Relation of fuel temperature and gas emissions

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Abstract: - One of the major global problems is the air pollution. Air pollution is the introduction of chemicals that can threat the health of human being, animals, and plants as well as damage the environment. Some of these pollutants can be created by indoor activities, such as cooking, smoking, car emissions, smokestacks and other industrial inputs into the atmosphere. It also can be created by outdoor activities, such as smog and acid rain. The two main sources of air pollution are transportation and fuel combustion. The main aim of this essay is to examine the effect of temperature of fuel in the gas emissions that is used in four-stroke diesel engine. The temperatures of fuel that were used are 10°C, 20°C, 30°C, 40°C, 50°C and 60°C. For those fuel temperatures the gas emissions of carbon monoxide (CO), hydrocarbons (HC), nitrogen monoxide (NO), smoke are being measured and the fuel consumption is also examined.

Key-Words: - Gas emissions, Fuel temperature, CO, HC, NO, smoke

I. INTRODUCTION

The industrialization of society, the introduction of motorized vehicles and the explosion of the population are factors contributing toward the growing air pollution problem. Moreover, the exhaust from burning fuels in automobiles, homes and industries is a major source of pollution in the air. Apart from the anthropogenic sources of air pollution there are natural sources as well. Natural sources related to dust from natural source, usually large areas of land with little or no vegetation, the smoke and carbon monoxide from wildfires, volcanic activity etc. Air pollution not only affects the air we breathe, but it also impacts the land and the water. The human health effects of poor air quality are far reaching, but principally affect the body's respiratory system and the cardiovascular system. The human health effects caused by air pollution may range from subtle biochemical and physiological changes to difficulty breathing. It can also cause deaths, aggravated asthma, bronchitis, emphysema, lung and heart diseases to human beings. There are several many types of air pollutant [1,2,3,4,5,6]. These include smog, acid rain, the greenhouse effect and holes in the ozone layer. The atmospheric conditions such as the wind, rain, stability affect the transportation of the air pollutant [7,8,9,10,11]. Furthermore, depending on the geographical location temperature, wind and weather factors, pollution is dispersed differently [12,13,14,15]. For instance, the wind and rain may effectively dilute pollution to relatively safe concentrations despite a fairly high rate of emissions. In contrast when atmospheric conditions are stable relatively low emissions can cause buildup of pollution to hazardous levels.

The quality of fuel affects diesel engine emissions (HC, CO, NOx and particulate emissions) very strongly. The fuel that is used in diesel engines is a mixture of hydrocarbons and its boiling temperature is approximately 170 °C to 360°C [16,17,18,19,20]. Diesel fuel emissions composition and characteristics depend on mixture formation and combustion. In order to compare the quality of fuels the following criteria are tested: ketene rating, density, viscosity, boiling characteristics, aromatics content and sylph content. For environmental compatibility, the fuel must have low density, low content of aromatic compounds, low sylph content and high ketene rating [21,22,23,24,25].

At this paper will be tested the use of soy oil as fuel in a four stroke diesel engine. The question that arises is how a four-stroke diesel engine behaves on the side of pollutants and operation, when it uses diesel as fuel in different temperatures.

