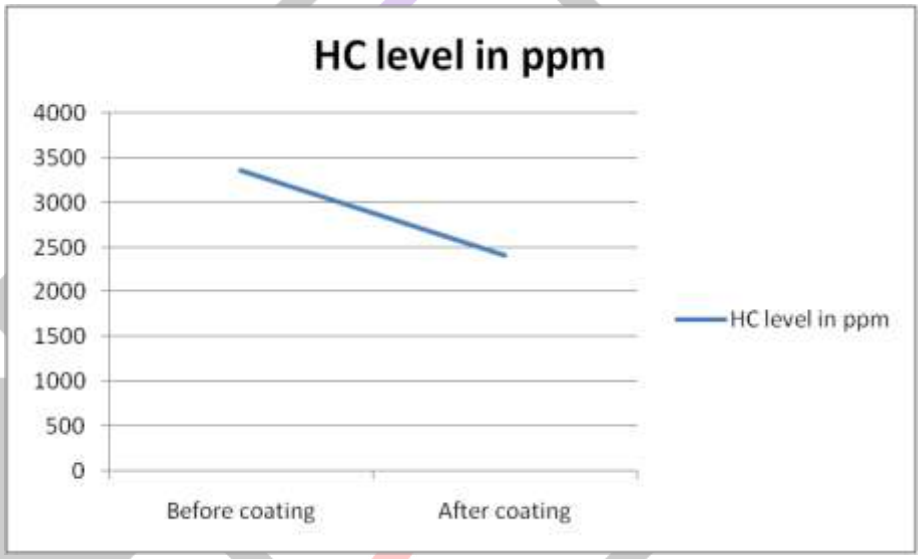

Fig.7 level in ppm

CONCLUSION

It concluded that by using zinc as a coating material on piston crown and cylinder head there is a reduction of CO, HC level from exhaust emission of engine.

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