Ethanol refining may release more of some pollutants than previously thought

May 5 2015

Air-quality readings over the Midwest were made from an aircraft in 2013 at three different distances downwind from an ethanol refining plant in Decatur, Illinois. The measurements were used to calculate emissions of various gases, including VOCs, nitrogen oxides and sulfur dioxide. Credits: Joost de Gouw

Ethanol fuel refineries could be releasing much larger amounts of some ozone-forming compounds into the atmosphere than current assessments suggest, according to a new study that found emissions of these chemicals at a major ethanol fuel refinery are many times higher than government estimates.

New airborne measurements downwind from an ethanol fuel refinery in Decatur, Illinois, show that ethanol emissions are 30 times higher than government estimates. The measurements also show emissions of all volatile organic compounds (VOCs), which include ethanol, were five times higher than government numbers, which estimate emissions based on manufacturing information. VOCs and nitrogen oxides react with sunlight to form ground-level ozone, the main component of smog.

If emissions at the more than 200 fuel other ethanol refineries in the U.S. are also being underestimated, these plants could be a higher source of VOC emissions than currently thought, according to the new findings accepted for publication in the *Journal of Geophysical Research: Atmospheres*, a publication of the American Geophysical Union.

Ethanol, a renewable transportation fuel made from corn, constitutes approximately 10 percent of the fuel used in gasoline vehicles in the U.S., according to the new study. The renewable fuel standard mandating the use of ethanol and other renewable fuels aims to reduce greenhouse gas emissions and petroleum imports, while encouraging development and expansion of the U.S. renewable fuels sector, according to the U.S. Environmental Protection Agency.

The new study is one of the first and most detailed investigations of emissions from ethanol fuel refining, according to its lead author Joost de Gouw, a scientist at the Cooperative Institute for Research in Environmental Sciences at the University of Colorado Boulder and NOAA's Earth System Research Laboratory in Boulder, Colorado.

Information about the refining process is one piece of examining the entire lifecycle of ethanol fuel emissions, from growing the corn used to make the fuel to the effect of emissions on urban air quality, he said.

"Over the past decade, because of the renewable fuel mandate, we have added 10 percent of ethanol to all the gasoline that is sold in the U.S. and so the question is: what does that do to the environment," de Gouw said. "That is a very complicated question and it has many different aspects. One of the aspects is the air-quality implications and, to get at them, we have to know what are the emissions associated with producing ethanol and using ethanol. That is where this study fits in."

To make the measurements they report, de Gouw and his colleagues flew an airplane downwind of an Archer Daniels Midland ethanol refinery, the third largest producer of fuel ethanol in the U.S., and took air-quality readings at three different distances from the plant. The researchers used those to calculate emissions of various gases, including VOCs, nitrogen oxides and sulfur dioxide.

They then compared their findings with government emissions estimates from 2011. Emissions of sulfur dioxide and nitrogen oxides - compounds generated by the coal-burning plant - were in-line with government estimates, but emissions of VOCs, including ethanol, were higher than government estimates. De Gouw said the VOC emissions are likely generated by the refining process, not the coal-burning that powers it.

The researchers also used government estimates and ethanol production numbers from the Renewable Fuels Association to analyze emissions from all fuel ethanol refineries in the U.S. and compare those to emissions from burning ethanol in motor vehicles.

Prevailing estimates had indicated that refining ethanol fuel and burning

it in cars and trucks generate equivalent amount of VOCs, including ethanol. But, the new emissions measurements from the Decatur plant show that ethanol emissions from production of one kilogram of ethanol at the refinery are 170 times higher than what comes out of a vehicle burning the same amount of ethanol, de Gouw said. If the Decatur refinery is like most other refineries in the U.S., he added, "the higher emissions of ethanol and VOCs that we calculated from our data would make the refining process a larger source of these gases than burning the ethanol fuel in your car."

"Obviously, this was just one refinery that we looked at, so we'd like to do more and see if these findings are more universal or if this plant was just exceptional," de Gouw added.

The new study points to the need for more measurements of emissions coming from ethanol fuel refineries, said Dylan Millet, an associate professor of atmospheric chemistry at the University of Minnesota in St. Paul. He was not involved with the new research. Additional observational data will help scientists better understand the emissions and their impact on air quality, he said.

"If we are going to accurately assess the air-quality implications of our fuel choices, then these are important emissions to know," Millet said.

More information: Airborne Measurements of the Atmospheric Emissions from a Fuel Ethanol Refinery, DOI: 10.1002/2015JD023138

Provided by American Geophysical Union

https://phys.org/news/2015-05-ethanol-refining-pollutants-previously-thought.html