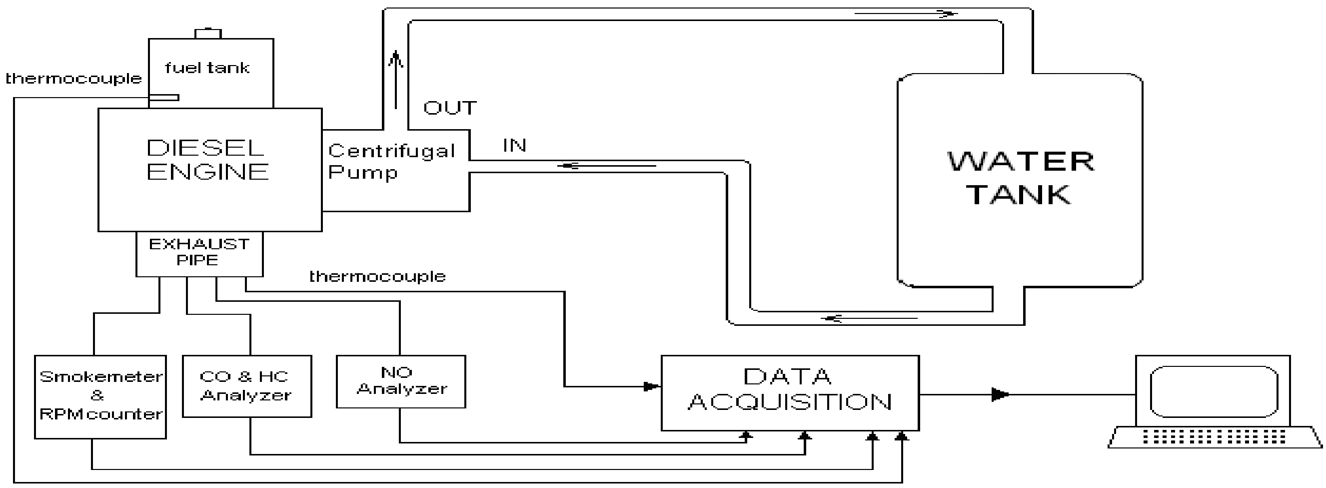
II. INSTRUMENTATION AND EXPERIMENTAL RESULTS

Specifically it has been used fuel diesel at different temperatures: 10°C, 20°C, 30°C, 40°C, 50°C and 60°C in a four-stroke diesel engine named Ruggerini type RD-80, volume 377cc, and power 8.2hp/3000rpm, who was connected with a pump of water centrifugal. Measurements were made when the engine was function on 1000, 1500, and 2000rpm.

During the experiments, it has been counted:

- The percent of (%) (CO)
- To ppm(parts per million) HC
- To ppm(parts per million) NO
- The percent of smoke
- Fuel consumption

The measurement of rounds/min of the engine was made by a portable tachometer (Digital photo/contact tachometer) named LTLutron DT-2236. Smoke was measured by a specifically measurement device named SMOKE MODULE EXHAUST GAS ANALYSER MOD 9010/M, which has been connected to a PC unit. The CO and HC emissions have been measured by HORIBA Analyzer MEXA-324 GE. The NO emissions were measured by a Single GAS Analyser SGA92-NO.
The experimental results are shown at the following tables and figures



rpm	CO%					
	10°C	20 °C	30 °C	40 °C	50 °C	60 °C
1000	0,068	0,056	0,064	0,063	0,059	0,061
1500	0,054	0,055	0,056	0,051	0,059	0,059
2000	0,049	0,043	0,050	0,025	0,046	0,051

Picture1. Experimental layout

rpm	HC(ppm)					
	10°C	20 °C	30 °C	40 °C	50 °C	60 °C
1000	39,91	31,78	35,31	30,20	32,92	27,27
1500	42,18	38,00	40,44	51,14	42,43	40,29
2000	30,95	38,33	42,89	25,29	27,49	34,29

Table 1. The CO average value variation on different rpm regarding to the fuel temperature.

Table 2. The HC average value variation on different rpm regarding to the fuel temperature.

rpm	NO(ppm)					
	10°C	20 °C	30 °C	40 °C	50 °C	60 °C
1000	787,64	454,22	575,55	827,67	331,89	431,33
1500	971,3	715,35	2750,28	1777,57	655,55	671,00
2000	940,89	1109,67	2628,69	568,03	744,93	741,15

rpm	%smoke					
	10°C	20 °C	30 °C	40 °C	50 °C	60 °C
1000	8,442	9,990	8,367	8,739	8,739	9,286
1500	8,186	7,363	8,364	7,392	7,392	9,085
2000	5,949	6,634	5,535	6,328	6,328	6,196

Table 3. The NO average value variation on different rpm regarding to the fuel temperature.

