Surface Functionalization as an Alternative to PFAS

CLAYENS – Matthieu BESSE & David GERARD

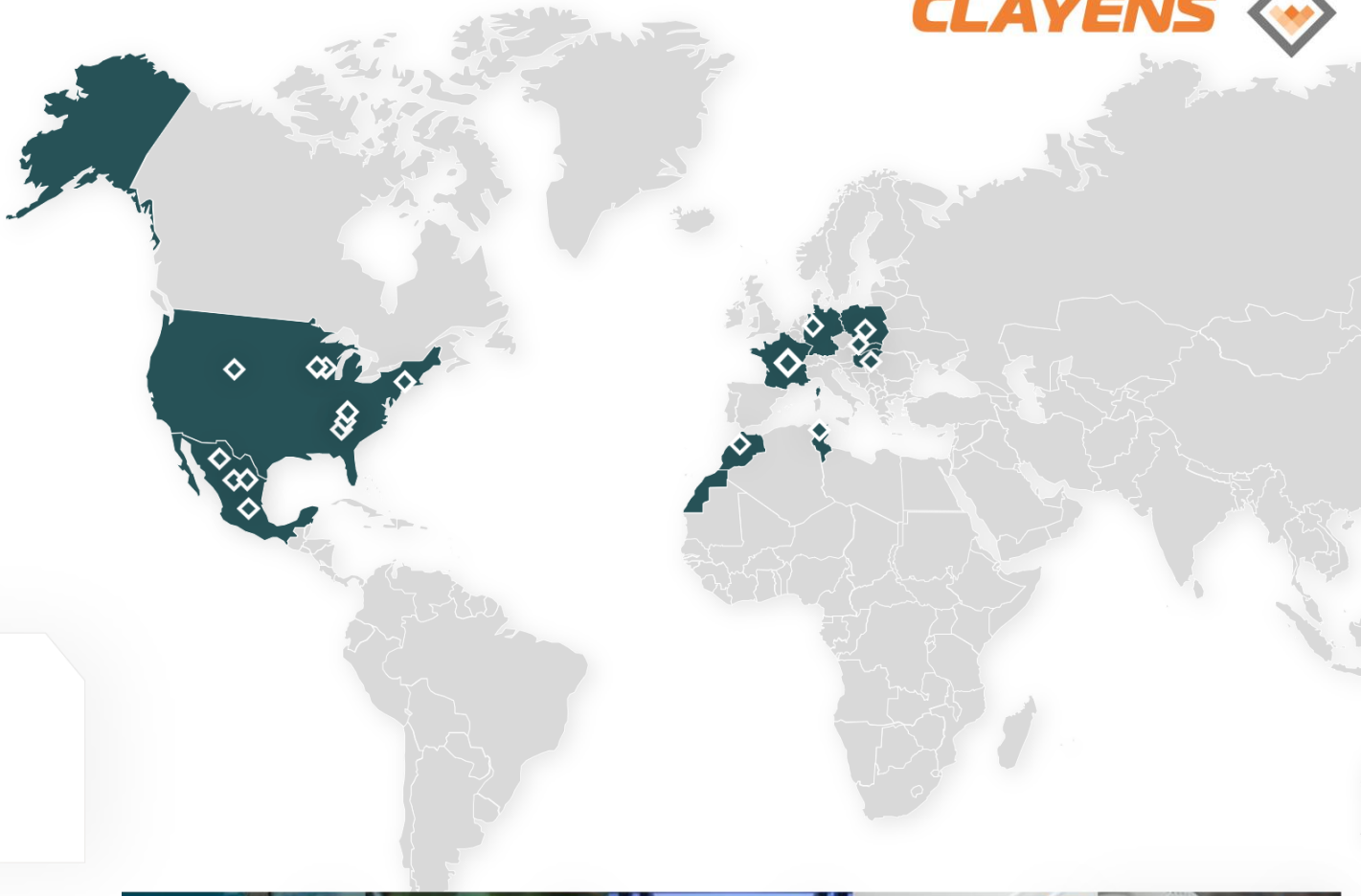
March the 26th 2026



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Company presentation

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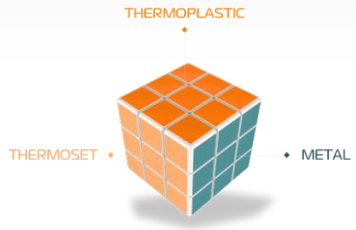


