'Perfect plastic' created

September 29 2011

(PhysOrg.com) -- Researchers at the University of Leeds and Durham University have solved a long-standing problem that could revolutionize the way new plastics are developed.

The breakthrough will allow experts to create the 'perfect plastic' with specific uses and properties by using a high-tech 'recipe book.' It will also increase our ability to recycle plastics. The research paper is published in the prestigious journal *Science* on Thursday.

The paper's authors form part of the Microscale Polymer Processing project, a collaboration between academics and industry experts which has spent 10 years exploring how to better build giant 'macromolecules.' These long tangled molecules are the basic components of plastics and dictate their properties during the melting, flowing and forming processes in plastics production.

Low-density polyethylenes (LDPEs) are used in trays and containers, lightweight car parts, recyclable packaging and electrical goods. Up until now, industry developed a plastic then found a use for it, or tried hundreds of different "recipes" to see which worked. This method could save the manufacturing industry time, energy and money.

The mathematical models used put together two pieces of computer code . The first predicts how polymers will flow based on the connections between the string-like molecules they are made from. A second piece of code predicts the shapes that these molecules will take when they are created at a chemical level. These models were enhanced by experiments on carefully synthesised 'perfect polymers' created in labs of the Microscale Polymer Processing project.

Dr. Daniel Read, from the School of Mathematics, University of Leeds, who led the research, said, "Plastics are used by everybody, every day, but until now their production has been effectively guesswork. This breakthrough means that new plastics can be created more efficiently and with a specific use in mind, with benefits to industry and the environment."

Professor Tom McLeish, formerly of the University of Leeds, now Pro-Vice Chancellor for Research at Durham University leads the Microscale Polymer Processing project. He said, "After years of trying different chemical recipes and finding only a very few provide useable products, this new science provides industry with a toolkit to bring new materials to market faster and more efficiently."

Professor McLeish added that as plastics production moves from oil-based materials to sustainable and renewable materials, the "trial and error" phase in developing new plastics could now be by-passed. He said, "By changing two or three numbers in the computer code, we can adapt all the predictions for new bio-polymer sources."

"This is a wonderful outcome of years of work by this extraordinary team. It's a testimony to the strong collaborative ethos of the UK research groups and global companies involved," he added.

Dr. Ian Robinson of Lucite International, one of the industrial participants in the wider project said, "The insights offered by this approach are comparable to cracking a plastics 'DNA.'"

The model was developed by Dr. Daniel Read, School of Mathematics, University of Leeds, Dr. Chinmay Das of the School of Physics & Astronomy, University of Leeds and Professor Tom McLeish, Department of Physics, Durham University. Their predictions were compared to the results of polymer analysis by Dr. Dietmar Auhl, at the time a physicist at Leeds.

Provided by University of Leeds