Clay and a little salt water can make for enhanced oil recovery

November 25 2016, by Nancy Bazilchuk

Researchers have designed a micrometre thin clay gel on an oil droplet in water by tinkering with the salt concentration in the water around the drop. This approach could help improve the amount of oil we can get out of oil reservoirs. Credit: Thinkstock/Norwegian University of Science and Technology

By controlling a mix of clay, water and salt, Norwegian and Brazilian researchers have created nanostructures that might help boost oil production, expand the lifespan of certain foods or that can be used in cosmetics or drugs

You've seen sauce or mayonnaise that separates, or a slippery layer of oil that forms on top of skin cream. Oil and water generally stay separate. It is actually hard work to keep water droplets or oil droplets stable in a substance called an emulsion.

Materials, called emulsifiers, can aid in keeping an emulsion stable and are used in processed food, medicine and enhanced oil recovery from oil reservoirs to address this challenge. But many industries also have the opposite challenge keeping oil separated from water.

Jon Otto Fossum, a physicist at the Norwegian University of Science and Technology (NTNU), has previously worked with controlling the behavior of clay and oil drops using electricity, a find that was published in *Nature Communications* in 2013.

In this latest effort, Fossum led an international group that created two different types of clay-based nanostructures on an oil droplet in water simply by fine-tuning the salinity of the water around the drop. The findings were published in the open-access online journal *Scientific Reports*.

The find builds on two well-known properties of clay in water. Clay particles repel one another in water that does not contain salt. In this case, the clays form the same kinds of nanostructures that are found in glass materials. In contrast, clay particles in saline water tend to aggregate and form a kind of gel consisting of a nano-network of clay particles.

"It is possible to design small particles of clay with a micrometer thin gel on an oil droplet in water by fine tuning the salinity of the water around the oil drop," said Fossum.

Mechanical strength important

Fossum said the find shows that there are micrometer-thick gel structures formed at specific salt concentrations in water with sufficient mechanical strength to prevent oil droplets in emulsions from merging with one another.

Until the team's research, no one had observed glass or gel nanostructures in nanofluids at fluid-fluid interfaces.

The ability to create micrometer-thick gel structures by controlling salt concentrations could be used to improve the amount of oil recovered from oil reservoirs, Fossum said, or might be able to improve the lifetime of specific food products. The structures might also find a use in medicines or cosmetics, he said.

Norwegian-Brazilian cooperation

The international team behind the research is drawn from NTNU, Norway's largest university, and from Pontifica Universidade Catolica do Rio de Janeiro (PUC-Rio), and Universidade de Sao Paulo (USP), two of Latin America's top universities.

The interdisciplinary network was composed of physicists from NTNU, led by Fossum, mechanical engineers from PUC-Rio, led by Marcio S. Carvalho and chemists from USP, led by Koiti Araki. Funding for the effort came from the Research Council of Norway, the Norwegian Centre for International Cooperation in Education, the Brazilian National Council for Scientific and Technological Development and CAPES.

More information: A. Gholamipour-Shirazi et al. Transition from glass- to gel-like states in clay at a liquid interface, *Scientific Reports* (2016). DOI: 10.1038/srep37239