New process doubles production of alternative fuel while slashing costs

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A new discovery should make the alternative fuel butanol more attractive to the biofuel industry. University of Illinois scientist Hao Feng has found a way around the bottleneck that has frustrated producers in the past and could significantly reduce the cost of the energy involved in making it as well.

"The first challenge in butanol production is that at a certain concentration the fuel being created becomes toxic to the organism used to make it (*Clostridium pasteurianum* and other strains), and that toxicity limits the amount of fuel that can be made in one batch. The second issue is the high energy cost of removing butanol from the fermentation broth at the high concentrations used by the industry. We have solved both problems," he said.

In the study, funded by the Energy Biosciences Institute, Feng's team successfully tested the use of a non-ionic surfactant, or co-polymer, to create small structures that capture and hold the butanol molecules.

"This keeps the amount of butanol in the fermentation broth low so it doesn't kill the organism and we can continue to produce it," he said.

This process, called extractive fermentation, increases the amount of butanol produced during fermentation by 100 percent or more.

But that's only the beginning. Feng's group then makes use of one of the polymer's properties—its sensitivity to temperature. When the

fermentation process is finished, the scientists heat the solution until a cloud appears and two layers form.

"We use a process called cloud point separation," he said. "Two phases form, with the second facing the polymer-rich phase. When we remove the second phase, we can recover the butanol, achieving a three- to fourfold reduction in energy use there because we don't have to remove as much water as in traditional fermentation."

A bonus is that the co-polymers can be recycled and can be reused at least three times after butanol is extracted with little effect on phase separation behavior and butanol enrichment ability. After the first recovery, the volume of butanol recovered is slightly lower but is still at a high concentration, he said.

According to Feng, alternative fuel manufacturers may want to take another look at butanol because it has a number of attractive qualities. Butanol has a 30 percent higher energy content than ethanol, lower vapor pressure, and is less volatile, less flammable, and mixes well with gasoline, he noted.

More information: "Extractive fermentation with non-ionic surfactants to enhance butanol production" appeared in the May 2012 issue of *Biomass & Bioenergy* and can be accessed at dx.doi.org/10.1016/j.biombioe.2012.02.007

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