Reactive Recycling

a WISE industrial PhD student project

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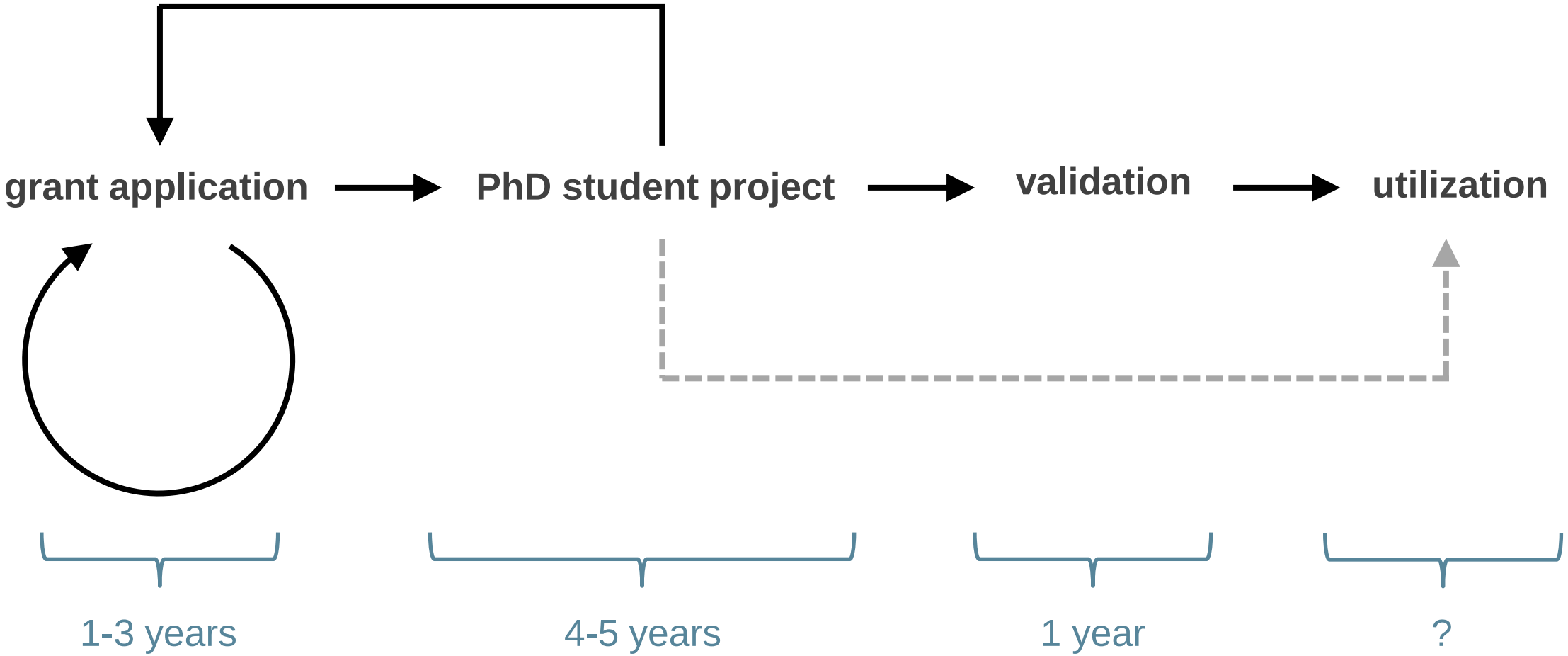
today's research and development cycle at a university



EU Directive 2019/904 on the reduction of the impact of certain plastic products on the environment

This Directive will contribute to the achievement of United Nations (UN) **Sustainable Development Goal 12** to ensure sustainable consumption and production patterns, which is part of the 2030 Agenda for Sustainable Development adopted by the UN General Assembly on 25 September 2015.

