

Latest Solutions for Water Management and Alternatives to Brass and Metal Alloys, Supported by Advanced Predictive Simulations

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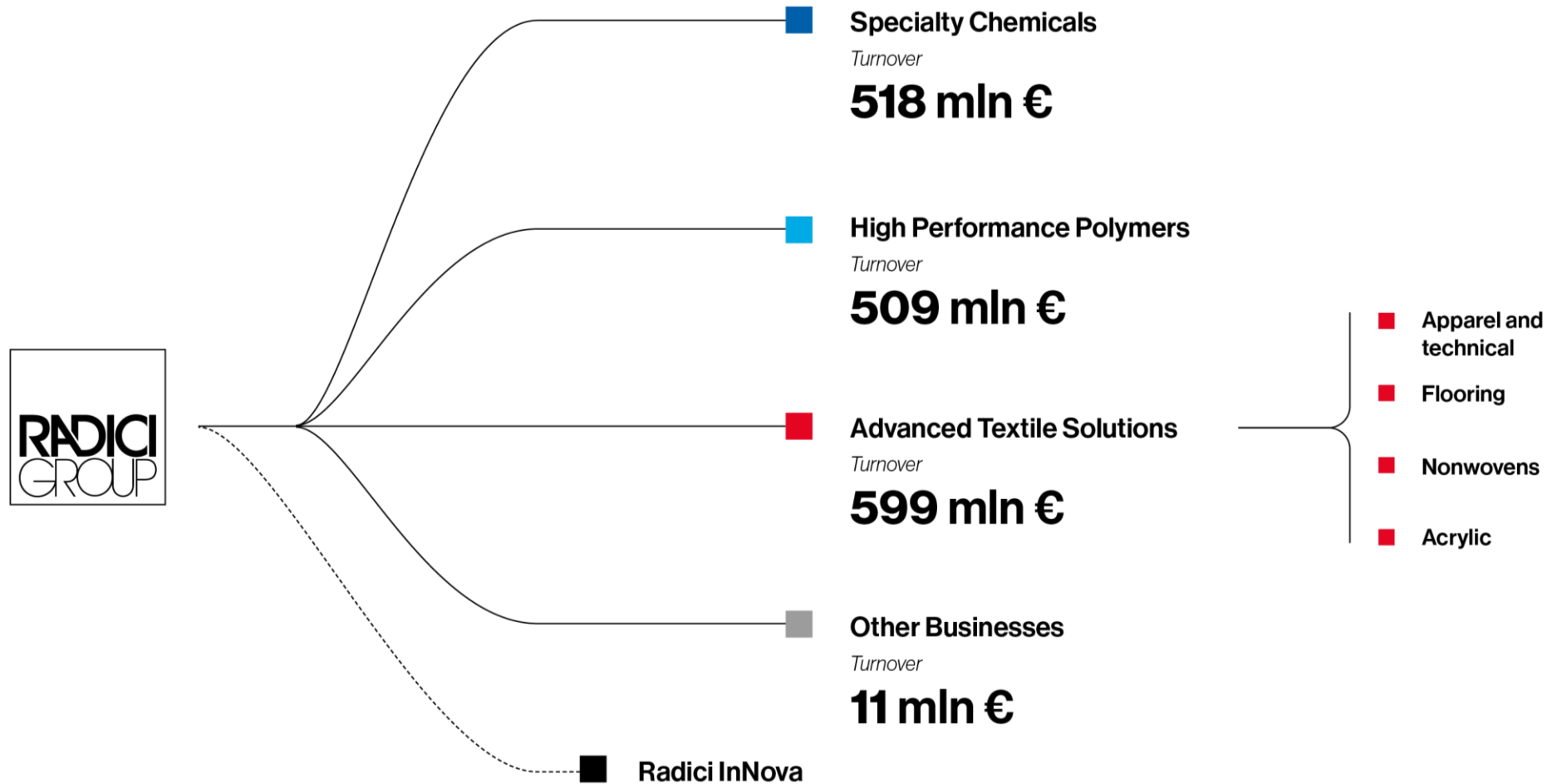
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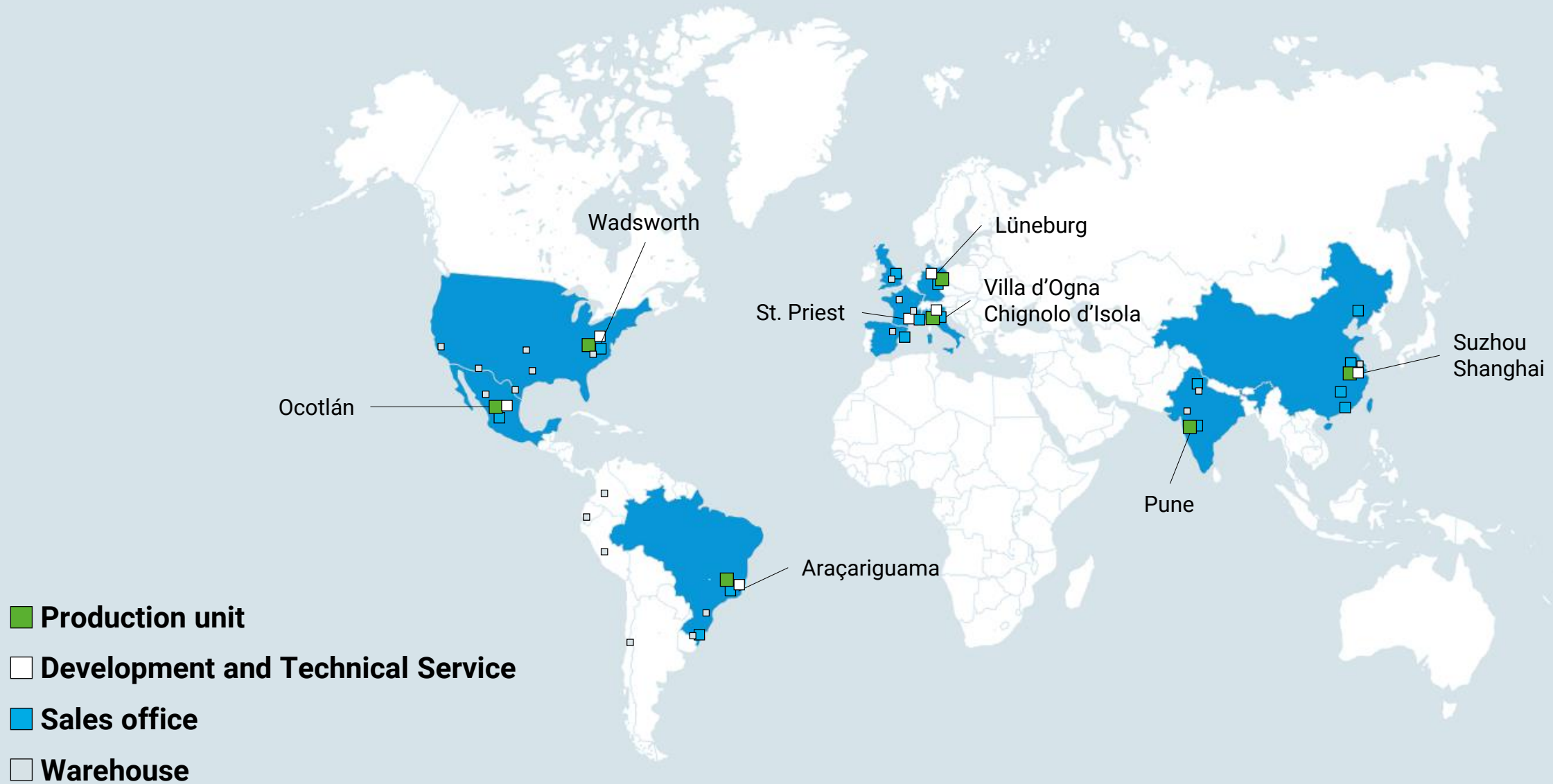
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Organizational structure



High Performance Polymers - Global presence



From RadiciGroup Vision & Mission to High Performance Polymers Facts



RadiciGroup

Vision

- **To be one of the leading chemical groups** in the polyamide, advanced textile solutions and high performance polymers production chain.

Mission

- To promote the **development of our businesses** while pursuing our Group values and culture.
- To pursue our vision by valorizing and **optimizing our resources, establishing alliances and searching for new markets**, including niche markets.
- To **embed sustainability** into new product and application **development**.

High Performance Polymers

Facts

- Growth through **innovation and sustainability** of all our processes and products.
- **Vertically integrated** polyamide production and specific **chemical know-how**.
- **Worldwide presence** with a complete range of materials and **tailored solutions**.
- Our **people's expertise** and support, offering our customers a competitive advantage.

Key drivers in metal replacement

KEY DRIVERS:

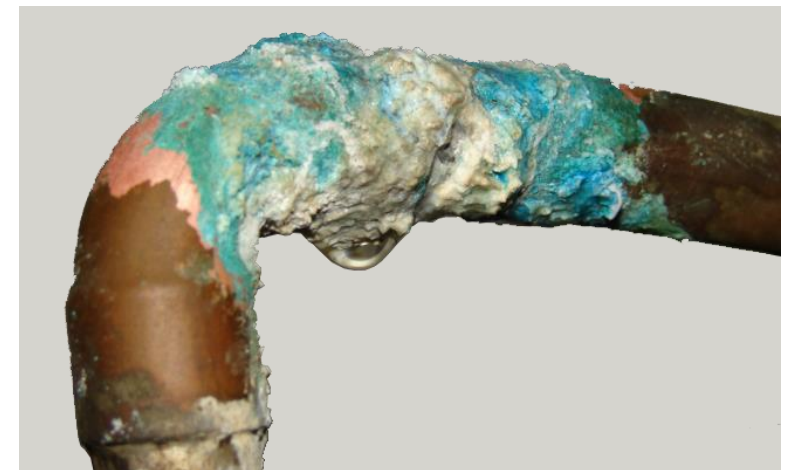
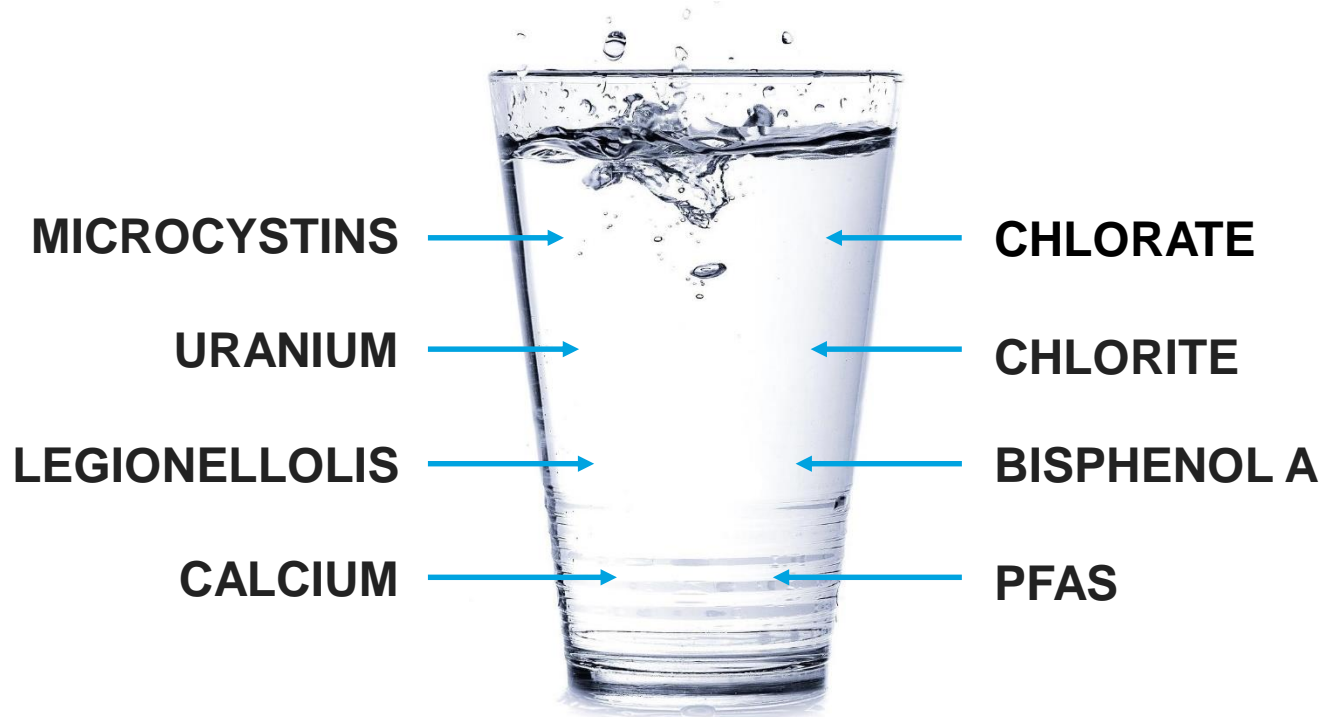
- Chemical resistance
- Lead restriction
- Cost reduction
- Ease of assembly
- Sustainability



Key drivers in metal replacement

Chemical resistance

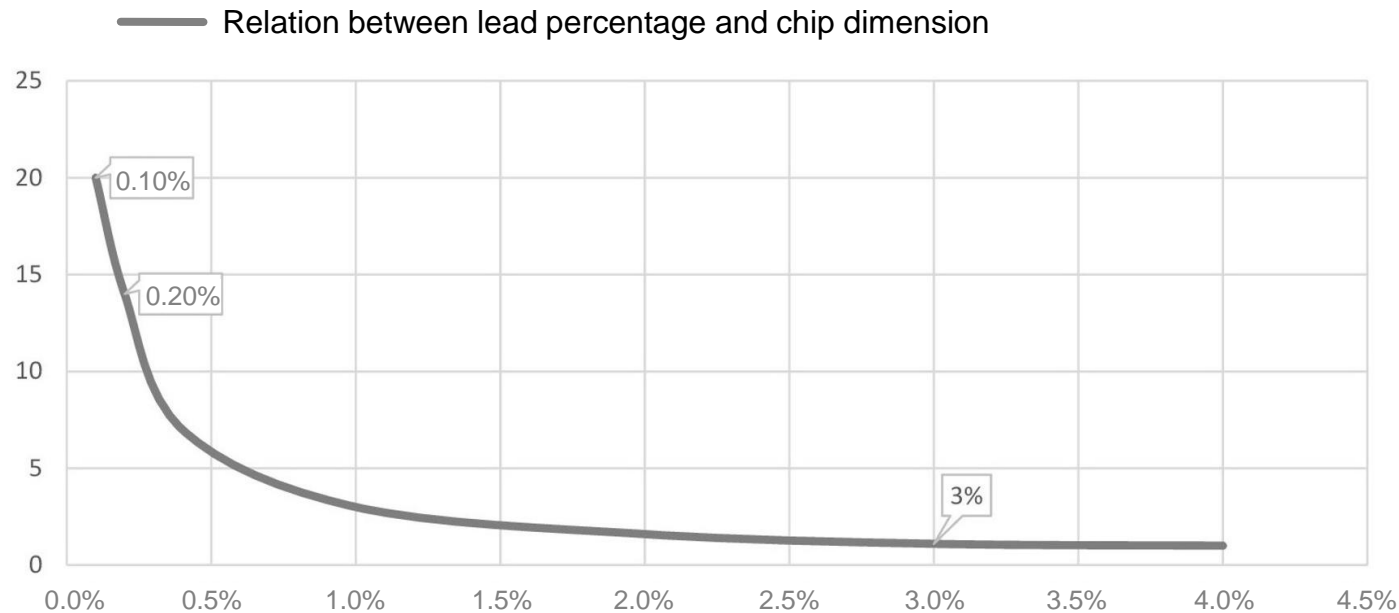
Day after day, potable water is becoming more aggressive. It is also treated with chemicals, such as disinfectants or PH regulators. The long life of components made of polymers is guaranteed since they are not subject to corrosion.



Key drivers in metal replacement

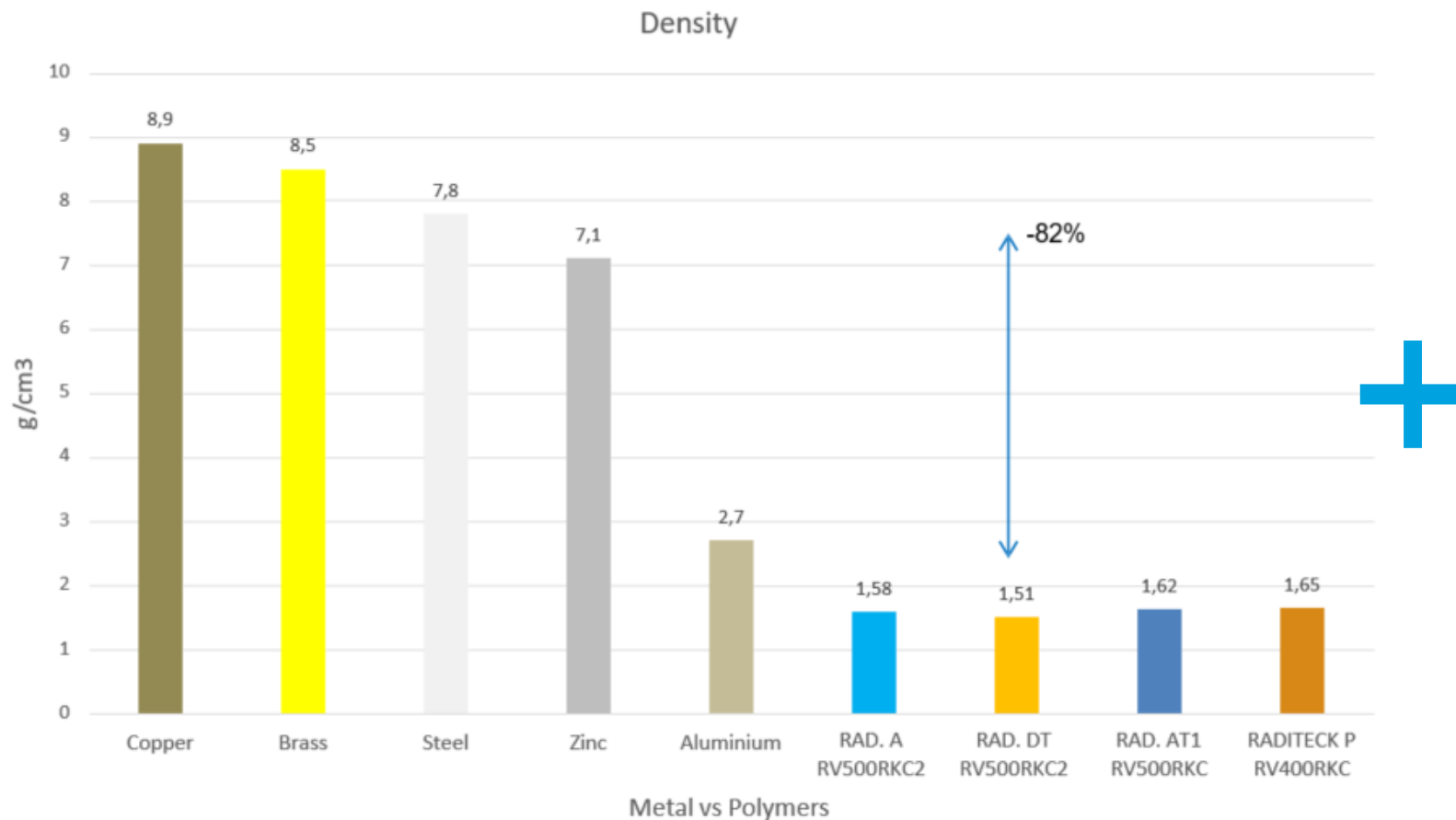
Lead restriction

European regulations will become more stringent in the future. Moreover, the new generation of brass/copper alloys (ECO BRASS) are expensive and have a negative effect on tool wear.



