OPEN FOR DISCUSSION

By Barbara Sitzman and Regis Goode

Oil Drilling Disaster in the Gulf of Mexico!

On April 20, 2010, an oil rig located 50 miles off the coast of Louisiana exploded, killing 11 people and causing oil to shoot from a well about one mile under the sea. This catastrophic event is the worst ecological disaster in U.S. history. Barbara Sitzman and Regis Goode, two *ChemMatters* contributors, discuss how chemistry relates to this environmental catastrophe.

Barbara: According to The New York Times and the Associated Press, between 94 million and 184 million gallons of oil gushed from the seafloor every day from April 20 to July 15 (when the oil well was capped)! Gosh, how many cars could all this oil power?

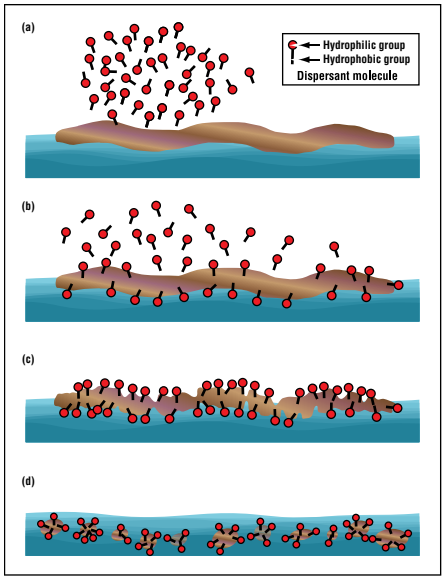
Regis: Yes, that's a lot. Surprisingly, some students in my class didn't seem to be bothered much by it. One of my students said, "What's the big deal about the oil spill? After all, my dad spills oil in the driveway all the time when he is working on his car."

B: Regis, you can tell this student there is a big difference between motor oil and the oil spewing out of a deep sea well.

R: Yes, especially given that crude oil is a mixture of thousands of different compounds, ranging from very small gas molecules to long carbon chains that form solids. Instead, motor oil is only a small component of what's in crude oil.

B: One of my students asked me, "Why couldn't they just scoop the oil off the top? After all, oil floats, and oil and water don't mix."

R: The student is right. Actually, some of the oil that gushed from the seafloor floated to the top quickly, because it is less dense than water. Crews burned and attempted to skim the top layer of oil at the surface, but with only limited success.



RHONDA SAUNDERS

How dispersants work: (a) Dispersant molecules are sprayed onto the oil slick; (b) the hydrophilic parts of the molecules stay outside the oil slick, while the hydrophobic parts are tucked inside; (c) the dispersant molecules start breaking the slick away; (d) the oil slick has been broken apart in the form of droplets surrounded by dispersant molecules.

B: That's because it's still difficult to skim it off the surface. Oil spreads out rapidly and covers large areas of water, which creates a thin layer. What's interesting is that water molecules form strong hydrogen bonds with one another, but that's not the case with the hydrocarbon molecules in the oil. So, we have a stable surface of water below the oil, but there is very little attraction between the hydrocarbon molecules in the oil and water molecules. So, the oil just spreads, forming a thin layer that is hard to skim. Also, as the oil rises to the surface, some of it forms an emulsion similar to mayonnaise, which is when tiny droplets of oil are completely interspersed in water. While skimming usually works for free-floating oil, it doesn't work for emulsions.

R: Unfortunately, much of the oil is below the surface, so it's a different situation from the leaking tanker Exxon Valdez, which occurred in 1989 in Prince William Sound off the coast of Alaska. The drilling of the well began 5,000 feet below the surface, and the oil was reached at an additional depth of 15,000 feet below the sea floor. At this depth, crude oil is under very high pressure and temperature, so when it escaped through the blown-out well, some of it (the smallest molecules in the oil) simply vaporized. This gas shot through the well with such force that it broke the water into tiny droplets, forming a mixture of oil and water much like the mist from hairspray. This created a reddish-brown emulsion called a mousse, which has the consistency of hand lotion and can remain below the surface of the water for days or weeks. Since the scientists have never faced this problem before, they don't have the answers to many of these questions.

B: My students wondered if this problem goes beyond cleaning oily birds and tar balls off the beach.

R: I tell them that scientists simply don't know. This is a new and complex problem. For example, if the oil emulsion remains below the surface, microbes may feed on it. Since these microbes need oxygen to digest the oil, they might take away a lot of the oxygen that is essential for marine life. But scientists don't know the extent of this damage, because they don't know how much oil is under the surface and how far it has spread, nor do they know when and whether the oil will surface.

B: Some of my students wondered, "What's the big deal? The Gulf of Mexico is large, and this oil is far below the surface of the water." Do you think they may have a point?

R: Little is known about marine life almost a mile below the surface, because the environment is not well studied at this depth. So, we don't know the extent of the damage to marine life—whether it will survive or die, and how this will affect marine life elsewhere in the Gulf of Mexico.

Now that we have discussed this problem, how has the oil leak in the Gulf of Mexico affected your life? Please let us know—including where you live—by sending a message to chemmatters@acs.org.

Barbara Sitzman and ***Regis Goode*** are high school chemistry teachers at Granada Hills Charter High School, Granada Hills, Calif., and Ridge View High School, Columbia, S.C., respectively.