iRecycle
4-NCL

MSc project series on household waste reprocessing

Why household waste?

UK households throw away over 26.8 million tonnes of waste EVERY YEAR

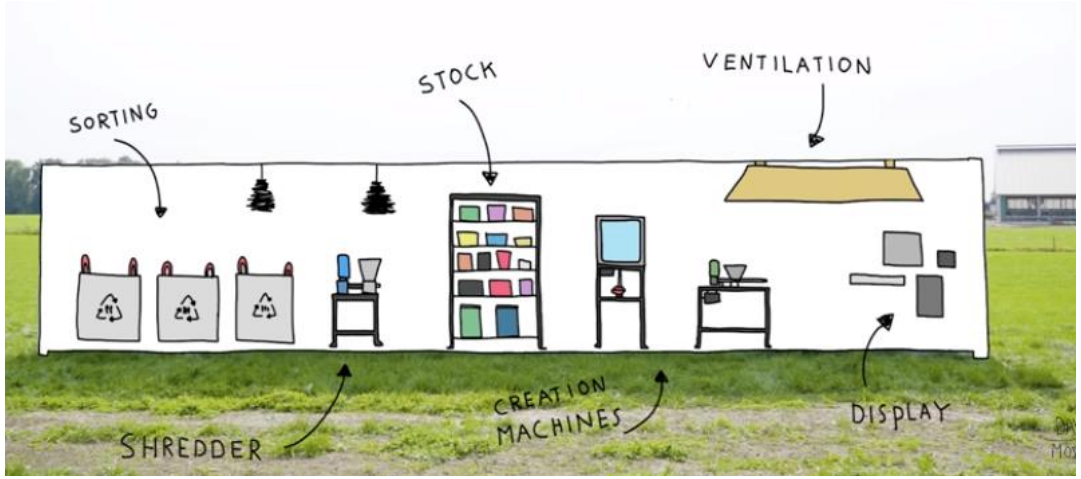
City councils struggle to recycle it; only 35% is currently retrieved and reprocessed

Household waste is difficult to sort, separate and reprocess. Most ends up exported overseas and buried in land fields around the world

iRecycle = AIMS

Nearly all types of plastics can be recycled. However, the extent to which they are recycled depends upon technical, economic and logistic factors.

- iRecycle is a series of MSc projects that will study different aspects of household waste reprocessing, from characterizing material types, to investigating reprocessing and recycled materials behaviours.
- The ultimate aim is to stablish a on-Campus recycling system where ‘sustainability- savvy’ individuals can bring their household waste in order to be converted into ‘feedstock’ for our 3D printing and manufacturing labs.



For an insight of similar ongoing projects, check: https://preciousplastic.com/

The projects

Project 1. Mechanical characterization of recycled polymers (X4)

AIM

- To explore the feasibility of converting waste plastic into useful objects via injection-moulding

Objectives

- To establish a plastic collection strategy
- To produce good quality pellets
- To understand mechanical characterization methods
- Understanding the properties of recycled materials

Activities/ Requirements:

- 1- Identify most common types of polymers that become waste in your household (packaging, bottles, kitchenware, single-use, etc.)
- 2- Characterise their profile, current recycling status and common disposal routes.
- 3-Select ONE type of plastic to focus your research on, and actively collect it from your household/community (this will be used as your personal material stock).
- 4-Categorize colours and convert to pellets using a dedicated shredder (provided).
- 5-Analyse the polymer particles sizes that are obtained by the shredding process.
- 6-Use melt-flow analysis (provided) to characterize flow stability.
- 7-Define a strategy to store, code an maintain your pellets' quality.
- 8-(For PP, PS, PE, Nylon and PU) Use one of the Desktop Injection moulding units (provided) and generate test specimens.
- 9-Undertake the mechanical characterization of your specimens.
- 10-Analyse texture, microstructure and visual analysis via microscopy
- 11-(Optionally) Repeat the shredding cycle and quantify the recycling ratio and quality decrease

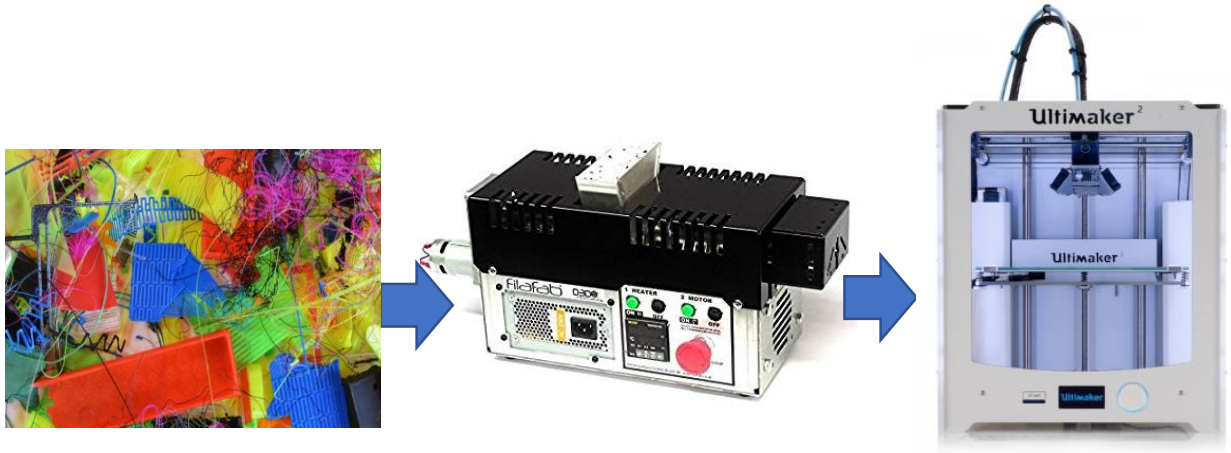
Project 2. 3D-printing Lab waste reduction (X1)

AIM

- 3D printers normally operate with two types of plastics: PLA and ABS. None of these is currently being recycled by local collection services and with all likelihood, PLA and ABS components and waste will end up in unidentified landfills. This project is aimed at reclaiming waste polymer from the 3DP lab and reprocessing it to re-make filaments to be re-used: by our 3D printers locally.