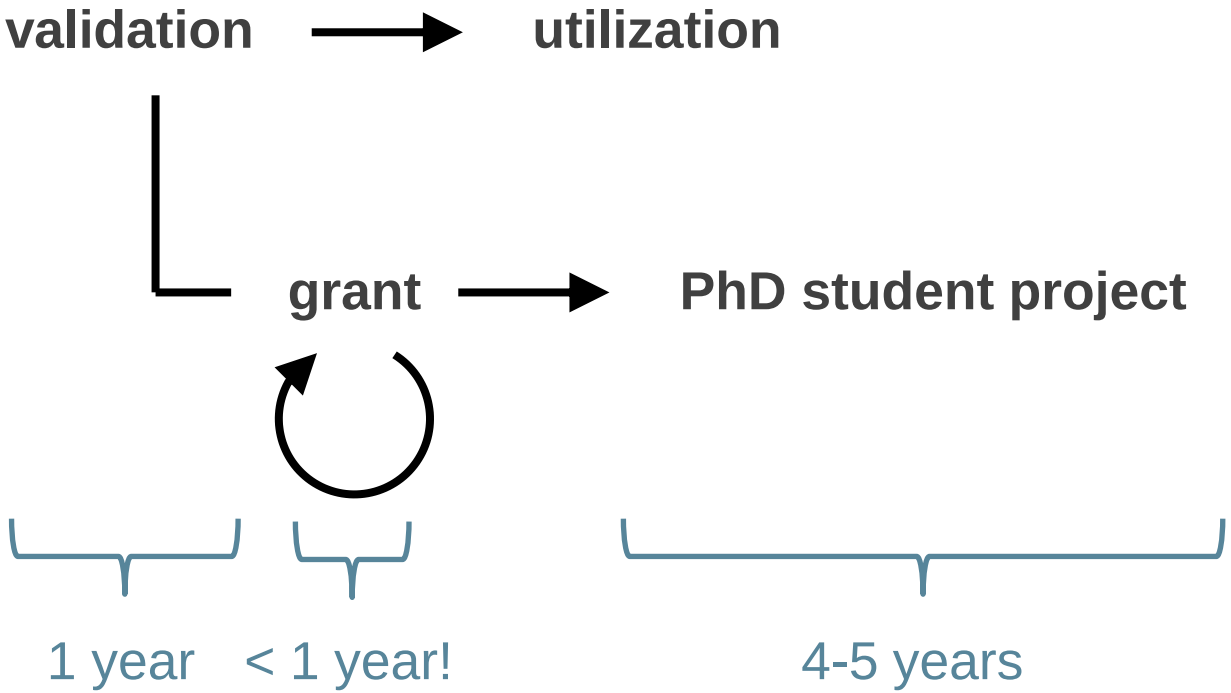
[…]

Member States shall take the necessary measures to **ensure the separate collection for recycling**:

(a) by **2025**, of an amount of waste single-use plastic products listed in Part F of the Annex **equal to 77 % of such single-use plastic products** placed on the market in a given year by weight;

(b) by **2029**, of an amount of waste single-use plastic products listed in Part F of the Annex **equal to 90 % of such single-use plastic products** placed on the market in a given year by weight.

“sustainable” research and development cycle



Why PhDs?

expert staff to manage

daily changes

in waste streams

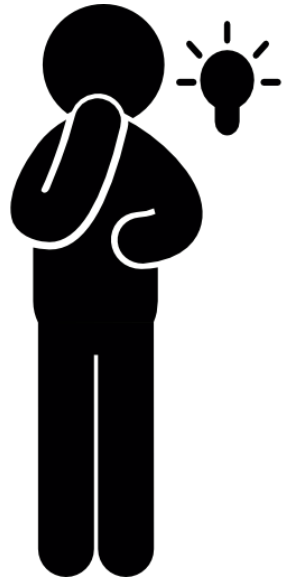


image from http://nordicfashionassociation.com/projects/textile-waste-as-a-resource/

