TotalEnergies Rotomolding Materials Sustainability Roads to the Success.

Executive Forum
Association of Rotational Molders
Belfast June 9-12 , 2026

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TotalEnergies OneTech Belgium

Driving Circularity: Launch of Our New Recycled Polyethylene Compound rPE 42640 for ROTOMOLDING

- This presentation introduces the development and launch of a new recycled Polyethylene compound designed with a very high content of recycled feedstock to meet sustainability and performance requirements for the rotomolding application. The compound leverages post-consumer recycled materials and advanced processing techniques to deliver high-quality properties suitable for industrial applications.

- The growing demand for sustainable materials has accelerated innovation in polymer recycling. This section introduces the context of circular economy initiatives, market drivers, and the role of recycled polymers in reducing environmental impact.

Recycled polymers: public authorities take actions

More sustainable sourcing

PPWR*: (on-going)

Mandatory **35%** recycled content in all non-contact sensitive plastic packaging by **2030**

Mandatory **10%** recycled content in all contact sensitive plastic (non-PET) packaging by **2030**

Regulatory framework on bio-based, biodegradable *(ongoing)* and compostable considering mandates on bio

Emergence of plastic taxes

Plastic tax effective in the UK (2022) and Spain (2023)

Planned tax on plastic packaging in Italy

Using plastic better

SUPD:**

Single-use plastics ban on a selection of articles starting in 2021

30% recycled content in beverage bottles by **2030**

France going beyond the EU measures:

AGEC law (Anti-Gaspillage et Economie Circulaire) :

- Banning all single-use plastics by **2040**

3R* decree**

- -20% single-use plastics by **2025**

Reuse Decree:

- Promoting reusable packaging

China, India and Malaysia: Plastic waste imports banned

Enlarge suitable technologies for food contact

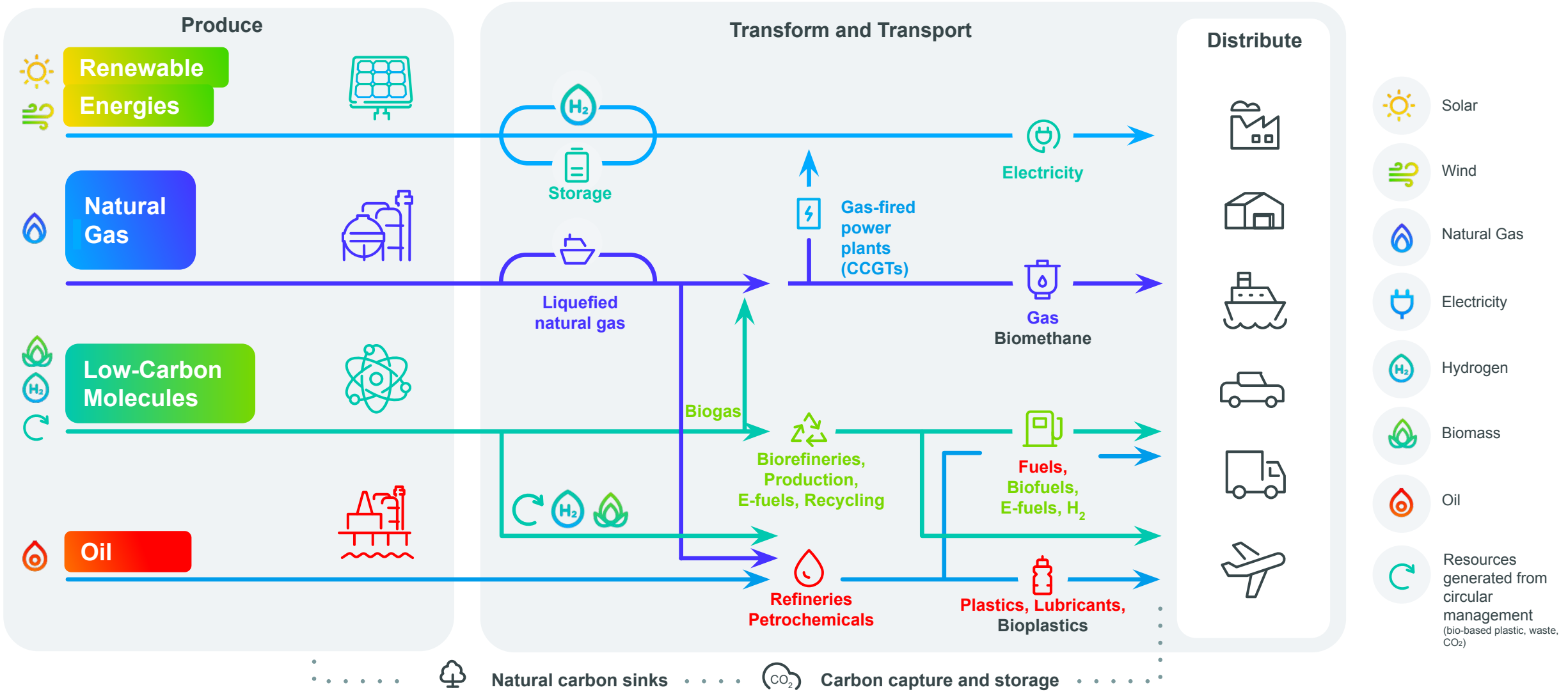
Revision of **Food Contact Material** framework, opening the door for the use of mechanical recycled material in food contact articles

Making the automotive sector more sustainable

End of Life Vehicles Directive, new vehicles must contain at least 20% recycled plastics within 6 years of the regulation taking effect, increasing to +25% after 10 years. (Subject to parliamentary vote)

** PPWR: Packaging and Packaging Waste Directive Regulation, European Commission*
*** SUPD: Single-Use Plastics Directive, European Parliament*
**** 3R: Reuse, reduce, recycling*

Leading global and integrated multi-energy Company



Integrated & Global value chain, with a strong EU commitment

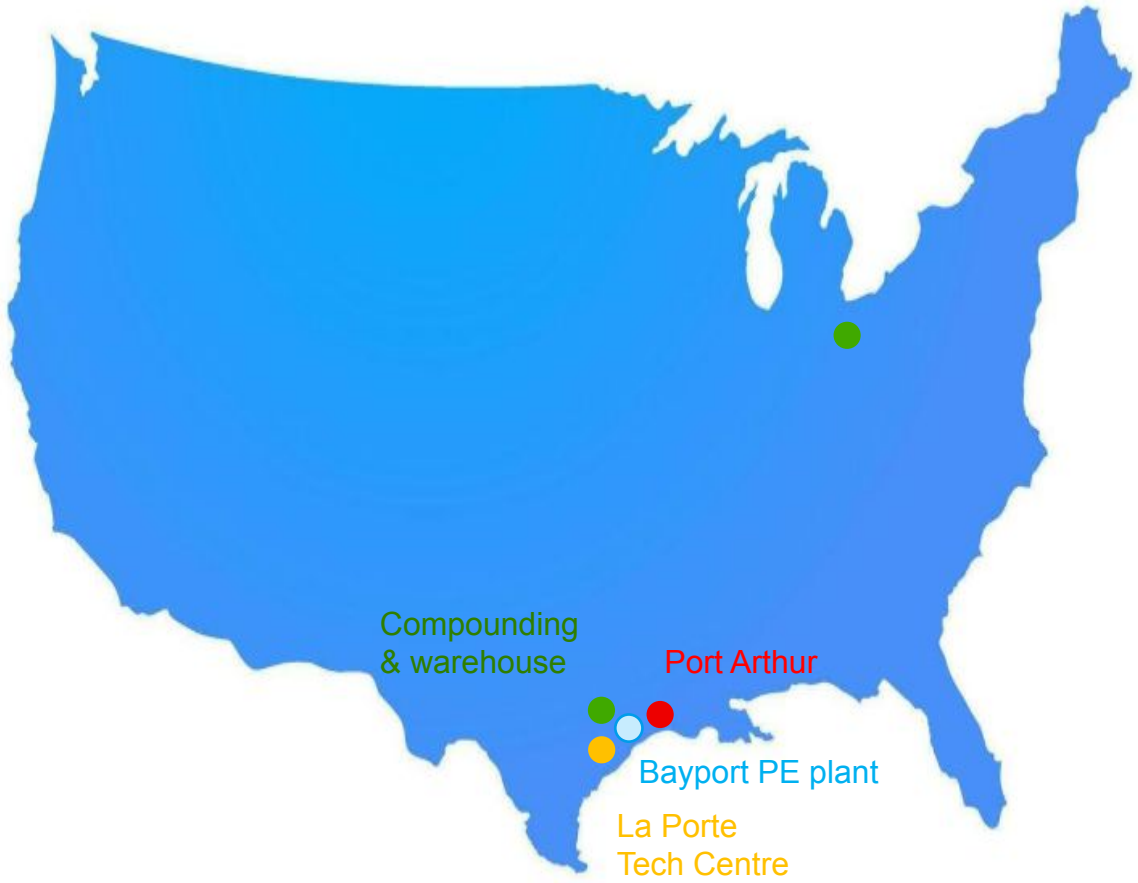
3.1 Mt per year of polypropylene (PP)*

2.7 Mt per year of polyethylene (PE)*

1 Mt per year of polystyrene (PS)*

Sales in 80 countries serving more than **200 applications**

North America Supply Footprint



- Port Arthur Complex
  - Major integrated platform
- Bayport PE Plant
  - Capacity: 1 million tons/year
- La Porte Tech Center
  - Variety of equipment and instruments used to simulate and test polymer plant procedures and conversion process
- Supply chain
  - Compounding site
  - Warehouse
  - Transfer terminals (various)

Scaling up our capacity as a key circular player

Our ambition in circular economy

RE:clic

Produce **1Mt circular polymers** by **2030**

Mechanical Recycling

RE:use

Synova (FR) - rPP for automotive, packaging & durables

Iber Resinas(SP) - rPP, rPE & rPS for durable applications

Antwerp (BE) - rPE for packaging

Carling (FR) - **rPP** compounds for automotive

Polyblend (DE) - **rPE & rPP** compounds.