Table 4. The %smoke average value variation on different rpm regarding to the fuel temperature..

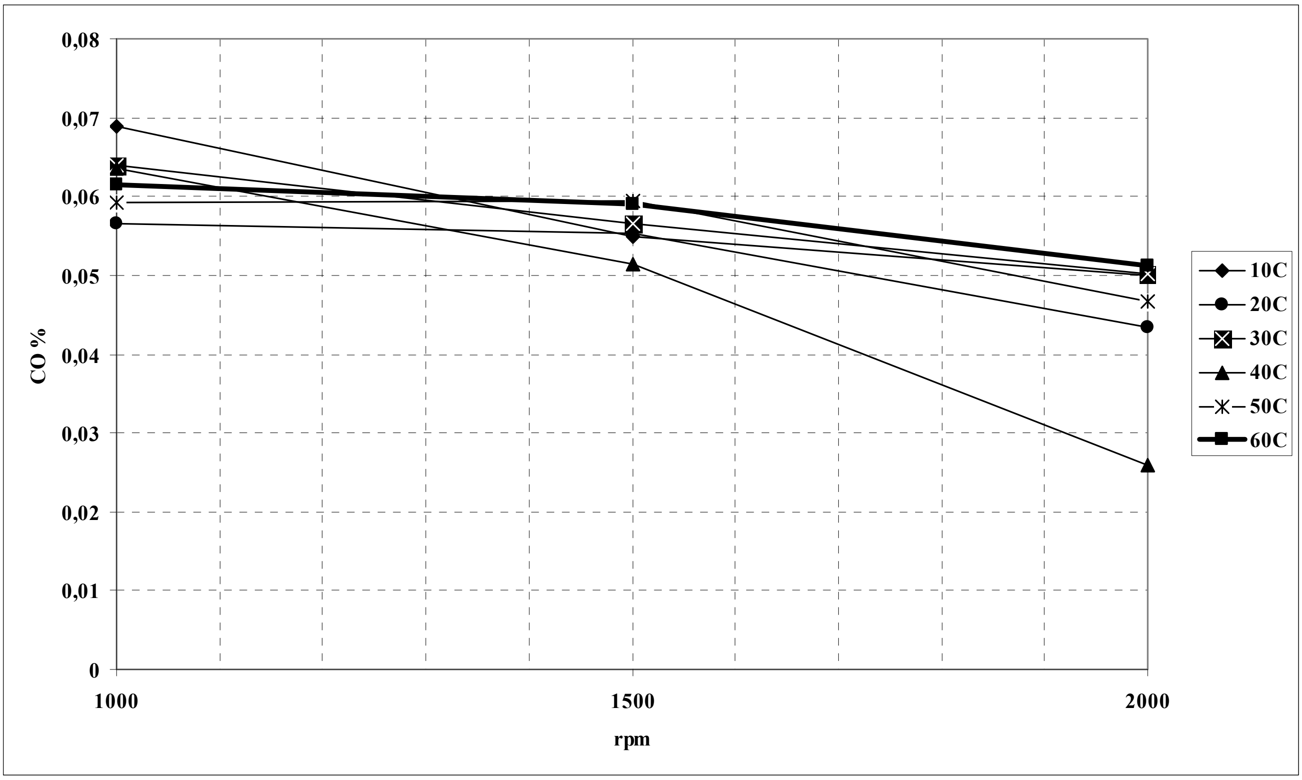


Figure 1. The CO variation on different rpm regarding to the fuel temperature.

