Popular science summary of the PhD thesis

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Title of the PhD thesis	Sorting Waste by Sedimentation: From Single-Particle Settling to Industrial Process Modeling
PhD school/Department	DTU Construct

Science summary

* Please give a short popular summary in English (approximately half a page) suited for the publication of the title, main content, results and innovations of the PhD thesis also including prospective utilizations hereof. The summary should be written for the general public interested in science and technology.

Plastic recycling depends on sorting. Mixed waste granulate has to be separated into single-polymer streams before it can be reprocessed, because even a small fraction of the wrong polymer degrades the properties of the recycled material.

Jigging is a well-established way to do this. The plastic granulate is placed on a sieve in a water column and the sieve is moved up and down. Each stroke lifts and loosens the particle bed; as the particles settle, the denser particles work their way downwards and lighter ones upwards. After enough strokes the bed is stratified by polymer and the layers can be drawn off separately.

The difficulty is that how fast a particle settles depends not only on its density but also on its size and shape - and shredded plastic waste is highly irregular. Two particles of different polymers can settle at the same rate, so the separation is never perfect. Operators have to trade purity, yield and process time against each other, largely by trial and error. This thesis aims to replace that trial and error with predictive models.

The work covers three investigations. First, a computer vision method was developed to track individual irregular particles as they settle in water. It measures gliding and tumbling of the settling irregular particles, and shows which existing drag correlations best predict the fluid forces acting on them. Second, these findings feed a 1D model of the jigging process that predicts separation from the feed material and the operating conditions. It runs in minutes, so a non-expert can quickly judge whether a given waste stream is suitable for jigging and which settings to start from. Third, a 3D CFD-DEM model resolves every particle and the water around it. It takes days on a compute cluster, but allows detailed analysis such as, showing that friction between particles can significantly affect stratification.

Together these models make jigging more predictable, and better prediction means cleaner recycled plastic from less energy and time.

Please submit the summary to the department PhD coordinator together with your thesis