Advanced Recycling

RE:build

Grandpuits (FR) - **Advanced Recycling plant**: convert plastic waste into pyrolysis oil (2025)

Antwerp (BE) - Since 2020 **pyrolysis oil conversion** to rPP, rPE, and rPS

Develop global partnerships and accelerate **projects (EU + USA)**

ISCC+ Mass Balance (certificate)

Biopolymers

RE:newable

La Mède (FR) & Grandpuits (FR) - Produce certified renewable polymers, by processing bio-based feedstock

Capture **PLA** market growth with our **JV TotalEnergies-Corbion**

Lifecycle Analysis data available for RE:clic & virgin polymers

The Compound Business @ ARC Business Unit:

TotalEnergies

TotalEnergies

Refining & Chemicals

POLYMERS

RE:newable

PLA

Low Carbon Solutions Division

Recycled PP/PE and PS

RE:use

Polypropylene

Polyethylene

Polystyrene

ARC

Neat mPE's for Rotomolding

PP Compounds for Automotive

Compounds for Rotomolding

PS Compounds for Electronics

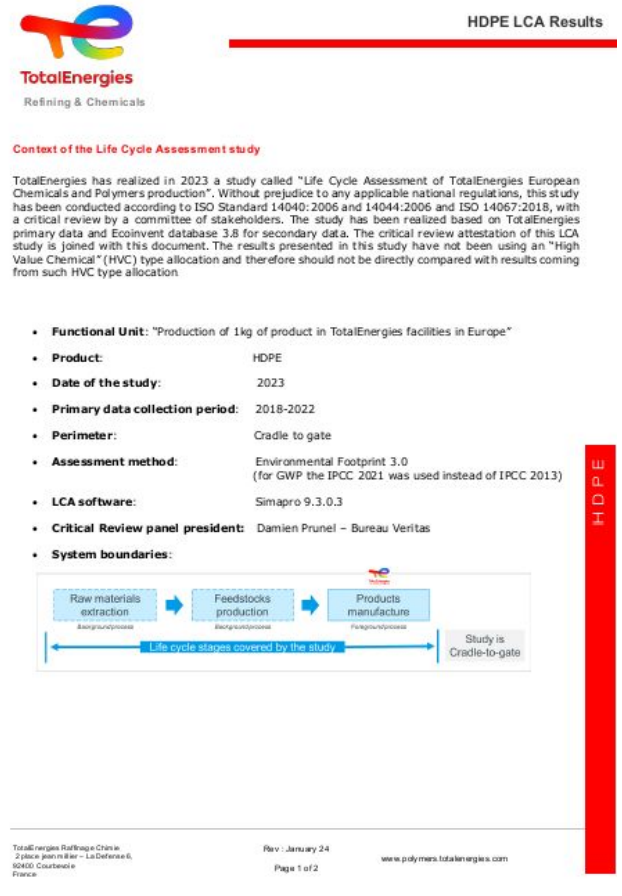
LCA approach at TotalEnergies Polymers

Approach

- LCA data is accessible for every virgin product & RE:clic range.
- If requested a meeting can be setup to explain the figures and hypotheses applied.

Impression of Life Cycle Analysis

- Subjected to external review,
- Application of TE hypotheses
- 16 different indicators



HDPE LCA Results

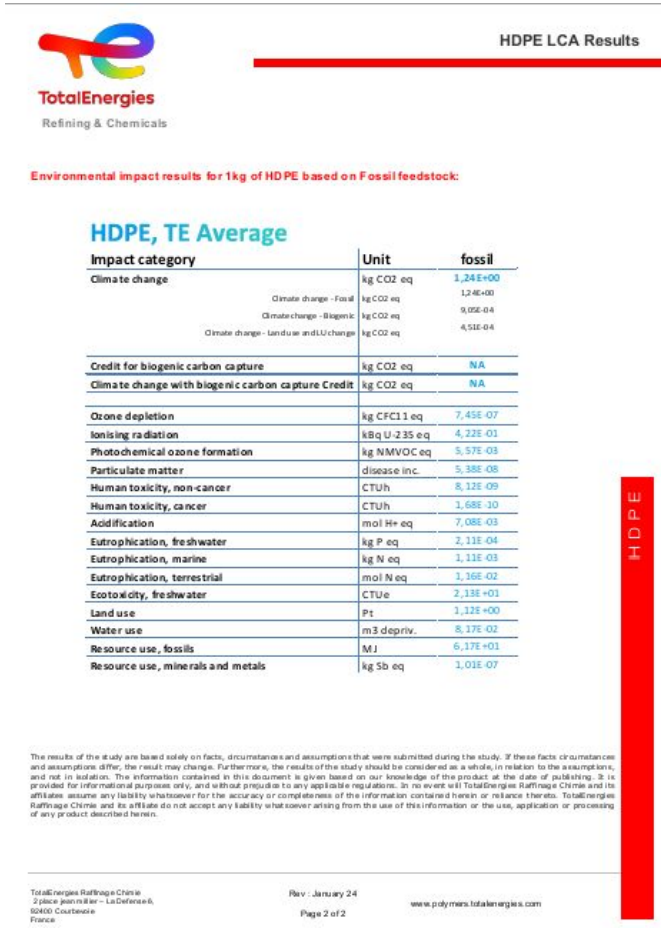
TotalEnergies
Refining & Chemicals

Context of the Life Cycle Assessment study

TotalEnergies has realized in 2023 a study called "Life Cycle Assessment of TotalEnergies European Chemicals and Polymers production". Without prejudice to any applicable national regulations, this study has been conducted according to ISO Standard 14040:2006 and 14044:2006 and ISO 14067:2018, with a critical review by a committee of stakeholders. The study has been realized based on TotalEnergies primary data and Ecoinvent database 3.8 for secondary data. The critical review attestation of this LCA study is joined with this document. The results presented in this study have not been using an "High Value Chemical" (HVC) type allocation and therefore should not be directly compared with results coming from such HVC type allocation

- **Functional Unit**: "Production of 1kg of product in TotalEnergies facilities in Europe"
- **Product**: HDPE
- **Date of the study**: 2023
- **Primary data collection period**: 2018-2022
- **Perimeter**: Cradle to gate
- **Assessment method**: Environmental Footprint 3.0 (for GWP the IPCC 2021 was used instead of IPCC 2013)
- **LCA software**: Simapro 9.3.0.3
- **Critical Review panel president**: Damien Prunel – Bureau Veritas
- **System boundaries**:

HDPE



HDPE LCA Results

TotalEnergies
Refining & Chemicals

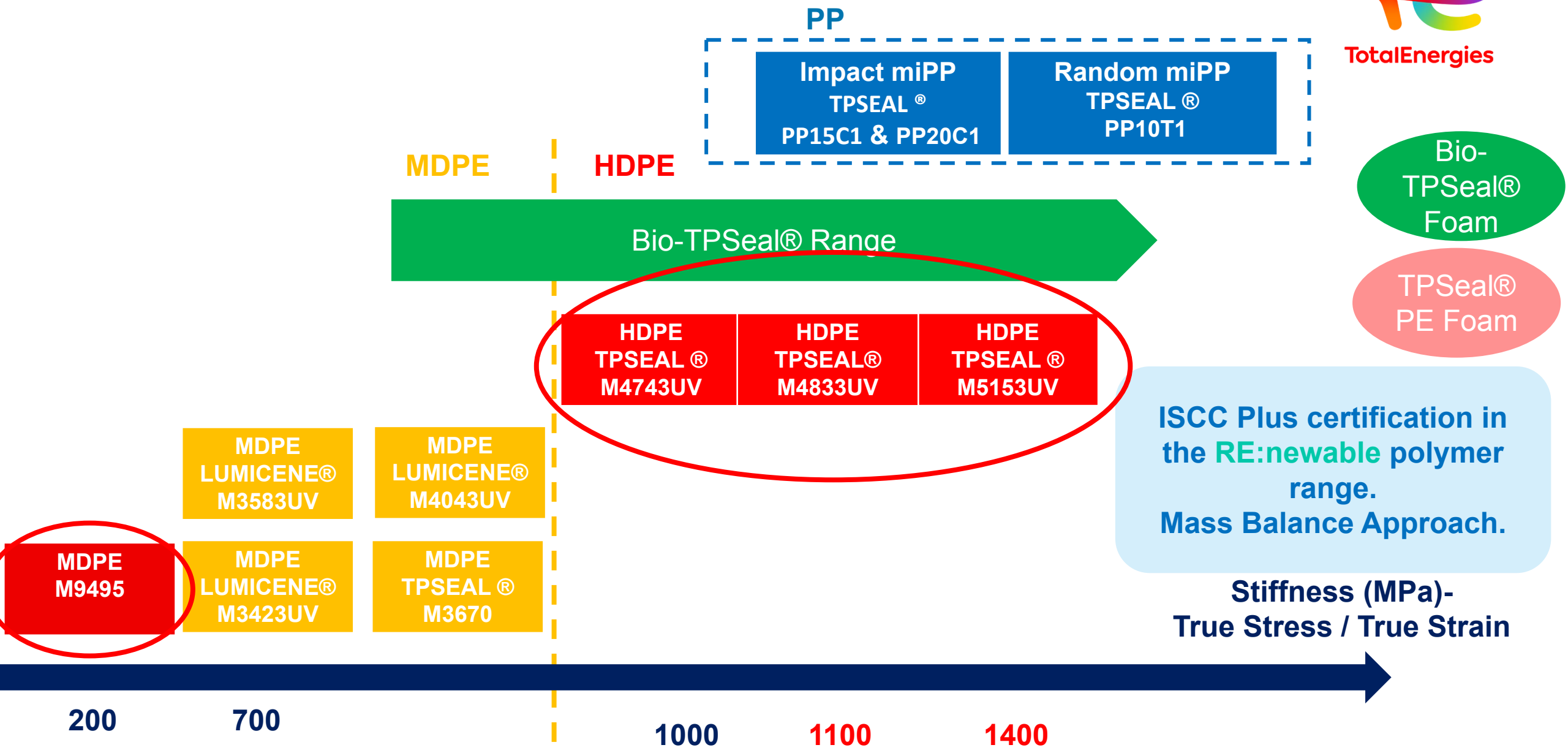
Environmental impact results for 1kg of HDPE based on Fossil feedstock:

HDPE, TE Average

Impact category	Unit	fossil
Climate change	kg CO2 eq	1,24E+00
Climate change - Fossil	kg CO2 eq	1,24E+00
Climate change - Biogenic	kg CO2 eq	9,05E-04
Climate change - land use and LU change	kg CO2 eq	4,51E-04
Credit for biogenic carbon capture	kg CO2 eq	NA
Climate change with biogenic carbon capture Credit	kg CO2 eq	NA
Ozone depletion	kg CFC11 eq	7,45E-07
Ionising radiation	kBq U-235 eq	4,22E-01
Photochemical ozone formation	kg NMVOC eq	5,57E-03
Particulate matter	disease inc.	5,38E-08
Human toxicity, non-cancer	CTUh	8,12E-09
Human toxicity, cancer	CTUh	1,68E-10
Acidification	mol H+ eq	7,08E-03
Eutrophication, freshwater	kg P eq	2,11E-04
Eutrophication, marine	kg N eq	1,11E-03
Eutrophication, terrestrial	mol N eq	1,16E-02
Ecotoxicity, freshwater	CTUe	2,13E+01
Land use	Pt	1,12E+00
Water use	m3 depriv.	8,17E-02
Resource use, fossils	MJ	6,17E+01
Resource use, minerals and metals	kg Sb eq	1,01E-07

HDPE

TotalEnergies Rotomolding Materials:



Bio-TPSeal® Foam

TPSeal® PE Foam

ISCC Plus certification in the RE:newable polymer range.
Mass Balance Approach.