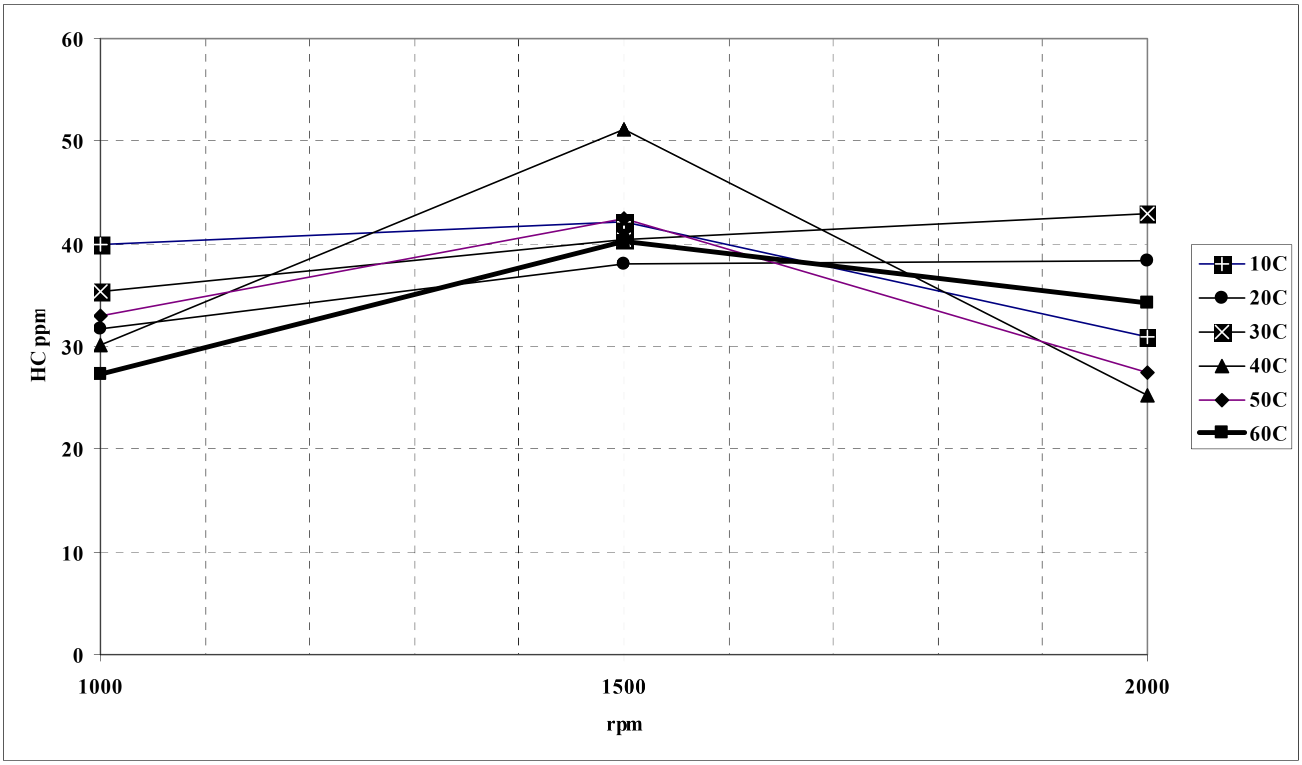


Figure 2. The HC variation on different rpm regarding to the fuel temperatures

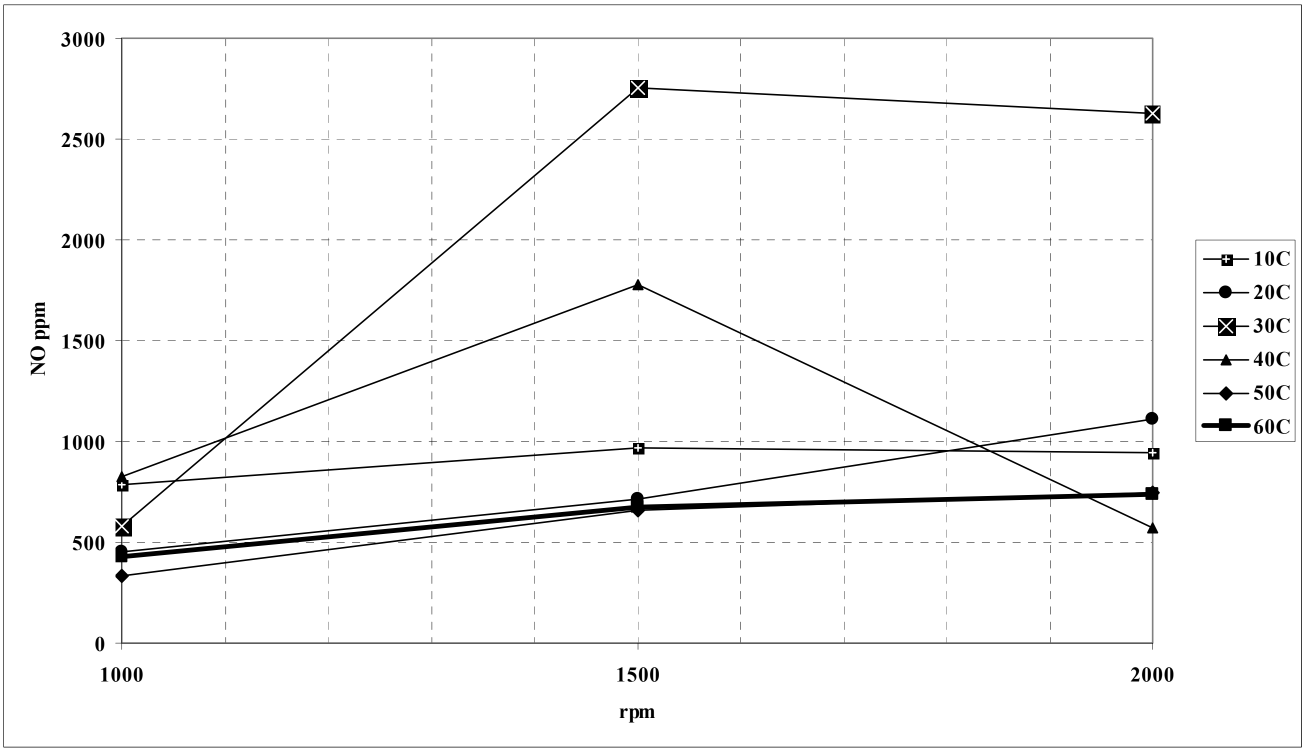


Figure 3. The NO variation on different rpm regarding to the fuel temperatures

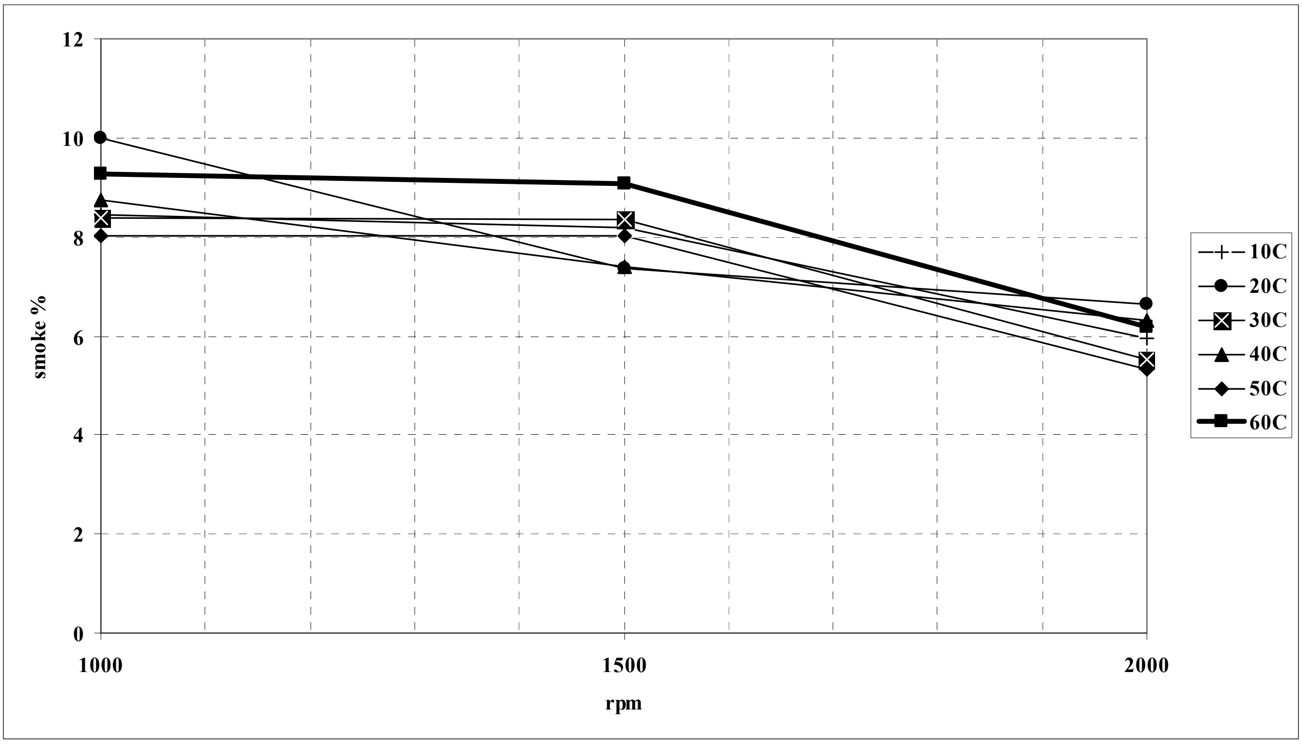


Figure 4. The smoke variation on different rpm regarding to the fuel temperatures

The following table presents the temperature of the exhaust regarding to the temperature of the fuel:

rpm	Exhaust gas temperature (^oC)					
	10^oC	**20 ^oC**	**30 ^oC**	**40 ^oC**	**50 ^oC**	**60 ^oC**
1000	108,7697	102,2631	101,3273	103,1034	102,8864	102,9746
1500	143,2355	133,4814	135,4561	136,2354	134,0283	137,0104
2000	193,3493	180,4922	195,8032	195,8376	188,9934	193,16

Table 5. The gas emissions temperature variation on different rpm regarding to the fuel temperature.

