Research demonstrates why going green is good chemistry

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Shaken, not stirred, is the essence of new research that's showing promise in creating the chemical reactions necessary for industries such as pharmaceutical companies, but eliminating the resulting waste from traditional methods. James Mack, a University of Cincinnati associate professor of chemistry, will present this research into greener chemistry on April 9, at the annual meeting of the American Chemical Society in New Orleans.

Instead of using solutions to create chemical reactions needed to manufacture products such as detergents, plastics and pharmaceuticals, Mack is using a physical catalyst – high-speed ball-milling – to force chemicals to come together to create these reactions. The mechanochemistry not only eliminates waste, but also is showing more success than liquids at forcing chemical reactions.

Traditional methods – dating back thousands of years – involve using solutions to speed up chemical reactions that are used to make products that we use every day. However, the leftover waste or solvents can often be a volatile compound, explains Mack.

Disposal and recycling is also becoming a growing and more costly challenge for companies as they follow increasing federal regulations to protect the environment. "The solvents comprise the large majority of chemicals that are handled, but the solvent doesn't do anything but serve as a mixing vehicle. For example, for every gram of pharmaceutical drug that is generated, 15 to 20 kilograms of solvent waste is generated in that process," Mack says.

"Mechanochemistry can develop new reactions that we haven't seen before, saving on waste and developing new science," Mack says.

Mack also will report on how he has used a metal reactor vial to create chemical reactions, allowing recovery of the catalyst used to make the reaction, which usually can't be achieved by using solutions. He also is exploring efforts at using natural chiral agents – agents that are non-superimposable, mirror images of each other – to successfully mix chemicals and eliminate waste such as oil.

Mack's research was supported by a $367,835 grant from the National Science Foundation that was awarded in 2011 and funded through 2014. His research received a highly competitive, $550,000 NSF CAREER Award in 2006. The CAREER Award is the NSF's most prestigious award in support of junior faculty who exemplify the role of teacher-scholars through outstanding research, excellent education and the integration of education and research within the context of the mission of their organizations.

Provided by University of Cincinnati