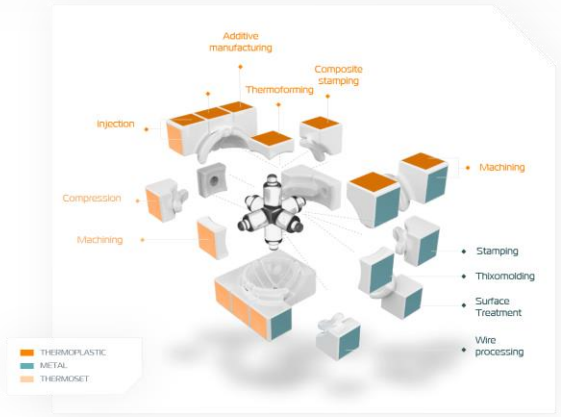
640M€
Revenue

+5 000
Employees

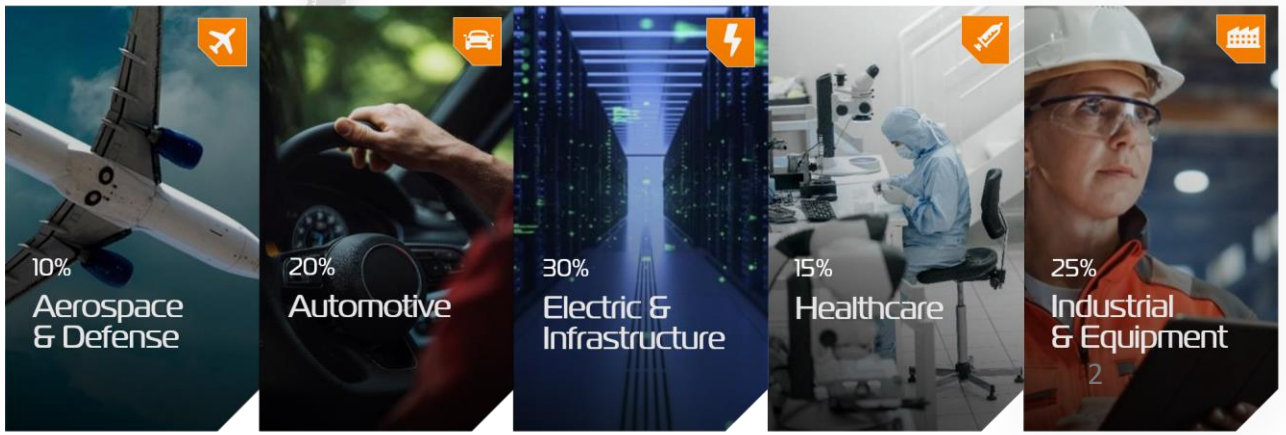
+30
Plants

9
Countries

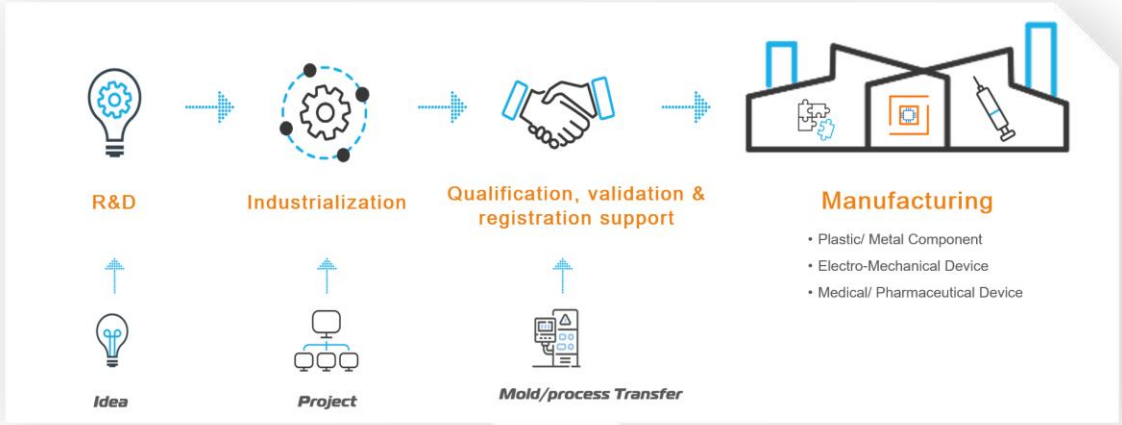








Company presentation





Healthcare disruptive innovations :



