Environmentally friendly chemistry important for manufacturing pharmaceuticals

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Limiting the quantity of catalysts – substances that trigger a chemical reaction – used in the manufacture of pharmaceuticals is important, and research from the University of Gothenburg, Sweden, has now demonstrated that small quantities of copper work well in this respect.

"This is an important finding, not just academically but also for industry," says chemist Per-Fredrik Larsson.

Catalysis is an incredibly valuable tool in the field of chemistry, with the Haber-Bosch process being one of the most important catalytic processes in the world. It is used to manufacture fertilizer, and calculations show that without it the world's population would be just half of what it is today.

Precious metals are often used as catalysts in organic chemistry as they enable the production of many organic molecules with applications in areas such as pharmaceuticals and fine chemicals. As recently as 2010 Richard F. Heck, Ei-ichi Negishi and Akira Suzuki were awarded the Nobel Prize in Chemistry for their work on palladium catalysis.

"A problem with precious metals like palladium is that they are both expensive and harmful to the environment," says Per-Fredrik Larsson at the Department of Chemistry and Molecular Biology.

Recent years have seen researchers evaluating several different non-precious metals – primarily iron and copper – as cheap and environmentally friendly alternatives to precious metals.

"Iron catalysts have proven to be a competitive alternative to precious metals for a number of reactions," says Per-Fredrik Larsson. "An in-depth understanding of how these reactions work is incredibly important if we are to take this further. The results from our studies with iron led to several important insights into just how complex the chemistry can be."

Larsson's research group works not only with experimental methods but also with calculation models to understand how the chemistry works.

The trend for swapping precious metals for non-precious alternatives also has a flipside. It was discovered during experiments with iron catalysis in conjunction with professor Carsten Bolm of RWTH Aachen University in Germany that some reactions thought to be catalysed by iron had actually been catalysed by traces of copper in the commercially available iron source.

The fact that traces of copper could catalyse a number of different reactions was surprising as copper had previously been thought to be an ineffective catalyst requiring large quantities and high reaction temperatures.

"Our results show that copper has been given an undeservedly bad name as a catalyst," says Per-Fredrik Larsson. "Given that copper chemistry is over a century old, it's surprising that nobody's realised this before."

It is important in the pharmaceutical industry to limit the use of catalysts as the quantity of metal in the end-product is strictly regulated and the recovery process can be both difficult and expensive. As such, the

finding that small quantities of copper can be used is an important discovery.

"We've developed and studied reactions with small quantities of copper and tried to understand how and why they work," says Per-Fredrik Larsson.

The results and conclusions for iron and copper catalysts are a major contribution to this field of research and are important for its continued development.

Provided by University of Gothenburg