NEXAM CHEMICAL

Nexam Chemical

- Established in 2009 as a spin-off from Perstorp AB
  - Production in SE, UK, PL and HU
  - HQ: Sweden
  - R&D: Scotland and Sweden

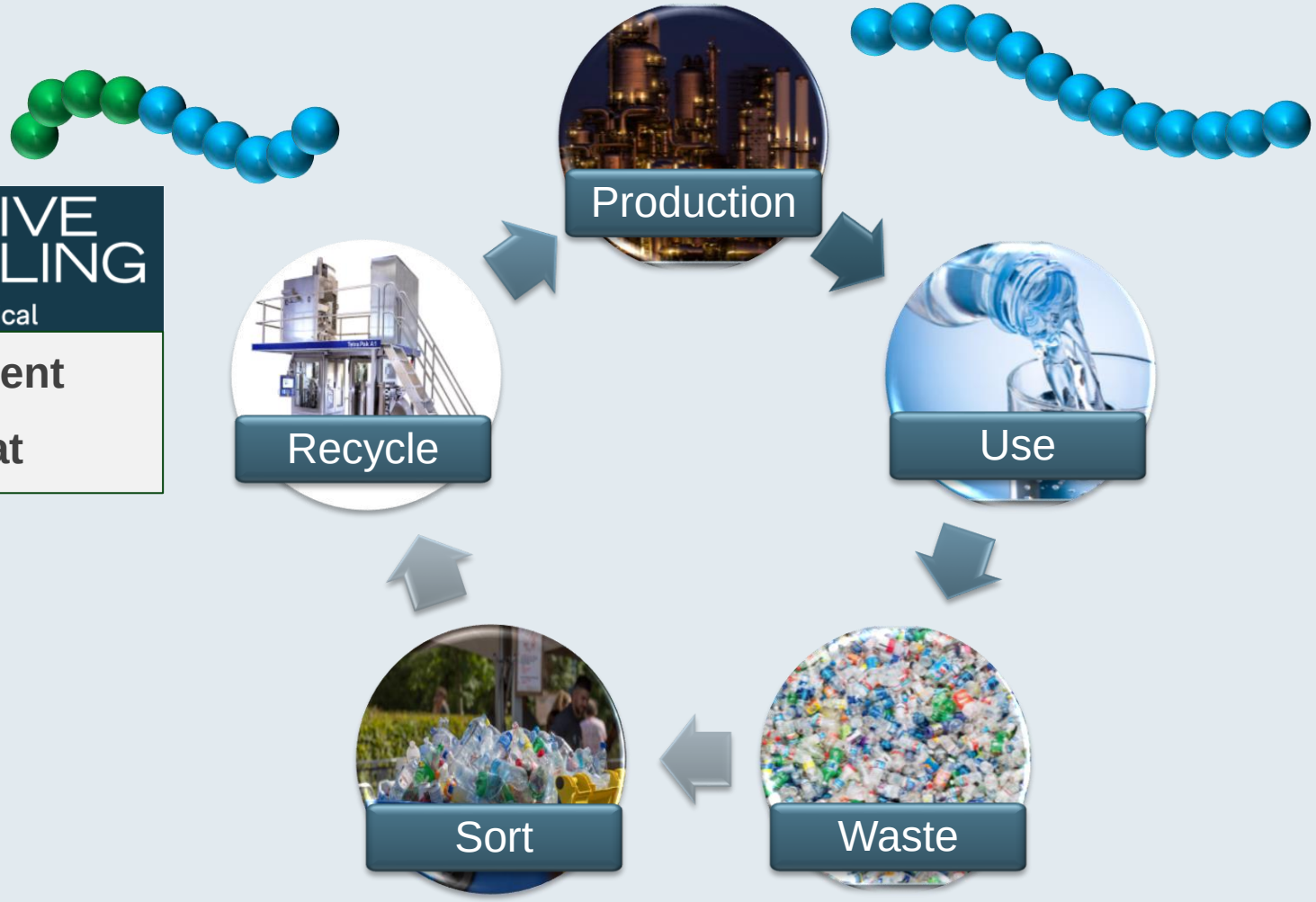
- Offering novel chemical additives and reactive masterbatches to improve processing/properties of prime and recycled polymers:
  - PET and r-PET
  - r-PE and r-PP
  - Polyimide

