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# Preheating the Air to the Engine Using Peltier Effect

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**Abstract:-** *Due to the stringent emission norms which are prevailing in the country, it has become a necessity to research and find out a solution to reduce the emissions caused by automobiles. Preheating the air to the engine causes complete combustion of the fuel and hence increase the efficiency of the engine and at the same time control the emissions too.Preheaters used nowadays are very large in size and require much complex circuits to run it. Hence, in our project we use a thermoelectric peltier module to make the arrangement compact and effective. This can increase the efficiency to a maximum of 0.5%.*

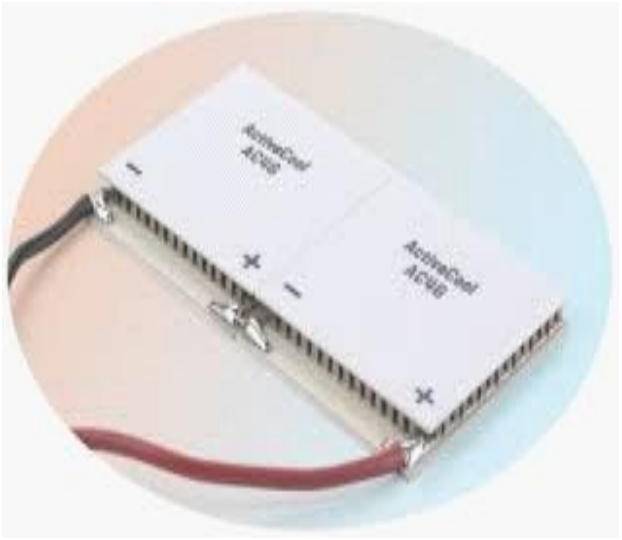
**Intorduction:-**

Climate change is one of the global environmental threats caused by people. It is seen as the second serious problem faced by the people in the world. The greenhouse effect is a natural process that plays a major role in changing the Earth's climate. Greenhouse gases in the atmosphere lead to climate change. The major greenhouse gases emitted to the atmosphere are by humans, industries and vehicles. By vehicles there are carbon dioxide, nitrogen oxides, methane, carbon monoxide and hydrocarbons (particulate matters).

The World Health Organization estimated that around 2.4 million people are getting affected by air pollution every year (WHO 2007). Many agencies and organizations have been working to prevent air pollution caused by pollutant emissions. They reported that 20-30% of pollutant emissions originates from transport (mainly from the diesel engine) and from industries. In order to prevent these issues the emission control systems are introduced.But these are not efficient in doing this. So to control these emissions preheating is one of the powerful way to achieve complete combustion which will control the emissions from the automobiles. A thermoelectric peltier module is used to achieve the same. The design is compact and hence can be fitted to the Intake Manifold.

**Components Used:-**

**Thermocouple Peltier:-**



A thermocouple peltier is a solid state device which uses seeback effect to segregate one side as hot junction and second side as cold junction. The **thermoelectric effect** is the direct conversion of temperature differences to electric voltage and vice versa via a thermocouple.[1] A thermoelectric device creates voltage when there is a different temperature on each side. Conversely, when a voltage is applied to it, it creates a temperature difference. At the atomic scale, an applied temperature gradient causes charge carriers in the material to diffuse from the hot side to the cold side.

This effect can be used to generate electricity, measure temperature or change the temperature of objects. Because the direction of heating and cooling is determined by the polarity of the applied voltage, thermoelectric devices can be used as temperature controllers.

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**Sheet metal box:-**

We use a sheet metal box to heat the air and increase the velocity of the air so that it impinges on the intake manifold with some velocity. We calculated the dimensions of the sheet metal box by performing some design calculations. The sheet metal box also has a provision to hold the thermoelectric module in the middle of the sheet metal box. It has a small hole at the bottom.

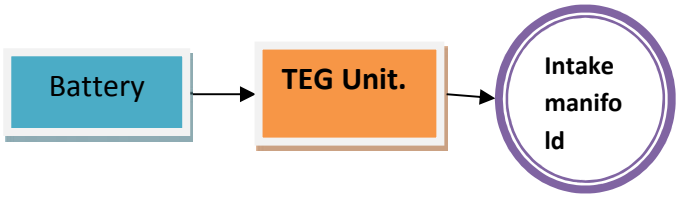
**Fan:-**

A small electric fan is used to supply the air to the sheet metal box. This fan lets the air sweep from the module, take the heat and come out from the box.

**Battery:-**

We use a 12V 7Amp battery to supply DC current to both thermoelectric peltier and the electric fan. But the maximum current which can be supplied to the peltier is 6amp. Hence a resistance is connected at the starting to reduce the rating of the current to 6amp.