Key drivers in metal replacement

Cost reduction



COST REDUCTION

Lower density and higher productivity are important factors for the mass production of thermoplastics.

1. ONE-SHOT PROCESS
2. MULTICAVITY
3. SHORT CYCLE
4. NO POST-TREATMENT NEEDED

Key drivers in metal replacement

Ease of assembly



Plastic parts in sanitary systems can be assembled faster without specific tools and with modular elements. The benefits are:

- Time saving
- Failure reduction
- Versatility



2K projects can also be designed without gaskets and hemp fibre.

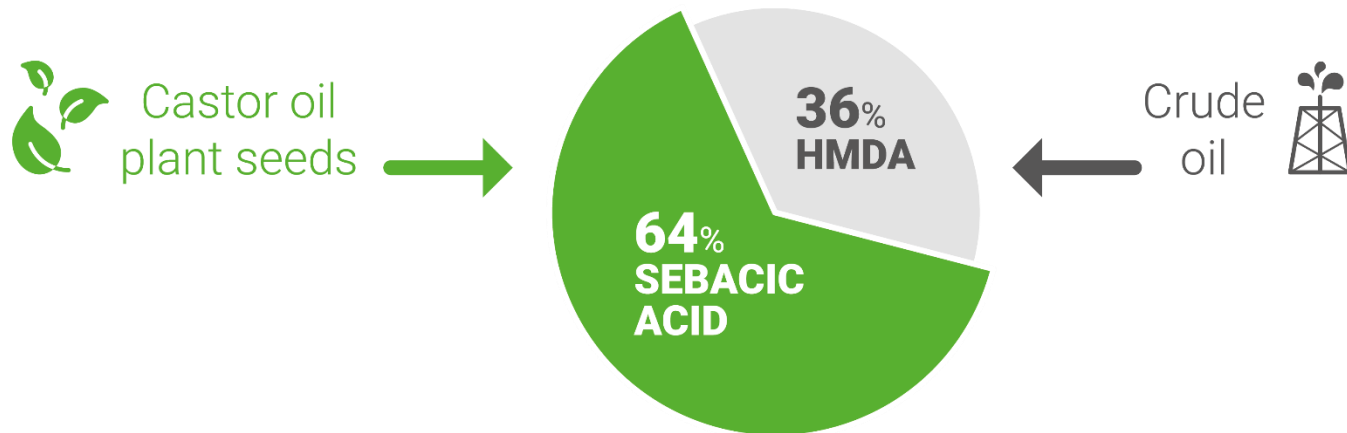
The advantages are:

- Faster production
- Chemical bonding
- Fewer parts



Key drivers in metal replacement Sustainability

Not all WM applications require potable water approvals. For example, floor heating system components and some appliance parts do not come into contact with drinking water!



RADILON D (PA610)

HIGH PERFORMANCE POLYMERS RADILON® D SUSTAINABLE

The Radilon® D trade name identifies the long molecular chain PA6.10 grades that have been developed for injection moulding and extrusion. These products, made with 64% renewable source materials, are polymerized from hexamethylenediamine and sebacic acid at RadiciGroup Specialty Chemicals plants and then compounded at various RadiciGroup High Performance Polymers production sites located all over the world. Sebacic acid is a substance of biological origin obtained from castor oil plant (*Ricinus communis*) seeds. The plant is cultivated, mostly in China and India, in arid environments and, for this reason, does not compete with agricultural products for human consumption.

Water management product range



Radilon® S (PA6)	Grades that combine very good mechanical performance properties, excellent processability & colourability for parts not in contact with water that do not require hydrolytic resistance.
Radilon® A (PA6.6)	Grades that combine high mechanical performance properties with good hydrolytic resistance at elevated temperatures (90°C).
Radilon® DT (PA6.12)	Grades that combine high mechanical performance properties with excellent chemical and hydrolytic resistance at elevated temperatures. They offer superior dimensional stability, including low moisture absorption, and superior resistance to oxidation degradation resulting in better weld line resistance to prolonged water exposure up to 60°C. The materials also exhibit high flow, which enables easier design and injection moulding of highly complex and/or thin-walled parts.
Radilon® D (PA6.10)	Grades that combine high mechanical performance properties with excellent chemical and hydrolytic resistance at elevated temperatures. They offer superior dimensional stability, including low moisture absorption, and superior weld line resistance to prolonged water exposure up to 60°C. These products are made partially from renewable sources.
Radilon® Aestus T1 (PPA)	Grades that combine high mechanical performance properties, including excellent creep resistance in hot water and steam, with outstanding chemical and resistance to oxidative degradation at elevated temperatures (120°C).
Radistrong® A (special PA)	Grades that combine superior mechanical performance properties with good hydrolytic resistance at high temperatures (90°C) and excellent surface finish as well as excellent processability.
Raditeck® P (PPS)	Grades that combine good mechanical performance properties with outstanding hydrolytic and chemical resistance at elevated temperatures (120°C) as well as outstanding dimensional stability & creep resistance.

Water management product range

RADILON® A (PA66)

RADILON® A RV300RKC 306 BK

RADILON® A RV300RKC 106 NT

RADILON® A RV500RKC 306 BK

RADILON® A RV500RKC 106 NT

RADILON® A RV300RKC2 306 BK

RADILON® A RV300RKC2 106 NT

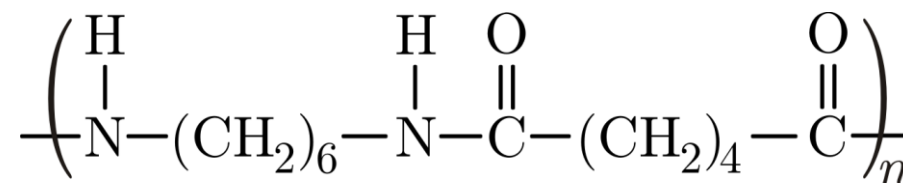
RADILON® A RV500RKC2 306 BK

RADILON® A RV500RKC2 106 NT

RADILON® A RCM4010RKC 306 BK

Nylon 66, synthesized by the polycondensation of hexamethylenediamine and adipic acid, is frequently used when the following characteristics are required:

- Stiffness and high mechanical strength
- Good elongation and impact resistance
- Wear and heat stability



Nylon 66

Raw polymer is produced at the RadiciGroup Chemicals plant in Novara – ITALY

VERTICALLY INTEGRATED PRODUCTION

Water management product range

RADILON A (PA66)



Complex geometries can be achieved with engineering polymers. Additionally, due to the low coefficient of thermal expansion, parts can be assembled in contact with metal, rubber and other polymers (screwed, glued or welded).

Water management product range

RADILON® DT (PA612)

RADILON® DT CV300RKC2 306 BK

RADILON® DT CV300RKC2 106 NT

RADILON® DT RV300RKC2 306 BK

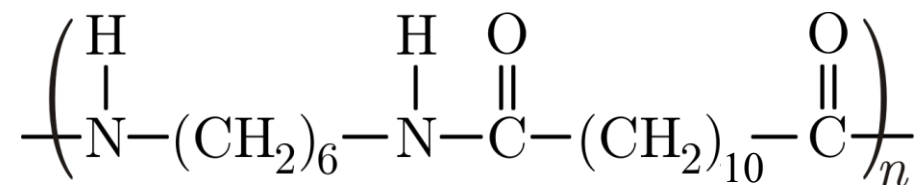
RADILON® DT RV300RKC2 106 NT

RADILON® DT RV500RKC2 306 BK

RADILON® DT RV500RKC2 106 NT

RADILON® DT PA612 is a long-chain polyamide produced from hexamethylenediamine and dodecanedioic acid. Some features are:

- Higher chemical resistance
- Hydrolysis resistance
- Increased dimensional stability
- Lower moisture absorption



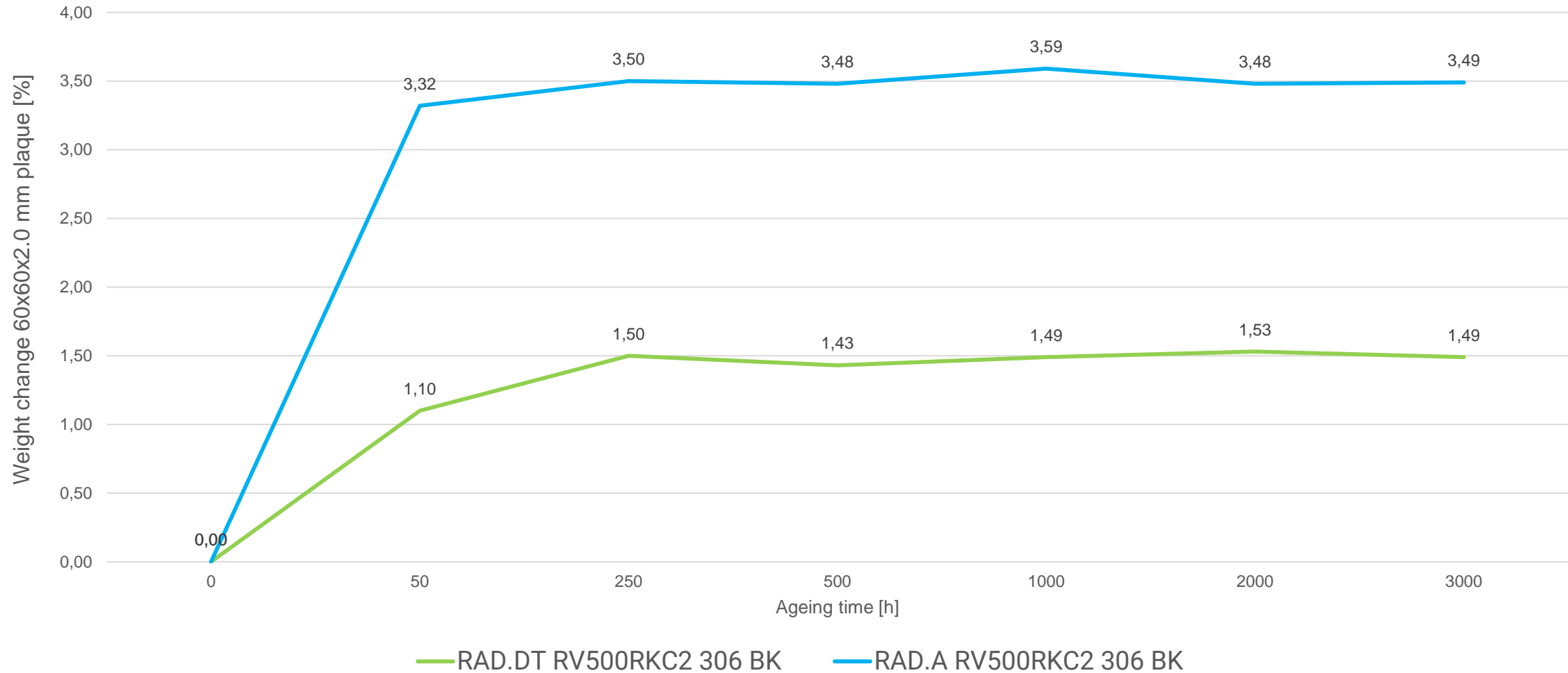
Raw polymer is produced at the RadiciGroup
Chemicals plant in Novara – ITALY

VERTICALLY INTEGRATED PRODUCTION

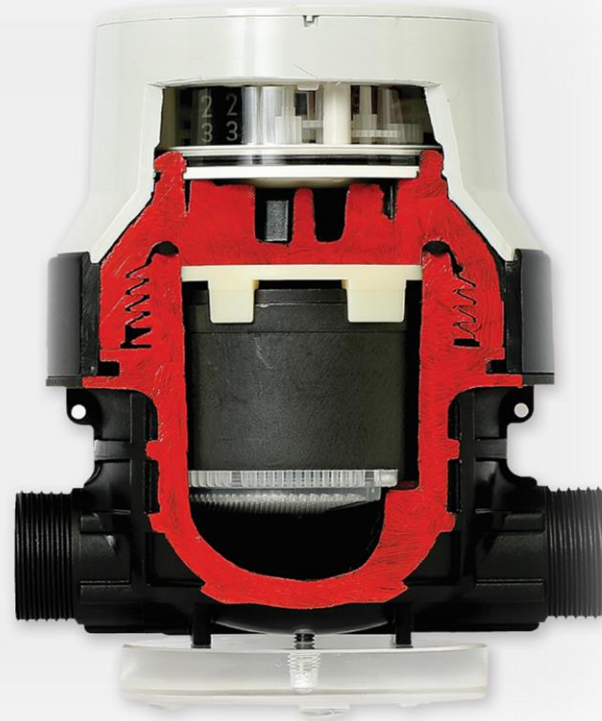
Water management product range

RADILON® DT (PA612)

WEIGHT CHANGE AFTER AGEING IN DEIONIZED WATER AT 60°C



Water management product range RADILON® DT (PA612)



Due to the low moisture absorption, our long-chain polyamide RADILON® DT can be used in combination with other moving parts, while maintaining the functionality of the system in any conditions.

Water management product range

RADISTRONG® AROMA (specialty PA)

RADISTRONG® AROMA RV300RKC2 306 BK

RADISTRONG® AROMA RV300RKC2 106 NT

RADISTRONG® AROMA RV400RKC2 306 BK

RADISTRONG® AROMA RV400RKC2 106 NT

RADISTRONG® AROMA RV500RKC2 306 BK

RADISTRONG® AROMA RV500RKC2 106 NT

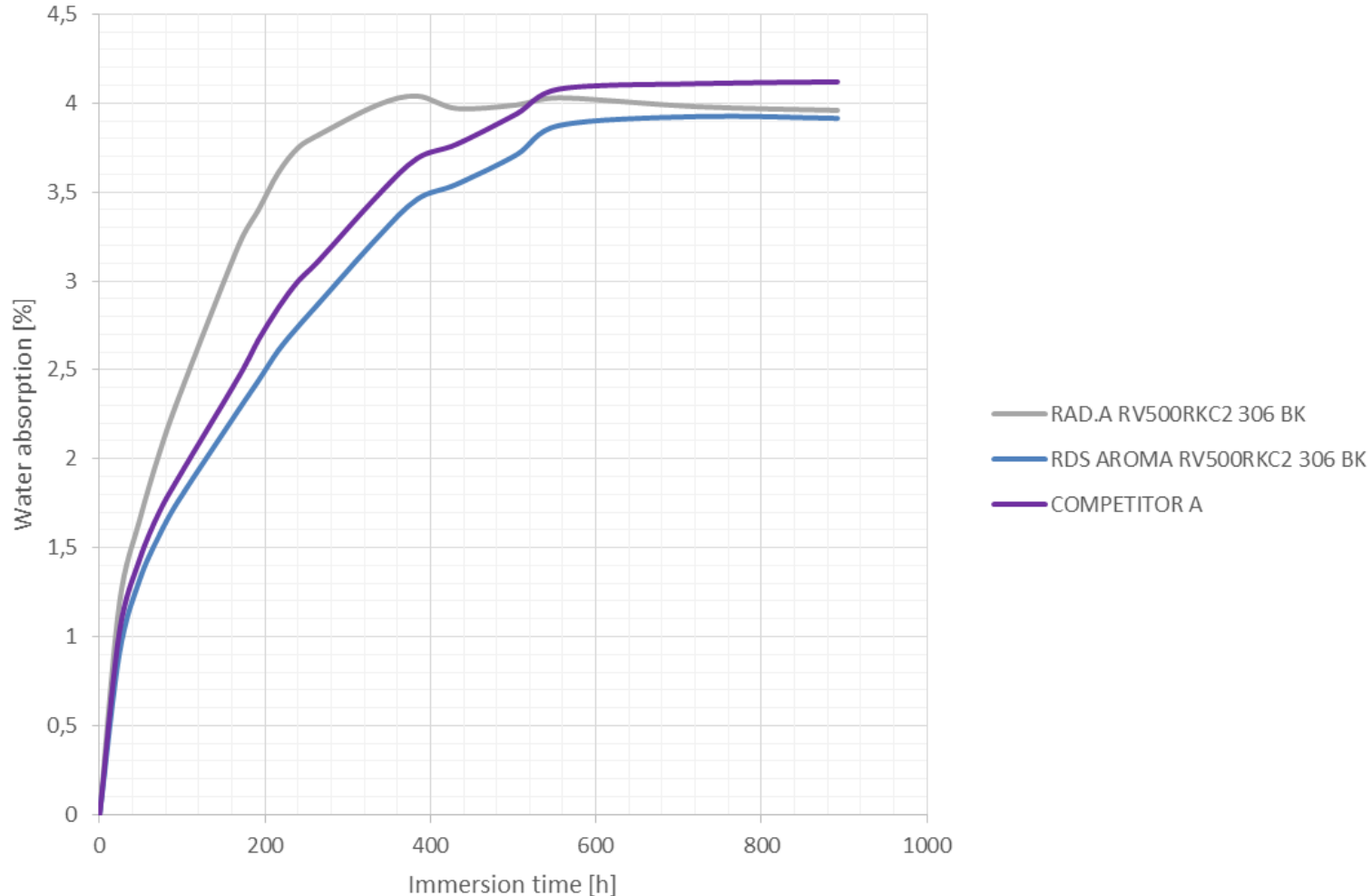
RADISTRONG® AROMA is a family of high-performance polyamides that bridge the performance gap between aliphatic polyamides (PA6 and PA66) and higher performing aromatic polyamides (PPA):

