Scientists turn old plastic bottles into fuel

Millions of tons of plastic garbage pollute our world. What if we could turn them into fuel instead? That's the ambitious plan of a team of scientists from the University of California, Irvine (UCI), and the Shanghai Institute of Organic Chemistry (SIOC) in China.

The technique involves breaking down the plastic to a molecular level to turn it into a readily usable fuel similar to diesel. The source material is the most common type of plastic, polyethylene, which is predicted to reach a global annual demand of nearly 100 million metric tons by 2018. Polyethylene is used to produce various types of packaging, from bags to bottles, but it doesn't degrade easily and can linger in the environment for hundreds of years. Along with other types of plastics it pollutes waterways and oceans (one large cluster is known as the Great Pacific Garbage Patch) and often gets eaten by birds and marine life. An easy system to turn used plastic into fuel could help relieve the burden on the environment of a material that loses 95% of its value after one use cycle.

A clean transformation

"The process does not involve any harmful chemicals and does not create waste products," explains Zhibin Guan of the University of California, Irvine, one of the authors of the study. Devised "in light of the huge plastic pollution as well as the critical energy needs in China," the process basically melts the old plastic into liquid fuels and waxes. The technique, published along with the team's findings in the journal Science Advances, requires three additional ingredients.

The first is a cheap byproduct of oil refinement, called an "alkane." The other two are catalysts, or chemical components that facilitate a chemical reaction. The goal is to break the molecules in the plastic down to their original components -- hydrogen and carbon -- to rearrange them into a usable form. "The short alkanes used in our process have very low values because they cannot be used as transportation fuels or as gases," says Zheng Huang of the Shanghai Institute of Organic Chemistry, also among the authors of the study. "Therefore, essentially, the process can transform two low-value substances -- old plastic and refinery byproducts -- into valuable fuels and waxes."

Expensive ingredients

Unfortunately, the other two ingredients in the recipe don't come cheap. "The iridium catalyst is relatively expensive, which requires high turnover to reduce the overall cost," says Guan. "The rhenium catalyst is also not cheap," says Huang, "To make this economically viable, the current plastic-to-catalyst ratio needs to be significantly improved." In the current trials, the plastic to catalyst ratio is 30 to 1. The researchers say it needs to increase to 10,000 to 1 or better. "Alternatively, we can make our catalyst recyclable to reduce the cost," says Huang. Currently, the catalyst is short lived and therefore needs frequent replacement. "If the catalyst activity and cost issue are addressed, the process is relatively simple and should fit smoothly within the current recycling patterns."

Future potential

The resulting fuel, although yet to be tested, should work with current combustion engines, the researchers say. "It's also very clean, so it should burn as cleanly as current diesel fuels, as all it contains are carbon and hydrogen atoms," says Guan. George Britovsek, a Catalysis Expert at the Imperial College London and not involved in the study, agrees on its potential: "The method devised by Huang, Guan and co-workers is a nice application of a known technique for the production of liquid fuels from waste plastic. "Its success will be determined by their ability to scale it up from grams to tons, to reduce the costs associated with the purification of the source material, to recycle the catalysts and to obtain a good end-product. If that happens, this approach may become favorable compared to the current options of recycling or burning the waste plastic."
CNN: *Jacopo Prisco, July 21, 2016.*