- Unique combination of chemical and compounding know-how
  - Chemical plant in Scotland and compounding facility in Sweden

Transition to Circular Economy

REACTIVE RECYCLING
By Nexam Chemical

- **Existing equipment**
- **Activated by heat**



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REACTIVE RECYCLING
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Reactive Recycling for r-LDPE – PCR example

- Upcycling of mechanically recycled waste stream from food packages
- Modification was made in the melt at normal processing temperatures
- With addition of NEXAMITE R305 it was possible to reduce the MFR and make a quality which could be film blown

PCR only

MFR: 4.4 g/10 min

PCR + 2.5 wt% R305

MFR: 2.1 g/10 min

Product	Activity	Benefits
NEXAMITE®R305	Processing temperature >210°C	Improved flow properties, higher melt strength and reduction of MFR

REACTIVE RECYCLING
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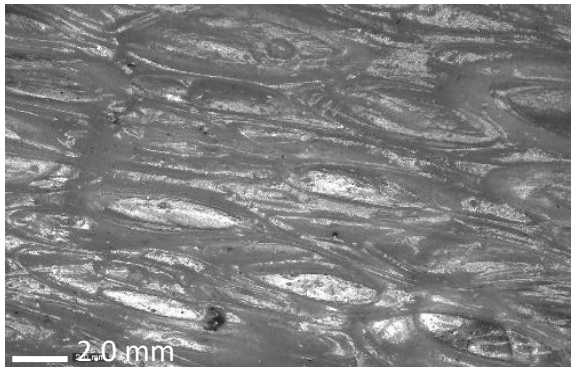
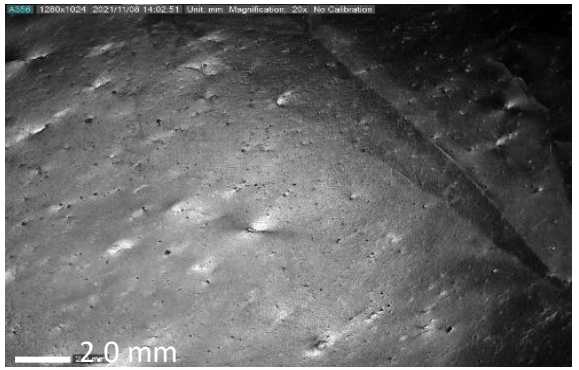
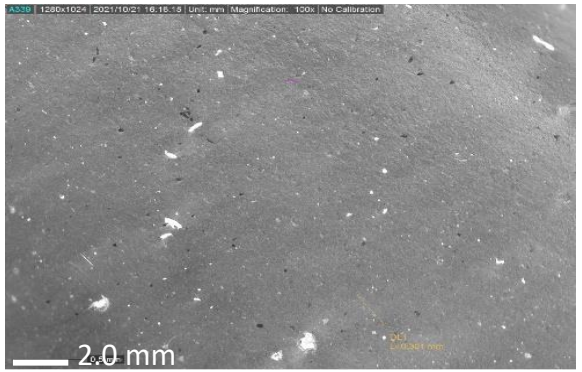
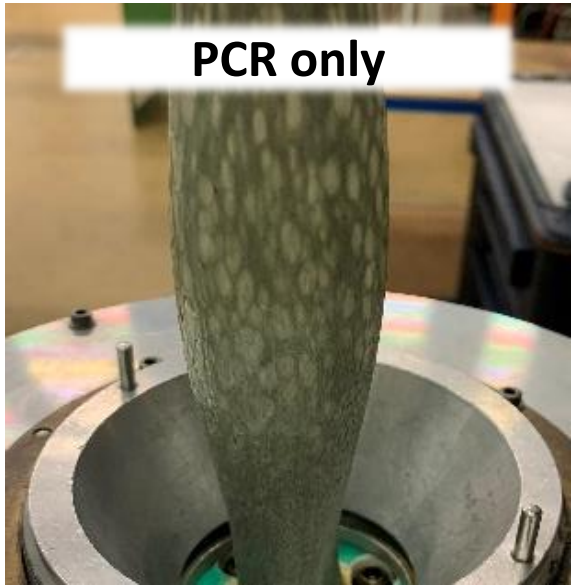
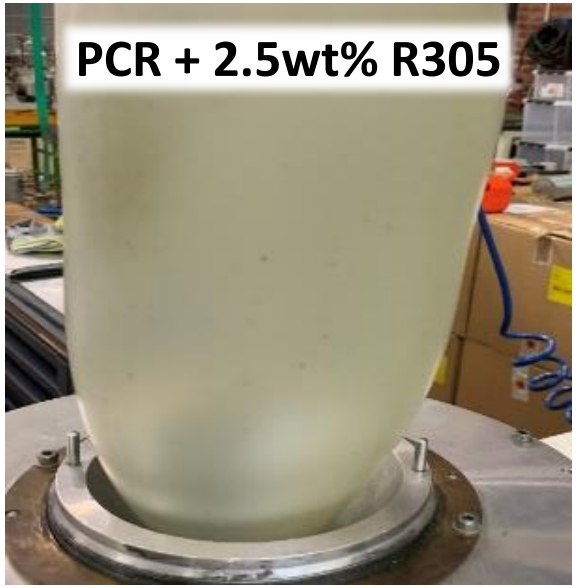
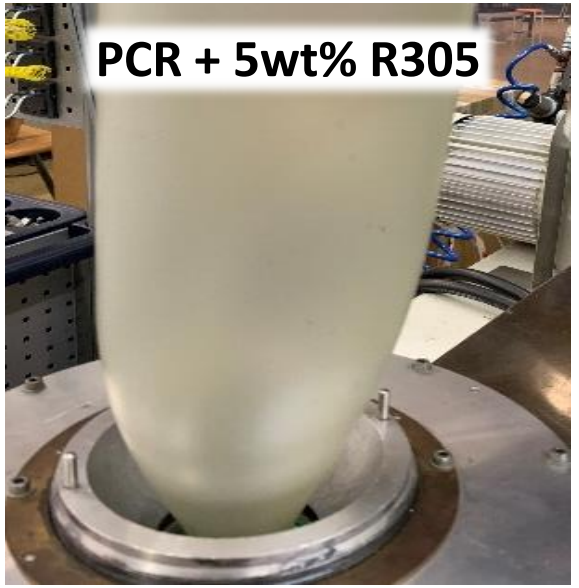
r-LDPE – PCR example