**Block Diagram :-**




**Working Principle:-**

As soon as the battery is connected to the thermoelectric module the module begins to heat to a maximum temperature of 423K. Always opposite polarity is given to the module so that both the sides are heated. This temperature is used to preheat the air to the engine. Now resistance is placed in between to reduce the current to 6amp. After this, the fan is switched on so that the air sweeps through the thermoelectric module which is at 423K. Due to this sweepage of the air, it gets heated to a maximum temperature of 333K. This preheating is used to control the emission norms.

**TESTING RESULT:**

**Emission before treatment:**

| S.NO | LOAD (kg) | EGT °c | CO % | NOX (ppm) | HC (ppm) | SMOKE (HSV) |
|---|---|---|---|---|---|---|
| 1. | 0 | 160 | 0 .07 | 185 | 27 | 10 |
| 2. | 3 | 195 | 0.07 | 195 | 28 | 11 |
| 3. | 6 | 230 | 0.075 | 350 | 33 | 18 |
| 4. | 9 | 265 | 0.08 | 491 | 37 | 28 |
| 5. | 12 | 334 | 0.15 | 720 | 42 | 42 |
| 6. | 15 | 390 | 0.28 | 900 | 49 | 54 |

**Emission after treatment:**

| S.NO | LOAD (kg) | EGT °c | CO % | NOX (ppm) | HC (ppm) | SMOKE (HSV) |
|---|---|---|---|---|---|---|
| 1. | 0 | 153 | 0.06 | 180 | 25 | 08 |
| 2. | 3 | 189 | 0.065 | 185 | 27 | 10 |
| 3. | 6 | 225 | 0.07 | 340 | 32 | 17 |
| 4. | 9 | 258 | 0.075 | 480 | 36 | 27 |
| 5. | 12 | 328 | 0.13 | 710 | 41 | 41 |
| 6. | 15 | 381 | 0.24 | 880 | 48 | 53 |

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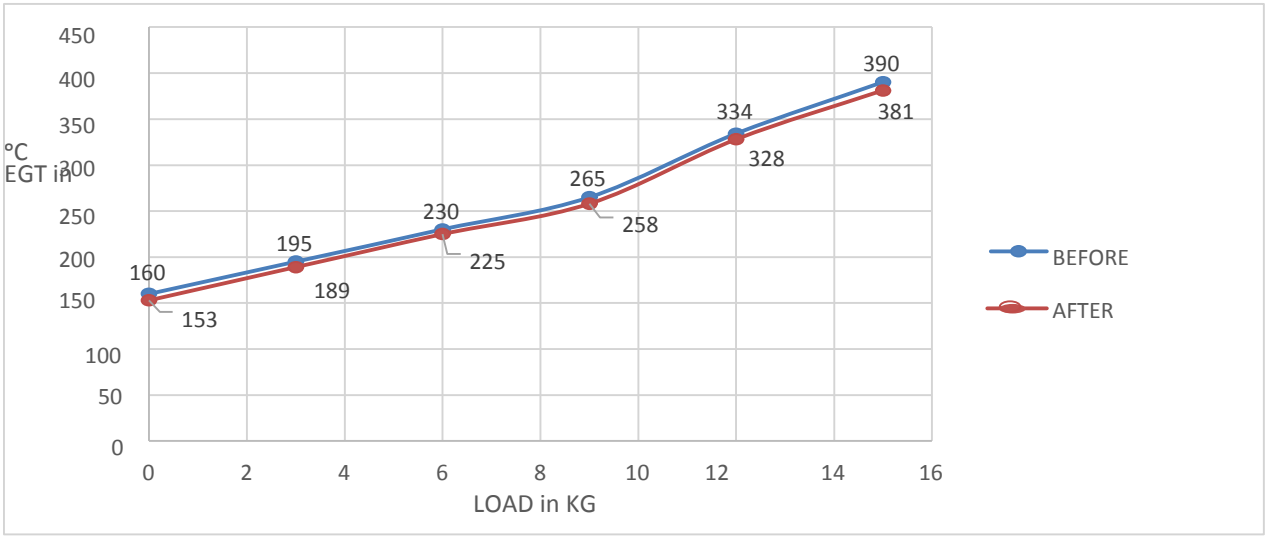
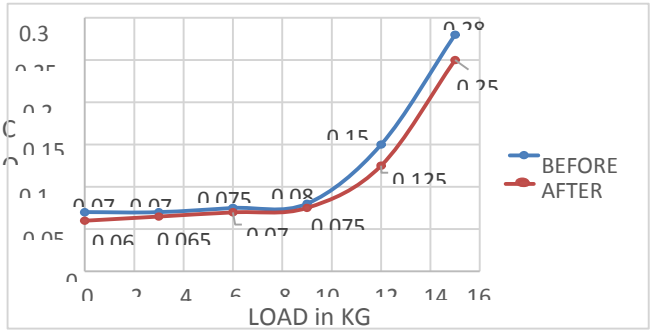
**GRAPHS:**