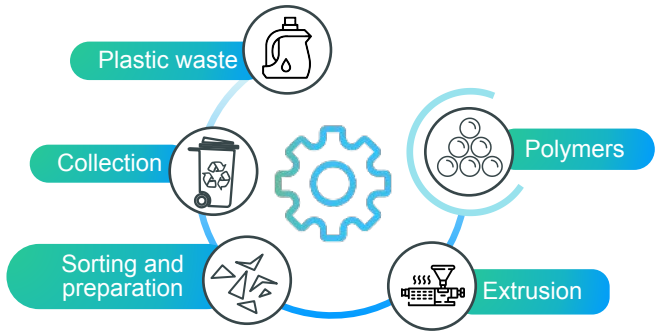
Stiffness (MPa)- True Stress / True Strain

RE:use polymers

Mechanical Recycling

RE:use

Mechanical recycling is the **most mature technology** on the market. It processes raw materials from collective sorting and collection centers and is particularly **suited to the needs of the automotive or construction markets.**



Integrate and develop our **recent acquisitions**

Synova (France)

French leader in producing **recycled PP compounds** for the automotive or construction sectors.

Capacity: **45 kt/y**

IBERresinas (Spain)

Recycled PP, PE, and PS producer for durable and automotive applications.

Capacity: **30 kt/y**

Develop **organic projects**

ANTWERP (Belgium)

Production of **circular PE compounds** for packaging.

Capacity: **8 kt/y**

CARLING (France)

production of high-performance **PP hybrid compounds** for the automotive industry.

Capacity: **15 kt/y**

Collaboration and **partnerships**

VANHEEDE.COM ENVIRONMENT GROUP

Partnership in **2022** for the supply of PCR* material to produce polymers for **durable applications**.

OPmobility

Partnership in **2021** to develop new plastic materials made from **recycled PP for the automotive industry**.

PURECYCLE

Partnership in **2020** for the supply of **high-purity recycled PP material**.

Up to 100% recycled material according to market needs

** PCR: post-consumer recycled*

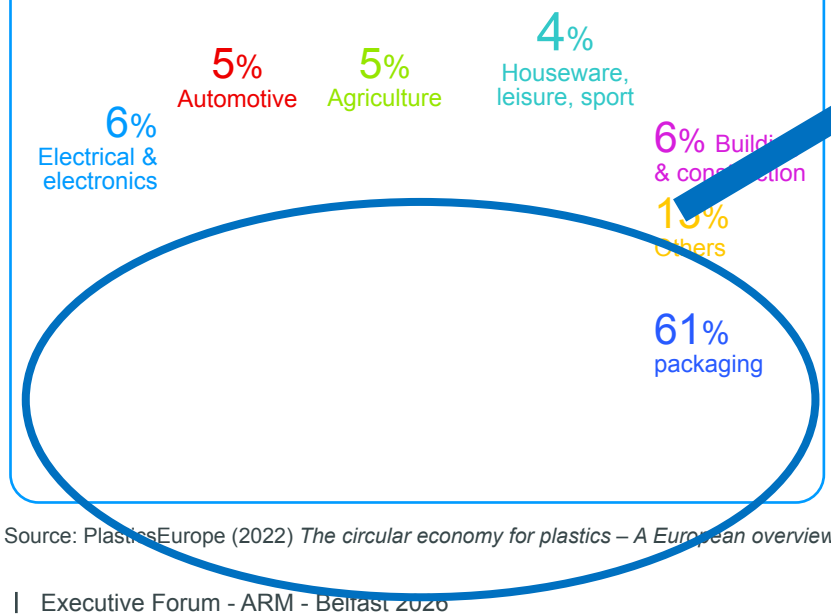
Recycling in Europe: available feedstock.

In 2018 **29.1 Mt**

In 2020 **29.5 Mt**

Of post-consumer plastics waste were collected in the EU27+3

Categorization of plastics waste collected in Europe in 2020



Source: PlasticsEurope (2022) *The circular economy for plastics – A European overview*

MI2 < 2 g./10'

DENSITY < 0.934 g./cc | > 0.952 g./cc

ROTOMOLDING ?

RE:use Range for TotalEnergies Rotomolding Materials: Launch of rPE 42640 compound.

Impact miPP TPSEAL ® PP15C1 & PP20C1

Random miPP TPSEAL ® PP10T1

MDPE

HDPE

Bio-TPSeal® Range

HDPE TPSEAL ® M4743UV

HDPE TPSEAL® M4833UV

HDPE TPSEAL ® M5153UV

MDPE LUMICENE® M3583UV

MDPE LUMICENE® M4043UV

New HDPE rPE 42640

MDPE M9495

MDPE LUMICENE® M3423UV

MDPE TPSEAL ® M3670

Stiffness (MPa)

300 700 1000 1100 1400

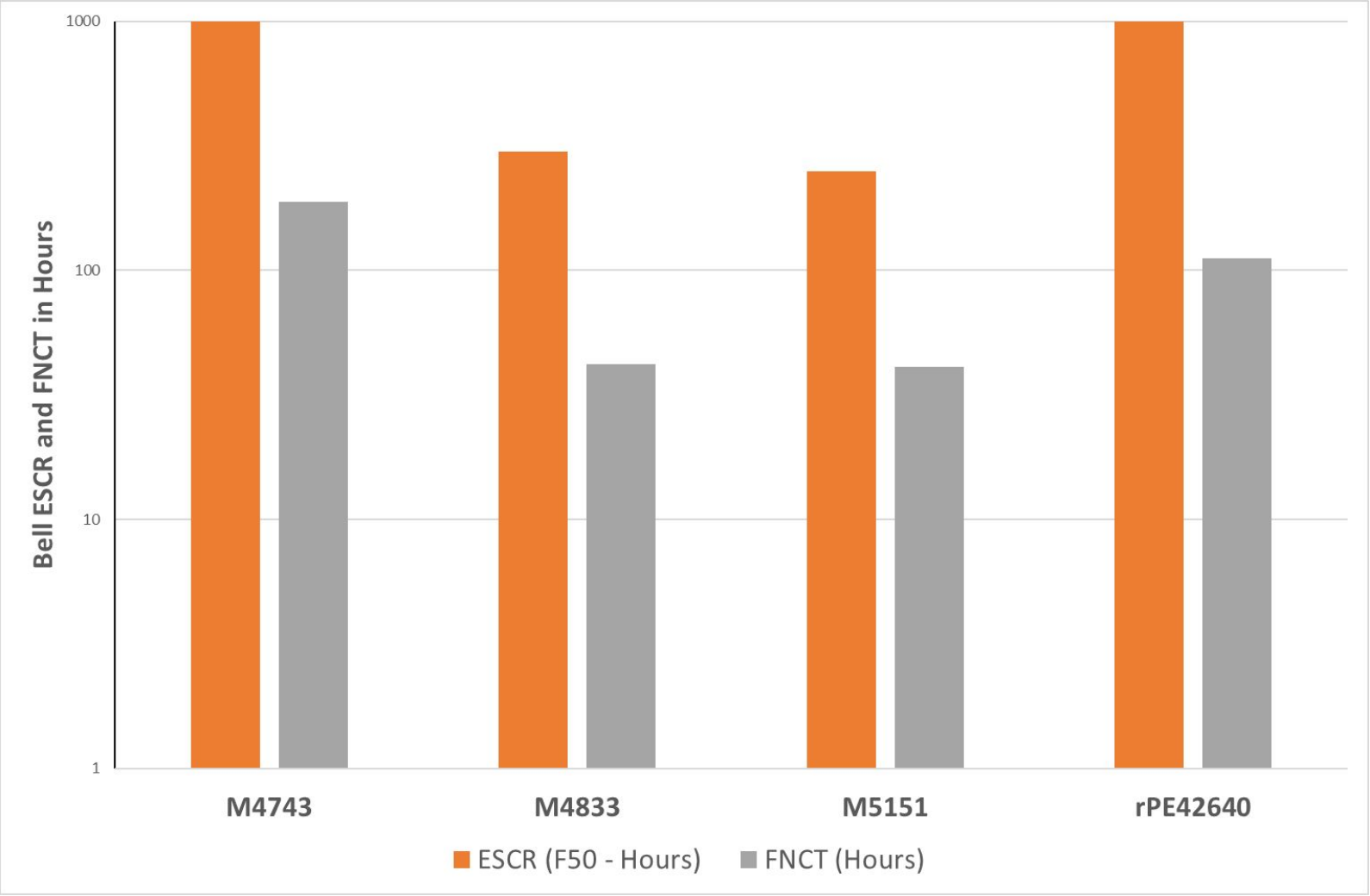
RE:use Range for TotalEnergies Rotomolding Materials: Launch of rPE 42640 compound.

- rPE 42640 compound is made **60+ % weigth of PCR !**

  - MI2 (190°/2.16 kgs) = 4.0 – 4.5 g./10'
  - Density = 0.942 to 0.945 g./cc
  - True Stress / True Strain Tensile Modulus (TotalEnergies Method) = 840 MPa

