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### Investigation and research on enhancing life of spark plug by using silicon gel, chromium oxide and zinc oxide

**Krishnamoorthi. T<sup>1</sup>, Anand. A<sup>2</sup>, Ashwinraj. R<sup>2</sup>, Deepak. C<sup>2</sup>, Muruganandham. N<sup>2</sup>**

<sup>1</sup>Professor, Department of Mechanical Engineering, Nandha Engineering College, Erode-52.

<sup>2</sup>UG Students, Department of Mechanical Engineering, Nandha Engineering College, Erode-52.

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#### ABSTRACT

Improving of a high performance, Enhancing life of spark plug has become essential in response to these demands. While improve performance (high ignitability and low required voltage), the discharge part of the spark plug needs to be reduced in size. But, in the past this has been difficult because of the limitations in terms of wear. It has been difficult to achieve both smaller discharge parts and longer life. Through this development we have been able to produce a various coating that surpasses the conventional platinum technology. This paper discussed about the silicone gel, zinc oxide, chromium oxide Coating on the spark plug

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#### INTRODUCTION

A Spark plug (sometimes, in British English, a sparking plug, and colloquially, a plug) is a device for delivering electric current from an ignition system to the combustion chamber of a spark ignition engine to ignite the compressed air/fuel mixture by an electric spark, while containing combustion pressure within the engine. A spark plug has metal threaded shell, electrically isolated from a central electrode by a porcelain insulator. The central electrode the spark plugs metal shell is screwed into the engine's cylinder head and thus electrically grounded. The central electrode protrudes through the porcelain insulator into the combustion chamber, forming one or more spark gaps between the inner end of the central electrode and usually one or more protuberances or structures attached to the inner end of the threaded shell and designated the side, earth or ground electrode. spark plugs are used to measure ionization in the cylinders – this ionic current measurement is used to replace the ordinary cam phase sensor, knock sensor and misfire measurement function.

#### LITERATURE SURVEY

H.T. Lin, M.P. Brady, R.K. Richards, D.M. Layton, Characterization of erosion and failure processes of spark plugs after field service in natural gas engines, Wear, Volume 259, Issues 7 – 12, July – August 2005, Pages 1063-1067, ISSN 0043-1648. Micro structural and optical spectroscopic analyses were carried out on as-received and used spark plugs after field service in natural gas (NG) reciprocating engines. The objectives of this work was to examine the corrosion and erosion mechanisms of natural gas engine spark plug as well as identify the primary life limiting processes during field operation. In addition, inter granular cracking was observed in the subsurface region of both iridium (Ir) and platinum-tungsten (Pt-W) alloy electrode insert tips. The coalescence and subsequent growth of these cracks would accelerate the wear of the electrodes and shorten the lifetime of the spark plugs. Also, extensive internal oxidation and subsequent crack generation occurred along the interface between Ni-based alloy electrode and Pt-W alloy tip insert during field service, which

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#### Author for correspondence:

Department of Mechanical Engineering, Nandha Engineering College, Erode-52.

would result in substantial degradation in the ignitability and performance of the electrodes, and thus spark plug failure [1-5].

## PROBLEM IDENTIFICATION

The deposits accumulated on the spark plug overheat and cause pre-ignition that may lead to melting of electrodes of the spark plug.

It also leads to engine starting problem and mis-firing during running.

### Possible solutions

Using various coating (like Silicone gel, chromium oxide, zinc oxide) sparkplug to increase the life time

## TYPE OF COATING

- Chemical Vapour deposition
- Physical vapour deposition

### Silicone gel

**Table.1Silicon Gel Properties**

|                      |            |
|----------------------|------------|
| Density              | 7.14 g/cm  |
| Compressive Strength | 67-71MPA   |
| Tensile Strength     | 2.6-4.4GPA |

### Zinc oxide

**Table.2Zinc Oxide Properties**

|                 |          |
|-----------------|----------|
| Density         | 6.81g/cm |
| Young's Modulus | 287GPa   |
| Melting Point   | 1600*c   |
| Boiling Point   | 2160*c   |

### Chromium oxide

**Table.3Chromium Oxide Properties**

|               |             |
|---------------|-------------|
| Density       | 7.19g/cm    |
| Melting Point | 1800-1950*c |
| Boiling Point | 2260*c      |

## TESTS ARE INVOLVING

- Corrosion Test

## Chemical Vapour Deposition

Chemical vapour deposition may be defined as the deposition of a solid on a heated surface from a chemical reaction in the vapor phase. It belongs to the class of vapor-transfer processes which is atomistic in nature that is the deposition species are atoms or molecules.

## Physical Vapour Deposition

Physical vapour deposition (PVD) is fundamentally a vaporization coating technique, involving transfer of material on an atomic level [6]. It is an alternative process to electroplating the process is similar to chemical vapor deposition (CVD) except that the raw materials precursors

## SELECTION OF COATING MATERIALS

- Silicone Gel
- Zinc Oxide
- Chromium Oxide

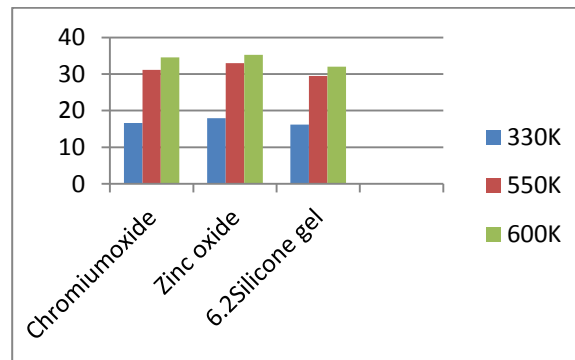
- Knoop Hardness Test
- Carbon Deposition Test.