- Slower water absorption rate vs PA66
- Higher mechanical properties and better weld lines
- Good aesthetic appearance of moulded parts and easy to mould



Water management product range

RADISTRONG® AROMA (specialty PA)



Water absorption rate of RADISTRONG® AROMA is 35% slower compared to standard PA66

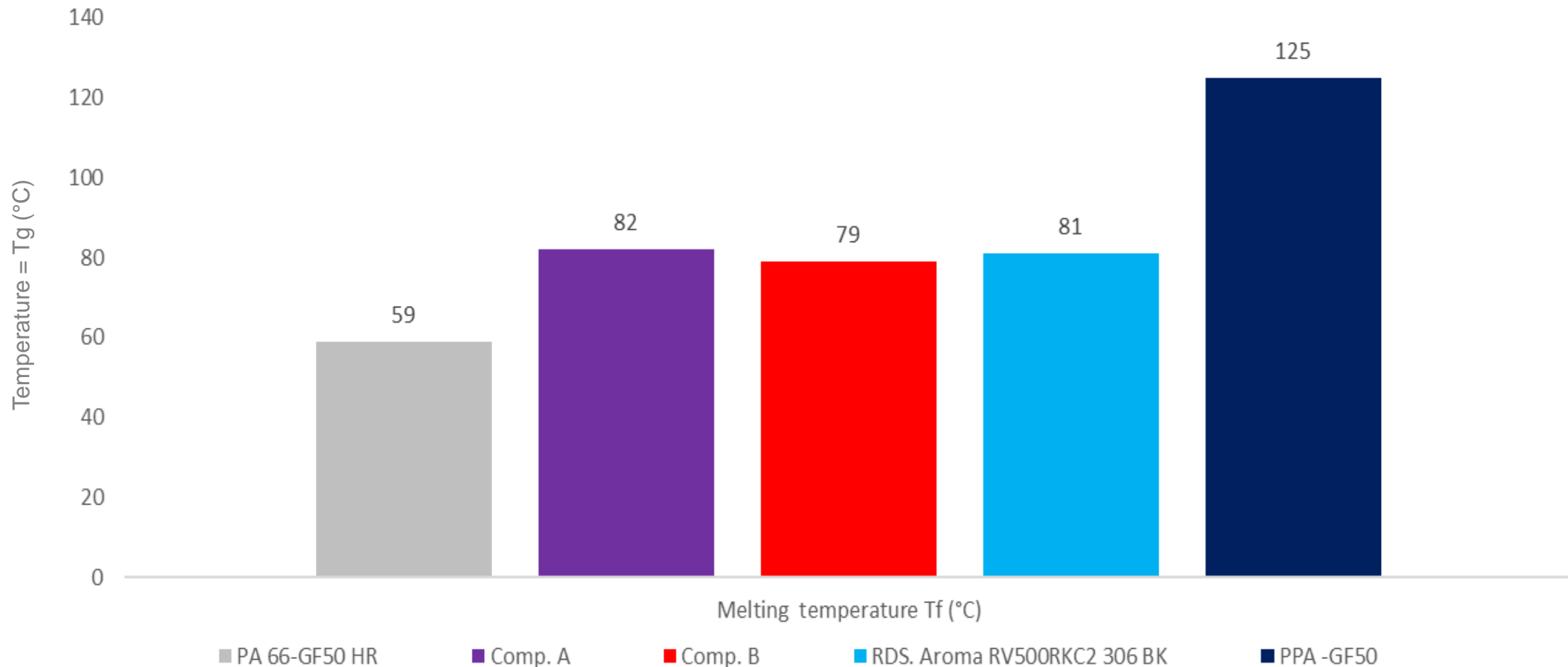


DIMENSIONAL STABILITY

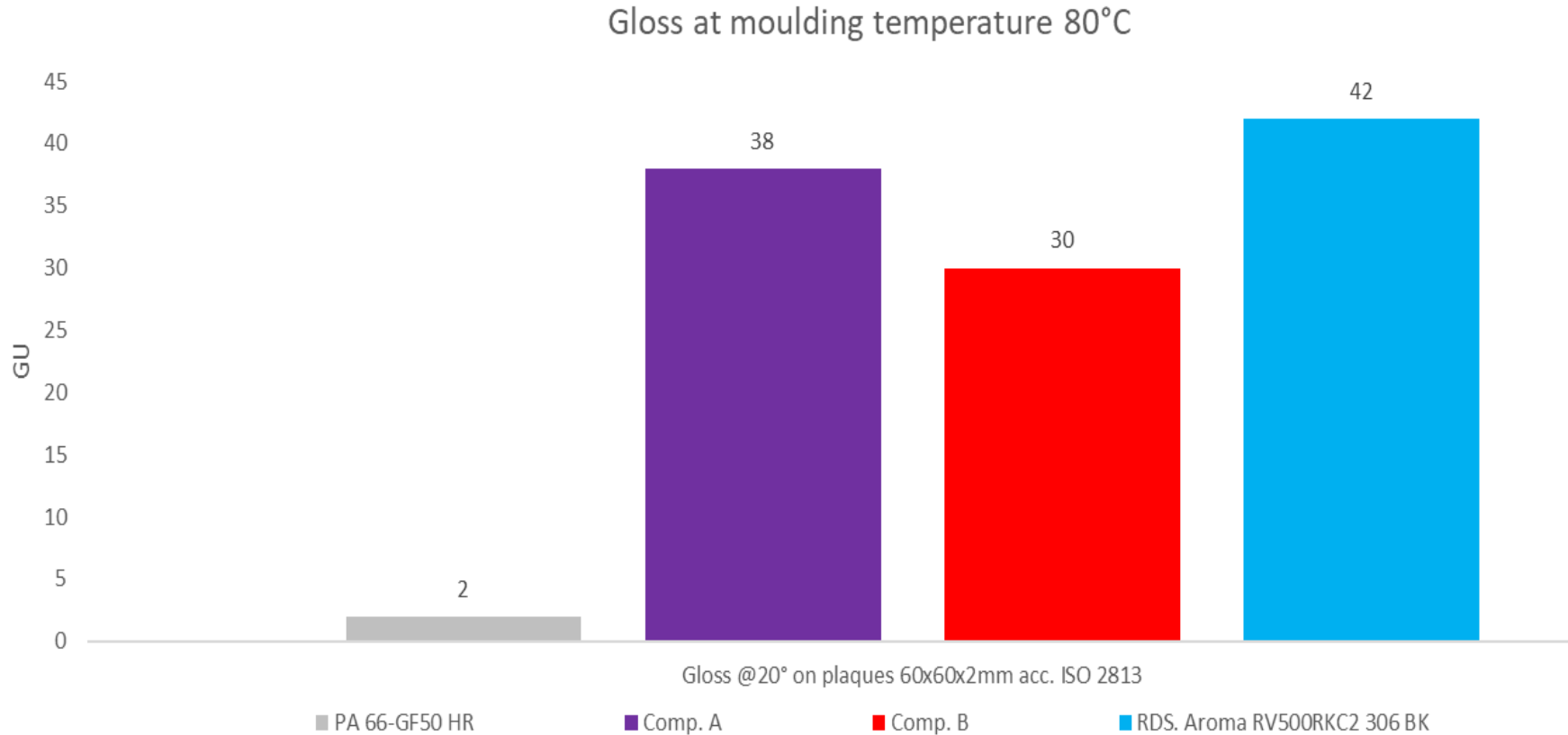
Water management product range

RADISTRONG® AROMA (specialty PA)

Glass transition temperature = Tg (°C)



Water management product range RADISTRONG® AROMA (specialty PA)



Why are the gloss and the surface appearance so important?

Water management product range

RADILON® AESTUS (PPA)

RADILON® Aestus T1 RV300RKC 306 BK

RADILON® Aestus T1 RV300RKC 106 NT

RADILON® Aestus T1 RV400RKC 306 BK

RADILON® Aestus T1 RV400RKC 106 NT

RADILON® Aestus T1 RV450RKC 306 BK

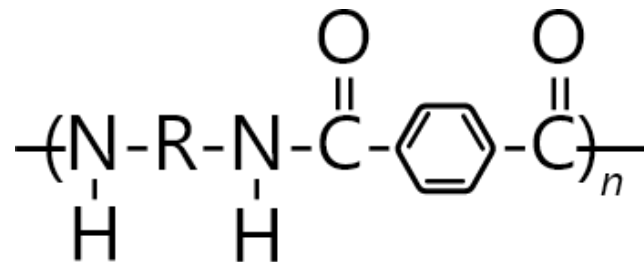
RADILON® Aestus T1 RV450RKC 106 NT

RADILON® Aestus T1 RV500RKC 306 BK

RADILON® Aestus T1 RV500RKC 106 NT

RADILON® AESTUS T1 PPA is a semi-aromatic polyamide that contains 55% or more moles of the carboxylic acid portion of the repeating unit in the polymer chain. The product is composed of a combination of terephthalic (TPA) and isophthalic (IPA) that provides ultra high features:

- Higher thermal properties (up to 160°C)
- Good chemical resistance



Water management product range

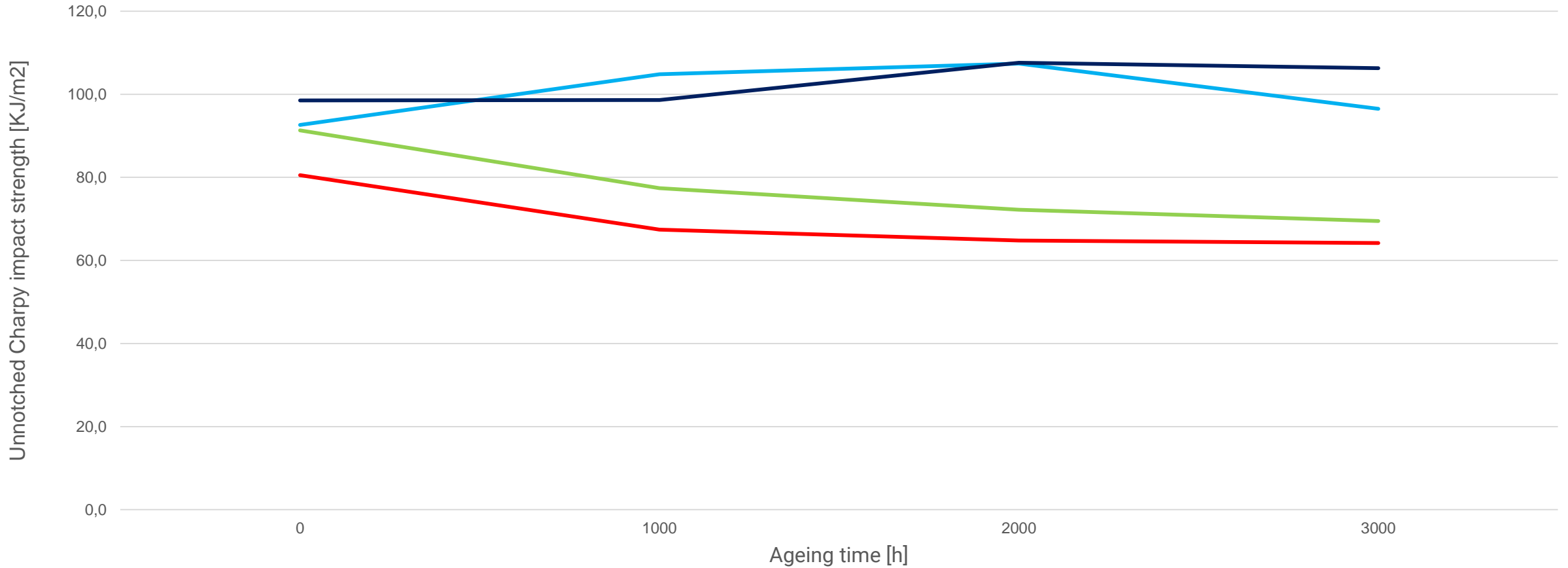
Overview of approvals



GRADE	POLYMER	COLOUR	FILLERS	KTW-BWGL		WRAS	ACS
RADILON® A RV300RKC 306 BK	PA 6.6	Black	GF30			85 °C	
RADILON® A RV300RKC 106 NT	PA 6.6	Natural	GF30			85 °C	
RADILON® A RV500RKC 306 BK	PA 6.6	Black	GF50			85 °C	
RADILON® A RV500RKC 106 NT	PA 6.6	Black	GF50			85 °C	
RADILON® A RV300RKC2 306 BK	PA 6.6	Black	GF30	23 °C		85 °C	✓
RADILON® A RV300RKC2 106 NT	PA 6.6	Natural	GF30	23 °C		85 °C	≡
RADILON® A RV500RKC2 306 BK	PA 6.6	Black	GF50	23 °C		85 °C	✓
RADILON® A RV500RKC2 106 NT	PA 6.6	Natural	GF50	23 °C		85 °C	≡
RADILON® A RCM4010RKC 306 BK	PA 6.6	Black	GF10 M30			85 °C	
RADILON® DT CV300RKC2 306 BK	PA 6.12	Black	GB30			85 °C	
RADILON® DT CV300RKC2 106 NT	PA 6.12	Natural	GB30			85 °C	
RADILON® DT RV300RKC2 306 BK	PA 6.12	Black	GF30	23 °C	60 °C	85 °C	✓
RADILON® DT RV300RKC2 106 NT	PA 6.12	Natural	GF30	23 °C	60 °C	85 °C	≡
RADILON® DT RV500RKC2 306 BK	PA 6.12	Black	GF50	23 °C	60 °C	85 °C	✓
RADILON® DT RV500RKC2 106 NT	PA 6.12	Natural	GF50	23 °C	60 °C	85 °C	≡
RADISTRONG® AROMA RV300RKC2 306 BK	PA 6.6*	Black	GF30	ON GOING	ON GOING	ON GOING	ON GOING
RADISTRONG® AROMA RV300RKC2 106 NT	PA 6.6*	Natural	GF30	ON GOING	ON GOING	ON GOING	ON GOING
RADISTRONG® AROMA RV400RKC2 306 BK	PA 6.6*	Black	GF40	ON GOING	ON GOING	ON GOING	ON GOING
RADISTRONG® AROMA RV400RKC2 106 NT	PA 6.6*	Natural	GF40	ON GOING	ON GOING	ON GOING	ON GOING
RADISTRONG® AROMA RV500RKC2 306 BK	PA 6.6*	Black	GF50	ON GOING	ON GOING	ON GOING	ON GOING
RADISTRONG® AROMA RV500RKC2 106 NT	PA 6.6*	Natural	GF50	ON GOING	ON GOING	ON GOING	ON GOING
RADILON® Aestus T1 RV300RKC 306 BK	PPA	Black	GF30	UPDATI NG		UPDATI NG	≡
RADILON® Aestus T1 RV300RKC 106 NT	PPA	Natural	GF30	UPDATI NG		UPDATI NG	≡
RADILON® Aestus T1 RV400RKC 306 BK	PPA	Black	GF40	UPDATI NG		UPDATI NG	≡
RADILON® Aestus T1 RV400RKC 106 NT	PPA	Natural	GF40	UPDATI NG		UPDATI NG	≡
RADILON® Aestus T1 RV450RKC 306 BK	PPA	Black	GF45	UPDATI NG		UPDATI NG	≡
RADILON® Aestus T1 RV450RKC 106 NT	PPA	Natural	GF45	UPDATI NG		UPDATI NG	≡
RADILON® Aestus T1 RV500RKC 306 BK	PPA	Black	GF50	UPDATI NG		UPDATI NG	≡
RADILON® Aestus T1 RV500RKC 106 NT	PPA	Natural	GF50	UPDATI NG		UPDATI NG	≡