Objectives

- Understand the operation of FFF 3D printers
- Familiarize with different Extruder + winder methods
- To understand mechanical characterization methods
- Understanding the properties of recycled materials



Activities/ Requirements:

- 1-Understanding 3D printing and the sources of waste
- 2- Planning a strategy for sorting components based on polymer type/size/colour.
- 3 -Use a shredder (provider) to obtain flakes/pellets
- 4- Analyse particle size and morphology
- 5- Make use of a desktop filament maker (provided) to generate filament from recycled ABS or PLA
- 6- Develop a procedure to measure and ensure the filament diameter is constant.
- 7- 3D print test specimens from recycled filament
- 8- Undertake the mechanical characterization of your specimens.
- 9-Analyse texture, microstructure and visual analysis via microscopy
- 10- Repeat the shredding cycle and quantify the recycling ratio and quality decrease

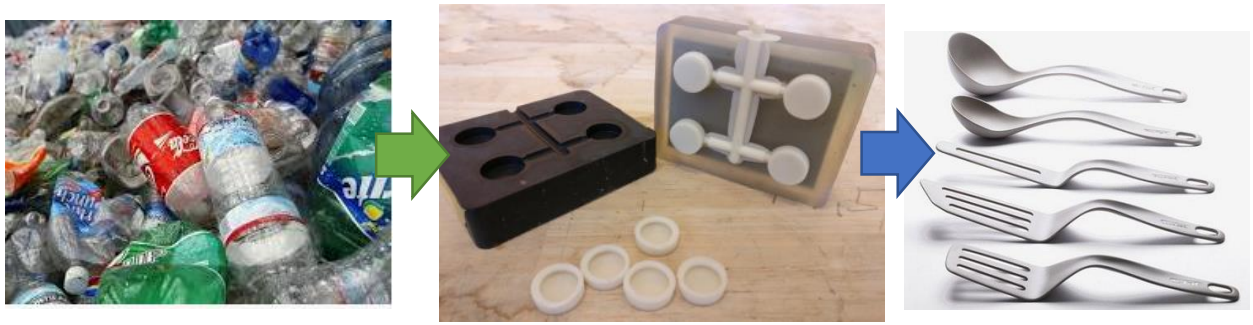
Project 3. PET bottles reclaiming for recycled cutlery (X2)

AIM

- Explore the feasibility of converting standard PET waste (or other common single-use bottle materials) into cutlery via injection moulding on soft injection-moulds.

Objectives

- Understand polymer recycling routes
- Establish a reclaiming/recycling strategy
- Operate a desktop injection moulder
- Understanding the behaviour of recycled PET



Activities/ Requirements:

- 1-Understanding PET (or similar) properties and recyclability
- 2- Planning a strategy for sorting components based on polymer type/size/colour.
- 3 -Use a shredder (provider) to obtain flakes/pellets
- 4- Analyse particle size and morphology
- 5- Make use of a desktop Injection moulder to create cutlery pieces
- 6- Understand the uses and limitations of soft-moulds, compared to standard metal moulds.
- 7- Perform a visual and wear characterization of soft moulds
- 8- Undertake the mechanical characterization of your specimens.
- 9-Analyse texture, microstructure and visual analysis via microscopy
- 10- Repeat the shredding cycle and quantify the recycling ratio and quality decrease

Useful links

- SUSTAINABLE PACKAGING Blog http://sustpkgg.blogspot.com/
- Recycling 3D Printer Plastic https://all3dp.com/2/3d-printer-recycled-plastic-tips-for-your-waste-plastic/
- Redistributing material supply chains for 3D printing https://www.ifm.eng.cam.ac.uk/uploads/Research/TEG/Redistributing_material_supply_chains_for_3D_printing.pdf
- Zero Waste project- UC Berkely https://www.youtube.com/watch?v=9a_ZYDcQV0w
- https://news.berkeley.edu/2017/02/15/3d-printer-filament-reclamation-project/
- How useful might that used plastic water bottle be for the military? https://www.arl.army.mil/www/default.cfm?article=3178
- Plastic Injection Molding: https://www.youtube.com/watch?v=RMjtmsr3CqA
- Precious Plastic - How to finish objects from recycled plastic: https://www.youtube.com/watch?v=JwdlLelQWws

News reports

How the UK is moving towards recycling most of its plastic waste
https://www.telegraph.co.uk/business/reducing-plastic-waste/uk-recycling/

Where does all our rubbish go?
https://www.independent.co.uk/environment/where-does-all-our-rubbish-go-465773.html

Plastic recycling in the UK: What happens to the plastic in your recycling bin?
https://www.standard.co.uk/futurelondon/theplasticfreeproject/plastic-recycling-in-the-uk-what-happens-to-the-plastic-in-your-recycling-bin-a4156036.html

Why plastic recycling is so confusing
https://www.bbc.co.uk/news/science-environment-45496884

Newcastle Council looks to combat 'recycling contamination'
https://governmentbusiness.co.uk/news/01082017/newcastle-council-looks-combat-%e2%80%98recycling-contamination%e2%80%99