- Easy Grinding

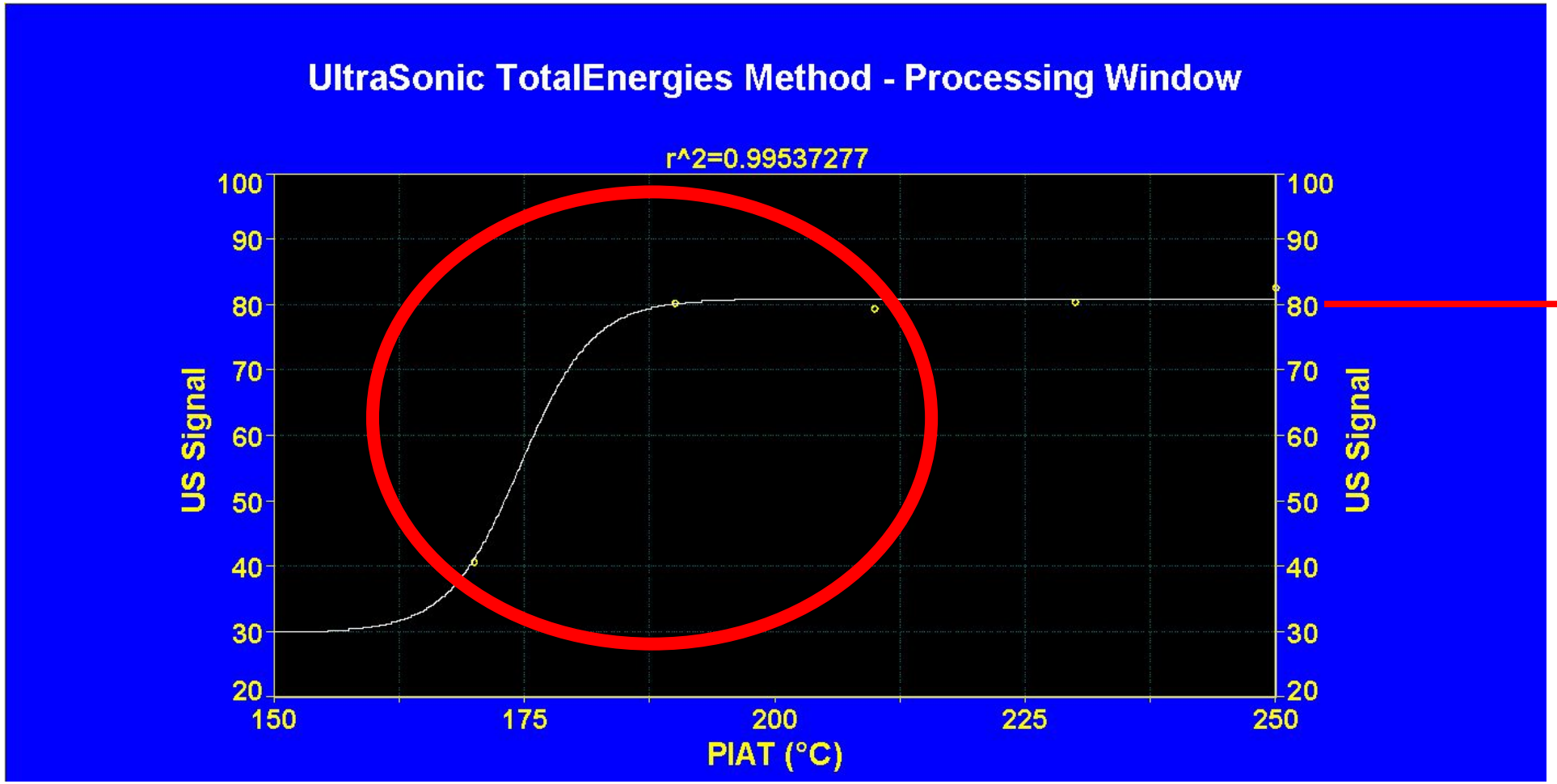
Bell ESCR vs FNCT HDPE's – FNCT at 3MPa / 50°C / Igepal 10%



TotalEnergies OneTech Belgium
Smart Machine: rPE 42640 rotomolding.

6.0 mm Wall Thickness Parts
Different PIAT's from 170 to 250 °C

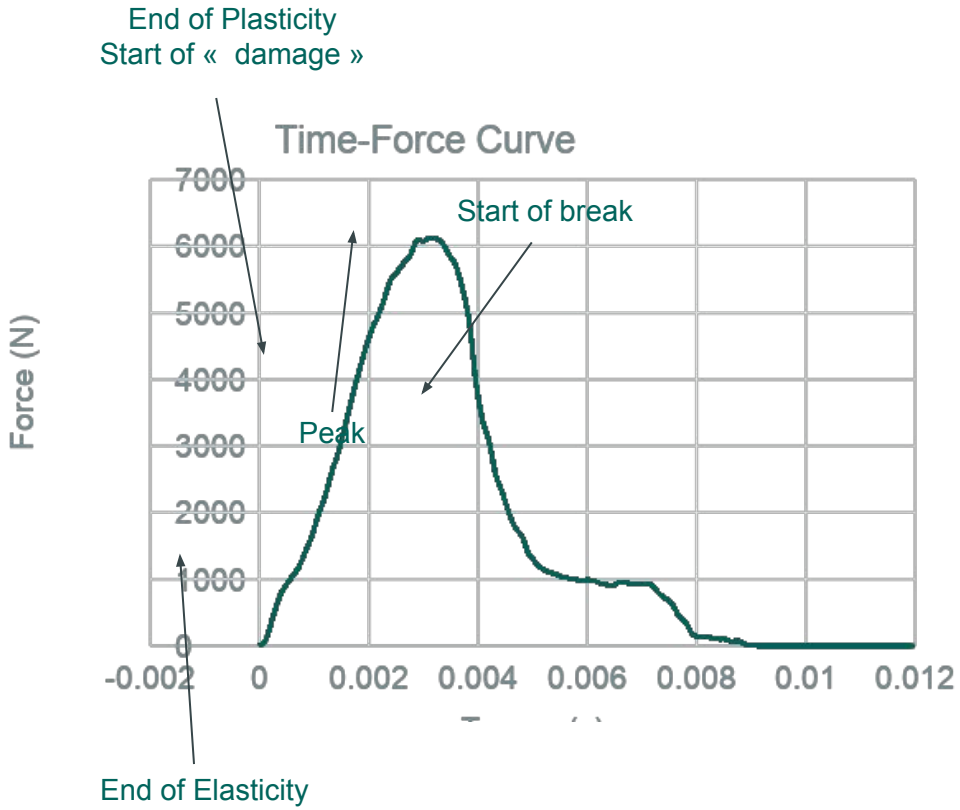
Smart Machine: rPE 42640 rotomolding.
Processing Window
Ultrasonic NDT TotalEnergies Method.

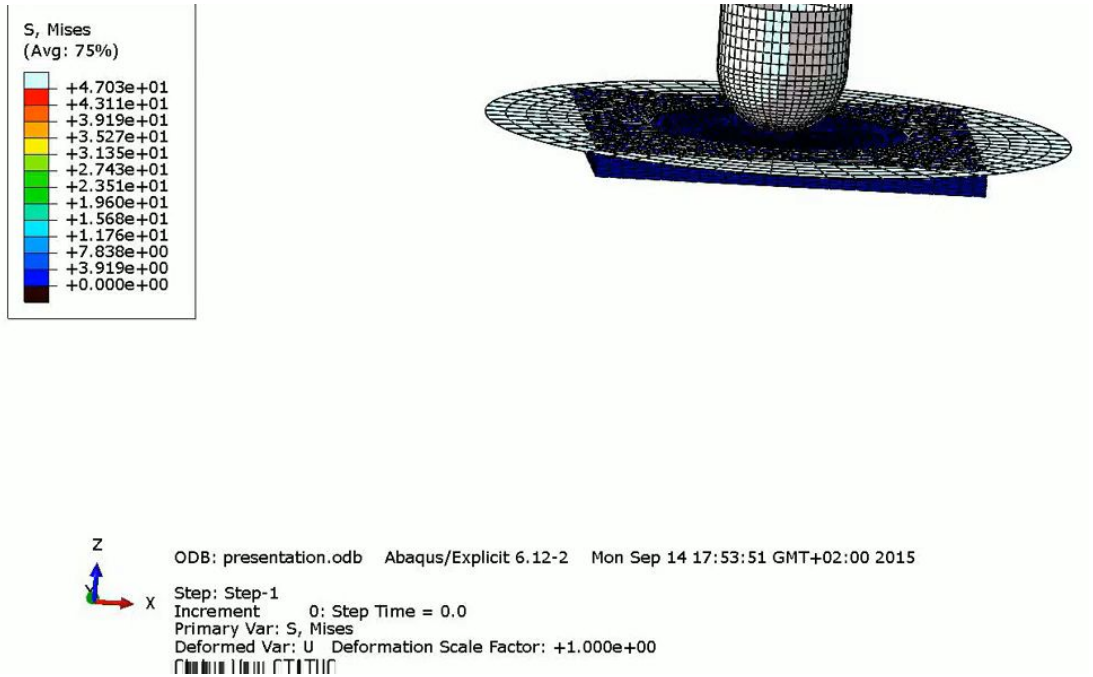


Bubble Free

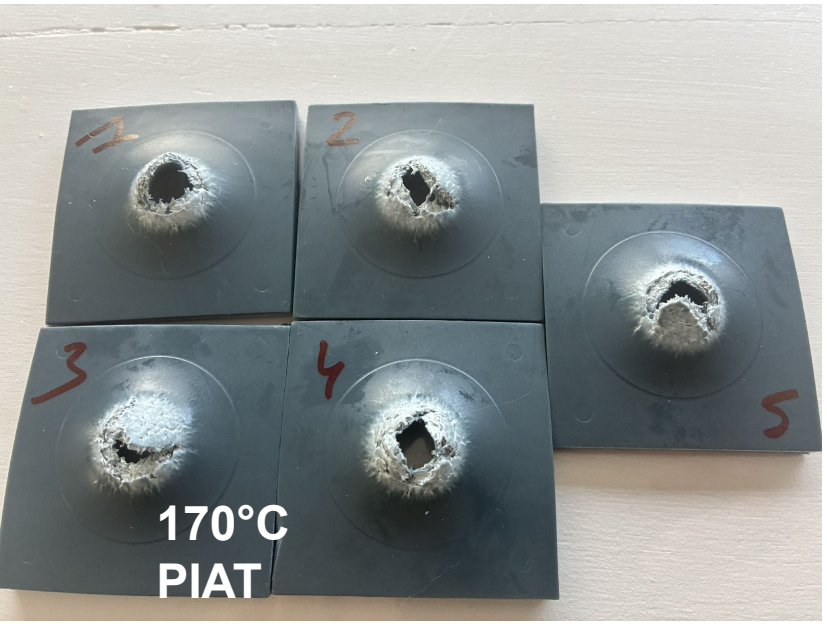
Smart Machine: rPE 42640 rotomolding. Inner Surface at different PIAT's