>10 Healthcare Plants

3 Countries

8 Cleanrooms ISO7 – ISO8



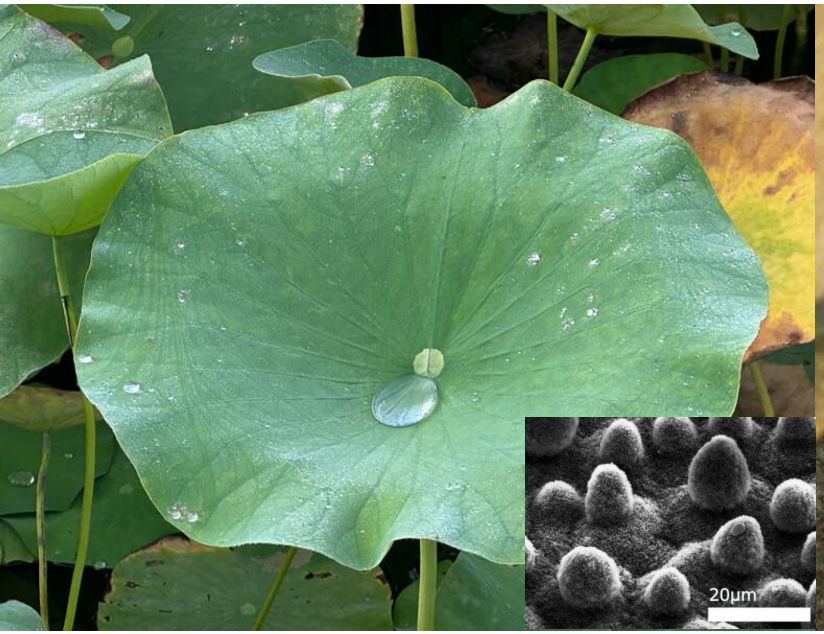
Agenda about surface functionalization

- Introduction of the topic
- Technology presentation
- Innovation approach
- PFAS alternative
- Conclusion

