PolyUrethane Recycling Towards
a Smart Circular Economy

Deliverable

D6.14 Five MOOCs put online along the project

WP6 – Communication, Dissemination and Exploitation

Project Information

Grant Agreement n°	814543
Dates	1st January 2019 – 31st December 2022

This project has received funding from the European Union's Horizon 2020 research and innovation program under grant agreement No 814543.
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Document status

Document Information

Deliverable name	PUReSmart_D6.14
Responsible beneficiary	Dirk De Vos / KUL
Contributing beneficiaries	REF - UGENT – RW
Contractual delivery date	M48 – 31 / 12 / 2022
Actual delivery date	M48 – 10 / 1 / 2023
Dissemination level	Public

Document approval

Name	Position in project	Organisation	Date	Visa
	WP Leader			
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Document history

Version	Date	Modifications	Authors
V1	10/1/23	First version	Dirk De Vos

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Publishable Summary

Five MOOCs have been designed and animated by the audio-visual technical team of KULeuven. The themes of these MOOCs are:

MOOC 1: Recycling end-of-life mattresses by split-phase reactions (published Dec 7, 2021);

MOOC 2: Sorting of plastic waste streams by near-infrared spectroscopy (published April 11, 2022);

MOOC 3: Smart design of plastics for improved recycling (published August 22, 2022);

MOOC 4: Polyurethane in the landscape of polymer recycling (published October 6, 2022);

MOOC 5: Cradle-to-cradle: Mattress waste as a renewable resource? (published January 10, 2023).

The MOOCs are available on the MOOC section of the KULeuven Youtube channel.

Executive summary

1 Description of the deliverable objective and content

Task 6.3 focuses on knowledge spreading to a broad and general audience. To this aim, through massive online open classes (MOOC), a large audience will be reached through targeted sessions taking advantage of the advances of the project. At least 5 MOOCs will be proposed, with one per WP, supervised by KUL. Academic partners have quite a large experience in such initiatives, since they all propose some; KUL even proposes MOOC since 201557. Industrial partner will bring insights to these MOOC.

D6.14 stipulates that five MOOCs will be placed online along the project.

2 Brief description of the state of the art

Not relevant.

3 Deviation from objectives and corrective actions

None.

4 Innovation brought and technological progress

Not relevant.

5 Analysis of the results

Not relevant.

6 Impact of the results

Little more than a year after publication of the MOOCs, they have already found their way to a broader public. MOOC2, published April 11 2022, already has > 2000 views after 9 months; MOOC1 is close to 1000. This is clear proof that the public enjoys watching these well-made video presentations.

7 Related IPR

Not relevant.

8 Publishable information

These are the URLs of the videos concerned:

MOOC 1, Recycling end-of-life mattresses by split-phase reactions

https://www.youtube.com/watch?v=UuLfjJNT3k8

MOOC 2, Sorting of plastic waste streams by near-infrared spectroscopy

https://www.youtube.com/watch?v=KbZxEnoUZ5M&t=26s

MOOC 3, Smart design of plastics for improved recycling

https://www.youtube.com/watch?v=N3GLJTVv36Y

MOOC 4, Polyurethane in the landscape of polymer recycling

https://www.youtube.com/watch?v=OBqQh0FcpJw

MOOC 5, Cradle-to-cradle: Mattress waste as a renewable resource?

https://www.youtube.com/watch?v=uTOnU85x7Ag

9. Conclusion

All 5 promised MOOCs were successfully completed during the project (the last MOOC was actually finalized Dec 23, 2022), and the high viewing rates prove that the public easily finds the way to this very accessible dissemination channel.