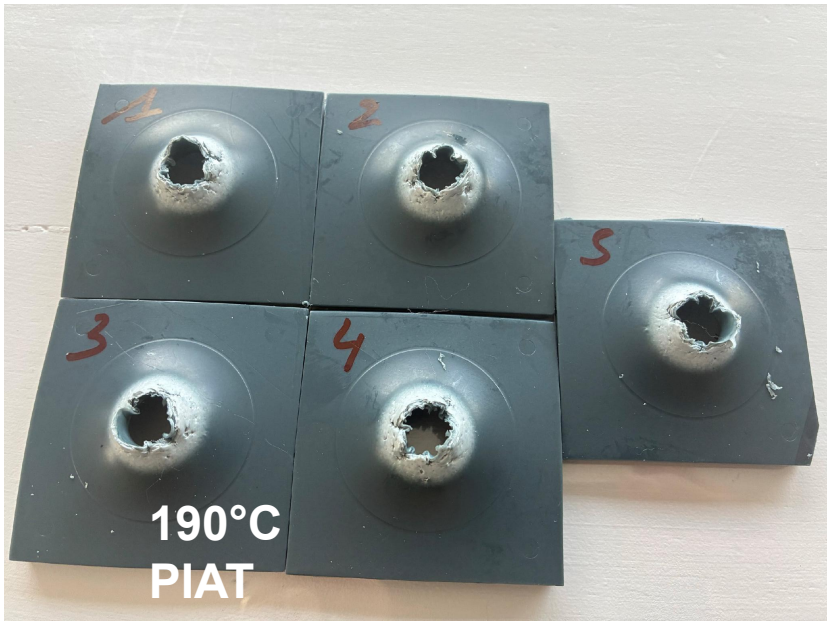
Impact tests: ISO 6603-2

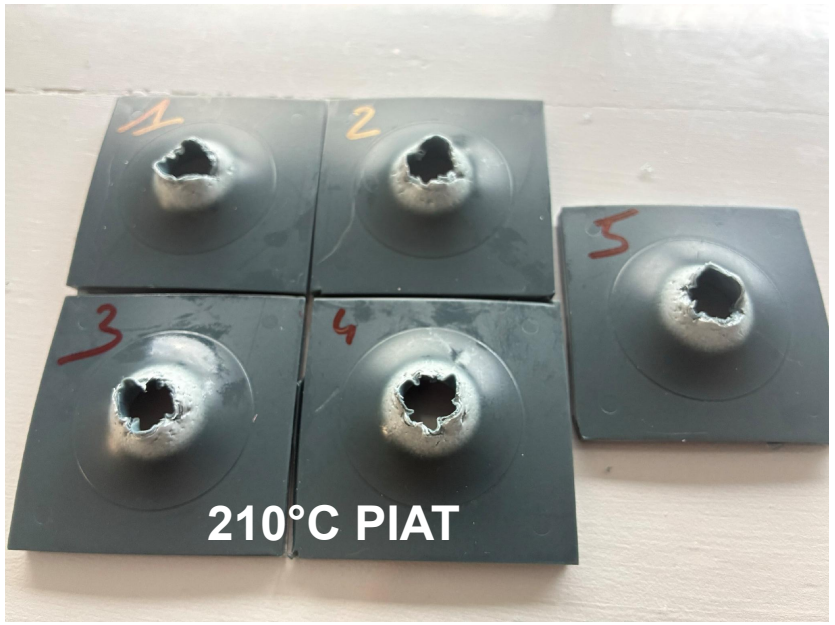


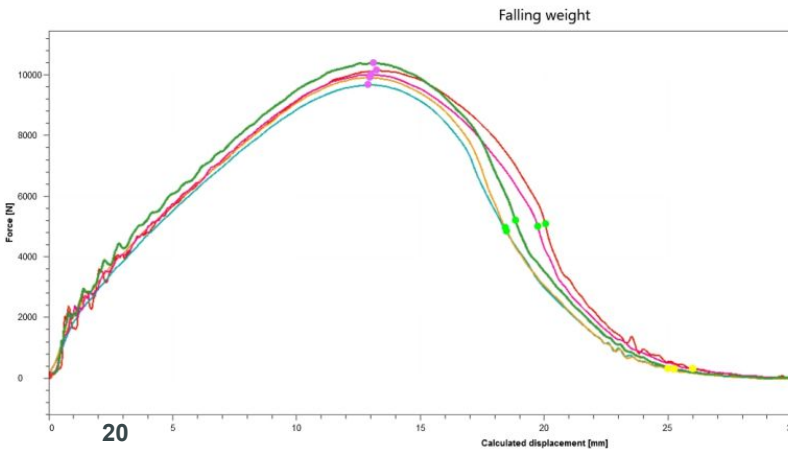


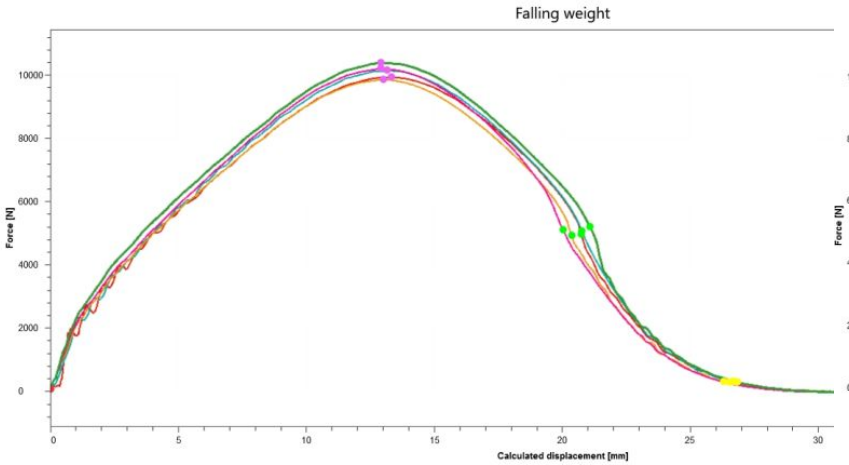
Smart Machine: rPE 42640 rotomolding.
Processing Window ISO 6603-2 Impacts @ - 40°C

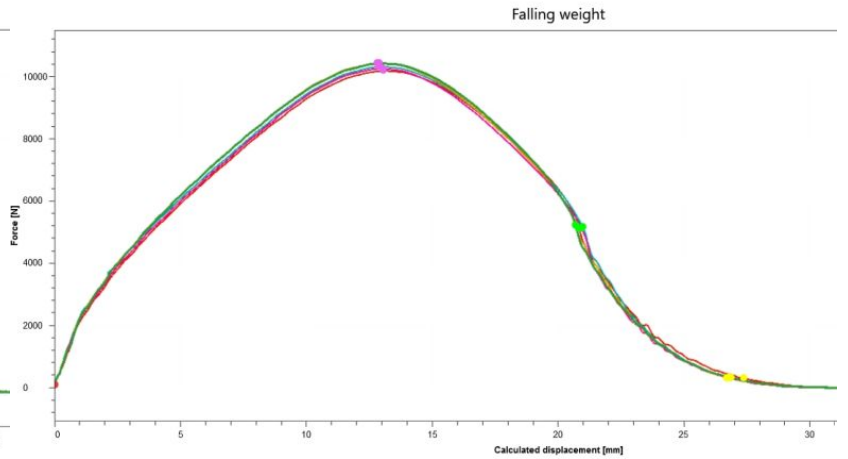




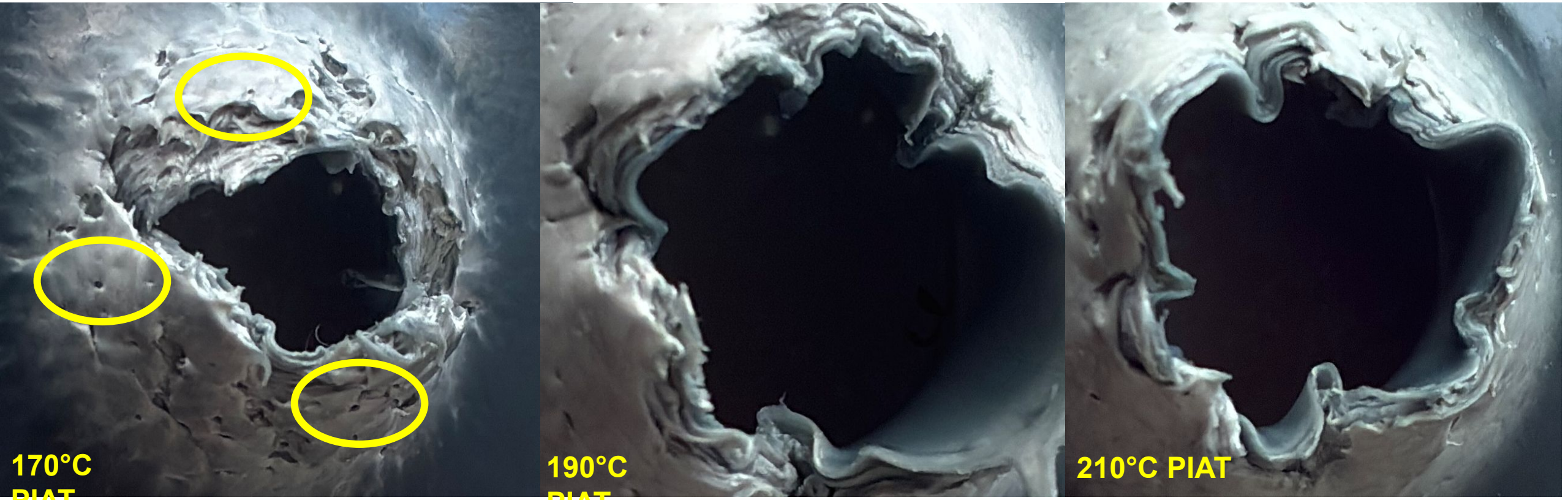








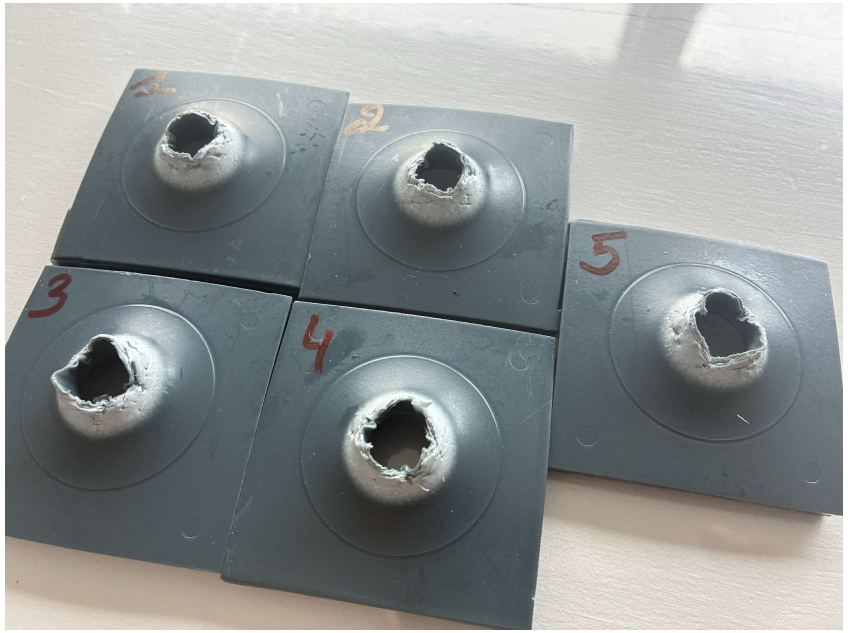
Smart Machine: rPE 42640 rotomolding. Processing Window ISO 6603-2 Impacts @ - 40°C