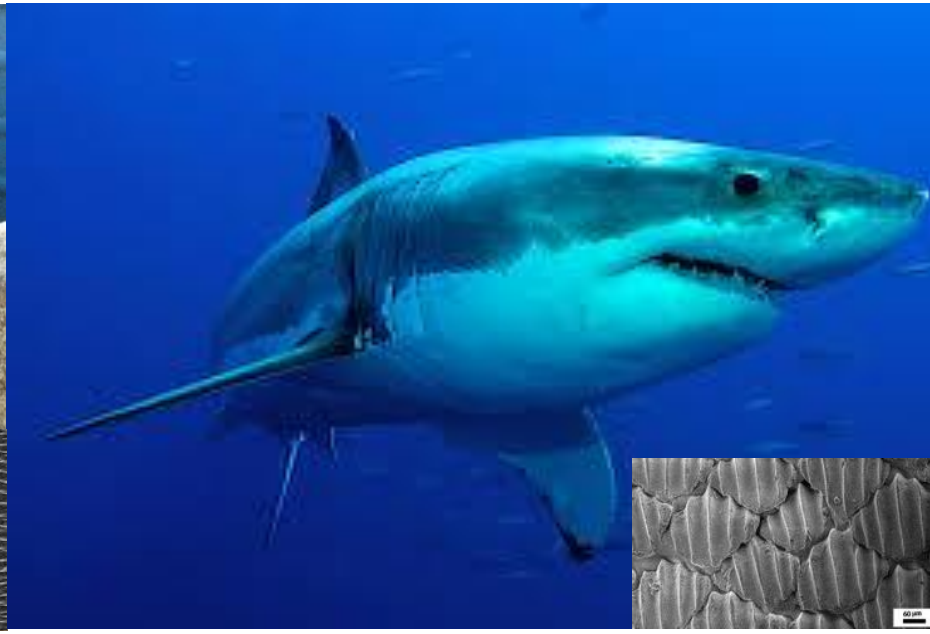


Surface functionalization

Surface functionalization - introduction to the topic







LOTUS LEAF

⬇

SUPER-HYDROPHOBICITY

GECKO

⬇

ADHESION

SHARK SKIN

⬇

HYDRO-DYNAMISM
ANTI-BIOFOULING

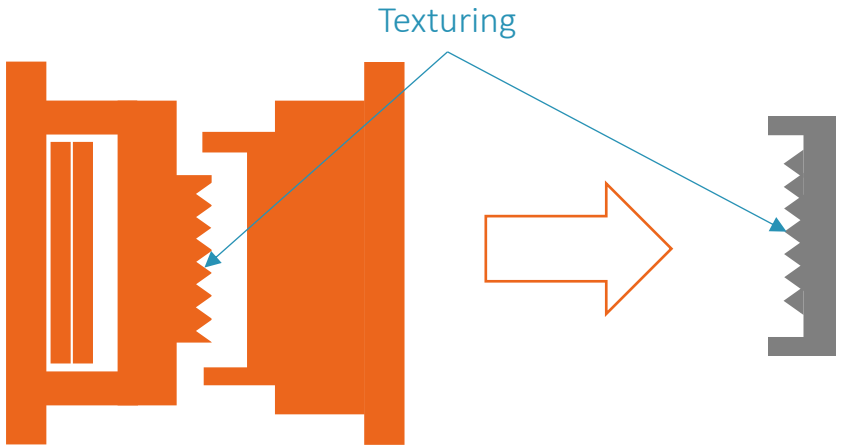
COMMON POINT ?

➔ Properties obtained thanks to particular surface topographies

Surface functionalization - technology presentation

Description

- Micro and nanotexturing of injection molding
- Duplication of the texturing during injection molding



- Applicable to many geometries and materials: PE, PP, PA loaded fibers, PC, PEEK, COC, elastomers....

Which properties ?

- **Fluids management** : hydrophobicity, hydrophilicity, repellency
- **Tribology and friction management** : reduction of friction between two surfaces, limitation of sticking with elastomeric material, etc...
- **Antibacterial :** reduction of microbial load without use of chemicals/disinfectants
- **Aesthetic and anti-counterfeiting:** Iridescent aspect/ hologram
- **Hydro-aerodynamics**
- **Mechanical and thermal resistance**

Surface functionalization - approach

T0

STEP 1
Needs definition

- **Needs** definition and expected **properties**
- Understanding the phenomenon

T0+2W

STEP 2
Research of the best profiles

- **Research** of the most suitable **profiles** among 60 texturizing profiles (based on our experience), depending on material and fluid considered
- **Surface testing** according to the property
- **Characterization** of the selected profiles

T0+6W

STEP 3
Application / Texturation of mould insert

- Demolding study
- Mold insert or cavity **texturation** according to the selected pattern (step 2)
- **Fonctionalized parts** injection molding

T0+12W

STEP 4
Functional tests

- **Functional tests** according to the properties required (internal/external)

T0+16W

STEP 5
Process robustness verification

- Study of the **process robustness** according to the considered material, selected pattern and part geometry

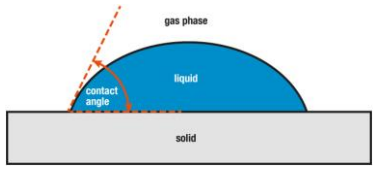
Surface functionalization - PFAS alternative

Aim of the R&D study

To remplace PTFE (PFAS), a material known for its hydophobicity and low-friction properties