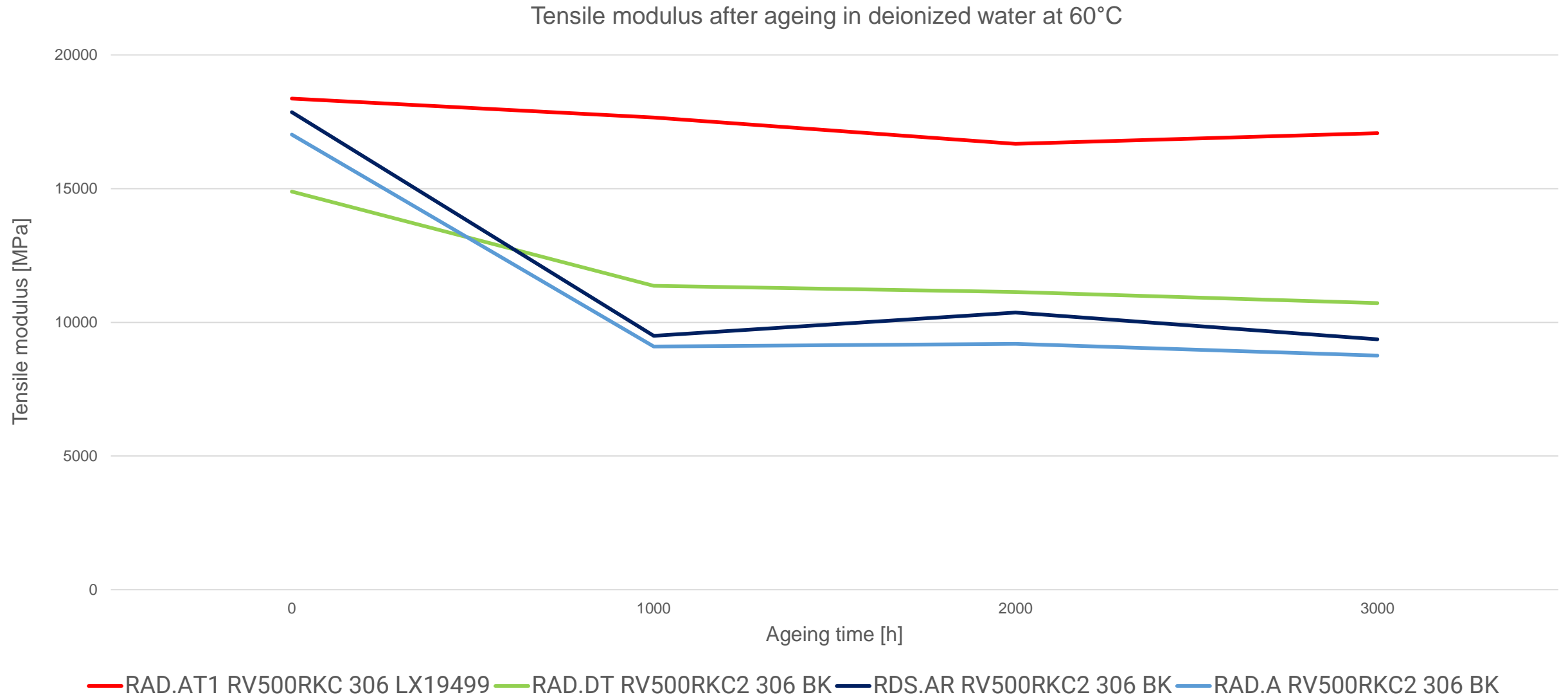
Technical advantages - Impact strength

Charpy impact strength after ageing in deionized water at 60°C



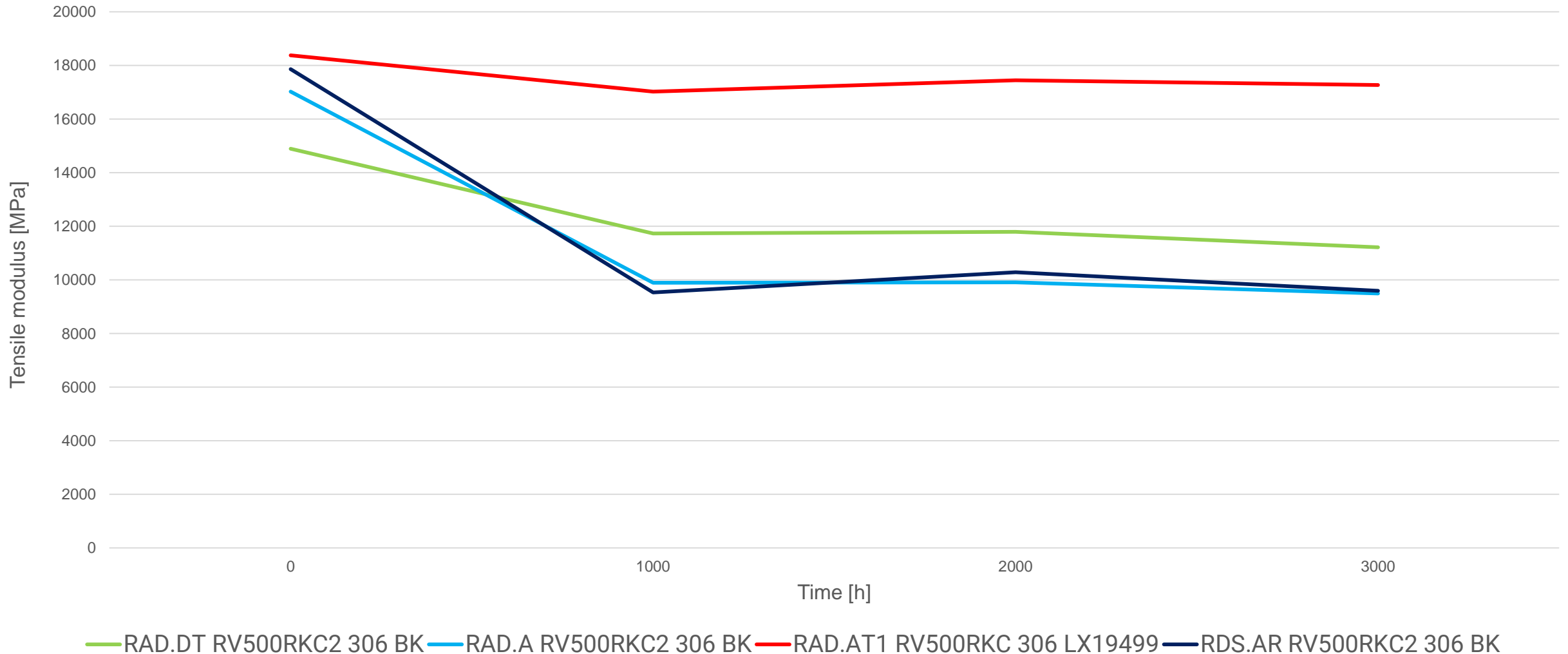
— RAD.DT RV500RKC2 306 BK — RAD.A RV500RKC2 306 BK — RDS.AR RV500RKC2 306 BK — RAD.AT1 RV500RKC 306 LX19499

Technical advantages - Hydrolysis resistance



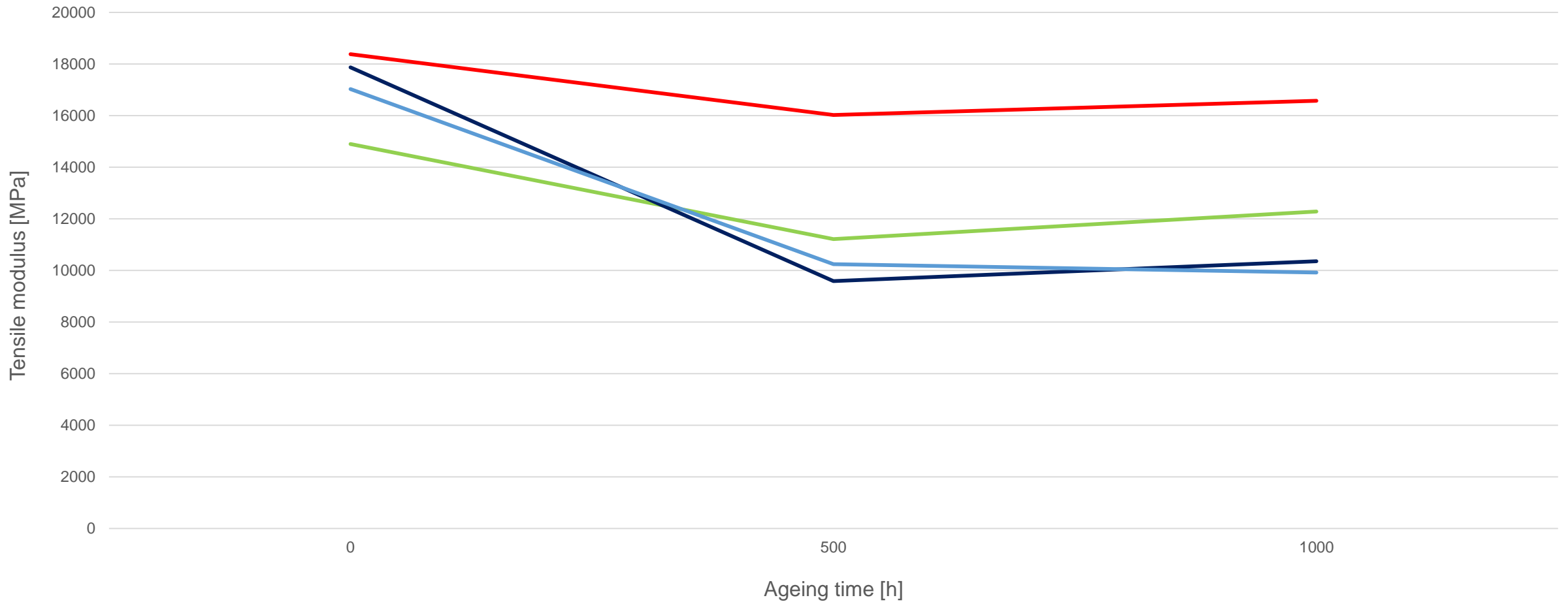
Technical advantages - Hydrolysis resistance

Tensile modulus after ageing in deionized water at 90°C



Technical advantages - Hydrolysis resistance

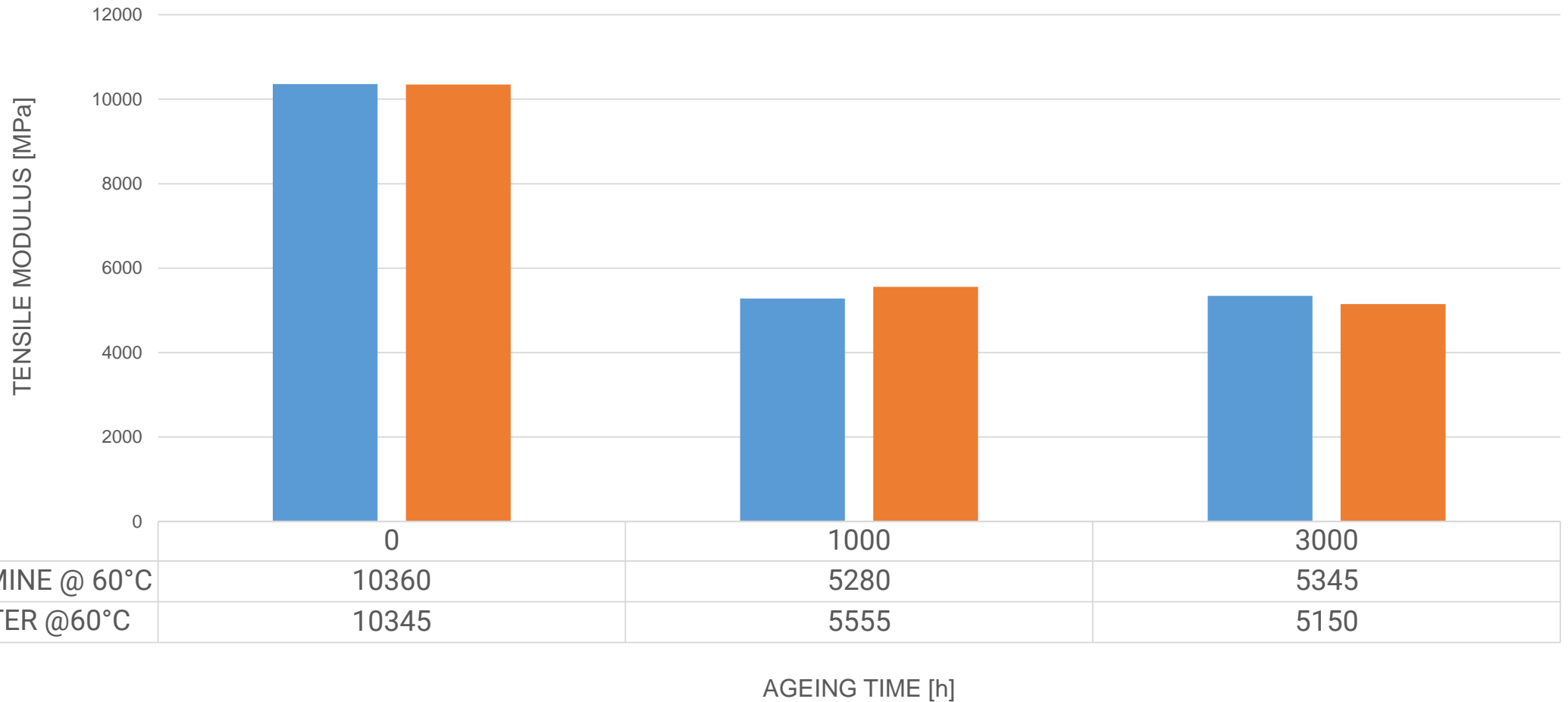
Tensile modulus after ageing in deionized water at 120°C ≈1,5bar



— RAD.AT1 RV500RKC 306 LX19499 — RAD.DT RV500RKC2 306 BK — RDS.AR RV500RKC2 306 BK — RAD.A RV500RKC2 306 BK

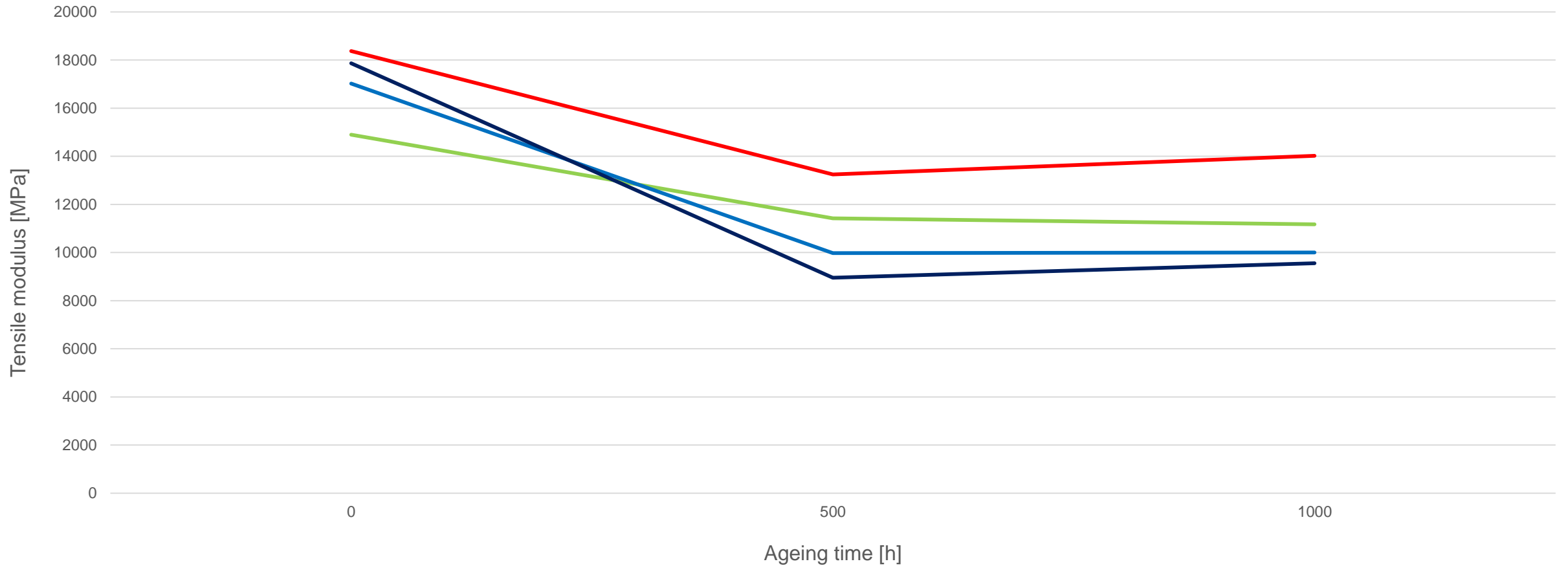
Technical advantages - Chemical resistance

RADILON A RV300RKC2 306 BK



Technical advantages - Chemical resistance

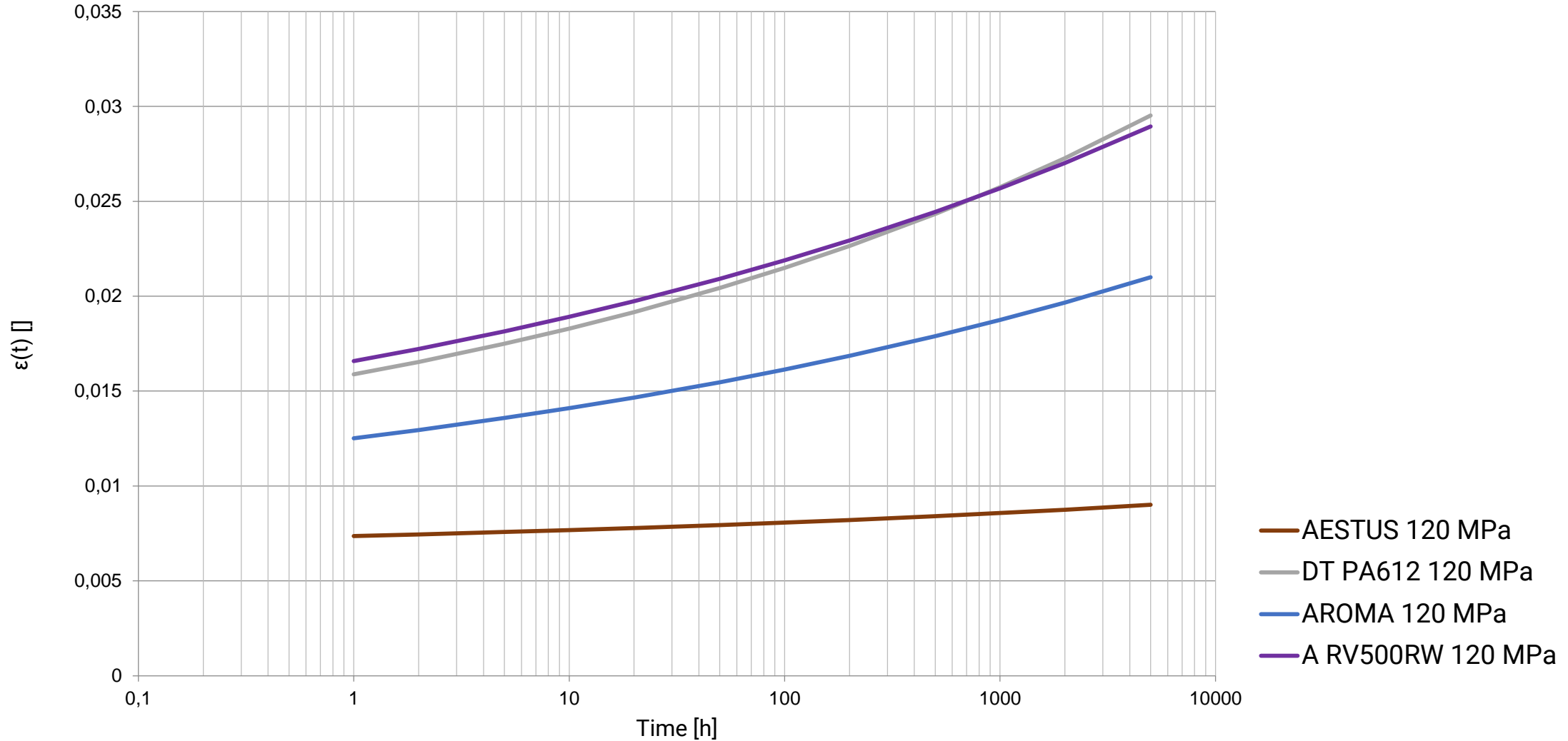
Ageing in deionized water + glycol (glysantin g13) 50/50 @120°C ≈1,5bar