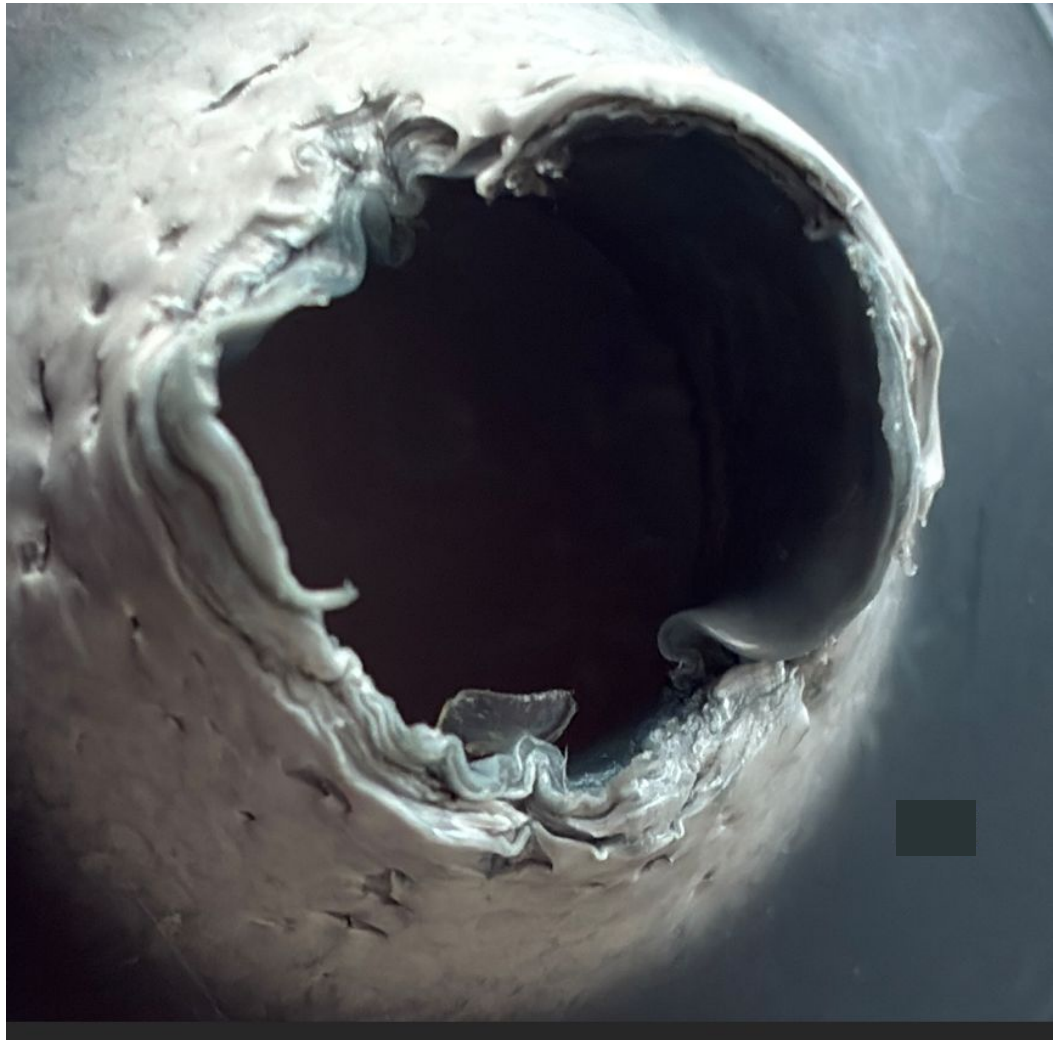


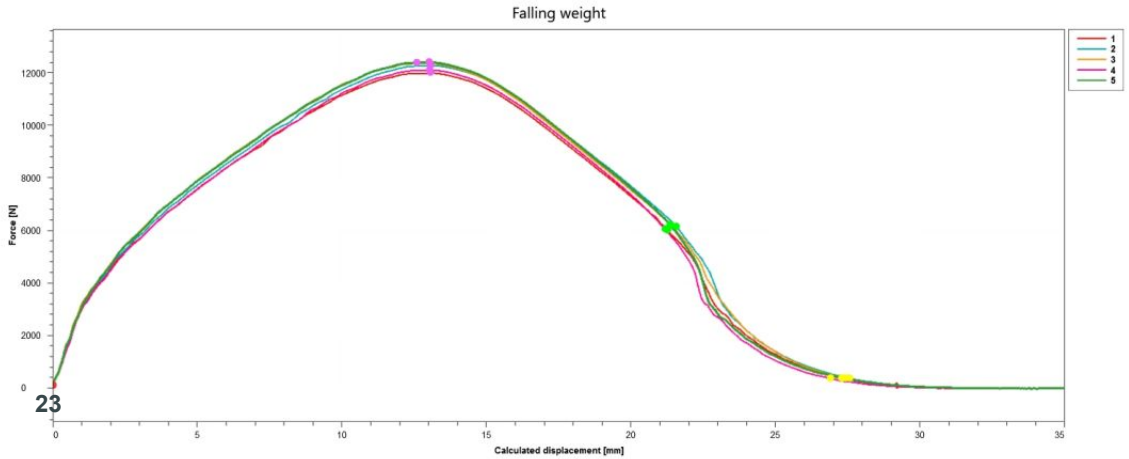
rPE 42640 Testing at FINNCONT Oy - VIRRAT

- Production of a commercial technical tank.
- Same conditions as serial production.
- PIAT 193- 195°C.
- US Signal at 80 □ Bubble Free.
- Easy processing.
- Perfect Insert coverage.
- Very nice inner and outer surface finish.

rPE 42640 Testing at FINNCONT Oy – VIRRAT –IMPACTS performed at TotalEnergies ISO 6603 @ - 40°C

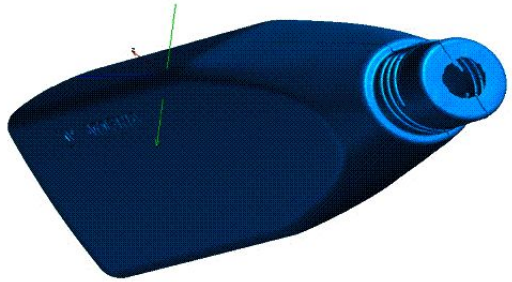


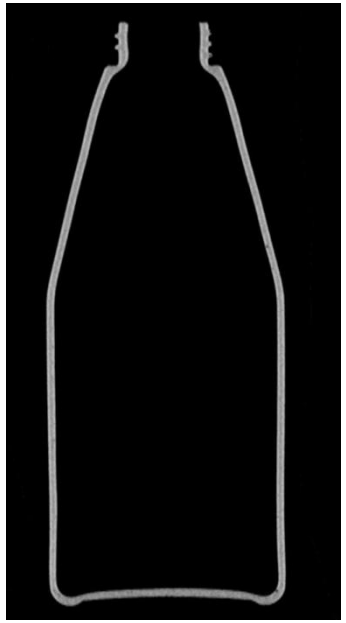




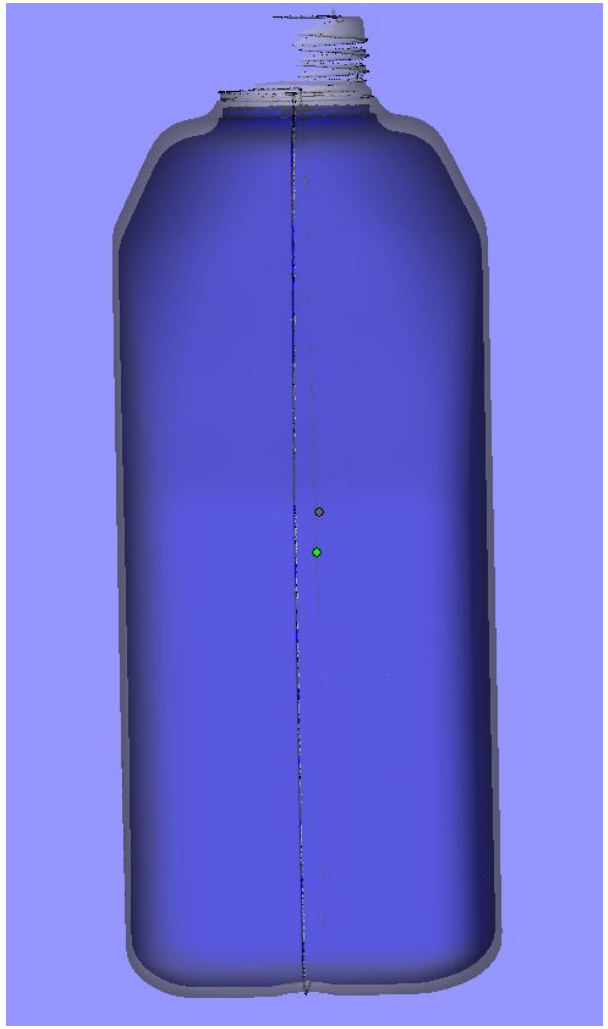
TotalEnergies Shrinkage Estimation

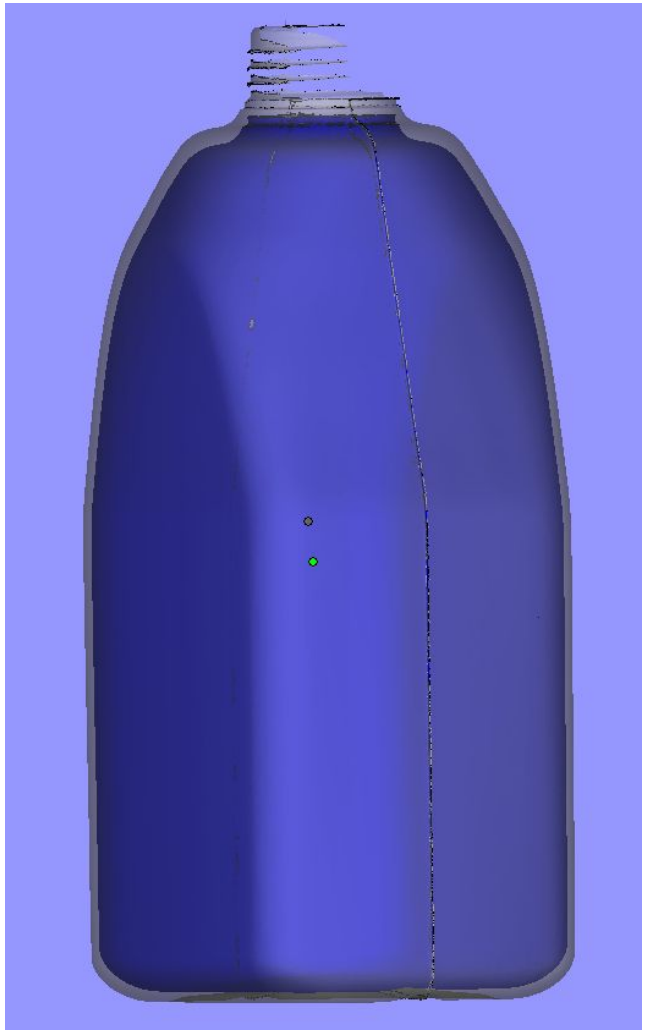
- A) Optical 3D scanning :
  - 3D CAD file of external surface
  - 3D ACD file of the mould
  - No limits in size and shape
  - Volume calculation
  - Best fit calculation mould/part
- B) Tomography scanning :
  - 3D scanning internal and external surfaces and in between
  - Size limitation 50 * 50 * 200 cm
  - Volume and thickness determination
  - Mould/part comparison