HYDROPHOBICITY

→ Contact angle of PTFE : 110 to 126°
(hydrophobicity if contact angle > 90°)

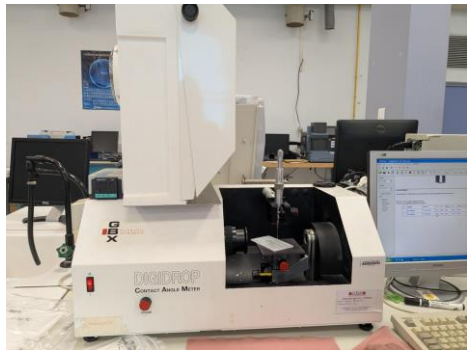


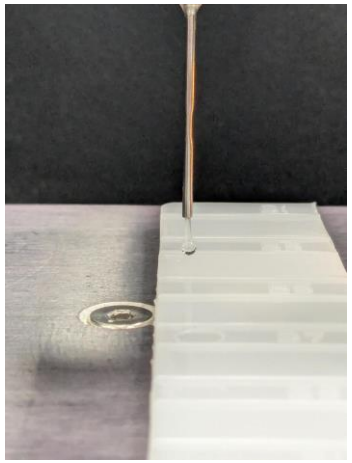
→ Is it possible to have a material with a similar contact angle, but without PFAS ?

Approach

1) Injection molding of **textured plates** with different materials : PE, PP, PA

2) Contact angle measurement on molded samples







Results :

Material tested	Contact angle
PTFE	126°
Textured PA	118°
Textured PP	120°
Textured PE	144°

Better results with textured PE than PTFE

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Surface functionalization - PFAS alternative

Aim of the R&D study

To remplace PTFE (containing PFAS), a material known for its hydophobicity and low-friction properties

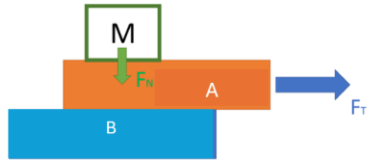
FRICTION

→ PTFE often added to materials to improve their friction properties

→ Can we get similar friction between a PA containing PTFE and a natural PA ?

Approach

1) Injection molding of textured plates in PA :
- *PA66 natural*
- *PA66 lubricated with MoS2*
- *PA66 with PTFE*



2) Friction tests performance (traction bench) :
- *PA66 natural* : textured surfaces tested
- *PA66 lubricated with MoS2* : untextured surface tested
- *PA66 with PTFE* : untextured surface tested

→ all surfaces tested in contact with natural and untextured PA66

Results :

Reduction of the traction force needed up to 30% with the best textured profile compared to lubricated PA66

Similar results obtained for both lubricated PA66 (with MoS2 or PTFE)

Surface functionalization - PFAS alternative

Aim of the R&D study

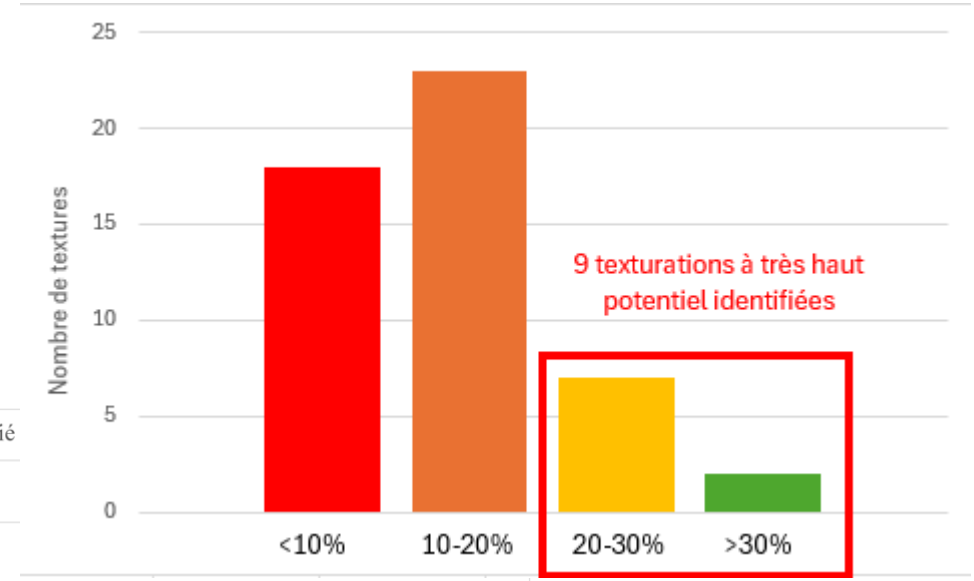
To remplace PTFE (containing PFAS), a material known for its hydophobicity and low-friction properties