— RAD.DT RV500RKC2 306 BK — RAD.A RV500RKC2 306 BK — RDS.AR RV500RKC2 306 BK — RAD.AT1 RV500RKC 306 LX19499

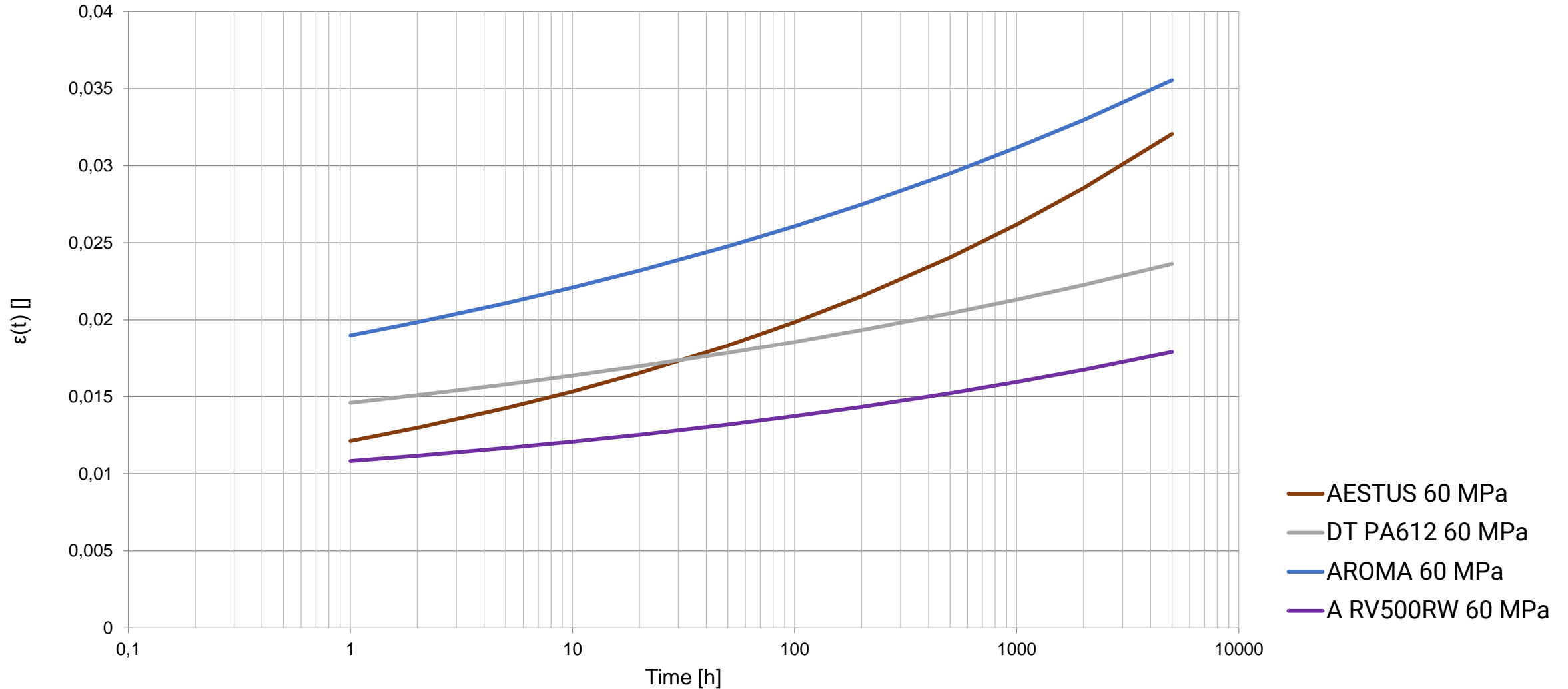
Technical advantages - Creep resistance

$\epsilon(t)$ - 23°C RH50

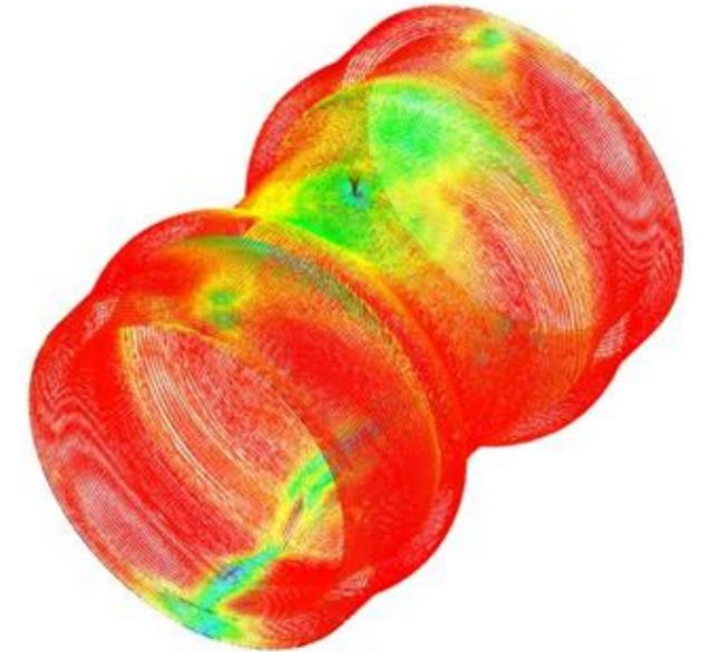
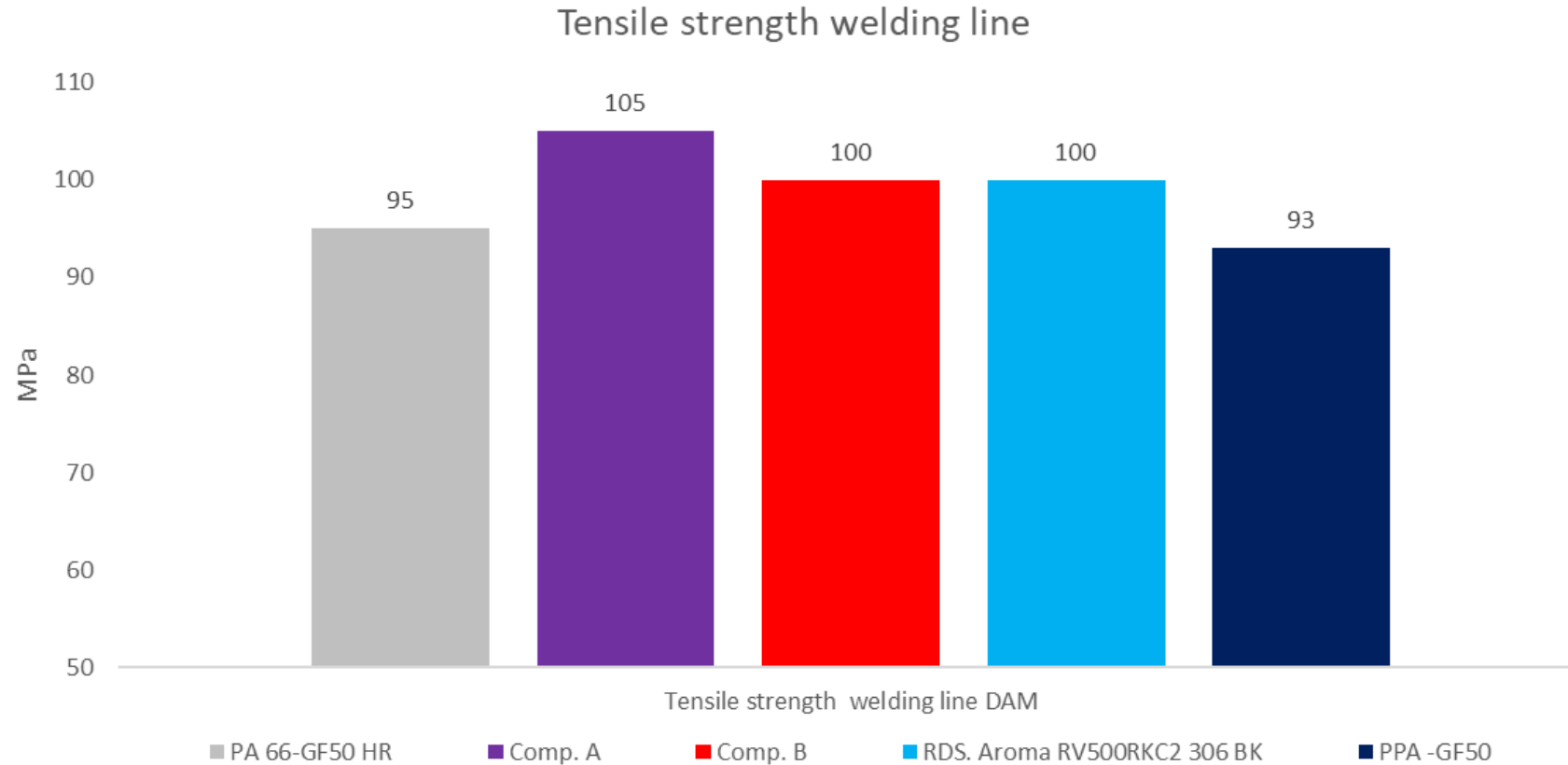


Technical advantages - Creep resistance

$\varepsilon(t)$ - 120°C DAM



Technical advantages - Flowability



Strong weld lines are an important aspect to consider in water management applications, since they are often present and can cause failure.

Case Histories - PA66

MAGNETIC SLUDGE SEPARATOR BODY AND COMPONENTS

Material:

RADILON® A RV300 RKC 306BK

Description:

PA66-GF30, suitable for drinking water contact and hydrolysis resistant.



Case Histories - PA66

ELECTROVALVE FOR APPLIANCES VALVE HOUSING

Material:

RADILON® A RV300 RKC 106NT

Description:

PA66-GF30, suitable for drinking water contact and hydrolysis resistant.

Mechanical resistance and good elongation to maintain thread functionality.



Case Histories - PA612

TAPPING SADDLE BUTTERFLY VALVE (INNER DISC)

Material:

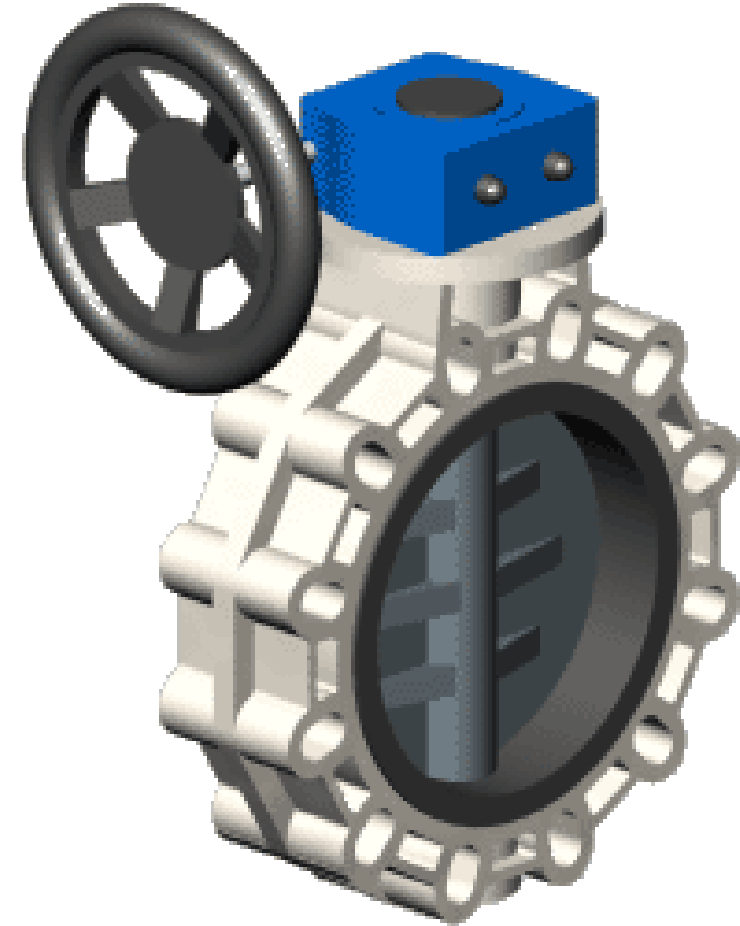
RADILON[®] DT RV600 RKC2 306BK

Description:

PA612-GF60, good stiffness.

Can be overmoulded with other polymers
(gaskets or protective layers).

Chemical resistance from -10 to + 80°C.



Case Histories - Specialty PA66



MANIFOLD FLOW METER BLOW DOWN VALVE

Material:

RADISTRONG® AROMA

RV500 RKC2 306 BK

Description:

Specialty PA-GF50, high burst pressure resistance, also for long-term contact with hot water (60°C).



Case Histories - Specialty PA66



WASHING MACHINE DOOR LEVER

Material:

RADISTRONG® A RV500W 333 BK

Description:

Specialty PA66 - GF 50%,
high mechanical and fatigue properties
for metal replacement.



RadiciGroup High Performance Polymers for Additive Manufacturing

Fused Filament Fabrication Radilon[®] Adline

Radilon® Adline 3D Printing Filament Range



Nomenclature



Radilon® Adline Filaments are based on **Radilon® polyamide grades**, a well-known brand portfolio in the injection moulding and extrusion market.

Specific formulations with low warpage and high dimensional stability have been developed for each Radilon® Adline grade in order to guarantee ease of printing, in combination with the semicrystalline nature of polyamide polymers.

All the products feature advanced properties, such as mechanical, chemical and thermal resistance, thanks to our 40 years' expertise in compounding.



RADILON® ADLINE CS NAT

An easy-to-print polyamide 6/66 with low warpage, good surface appearance and ductile behaviour.

Nozzle temperature: 250-280°C
 Bed temperature: 70-100°C
 Adhesion promoter: Magigoo glue
 Print speed: 30-40 mm/s
 Drying: 8-12 h at 70-80°C

Weight: 750 g spool
 Filament diameter: 1.75 mm or 2.85 mm

Radilon® Adline CS grades



RADILON® ADLINE CS CF10 HP BK

An easy-to-print polyamide 6/66 reinforced with 10% carbon fibre. The key characteristics of this product are stiffness and high mechanical properties, together with high dimensional stability and excellent surface appearance.

Nozzle temperature: 250-280°C
 Bed temperature: 70-100°C
 Adhesion promoter: Magigoo glue
 Print speed: 30-40 mm/s
 Drying: 8-12 h at 70-80°C

Please note: the parameters depend on the printer used.

Radilon® Adline



Radilon® Adline 3D Printing Filaments have been tested with several open 3D printing systems to guarantee the ease of processing of the materials.



Ongoing research activities, in collaboration with **printer manufacturers**, are aimed at developing official printing profiles of Radilon® Adline 3D Printing Filaments for specific 3D printer brands.



Ultimaker



DRY~~W~~ISE

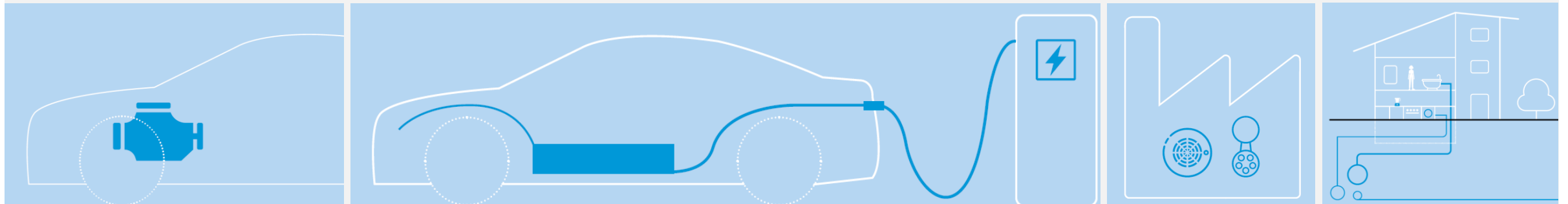
RadiciGroup - Ciano Shapes



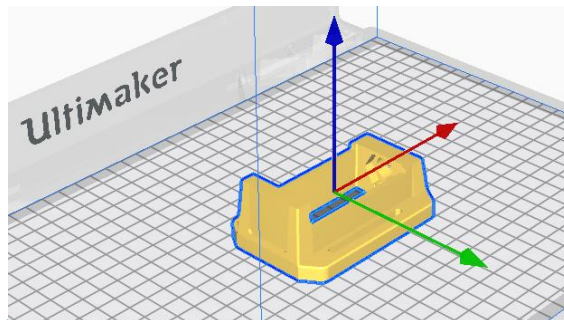
On-demand parts manufacturing

3D printing technology can be applied to projects in different market sectors from the early stages of their development for quick production of prototypes and functional parts. RadiciGroup's partnership with Ciano Shapes, a 3D printing service provider and 3D printer/materials reseller, aims at offering complete support, by putting together extensive knowledge from both material and manufacturing technology points of view.

