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Development of green alternatives to phthalate plasticizers

Hanno C Erythropel, Jim A Nicell, Milan Maric and **Richard L Leask**
McGill University, Canada

Plasticizers are widely used additives to hard and brittle polymers such as poly(vinyl chloride) (PVC). Plasticizers are only loosely bound to the polymer matrix and therefore leach out over time, ending up in the environment. One of the most used plasticizers is di(2-ethylhexyl phthalate) (DEHP), yet it has come under scrutiny in the past due to its slow biodegradation and subsequent build-up in the environment. Moreover, it produces problematic breakdown products, specially its monoester MEHP. This has led to efforts to design new, green plasticizers. This project investigated compounds with the potential to replace phthalates. These were diester compounds based on maleic and succinic acid, esterified with straight-carbon alcohols. These were then tested for their plasticizer properties in rigid unplasticized PVC, as well as for their biodegradation rates when the pure compounds were exposed to the common soil bacterium *Rhodococcus rhodocrous*. In cross-disciplinary cooperation, these new green compounds are also being tested for toxicity and androgenic activity. Plasticizing properties of these blends were assessed using DSC, mechanical testing, as well as rheology. Results indicate that both groups of green plasticizers seem suitable candidates for replacing DEHP. Biodegradation experiments showed that a substantial difference in hydrolysis rates of one ester bond between the cis-structured maleates, which structurally resemble DEHP, and the saturated succinate compounds. While hydrolysis rates for the maleates were slow, the succinate compounds were removed from the broth in a matter of days. This could help to explain the slow hydrolysis of DEHP in the environment. However, the maleate compounds could be rendered more biodegradable by using straight carbon chains. Combining the results of these tests, we have shown the dramatic influence of the structure of these diester compounds on biodegradation rates, as well as demonstrated ways of rendering the maleate compounds more biodegradable, while maintaining good plasticizer properties.

Biography

Hanno C Erythropel has completed his German diploma in Chemistry from the Carl-von-Ossietzky Oldenburg, Germany in 2009, his Master's in Chemical Engineering from McGill University, Montréal, Canada in 2011, and is currently a PhD student in the lab of Prof. Richard L. Leask at McGill University. He has published more than 5 papers in reputed journals.

hanno.erythropel@mail.mcgill.ca