**The molecular science of recycling plastics**

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| *Professor Daniel Read, Dr Johan Mattsson and Dr Costas Velis (all University of Leeds) – with Dow* |

Plastics are wonderful, amazing and highly successful materials, which enable cost- and energy-efficient production of products! However, their very success has led to huge problems of material waste and environmental impact.  This project is aimed at exploring solutions to this problem using state-of-the-art theory, but also provides opportunity for some experimental investigation.

Various solutions are available: one of the more common is recycling. Often (e.g. for milk bottles) there are now targets for using a substantial fraction of recycled material in each item produced.  Plastics are recycled according to material type – LLDPE, PP, LDPE, HDPE.  But, all resins of a given type are different, since they each have different molecular weight distributions and placement of branches.  These affect the usefulness of the material, both in processing and final properties.  Moreover, the material itself changes during repeated processing due to degradation of the molecules: affecting both molecular weight and branching.  Making good material from recycled feedstock requires an appreciation of blending different grades, and of how the molecules change during reprocessing.

Leeds has developed world-leading theoretical modelling capability for the effects of molecular weight and branching on polymer flow behaviour, how reaction processes affect molecular weight and branching, and for flow induced crystallization. These are encoded in software such as BoB and Reptate (<https://sourceforge.net/projects/bob-rheology/>, <https://reptate.readthedocs.io/>).  So far, these tools have been usefully applied in designing new polymer materials, but we have a strong desire to use them to address the polymer recycling problem.

This project aims to further develop our modelling capability, and apply it to the recycling problem: specifically, molecular blending and degradation during repeated recycling.  Experimental investigation (e.g rheology) is be possible, as is consideration of the wider economy of closed loop recycling. Jaap den Doelder (Dow) is a long-standing collaborator with deep interest in addressing recycling challenges. In addition to all this, there is opportunity for purely scientific investigation into the theory of molecular polymer rheology.