Development projects with engineering polymers for **automotive, E&E, industrial and water management applications**



Workflow example:
Clamp system



Material selection:
Radilon® Adline CS CF10 HP BK
Printer selection:
Ultimaker S5
Quick part delivery

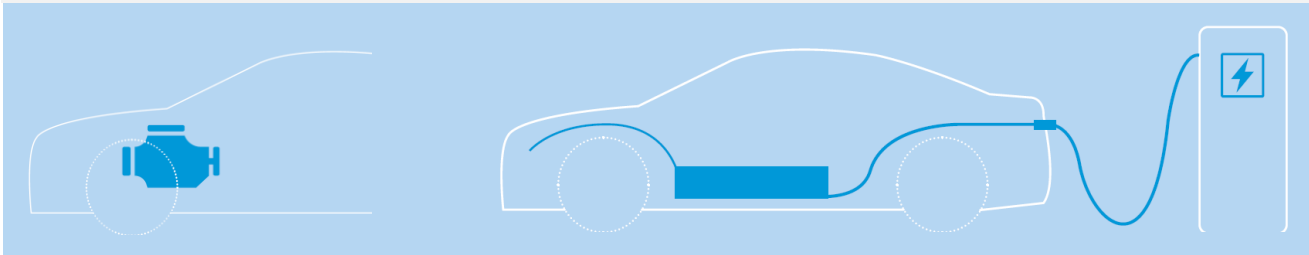


RadiciGroup - Ciano Shapes

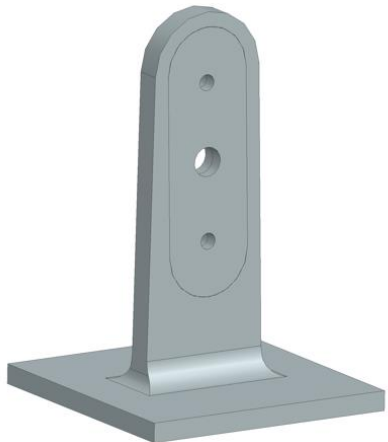


On-demand parts manufacturing: Automotive case study

Project for quick manufacturing of front and rear wings for a car prototype.



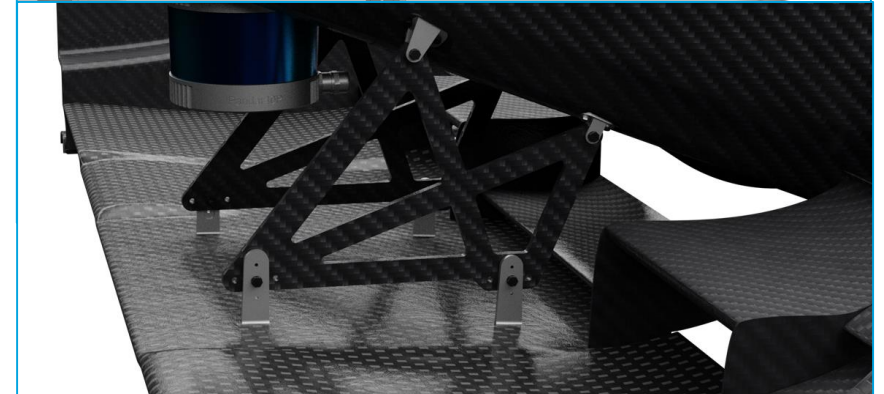
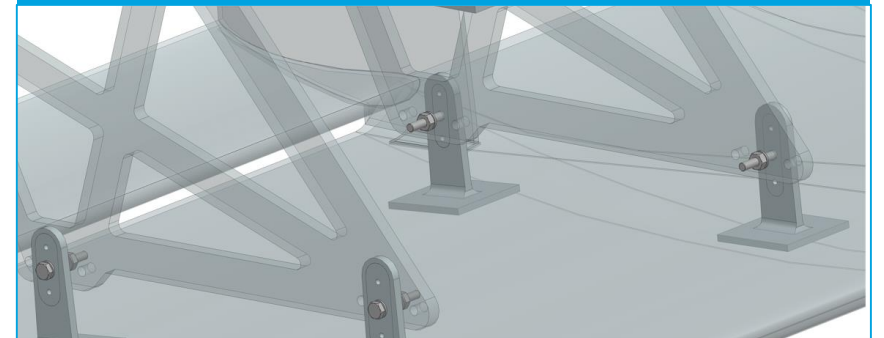
CAD MODEL



PART PRODUCTION with Radilon® Adline CS CF10 HP BK and Ultimaker S5 printer



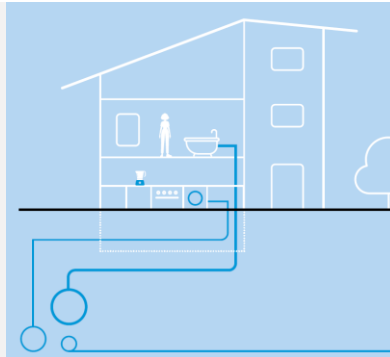
FINAL PART DELIVERY, testing ongoing



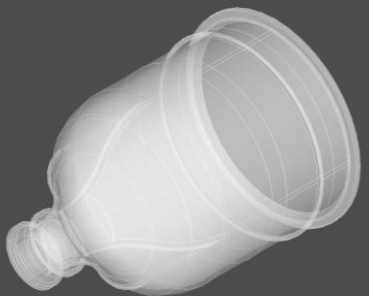
RadiciGroup - Ciano Shapes

On-demand parts manufacturing: Industrial/WM case study - water meter demonstrator

Project in cooperation with RadiciGroup CAE/R&D department for quick manufacturing of a **pressure vessel prototype for mould design optimization**. 3D printing provided time and cost saving for this project, which successfully ended with the final mould production.



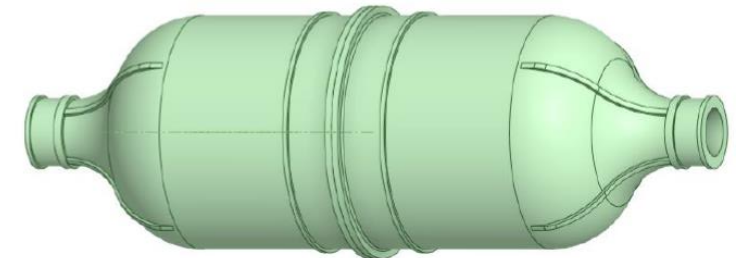
CAD MODEL



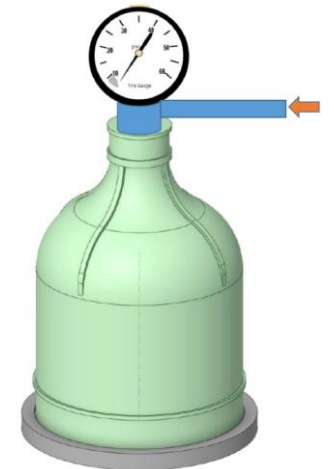
PART PRODUCTION with Radilon® Adline CS NAT and Ultimaker S5 printer



FINAL PART DELIVERY



The 3D-printed pressure vessel helped to better evaluate some adjustments to the component geometry. Thus, the design of the injection mould was successfully finalized.



Radilon® Adline development grades



RadiciGroup High Performance Polymers' target is to develop advanced material solutions with additional attention to reducing their environmental impact.

New Radilon® Adline grades based on polyamide 6 and bio-based polyamides are the next products to be launched.

Radilon® Adline MS CF10 BK

is a 10% carbon fibre-filled, black polyamide 6 blend.

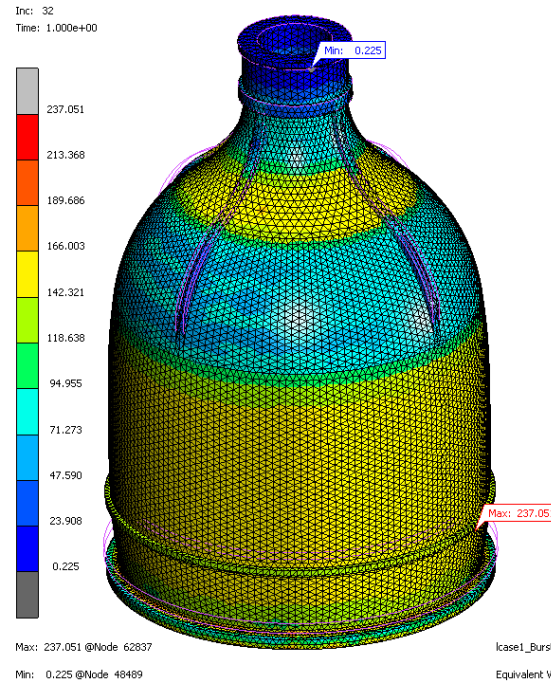
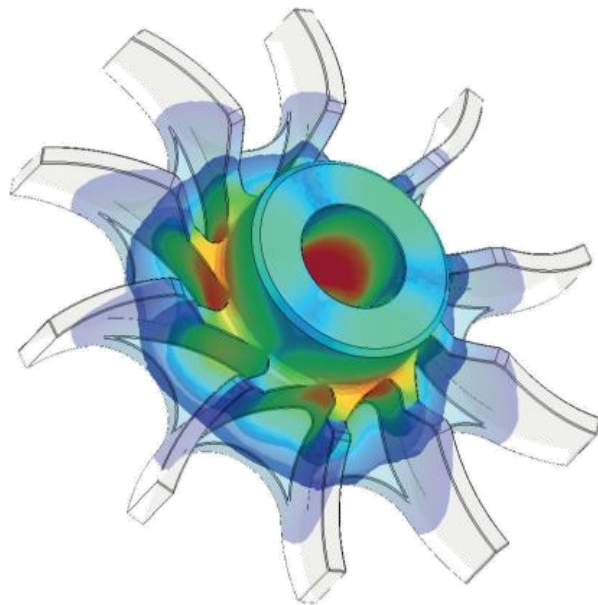
Key features: high dimensional stability, chemical and thermal resistance, strength and stiffness; good impact resistance; high interlayer adhesion; lower water absorption compared to standard polyamide 6.

Radilon® Adline D GF10/CF 10

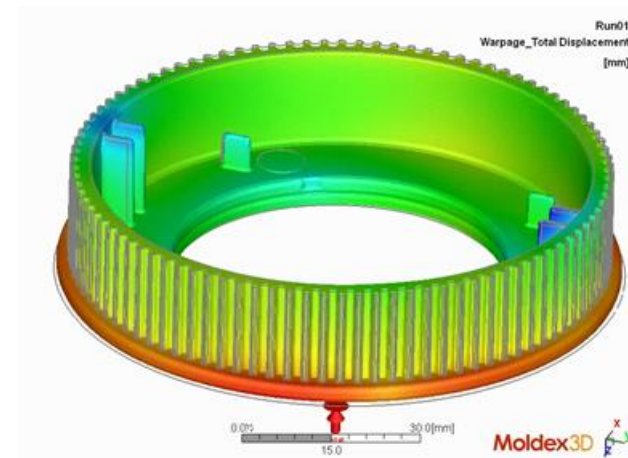
is a 10% glass or carbon fibre-filled polyamide 610.

Key features: good dimensional stability and superior chemical resistance compared to PA6 and PA66; hydrolysis resistance, thermal resistance and low water absorption; 64% renewable source polymer.

How the advanced calculation approach leads to lighter and reliable parts: choosing the right engineering polymers



Case1_Burst_Pressure
Equivalent Von Mises Stress



RadiciGroup HPP CAE Service role



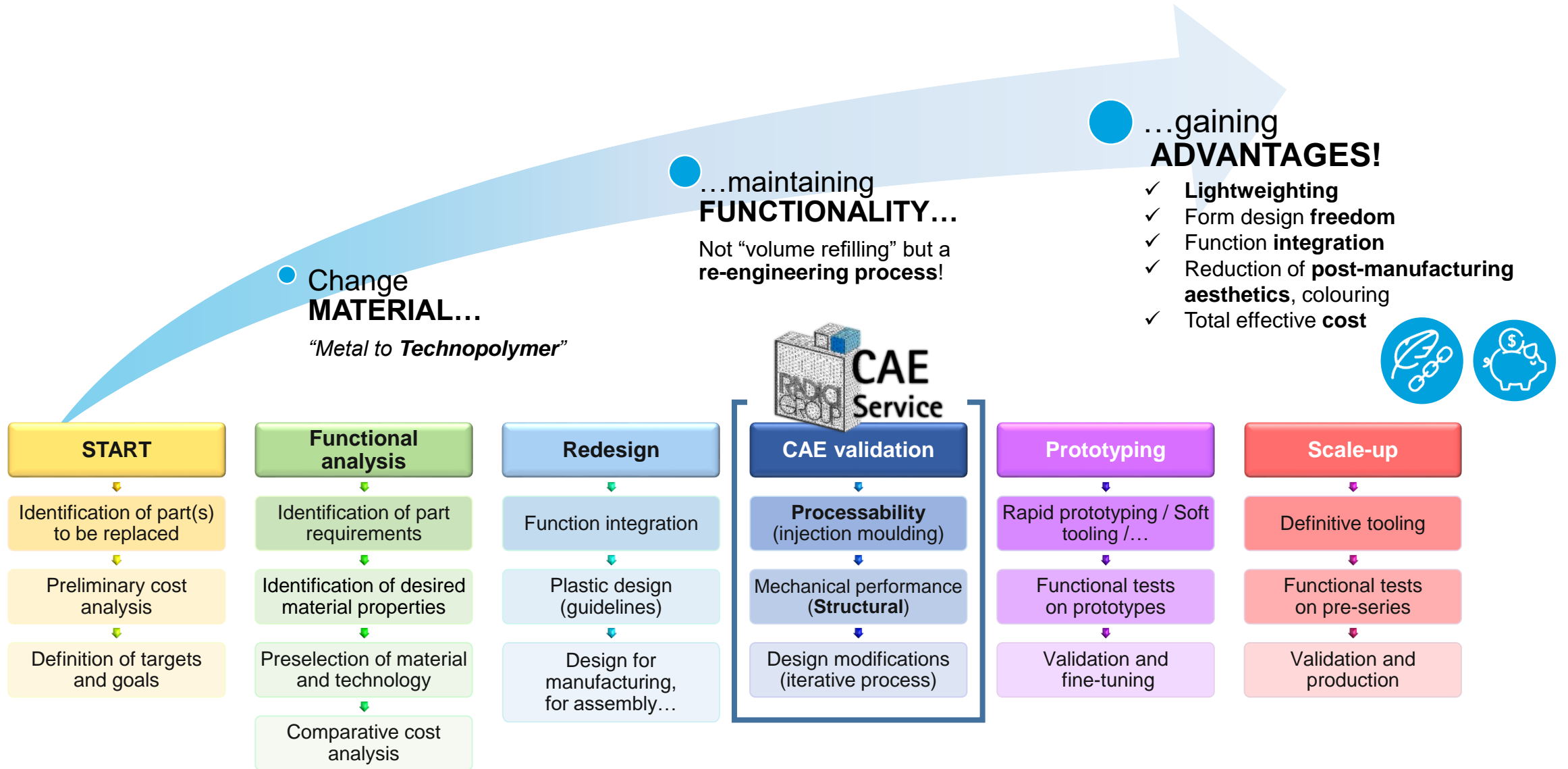
Perform **CAE simulations**, when requested, in support of applications involving RadiciGroup special thermoplastic compounds, using state-of-the-art software tools and methods available on the market, with the scope of:

- › Assessing project feasibility
- › Validating material selection and part (re)design
- › Evaluating solutions for issues occurring in prototyping or regular production

Coordinate with R&D, external suppliers and software producers, so as to ensure that up-to-date and reliable **material cards** for RG-HPP products are made available for use by simulation communities.

Communicate with customers' **CAE experts** in order to facilitate a positive exchange of information in material selection and modelling, when RadiciGroup grades are involved in components or assembly simulations.

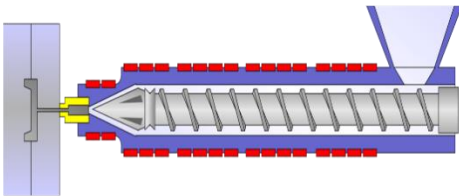
Metal Replacement in WM Sector: Key concept



RadiciGroup HPP CAE simulation skillset



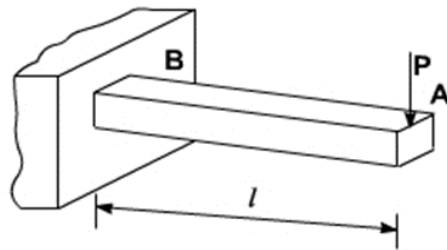
Process



- Injection moulding process simulation
- Flow, packing, cooling, warpage
- Prediction of process-related output and defects

Moldex3D

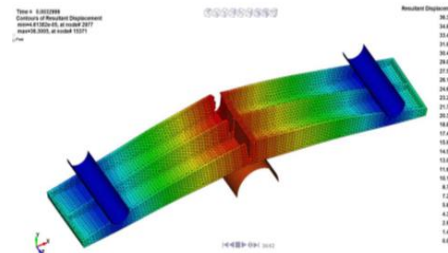
Structural Static



- Linear and non-linear, multi-body contact
- Stiffness, strength, failure
- Modal and harmonic
- Fatigue and creep long-term evaluation
- Thermal and thermo-mechanical

M Marc

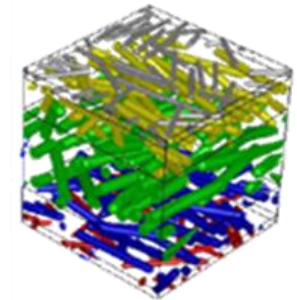
Structural Dynamic



- Transient dynamic simulations
- Explicit and implicit solver
- High-speed impact, crash simulation
- Special manufacturing (e.g., TPC)