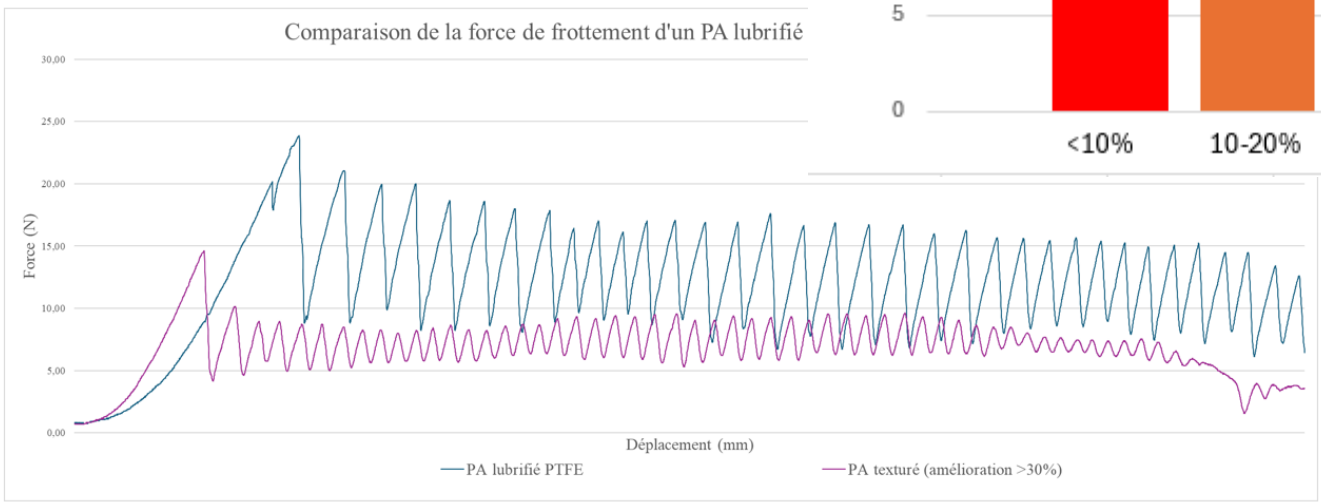
Results :

FRICTION

Reduction of the traction force needed up to 30% with the best textured profile compared to lubricated PA66

Graph showing the number of textures as a function of their percentage improvement compared to lubricated PA





Surface functionalization - conclusion

Benefits of the technology :

- Integration of functions on injected parts for a limited investment on large series production
- Alternative to other more expensive, complex or less sustainable technologies:
  - Hydrophobicity: spray treatments
  - Friction/antisticking: Silicone, slippery agents
  - Antibacterial: disinfectants, preservatives
  - Etc...
- Low process impact compared to other functionalization technologies (ex: plasma), because no further action is required after injection molding

Current limits of the technology

- Experimental approach to select the best pattern
- Lifetime of the textured plastic part and mould cavity currently in study
- Feasability depend also on the design of the part and the mould

Surface functionalization - conclusion

Our expertises ?

- Selection of the most suitable profiles for the property sought according to material and elements (fluids)
- Carrying out customized tests according to applications
  - Internal: friction, wettability, wear
  - External: microbiology, specific tests
- Optimization of the part geometry and micro-nanotextured profiles for texturing and injection
- Duplication of profiles during injection
- Profile control on tooling/ molded part
- Robustness studies of the process

Any question ?

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