CALIFORNIA STATE SCIENCE FAIR
2009 PROJECT SUMMARY

Name(s)
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Project Number
J1110

Project Title
Car Exhaust and Acid Rain

Abstract

Objectives/Goals
Do catalytic converters eliminate harmful pollutants enough in larger engines? I will test the hypothesis that catalytic converters will do their job quite well in small engines (4-cylinder), but not as well in 6 and 8-cylinder engines.

Methods/Materials
Materials: 1 of each: 4, 6, and 8 cylinder cars
Testing supplies include pH meter, thermometer, testing apparatus of my design.
Method: The apparatus uses 2 1/4" copper tubes connected to a mason jar. The 1st tube funnels gases from the tailpipe into the mason jar filled with water. The gases bubbles in water and dissolve. The 2nd tube vents remaining gases out of the jar.
I tested the exhaust from 4-, 6- and 8-cylinder cars for the change in pH of the water before and after exhaust gases were dissolved in water for 5 minutes. I also measured temperature change, as pH is temperature sensitive.

Results
The 4-cylinder car created the most acidic water sample at 5.83 pH (a negative change of 1.18 pH.) The 6-cylinder car created the next most acidic sample at 6.11 (a negative change of .9 pH.) The 8-cylinder car#s sample was 6.19 pH (a negative change of only .82 pH). The water samples went up in temperature most in the 8-cylinder car, to 129º F, then 114 º F in the 6-cylinder and 106.3 º F in the 4-cylinder car.

Conclusions/Discussion
The results were surprising. I expected the engine with 8 cylinders to have the most potent results, but it actually had the least harmful results. I conducted a test to see if the pH had changed when the temperature was constant between samples. The pH did change, and for the better. All the pH levels went up to more neutral levels. It looked like acid rain is not as harmful if it stays cold. This is what I thought until I did some more research. Another reason this probably occurred is because the jars were not vacuum sealed. The fact that there was air still in the jar meant that the chemical reactions that affected the pH still had the chance to occur. So, it would seem that acid rain is more potent as it is falling, not as it has collected and become stagnant.
As it turns out, our 8-cylinder car had a few engine modifications. This could have altered the results. I think that the reason the 4-cylinder engine creates more harmful pollutants is because more power may have to be directed to get them to produce the horsepower, and so they release more exhaust.

Summary Statement
Catalytic converters do not remove all of the harmful gases produced by combustion engines, and these contributes to acid rain, which is harmful to our environment.

Help Received
My dad helped manufacture the testing apparaturs; my mom and Mr. Gutierrez provided helpful advice.