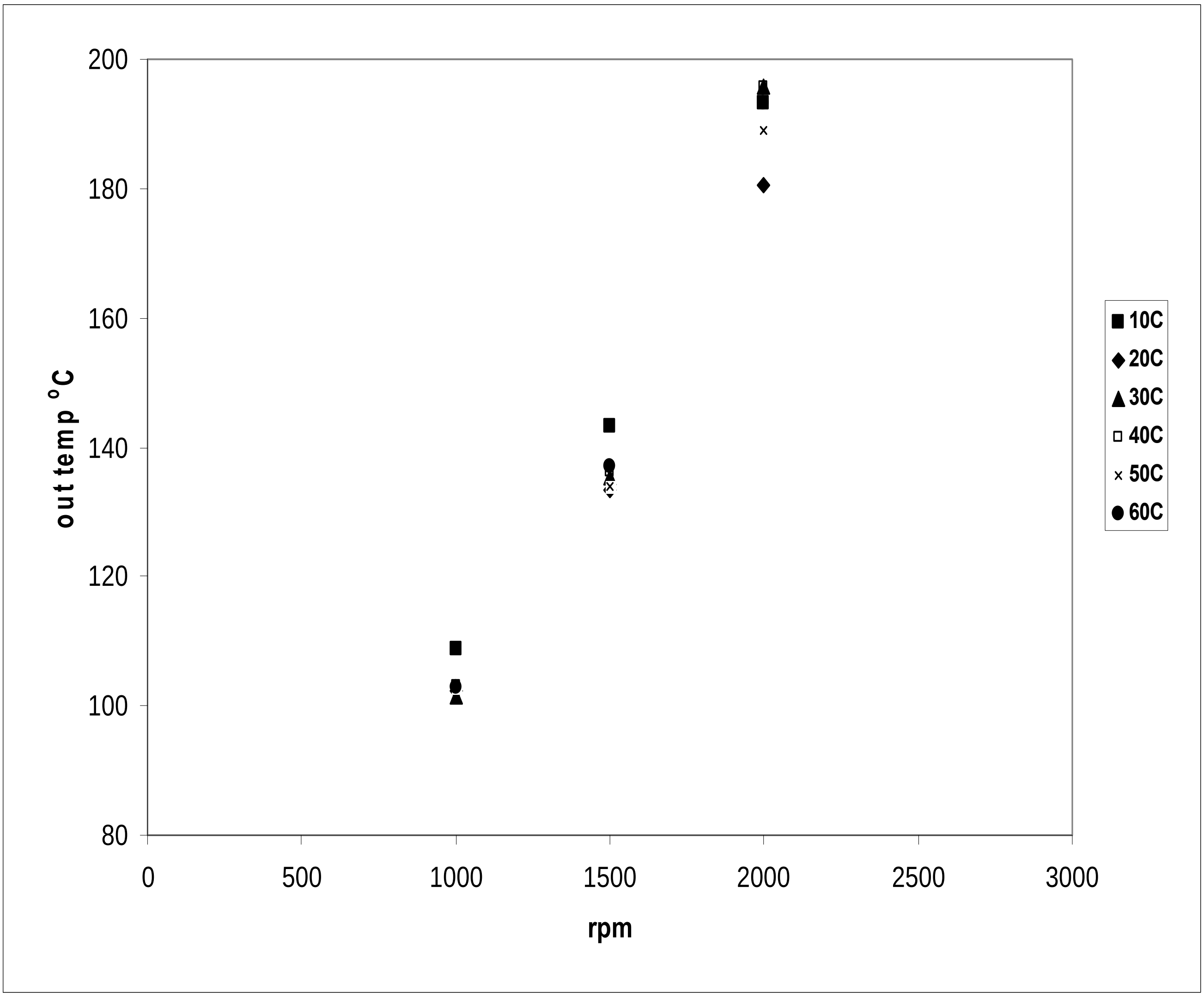


Figure 5. The gas emissions temperature variation on different rpm regarding to the fuel temperatures

From figure 1 it is clear that when the diesel temperature is 40°C the CO emissions are lower. From figure 2 it can be noticed the biggest reduction of HC in case of the 20°C temperature until 1500rpm. After 1500rpm when the diesel temperature is 40°C the HC emissions are lower. From figure 3 it can be noticed the biggest reduction of in the case of the fuel temperatures 50°C and 60°C. From figure 4 it can be seen the lower value of smoke in 40°C of fuel temperature. From figure 5, it can be seen that the different temperature of fuel has a little influence in the temperature of exhaust. It is also important the fact that there was no changes in the rounds of the engine, as well as in the supply of water. Finally as far as the consumption is concerned, did not observed changes.

III. CONCLUSION

The different temperatures of diesel have the following impacts:

- About CO it can be noticed that when the diesel temperature is 40°C the CO emissions are lower.
- About it can be noticed the biggest reduction of HC in case of the 20°C temperature until 1500rpm. After 1500rpm when the diesel temperature is 40°C the HC emissions are lower .
- The smoke is lower in the case of 40°C of fuel temperature.
- The temperature of exhaust gases is minimal affected by the change of the temperature of fuel.

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