## CORROSION TEST READING

### Percentage of petroleum-6.2 as per the “ASTM” Standard.

**Table. 4 Percentage of petroleum – 6.2**

| MATERIALS      | 330K  | 550K  | 600K  |
|----------------|-------|-------|-------|
| Chromium oxide | 16.62 | 31.12 | 34.56 |
| Zinc oxide     | 17.99 | 32.96 | 35.21 |
| Silicone gel   | 16.17 | 29.45 | 31.98 |

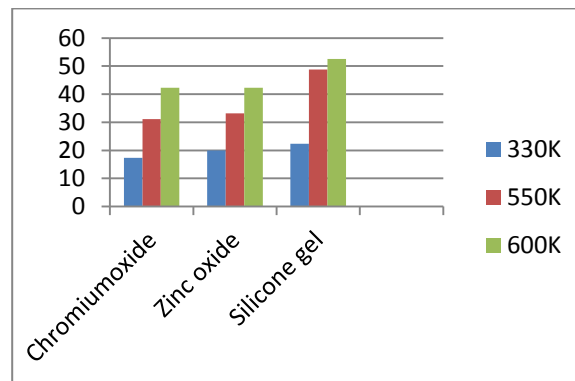


**Fig. 1 percentage of petroleum – 6.2**

### Percentage of petroleum-8.2 as per the “ASTM” standard

**Table. 5 Percentage of petroleum-8.2**

| MATERIALS      | 330K  | 550K  | 600K  |
|----------------|-------|-------|-------|
| Chromium oxide | 17.36 | 31.08 | 42.31 |
| Zinc oxide     | 19.92 | 33.13 | 42.34 |
| Silicone gel   | 22.34 | 48.76 | 52.56 |



**Fig. 2 Percentage of petroleum-8.2**

### Percentage of petroleum-10 as per the “ASTM” standard.

**Table. 6 percentage of petroleum-10**

| MATERIALS      | 330K  | 550K  | 600K  |
|----------------|-------|-------|-------|
| Chromium oxide | 20.98 | 38.49 | 44.10 |
| Zinc oxide     | 22.82 | 39.85 | 46.14 |
| Silicone gel   | 24.34 | 48.76 | 52.56 |

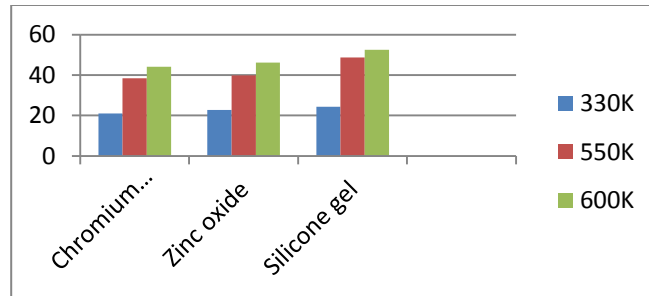


Fig. 3 percentage of petroleum-10

**Knoop Hardness Test**

Table. 7 Knoop Hardness Test

| MATERIALS      | THICKNESS | VALUE |
|----------------|-----------|-------|
| Mild steel     | 0         | 360   |
| Silicone gel   | 10(μm)    | 623   |
| Chromium oxide | 15(μm)    | 486   |
| Silicone gel   | 15(μm)    | 398   |

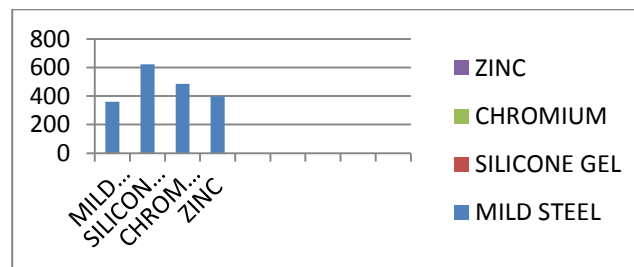


Fig. 4 Knoop Hardness Test

**Carbon Deposition Test**

Table. 8 Carbon Deposition Test

| MATERIALS     | VALUE |
|---------------|-------|
| Mild steel    | 80%   |
| Silicone gel  | 68%   |
| Chromiumoxide | 74%   |
| Silicone gel  | 72%   |

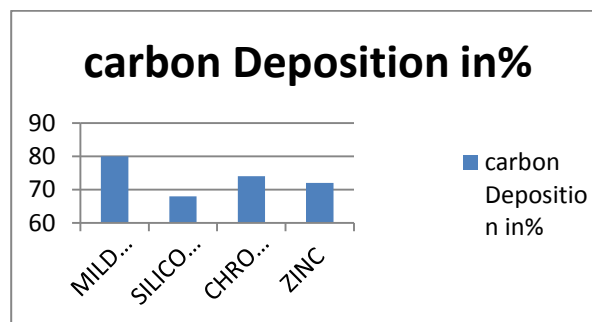


Fig: 5 Carbon Deposition Test

**POWDER IMAGE**



**Zinc**

**Fig. 6 zinc powder**



**Silicon**

**Fig. 7 silicon powder**



**Chromium**

**Fig. 8 chromium powder**

## COATED SPARKPLUG



**Fig. 9 zinc oxide**



**Fig. 10 chromium oxide**



**Fig. 11 silicon gel**

## CONCLUSION

Proper electro deposition of mild steel using zinc oxide, Chromium oxide and silicon gel particle was carried out. The Carbon Deposition, Knoop Hardness and Corrosion Test of the resultant deposition were investigated with the

following deductions. Increasing of Chromium Oxide percentage causes decreasing the Corrosion. By using silicon gel, Zinc oxide and Chromium oxide the hardness of the ground electrode gets increased Zinc oxide and Chromium oxide is used to resists the corrosion in spark plug.

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