LS-DYNA

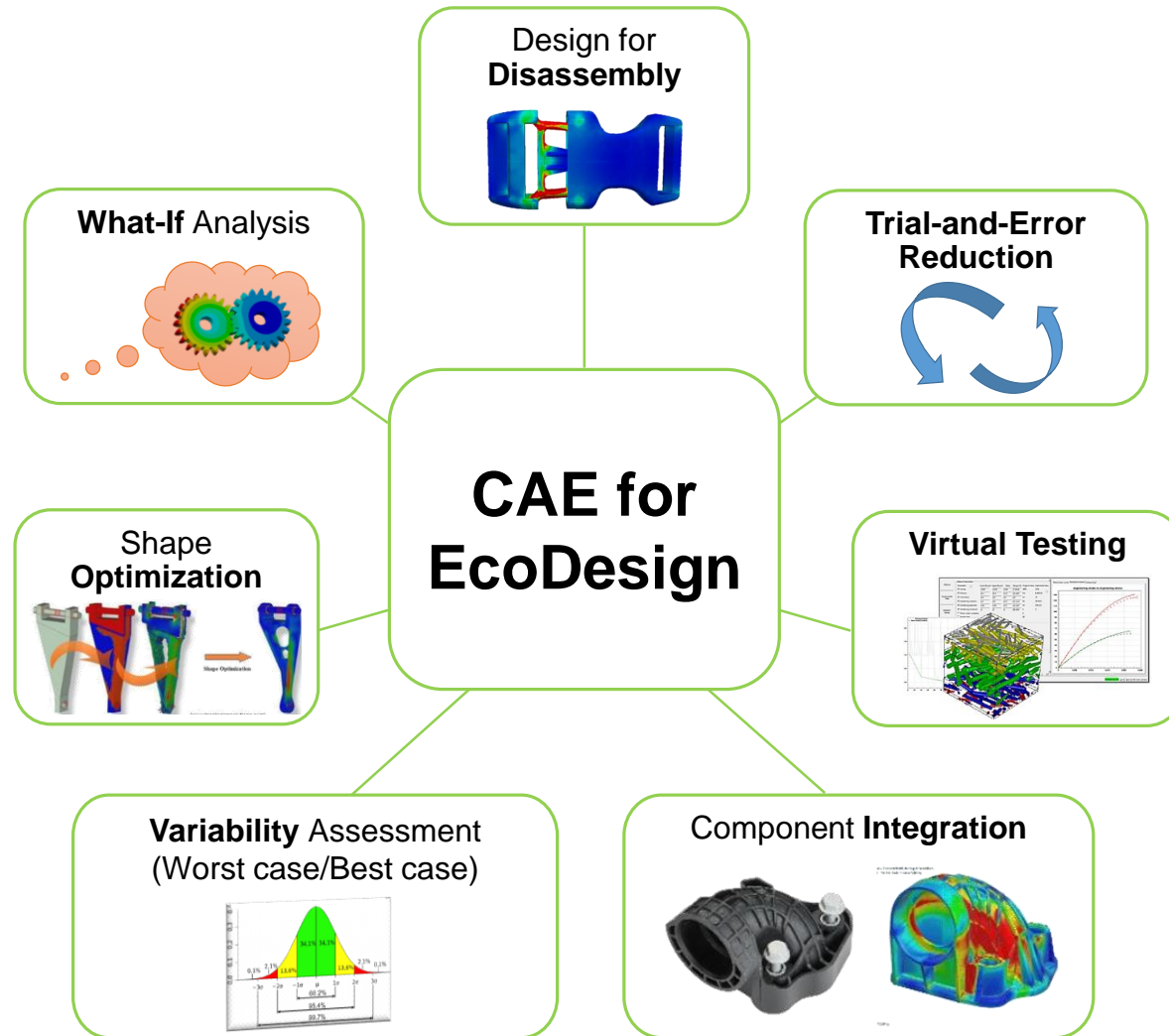
Integrated



- Linking process to structure
- Anisotropic behaviour, GF orientation, weld lines, warpage
- Multi-scale material modelling
- Available for static, dynamic and long-term analysis

Digimat

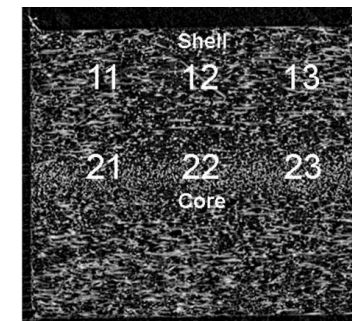
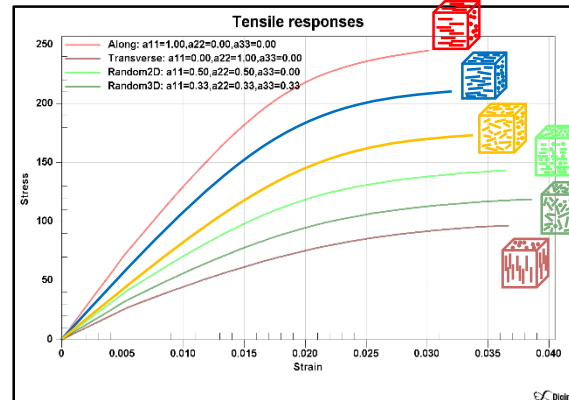
CAE for EcoDesign



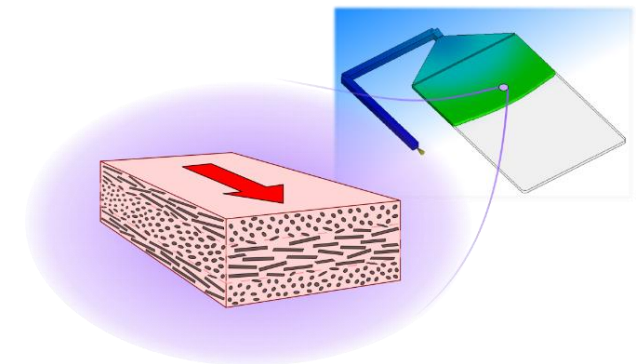
- › **Design for disassembly:** to easily dismantle the item at end of life, making it easy to recover recyclable parts.
- › **Minimizing trial-and-error**, saving time and material for disruptive trials and prototyping.
- › **Formulation** of new materials made quicker by the use of multi-scale **virtual testing**.
- › Possible reduction in the number of components by **integrating** with few multi-functional parts.
- › Assessing **variability**, which is intrinsic to recycled materials, evaluating best/worst cases.
- › **Optimizing** the shape of items by fully exploiting the potential of materials.
- › Exploring **alternative solutions** (what if?).

Integrated approach to simulation

- › **Short glass-fibre reinforcement** fibres have a significant aspect ratio (>20)
- › Mechanical properties of GFRP heavily depend on the **fibre orientation** with respect to loading direction (anisotropy): **PROPERTIES = f (MICROSTRUCTURE)**



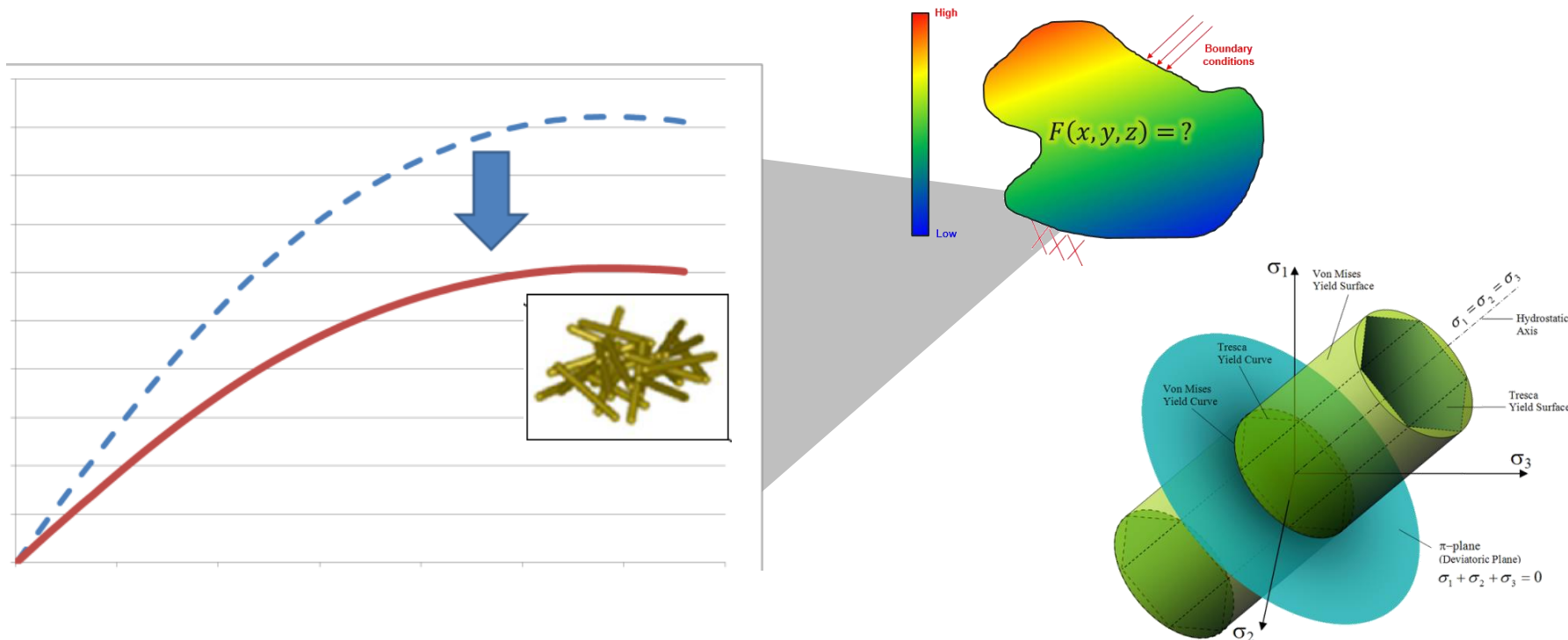
- › The fibre orientation is a consequence of the phenomena which occur during the **mould filling phase**. Thus, these phenomena are related to the part's geometry and transformation process: **MICROSTRUCTURE = f (PROCESS)**
- › **Therefore PROPERTIES = f (PROCESS)**



Typical “sandwich” microstructure of an injected plate

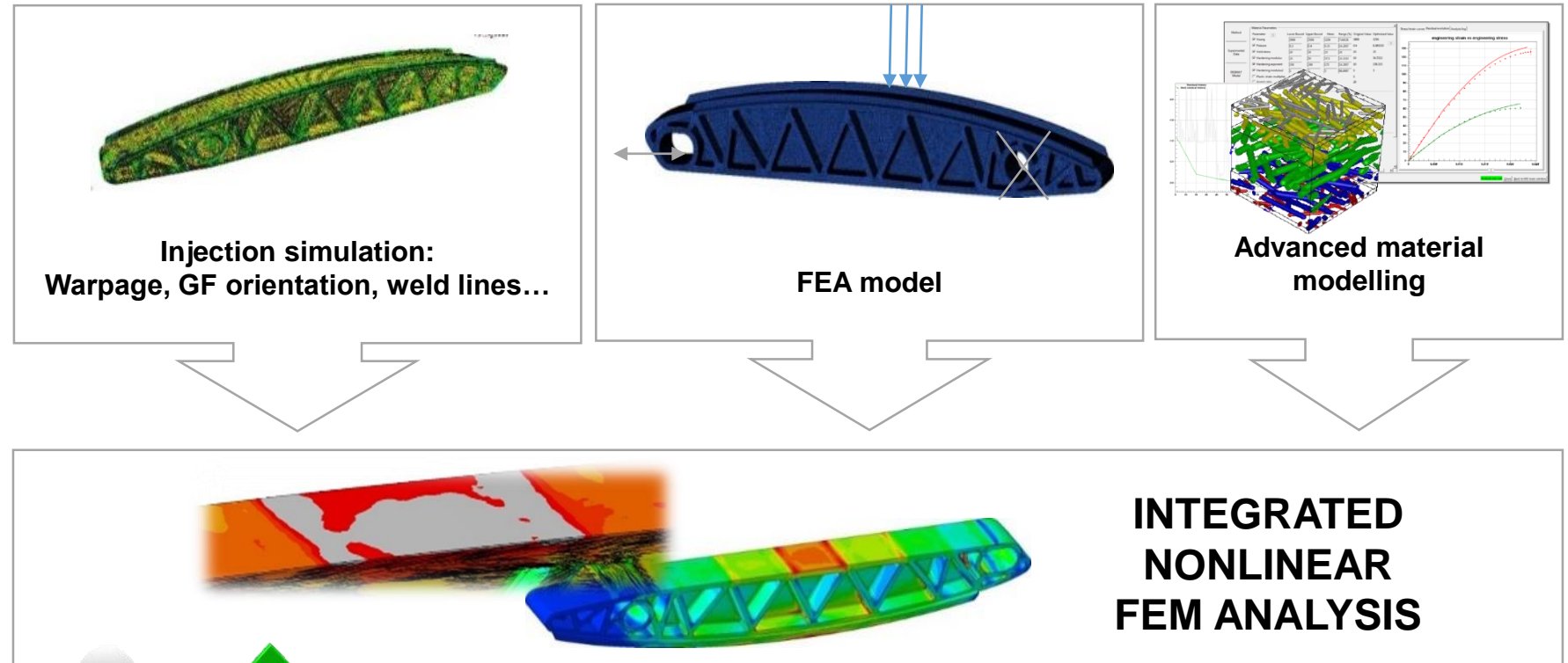
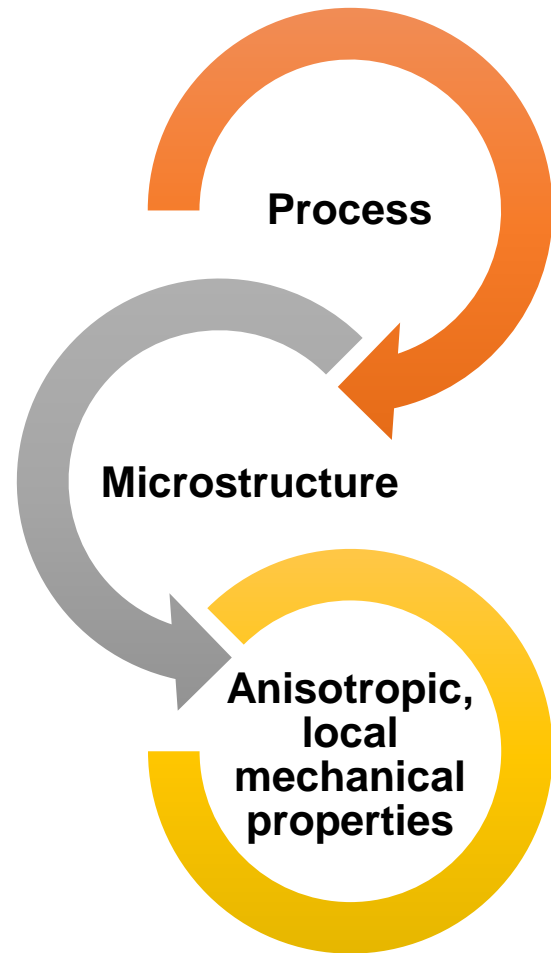
“Classic” CAE: Pseudo-isotropic approximation

- › Simplifying assumption: material is treated as homogeneous and isotropic, with characteristics equivalent to fibres oriented in a random manner.
- › In practice, this is done by **rescaling** ISO-527 data (from TDS), obtained on very oriented specimens, with an appropriate **penalty factor**, calculated based on the analyst’s experience.



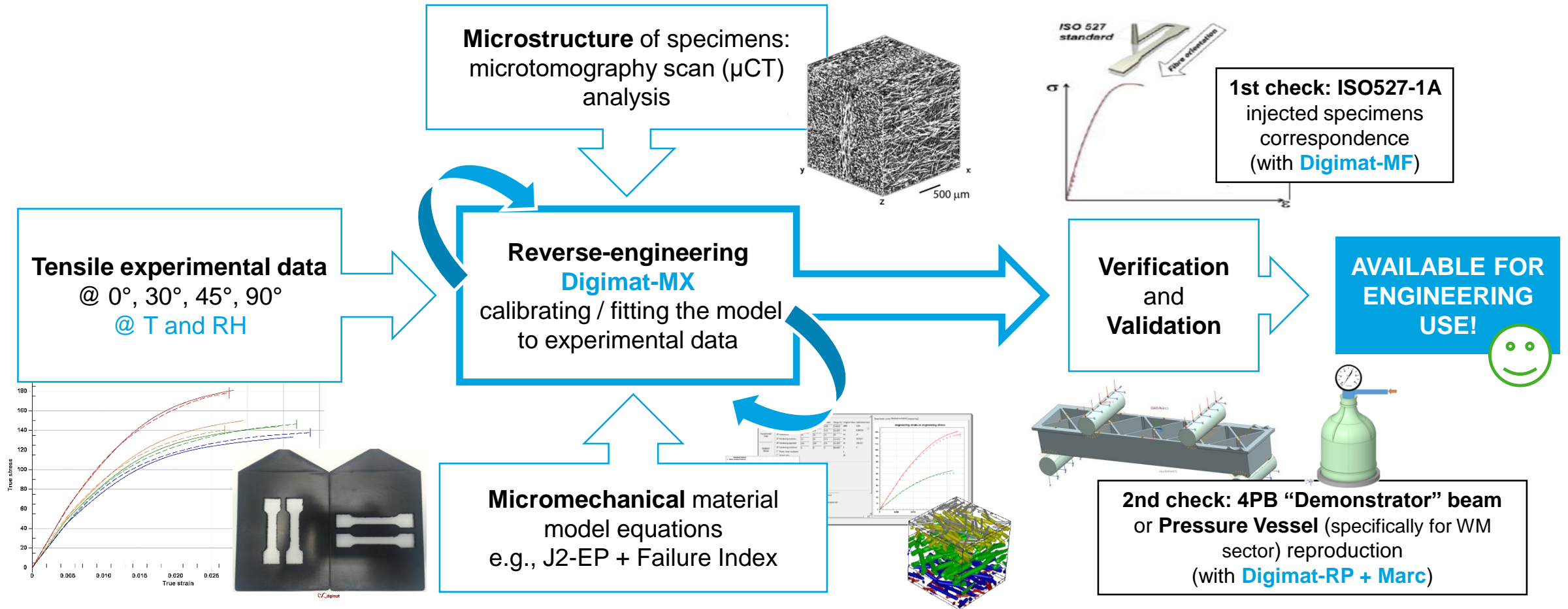
In pseudo-isotropic analysis, **Von Mises equivalent stress** is typically used as the failure criterion, vs. uniaxial **stress at break** in tension.

