Ethanol results in higher ozone concentrations than gasoline, researchers say

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If all the vehicles in urban areas were running on E85, a blend of 85 percent ethanol and 15 percent gasoline, the ozone problem in those areas would be worse than with all the vehicles running on gasoline.

(PhysOrg.com) -- Ethanol, often promoted as a clean-burning, renewable fuel that could help wean the nation from oil, would likely worsen health problems caused by ozone, compared with gasoline, especially in winter, according to a new study led by Stanford researchers.

Ozone production from both gasoline and E85, a blend of gasoline and ethanol that is 85 percent ethanol, is greater in warm sunny weather than during the cold weather and short days of winter, because heat and sunlight contribute to ozone formation. But E85 produces different byproducts of combustion than gasoline and generates substantially more aldehydes, which are precursors to ozone.

"What we found is that at the warmer temperatures, with E85, there is a slight increase in ozone compared to what gasoline would produce," said Diana Ginnebaugh, a doctoral candidate in civil and environmental engineering, who worked on the study. She will present the results of the study on Tuesday, Dec. 15, at the American Geophysical Union meeting in San Francisco. "But even a slight increase is a concern, especially in a place like Los Angeles, because you already have episodes of high ozone that you have to be concerned about, so you don't want any increase."

But it was at colder temperatures, below freezing, that it appeared the health impacts of E85 would be felt most strongly.

"We found a pretty substantial increase in ozone production from E85 at cold temperatures, relative to gasoline when emissions and atmospheric chemistry alone were considered," Ginnebaugh said. Although ozone is generally lower under cold-temperature winter conditions, "If you switched to E85, suddenly you could have a place like Denver exceeding ozone health-effects limits and then they would have a health concern that they don't have now."

The problem with cold weather emissions arises because the catalytic converters used on vehicles have to warm up before they reach full efficiency. So until they get warm, a larger proportion of pollutants escapes from the tailpipe into the air.

There are other pollutants that would increase in the atmosphere from burning E85 instead of gasoline, some of which are irritants to eyes, throats and lungs, and can also damage crops, but the aldehydes are the biggest contributors to ozone production, as well as being carcinogenic.

Ginnebaugh worked with Mark Z. Jacobson, professor of civil and environmental engineering, using vehicle emissions data from some earlier studies and applying it to the Los Angeles area to model the likely

output of pollutants from vehicles.

Because E85 is only now beginning to be used in mass-produced vehicles, the researchers projected for the year 2020, when more "flex fuel" vehicles, which can run on E85, will likely be in use. They estimated that vehicle emissions would be about 60 percent less than today, because automotive technology will likely continue to become cleaner over time. They investigated two scenarios, one that had all the vehicles running on E85 and another in which the vehicles all ran on gasoline.

Running a widely used, complex model involving over 13,000 chemical reactions, they did repeated simulations at different ambient temperatures for the two scenarios, each time simulating a 48-hour period. They used the average ozone concentrations during each of those periods for comparison.

They found that at warm temperatures, from freezing up to 41 degrees Celsius (give F conversion), in bright sunlight, E85 raised the concentration of ozone in the air by up to 7 parts per billion more than produced by gasoline. At cold temperatures, from freezing down to minus 37 degrees Celsius, they found E85 raised ozone concentrations by up to 39 parts per billion more than gasoline.

"What we are saying with these results is that you see an increase," Ginnebaugh said. "We are not saying that this is the exact magnitude you are going to get in a given urban area, because it is really going to vary from city to city depending on a lot of other factors such as the amount of natural vegetation, traffic levels, and local weather patterns."

Ginnebaugh said the results of the study represent a preliminary analysis of the impact of E85. More data from studies of the emissions of flex fuel vehicles at various temperatures would help refine the estimates, she

said.

Source: Stanford University (news : web)