Deliverable report

MOOC 1: Recycling end-of-life mattresses by split-phase reactions

https://www.youtube.com/watch?v=UuLfjJNT3k8

Plastics are generally classified into thermoplastics and thermosets, according to their response to heating. Thermoplastics become liquid or plasticize upon heating and harden again upon cooling, which can be repeated in multiple cycles. By contrast, thermosets do no plasticize upon heating and will eventually degrade or pyrolyze at high temperatures. The problematic recycling of end-of-life thermosets could be resolved by the introduction of dynamic or reversible covalent bonds. Such materials are designated as 'Covalent adaptable networks' or CANs. Covalent adaptable network materials based on the unique reactivity of 1,2,4-triazoline-3,5-dione (TAD) components were developed by the university of Ghent. TAD-indole based comonomers were incorporated into existing PU thermoset formulations.

MOOC 2: Sorting of plastic waste streams by near-infrared spectroscopy

https://www.youtube.com/watch?v=KbZxEnoUZ5M&t=26s

Plastic has been a defining material for our modern society with the annual production reaching almost 370 million tons. However, the widespread use of plastic materials also generates huge volumes of plastic waste, posing severe environmental problems. Therefore, the recycling of plastic is of critical importance to attain a sustainable society. The sorting of plastic waste according to the resin material is a critical step in the recycling process. Near infrared reflectance spectroscopy has been integrated into sorting machines designed and manufactured by Redwave. The intensity of radiation reflectance depends on the chemical and physical nature of the plastic material, allowing for the identification of characteristic reflection signatures.

MOOC 3, Smart design of plastics for improved recycling

https://www.youtube.com/watch?v=N3GLJTVv36Y

Plastics are generally classified into thermoplastics and thermosets, according to their response to heating. Thermoplastics become liquid or plasticize upon heating and harden again upon cooling, which can be repeated in multiple cycles. By contrast, thermosets do no plasticize upon heating and will eventually degrade or pyrolyze at high temperatures. The problematic recycling of end-of-life thermosets could be resolved by the introduction of dynamic or reversible covalent bonds. Such materials are designated as 'Covalent adaptable networks' or CANs. Covalent adaptable network materials based on the unique reactivity of 1,2,4-triazoline-3,5-dione (TAD) components were developed by the university of Ghent. TAD-indole based comonomers were incorporated into existing PU thermoset formulations

MOOC 4, Polyurethane in the landscape of polymer recycling

https://www.youtube.com/watch?v=0BqQh0FcpJw

Plastic waste is processed by a variety of techniques comprising incineration, pyrolysis, dissolution/precipitation, mechanical recycling and chemical recycling. Incineration allows for the recovery of thermal energy but also requires extensive scrubbing of exhaust gasses and produces greenhouse gasses. Pyrolysis involves the thermal decomposition of plastic at elevated temperatures in an inert atmosphere. The product mixture comprises a wide range of hydrocarbons requiring further processing by cracking. Dissolution and precipitation processes require the use of non-toxic and easily recoverable solvents to produce plastic granulates for product manufacturers and accounts for less than 1% of plastic waste. Mechanical recycling results in lower quality plastics (also known as downcycling) and accounts for 12% of annual plastic waste. Chemical recycling requires the dissolution and depolymerization of polymers to constituent chemical materials for virgin grade producers and accounts for less than 1% of the plastic waste. An innovative process for the chemolysis of end-of-life polyurethane mattresses is being developed as part of the PUReSmart project, with the goal of recycling the two main components comprising the polyol and the isocyanate. Concurrently, an intelligent sorting process is being developed for separating the various polyurethane foams from end-of-life mattresses.

MOOC 5, Cradle-to-cradle: Mattress waste as a renewable resource?

https://www.youtube.com/watch?v=uTOnU85x7Ag

Old mattresses could be a re-used as a resource to produce new high quality polyurethane materials. In the EU PureSMART process, KULeuven discovered a process to split the waste material in an energy-efficient way. This MOOC explains how the building blocks for polyurethane are produced traditionally, in the 'linear' economy, based on fossil resources. As an alternative, we explain the chemistry behind the new splitting process. This is a large stride forward towards a truly circular materials economy.