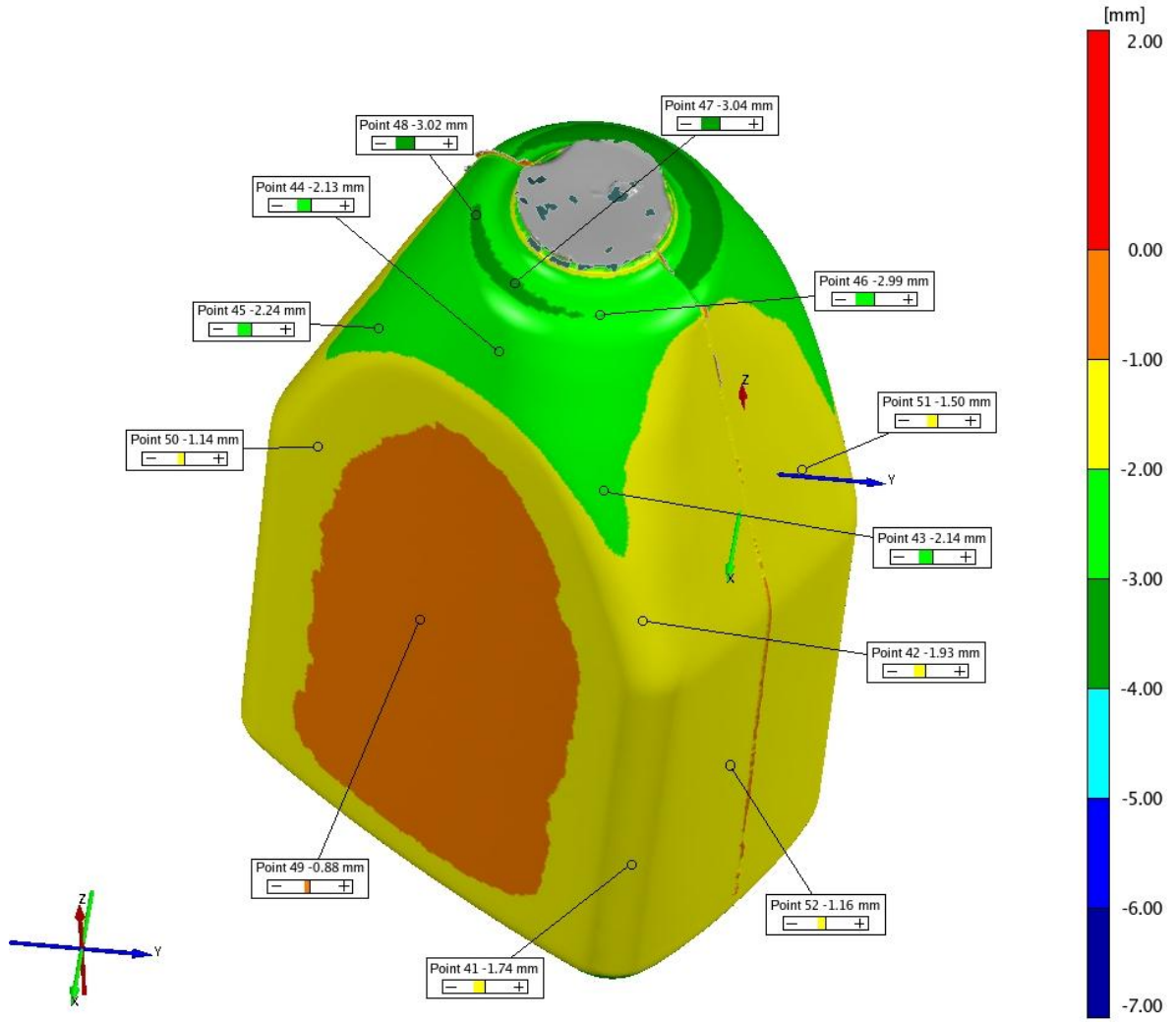


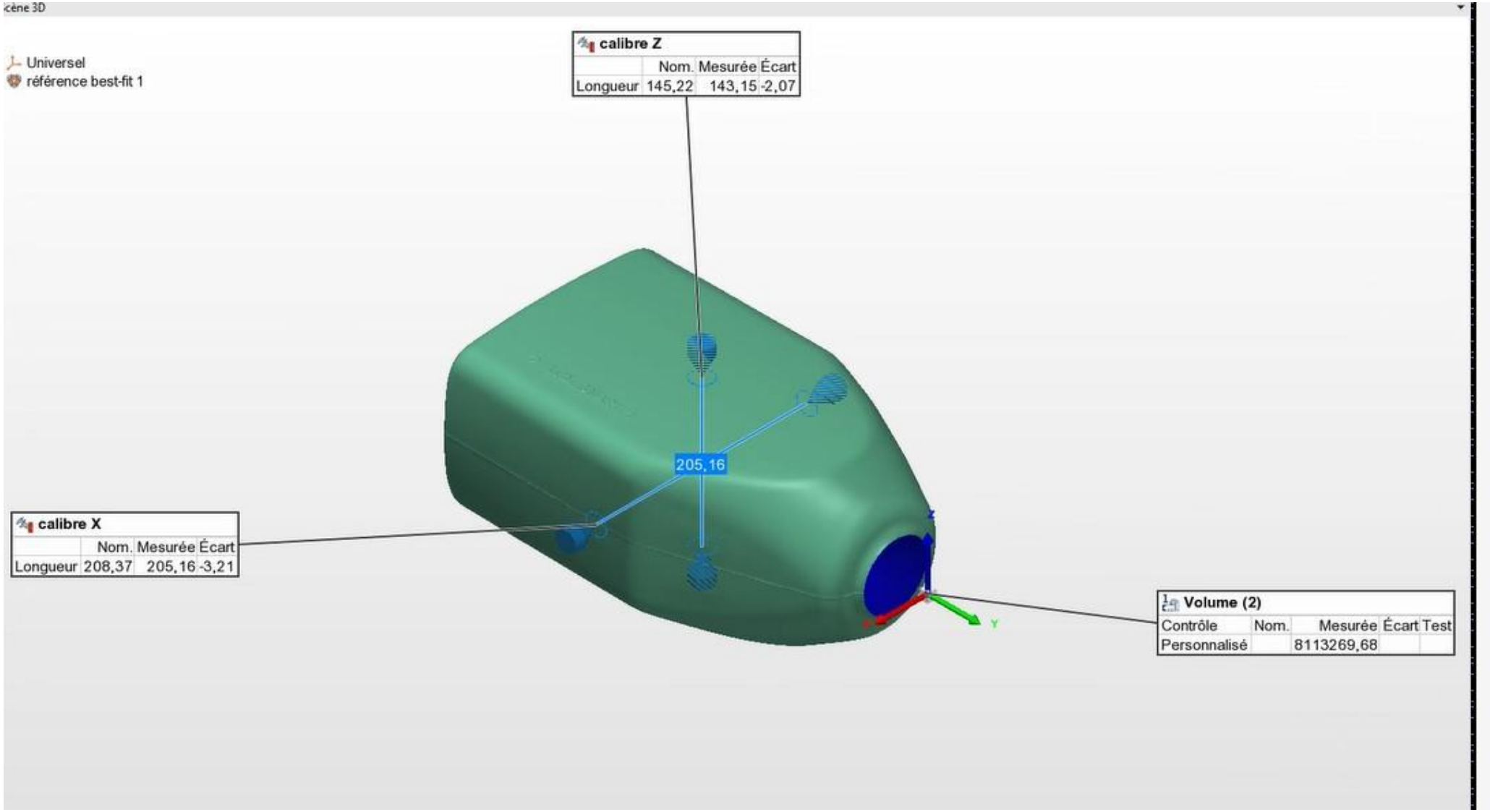
Best Fit Calculation for a 10 litres part.



