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Prof. Maaike Kroon at the Eindhoven University of Technology is developing new and sustainable separation methods with potentially wide-ranging applications. Working with both KIEM and ECHO funding, she aims to develop greener ways to recover valuable chemicals from waste and wastewater.

'One year is not enough to develop ground-breaking technology, but it is definitely enough to make a start', says Maaike Kroon, professor of separation technology at the Eindhoven University of Technology. In October 2013, she received funding through NWO's Knowledge Innovation Mapping (KIEM) initiative – a relatively small-scale, short-term funding instrument intended for public-private partnerships between a university and a small-to-medium-sized enterprise (SME).

In her KIEM project, Kroon is working together with the company ETD&C in Delft to develop new extraction methods to recover valuable chemicals from organic household waste. 'The KIEM funding allows one of the company's researchers to use our facilities here at the university', says Kroon. 'Our aim is to establish a proof of principle. The nice thing is that the company can directly apply any results.'

Kroon's work through her ECHO grant – NWO's funding instrument for excellent chemical research – is more substantial. This instrument enables four years of research on a related topic: 'We are developing new and more sustainable ways to separate complex mixtures of compounds', she explains. The complexity lies in the fact that these compounds cannot be separated through simple distillation, because their boiling temperatures are too similar. 'Ethanol mixed with water is a good example', says Kroon. 'By using distillation, you can never get 100% pure ethanol. That is a challenge, for instance if you want to use ethanol as a fuel.'

This problem is traditionally solved by adding a third component that alters the relative boiling points of the other two. A commonly used option is benzene, but that is toxic and cannot be used in a continuous production process. 'Our solution is to use a new class of solvents,' says Kroon, 'called deep eutectic solvents. These are themselves mixtures of natural compounds such as malic acid (an organic acid) and proline (an amino acid). When mixed, they display unique chemical characteristics. One of these is that they allow for the separation of complex mixtures through extractive distillation.'

These new solvents are not only more environmentally friendly than conventional options like benzene, she emphasises. They are also much cheaper than other alternatives, they allow for continuous production processes, and they can be safely used in the food industry. 'A potential application is the recovery of fatty acids from industrial wastewater', says Kroon. 'This is quite a promising line of research that makes me curious about the possibilities. This class of solvents was discovered a mere decade ago, but I have no doubt that the first applications will be available very soon.'

Industrial partner