MFR*	~4 g/10min	~2 g/10min	~1.2 g/10min
Optical Microscopy			
			

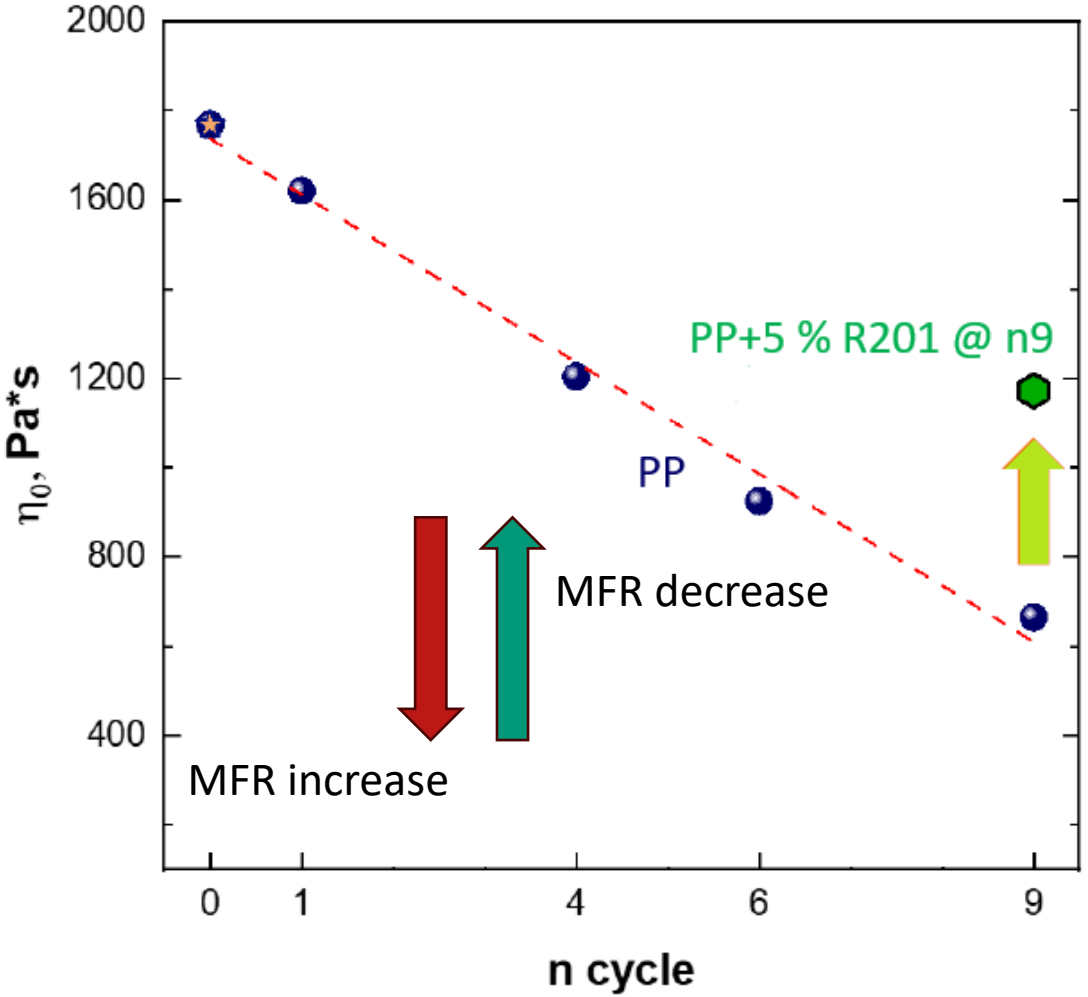
* MFR: 190C, 2.16 kg

REACTIVE RECYCLING
By Nexam Chemical

Simulation on effect on multiple extrusions*

- Multiple extrusions on virgin PP to simulate recycling process
- After 9 extrusion runs the viscosity of the PP had decreased with 60 % but could with Nexamite R201 be restored to 70 % of its original value

Conclusion: Nexamite R201 can repair and partially restore an already degraded PP and decrease the MFR closer to the initial MFR value



* Source: Politecnico di Torino, Dipartimento di Scienza Applicata e Tecnologia,: Dr Rosella Arrigo

REACTIVE RECYCLING
By Nexam Chemical

Fulfilling a life-long dream

- Top-ranked student in Applied Chemistry and Polymer Chemistry in Iran
- Moved to Sweden June 2020
- Got a position in QC at Nexam Chemical 2020.
- Moved on to R&D in November 2022.
- Always had the ambition to do a PhD.

Industrial PhD Grant from WISE:

- **Amin to fulfill a life-long dream**
- **Strategic growth for Nexam by building an expert internally**

NEXAM CHEMICAL

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