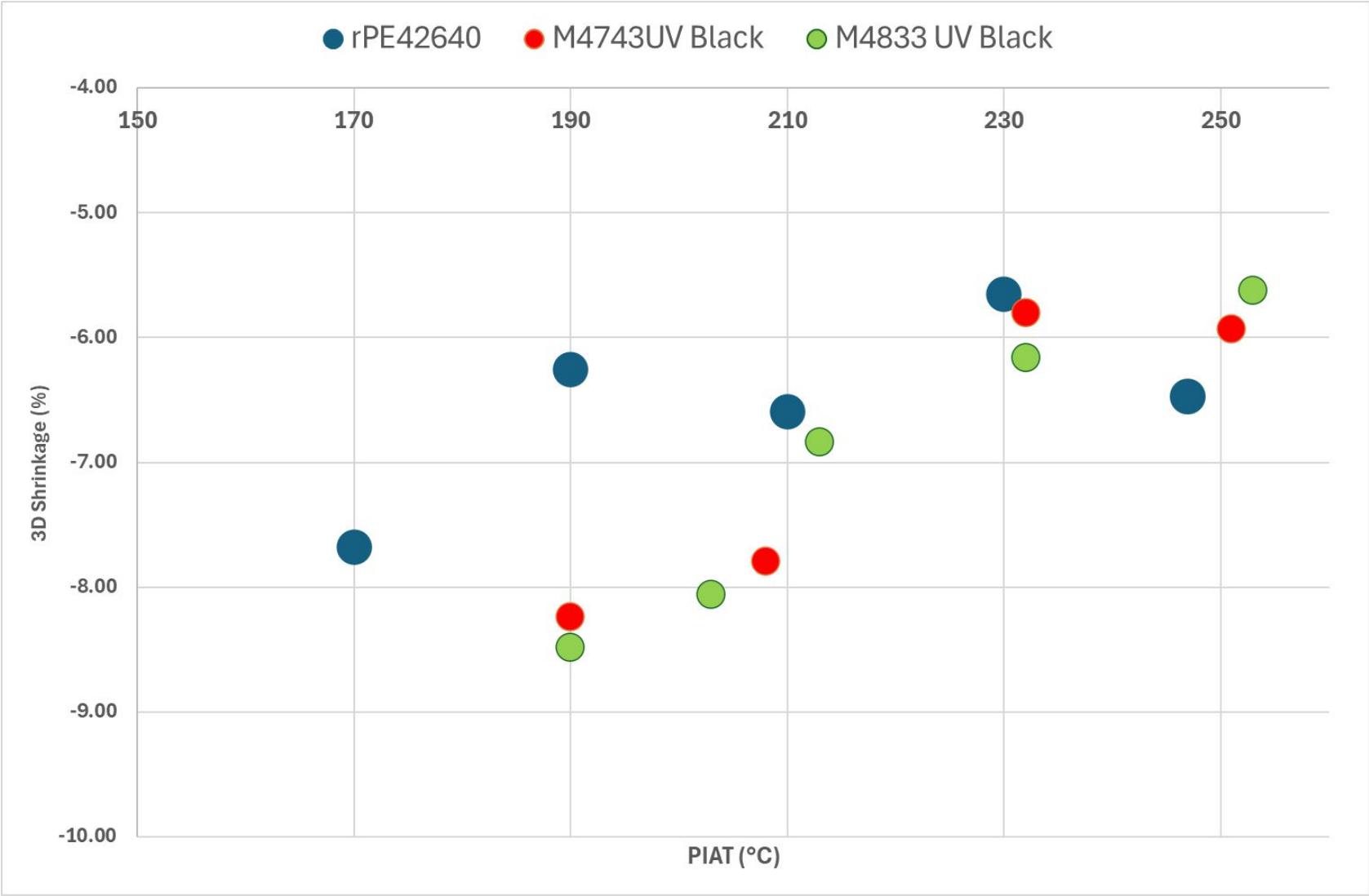


Best Fit Cartography of the 10 litres part:

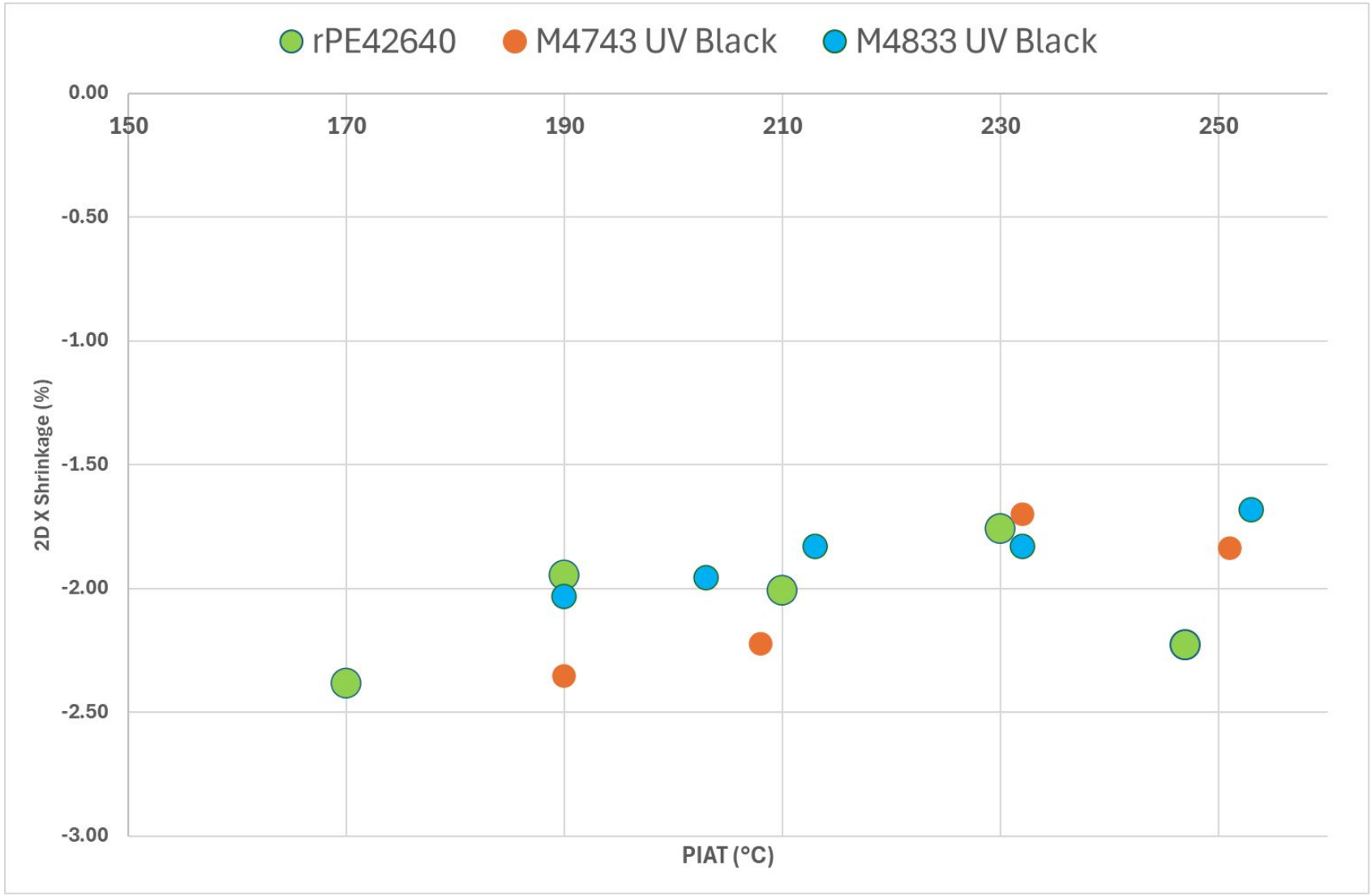



cène 3D
Universel
référence best-fit 1
calibre Z
Nom. Mesurée Écart
Longueur 145,22 143,15 -2,07
205,16
calibre X
Nom. Mesurée Écart
Longueur 208,37 205,16 -3,21
Volume (2)
Contrôle Nom. Mesurée Écart Test
Personnalisé 8113269,68

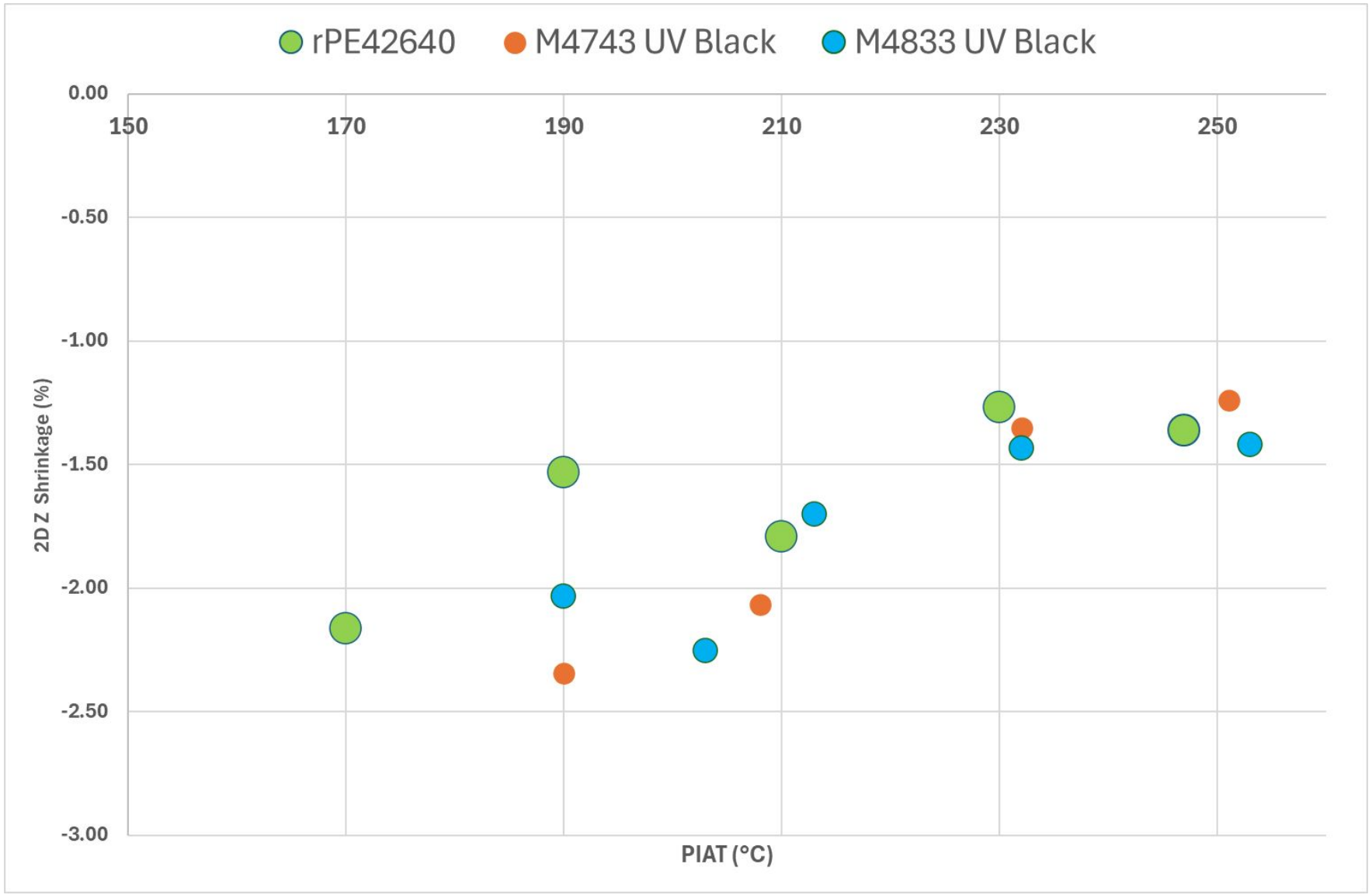
3D Shrinkage Versus TotalEnergies HDPE references:



2D Shrinkage Versus TotalEnergies HDPE References:



2D Shrinkage Versus TotalEnergies HDPE References:



What's Next ?

- **rPE42640:**
  - UV performance under tests : UV8 reached – Target UV16.
  - Creep Material Card under developement.
  - Dynamic Material Card under development.
  - Fatigue Material Card to start.
  - **Applications:**
    - Tanks
      - TotalEnergies Sagging tests performed OK for big tanks.
    - Ad Blue Tanks : chemical compatibitlity done = OK. OEM's Specifications !
    - Diesel Fuel Tanks : under progress
      - Fuel Tank soaking Diesel B30 at 80°C. Almost achieved.
      - Bars soaking for One Year at 80°C. Under progress.
    - Chemical tanks : Amazing ESCR confirmed.
    - Technical Parts : Easy processing confirmed.
- **Product range**
  - Colored version.
  - 70% + PCR content.

Any Question ?

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