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Mixing Processes Could Increase the Impact of Biofuel Spills on Aquatic Environments

San Diego, Calif., Nov. 16 – Ethanol, a component of biofuel made from plants such as corn, is blended with gas in many parts of the country, but has significantly different fluid properties than pure gasoline. A group of researchers from the University of Michigan wondered how ethanol-based fuels would spread in the event of a large aquatic spill. They found that ethanol-based liquids mix actively with water, very different from how pure gasoline interacts with water and potentially more dangerous to aquatic life. The scientists will present their results, which could impact the response guidelines for ethanol fuel-based spills, at the American Physical Society's (APS) Division of Fluid Dynamics (DFD) meeting, held Nov. 18 – 20, in San Diego, Calif.

"Ethanol/gasoline blends are often presented as more environmentally benign than pure gasoline, but there is, in fact, little scientific research into the effects these blends could have on the health of surface waters," says Avery Demond, an associate professor and director of the Environmental and Water Resources Engineering program at the University of Michigan, and one of the researchers who is working on the project. Some reports written for the State of California include methods for calculating the spread of ethanol into water based on a passive diffusion/dispersion process, notes Demond, but the method was not based on strong scientific evidence of how the two fluids interact.

The Michigan researchers were motivated to fill some of the knowledge gaps. They experimented by filling a tank with water, covering the water with a plate, and pouring ethanol mixtures on top. The plate was then pulled away and the researchers recorded videos of the two fluids as they began to mix. The videos showed flow patterns called convection cells forming at the interface of the ethanol mixture and water. The mixing of the two fluids produced heat that changed the density and viscosity of the fluid, giving rise to circulation currents. In contrast, pure gasoline is essentially insoluble in water and primarily remains on the surface where it vaporizes into the air.

"The mixing behavior [of ethanol-based fuel mixtures and water], from my perspective, is very unusual," says Demond. "I've never seen anything quite like it and it certainly is not passive the way that modeling guidelines suggest." Aline Cotel, also an associate professor at the University of Michigan and another member of the research team, will present videos of the unusual mixing patterns at the conference.

As a next step, the researchers would like to study how different ethanol mixtures vaporize, helping them to determine how much of a spill would end up mixed into the water and how much would volatilize into the air. Although ethanol is biodegradable, in high concentrations it can be toxic to fish and other aquatic life. The ethanol in ethanol/gasoline blends might also transport some of the carcinogenic components of gasoline into the water during the mixing process.

"We can't make statements about the environmental impact of ethanol before we've more fully investigated its potential effects on surface water quality in the event of a spill," note the researchers.

Ultimately, they hope their work will help answer outstanding questions about how ethanol mixes with water, giving scientists and policy makers a firmer grasp of the potential risks of ethanol-based biofuels.

Presentation: “Characterization of Mixing Between Water and Biofuels,” is at 9:31 a.m. on Tuesday, Nov. 20, in room 23A.
Abstract: http://meeting.aps.org/Meeting/DFD12/Event/178765

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MORE MEETING INFORMATION
The 65th Annual Meeting of the American Physical Society (APS) Division of Fluid Dynamics will take place from November 18-20, 2012, in San Diego, Calif. It will bring together researchers from across the globe to address some of the most important questions in modern astronomy, engineering, alternative energy, biology, and medicine. All meeting information, including directions to the Convention Center, is at: http://apsdfd2012.ucsd.edu/

USEFUL LINKS
Main Meeting Web Site: http://apsdfd2012.ucsd.edu/
Searchable Abstracts: http://meeting.aps.org/Meeting/DFD12/APS_epitome
Directions and Maps: http://apsdfd2012.ucsd.edu/?page=Venue_and_Maps

PRESS REGISTRATION
Credentialed full-time journalists and professional freelance journalists working on assignment for major publications or media outlets are invited to attend the conference free of charge. If you are a reporter and would like to attend, please contact Charles Blue (dfdmedia@aps.org, 301-209-3091).

SUPPORT DESK FOR REPORTERS
A media-support desk will be available. Press announcements and other news will be available in the Virtual Press Room (see below).

VIRTUAL PRESS ROOM
The APS Division of Fluid Dynamics Virtual Press Room will be launched in mid-November and will feature news releases, graphics, videos, and other information to aid in covering the meeting on site and remotely. See: http://www.aps.org/units/dfd/pressroom/index.cfm

GALLERY OF FLUID MOTION
Every year, the APS Division of Fluid Dynamics hosts posters and videos that show evocative images and graphics from either computational or experimental studies of flow phenomena. The outstanding entries are selected for their artistic content, originality, and ability to convey information. They will be honored during the meeting, placed on display at the 2013 APS March Meeting, and appear in the annual Gallery of Fluid Motion article in the American Institute of Physics' journal, Physics of Fluids.

Selected entries from the Gallery of Fluid Motion will be hosted as part of the Fluid Dynamics Virtual Press Room. In mid-November, when the Virtual Press Room is launched, another announcement will be sent out.

This release was prepared by the American Institute of Physics (AIP) on behalf of the American Physical Society’s (APS) Division of Fluid Dynamics (DFD).

ABOUT THE APS DIVISION OF FLUID DYNAMICS
The Division of Fluid Dynamics of the American Physical Society (APS) exists for the advancement and diffusion of knowledge of the physics of fluids with special emphasis on the dynamical theories of the liquid, plastic and gaseous states of matter under all conditions of temperature and pressure. See: http://www.aps.org/units/dfd/