Advanced CAE workflow: Integration



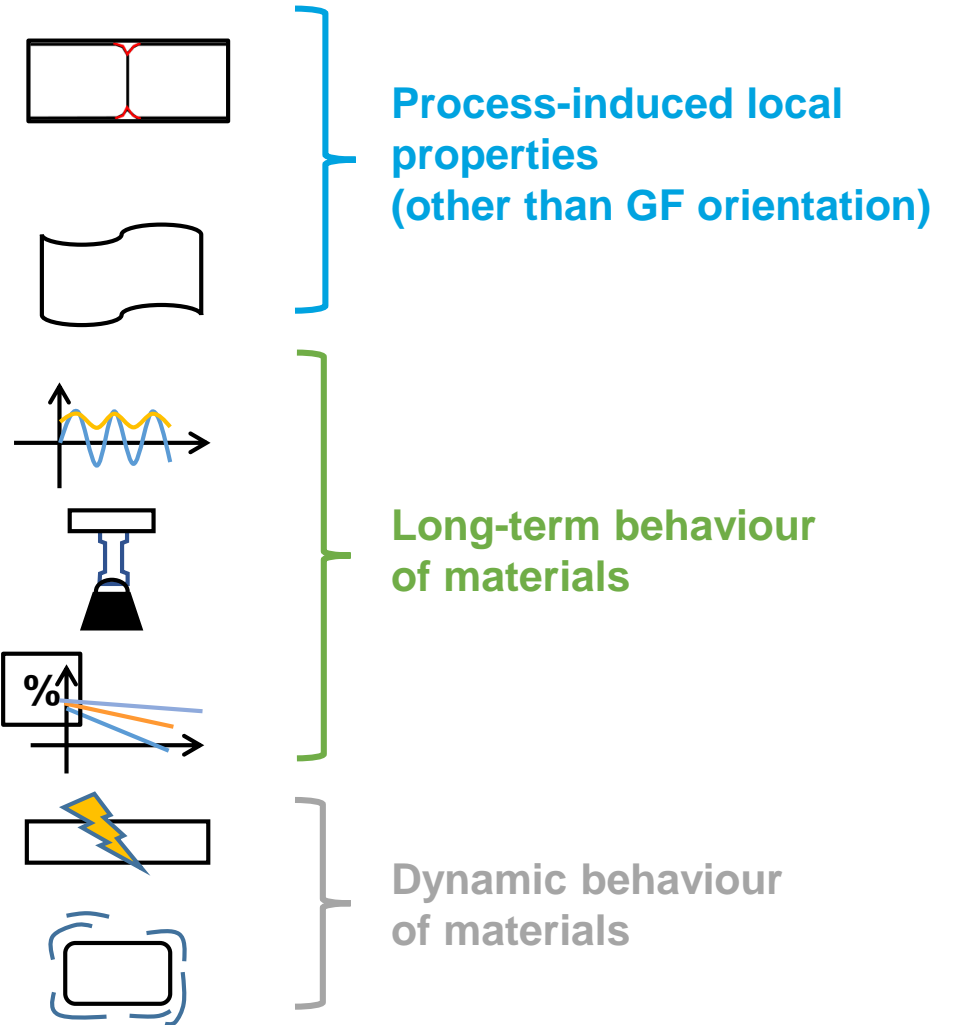
- Higher **ACCURACY** and **RELIABILITY** in predicting elasticity and failure
- More in-depth understanding of **MATERIAL BEHAVIOUR**
- Reduced **OVER-ENGINEERING** and use of high **SAFETY FACTORS**
- Less need for **PROTOTYPE TESTING**

Advanced CAE workflow: Modelling and check



Advanced CAE workflow: more fields of simulation

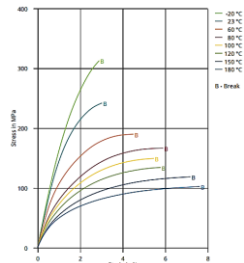
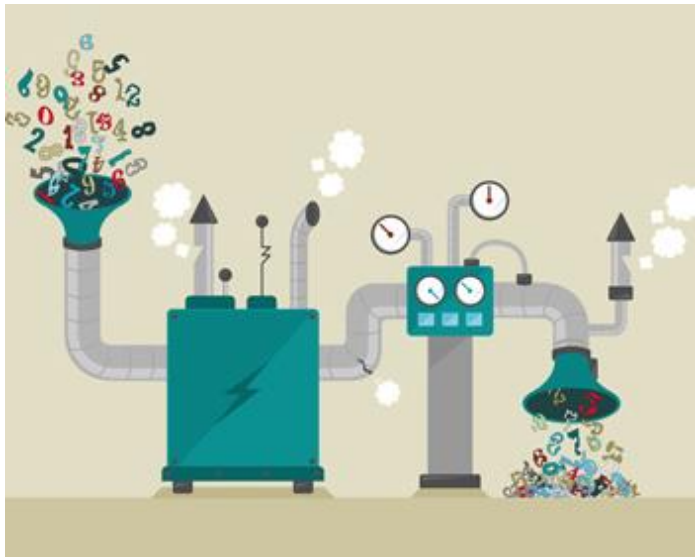
- › **Weld lines** - taking into consideration strength reduction according to formation conditions
- › **Warpage** - applying the deformation induced by injection moulding to the structural mesh
- › **Fatigue** - prediction of Critical N to failure on the part
- › **Creep** - deformation under continuous steady load
- › **Thermal / Chemical ageing**
- › **High-speed loading** (crash, impact...)
- › **Vibrations / Damping**



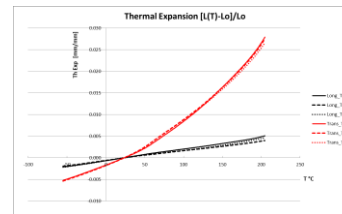
Providing reliable and controlled CAE material cards



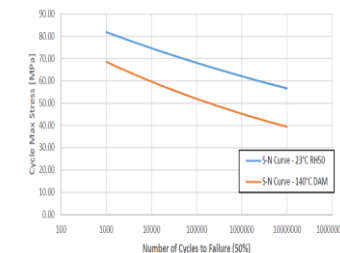
- › For our customers who prefer to carry out their own CAE studies internally, we provide **accurate characterizations** and **material cards** for many **RadiciGroup HPP materials** and support CAE engineers in choosing the optimal parameters for their applications.
- › If the specific data needed are not yet available for the desired grade, we can set up a **collaboration plan** to implement a dedicated testing campaign.



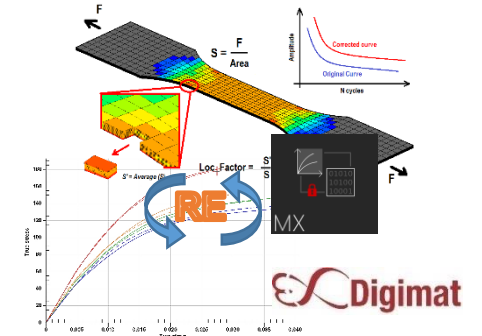
σ - ϵ curves various T_s , RHs (static structural)



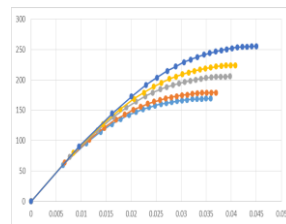
CLTE // and \perp (thermo-mechanical)



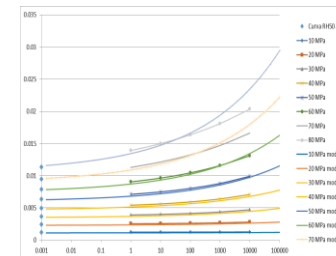
Fatigue Wohler curves



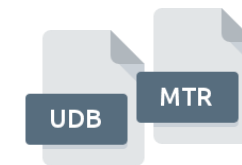
Anisotropic models EP, VEVP, SREP, creep, fatigue (integrated simulation)



σ - ϵ curves various $d\epsilon/dt$ (dynamic, crash)



Creep ϵ vs t curves



Material cards for process simulators

Providing reliable and controlled CAE material cards



- › For **process simulation**: **123** material cards currently available in the public databases for the most well-known software solutions. **7** grades specifically developed for the Water Management Sector, including **RADILON® DT** and **RADISTRONG® AROMA**.



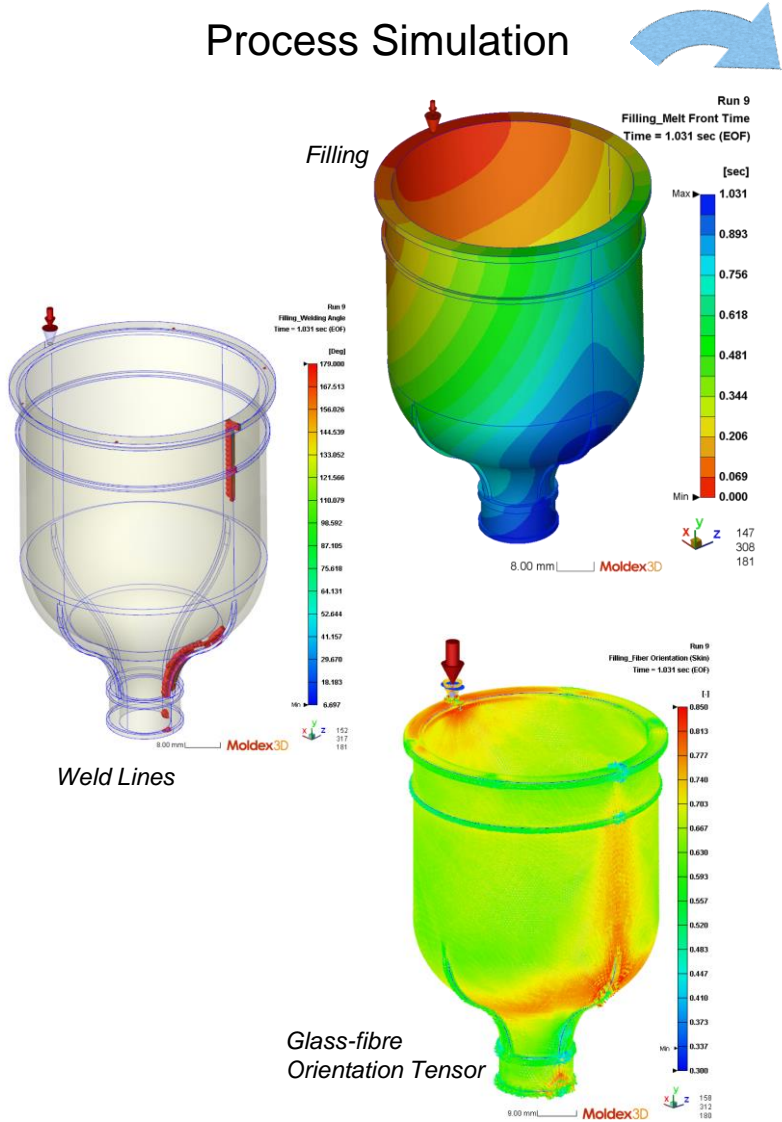
- › For **integrated simulation**: **268** material cards for **21** different grades available in Hexagon Digimat form. **6** grades specifically developed for the Water Management Sector, including **RADILON® DT** and **RADISTRONG® AROMA**.



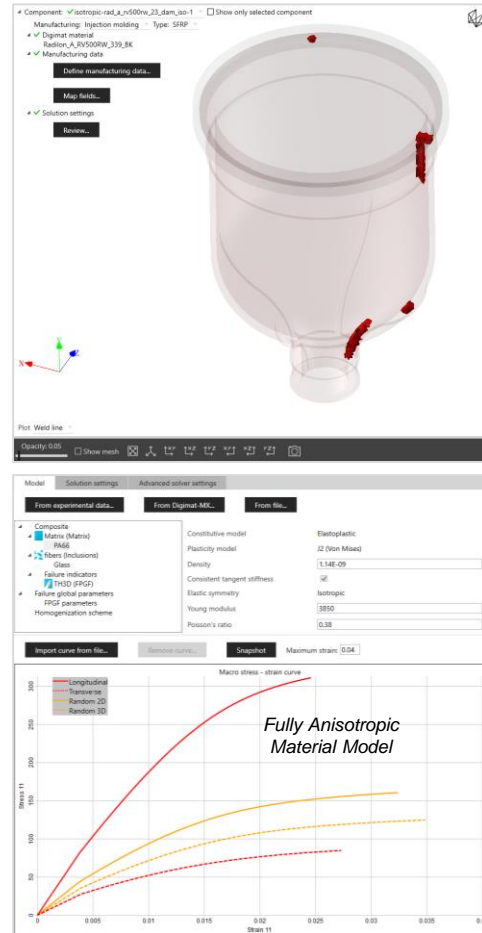
- › For **structural simulation**, the data can be made available any time, based on available stress-strain curves in various conditions.

CAE material card validation: Pressure vessel

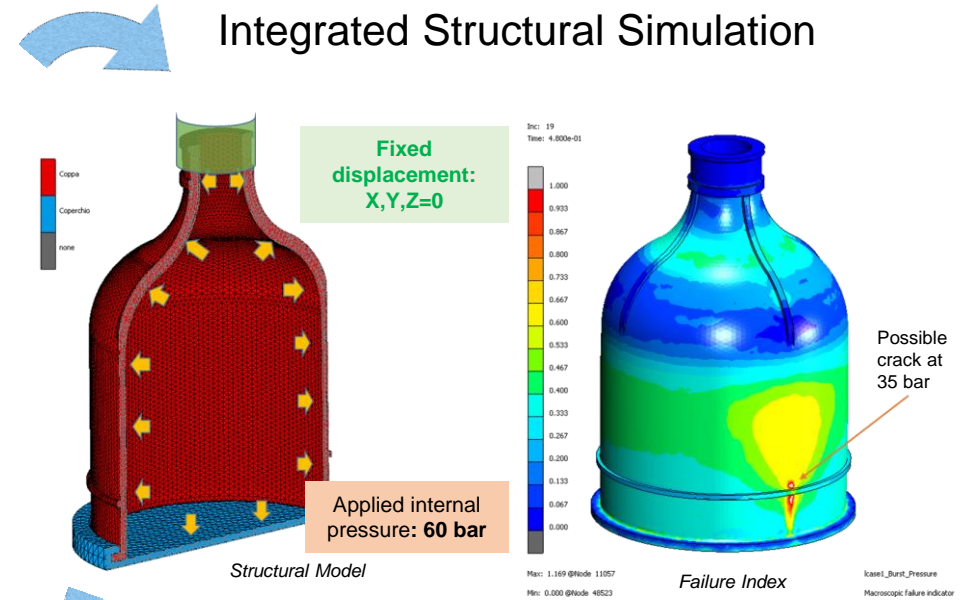
Process Simulation



Structural Model Mapping (Glass-fibre orientation, weld lines, warpage, residual stresses...)



Integrated Structural Simulation



Real Part Validation



- Burst pressure
- Pulsating pressure (fatigue)
- Creep
- Others...

Successful Metal Replacement Project for WM Sector



Component: Water Meter Diaphragm

Original material: Cast iron

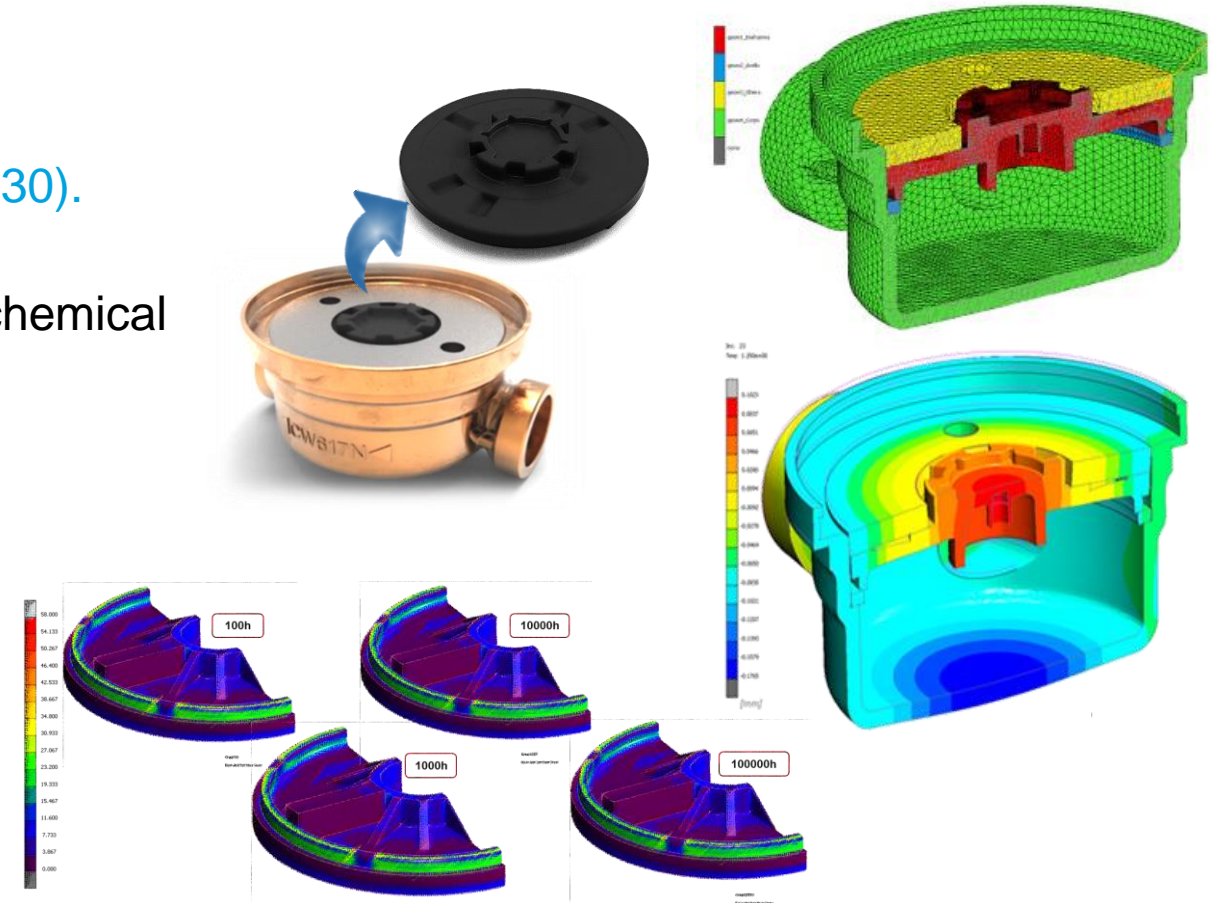
Material: **Radilon® DT RV300RKC2 306 BK (PA612 GF30)**.

High stiffness and high mechanical resistance.

Excellent dimensional stability, improved hydrolytic and chemical resistance

Requirements:

- High tensile strength at break
- **High modulus**
- Dynamic resistance to possible **burst pressure**
- **Fatigue** loading due to pulsating pressure cycles
- High **creep resistance**
- Continuous use temperature in contact with hot water **60°C**



Weight saving versus metal: ~20%

Conclusion



RadiciGroup and our team want to be a complete strategic partner to help you develop your project from your first idea to mass production. We can support our customers with our extensive knowledge, competence and passion.





HIGH PERFORMANCE POLYMERS

Q&A



CREDITS

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