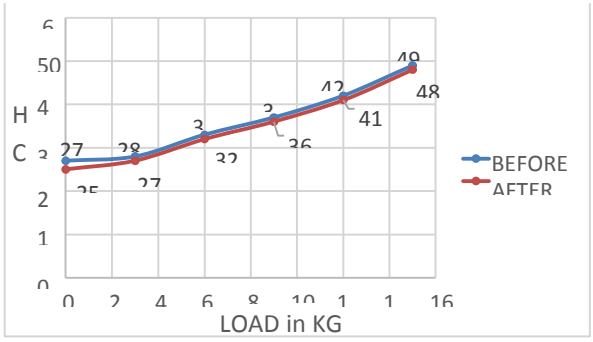
**LOAD VS EGT:**



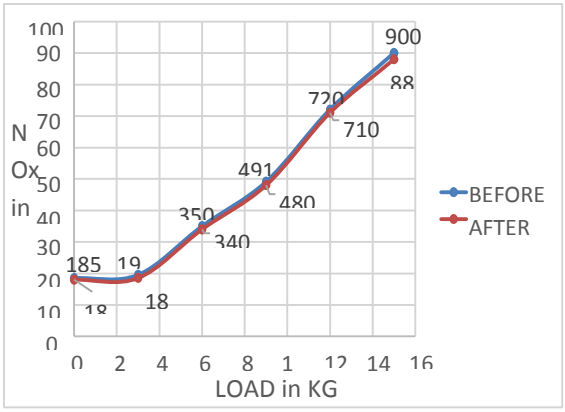

**LOAD VS CO:**



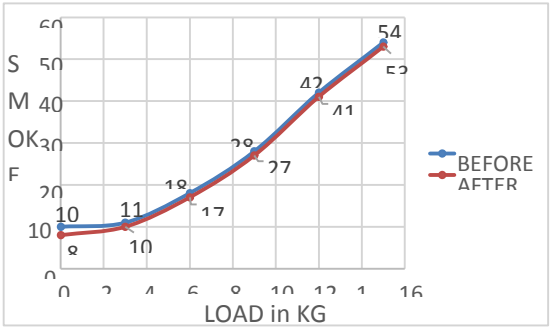

**LOAD VS HC:**




**LOAD VS $NO_x$:**




**LOAD VS SMOKE:**



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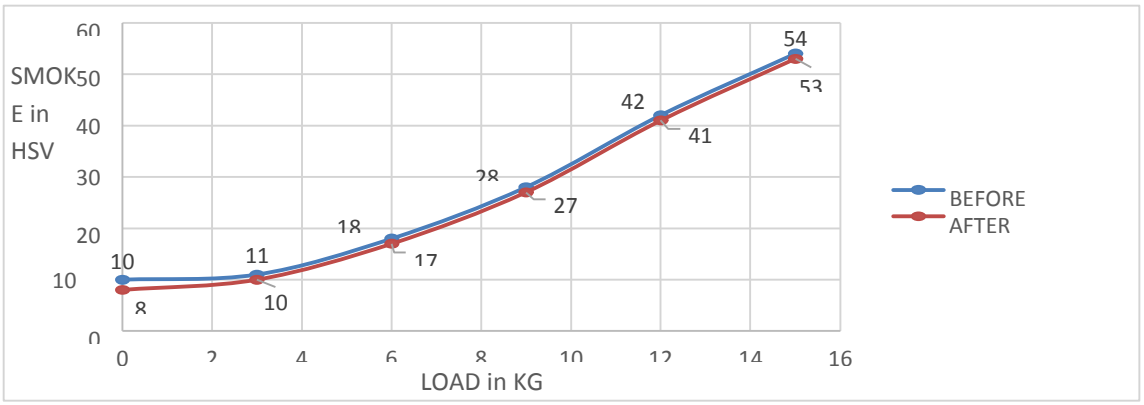


**Conclusion:-**

This article reviews the characteristics of main pollutants emissions (CO, HC, NOx, PM) from diesel engines and their control systems. Among these CO and HC are emitted because of incomplete combustion and un-burnt fuel while NOx emissions are caused because of high combustion temperatures above 1600°C, PM emissions are caused by very small particles of partly burned fuel, partly burned lube oil. These emissions have harmful effects on environment and human health. Many applications have been implemented on diesel engines to prevent the exhaust emissions but after treatment emission control systems do not have much potential to eliminate the pollutant emissions from exhaust gas. Thus we conclude that our setup will reduce the emissions which are prevailing in the automobile exhausts. It will reduce major pollutants like NOx, HC,CO etc. This is the optimum setup with low space occupying advantage.

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- Scholarly article on preheating.
- Base paper titled "Review on Performance of CI Engine By Preheating Of Inlet Air And Diesel By Waste Heat Utilization" By Mohit Raghuwanshi*, Dr. Aseem C Tiwari, Bikram Solanki, UIT RGPV Bhopal, Mechanical Engineering Department .