INEOS Styrolution at a Glance

- **3,500+** Employees
- **10** Countries
- **20** Production Sites
- **6** R&D Centers
- **24+** Sales Offices

**No. 1 Global Leader** in styrenics

- **85+ Years** of experience in styrenics
- Founded in 2011

- **2,000+ Applications** across seven industries
  - Automotive
  - Electronics
  - Household
  - Construction
  - Healthcare
  - Packaging
  - Toys, Sports & Leisure

- **Approx. 1,000+ Patents**
- **4,000+ Customers**
- **1,500+ Products**
- **5.4 Billion Euros in Revenue** in 2018
## ARRK Group at a Glance

### Who are ARRK

- International technology group
- Founded 1948
- Turnover 320 M € (2016/17)
- Worldwide > 3,729 employees
- 20 ARRK companies in 18 countries
- Listed on the Tokyo Stock Exchange (TSE)

### Capabilities

<table>
<thead>
<tr>
<th>Capabilities</th>
</tr>
</thead>
<tbody>
<tr>
<td>Engineering</td>
</tr>
<tr>
<td>Prototyping</td>
</tr>
<tr>
<td>Tooling</td>
</tr>
<tr>
<td>Low Volume Production (LVP)</td>
</tr>
</tbody>
</table>
ARRK|SHAPERS’ Moldmaker and Molder

Moldmaking
La Séguinière

Activities
- Tool modifications
- Tool expertise and feasibilities
- Milling, spark erosion, laser welding …

Molding
Aigrefeuille

Activities
- Production, assembly and finishing
- Part & Process development
- 3D control, supply chain …
Intention of our Cooperation

Replacement of a current thermoset solution …

Thermoset

... through an innovative way!

StyLight

- Functional integration
- Weight
- Cycle time
- Final cost
**Intention of our Cooperation**

Finding a new cost-efficient solution for growing volumes …

![Graph showing comparison between Thermoset and StyLight](image)

- Thermoset
- Thermoset on plastic
- StyLight

<table>
<thead>
<tr>
<th>Production volume (n)</th>
<th>Cost/part (€)</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>6</td>
</tr>
</tbody>
</table>
Intention of our Cooperation

Development of an aesthetic thermoplastic composite automotive interior part

- Coating layer $t = 30 \, \mu m$
- StyLight layer $t = 0.6 \, mm$
- Back-injected TP « Skeleton » $t = 2.4 \, mm$
StyLight is a thermoplastic composite based on SAN. It can be modified with SAN or combined with glass or carbon fiber. The result is a composite material suitable for aesthetic lightweight applications.
Key Features of StyLight

- Excellent surface quality
- Easy to coat and to glue with standard grades
- High E-modulus and low density
- High compatibility with styrenic injection molding grades
# StyLight Product Portfolio

<table>
<thead>
<tr>
<th>Material Description</th>
<th>Unit</th>
<th>StyLight Aesthetic S</th>
<th>StyLight Structural S</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>G290-1</td>
<td>G580-1</td>
</tr>
<tr>
<td></td>
<td></td>
<td>C245-1</td>
<td>G600-3</td>
</tr>
<tr>
<td>Fibers</td>
<td>-</td>
<td>Glass</td>
<td>Glass</td>
</tr>
<tr>
<td>Textile</td>
<td>-</td>
<td>Twill 2/2</td>
<td>Twill 2/2</td>
</tr>
<tr>
<td>Textile</td>
<td>-</td>
<td>Twill 2/2</td>
<td>Twill 2/2</td>
</tr>
<tr>
<td>Textile</td>
<td>-</td>
<td>Twill 2/2</td>
<td>NCF: 0°/90°</td>
</tr>
<tr>
<td>Area weight</td>
<td>g/m²</td>
<td>290</td>
<td>580</td>
</tr>
<tr>
<td>Yarn</td>
<td>tex</td>
<td>204</td>
<td>1200</td>
</tr>
<tr>
<td>Weight rate</td>
<td>%</td>
<td>50/50</td>
<td>50/50</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>80/20</td>
</tr>
</tbody>
</table>
ARRK|SHAPERS’ Prototype: Two-step Process

Development of a specific prototype tool for stamping/overmolding ...

A) Stamping

B) Backmolding

CORE

CAVITY
Step 1: Simply Stamping Step

1\textsuperscript{st}: Heating

- Core
- Infrared heater
- StyLight sheet
- Cavity

2\textsuperscript{nd}: Stamping

- Result

![Image](Image.png)
Step 2: Backmolding with ABS

1st: Positioning

Core

Cavity

StyLight cap

2nd: Backmolding

ABS in the feeding system

Result
Final Finishing by a Clear Coating System

Developing of a coating system for interior and exterior applications

High-gloss

Satin

Colored …
StyLight is Validated for Interior Parts

- Heat ageing \((DIN\ 60068-2-78)\)
- Use under heat and high humidity \((DIN\ EN\ 60068-2-78)\)
- Determination of scratch resistance \((ISO\ 1518)\)
- Resistance against media \((ISO\ 3865)\)
- UV-resistance \((ISO\ 4892-2\ B)\)
- Fogging test \((ISO\ 6452)\)

All tests are part of the major automotive interior specifications
Weight reduction of about 30% due to the skeleton concept

Thermoset

StyLight
“Carbon just where it’s necessary”

- 30%

45 g

32 g
Cycle time reduction up to 70%

StyLight Process

Forming
StyLight

Back-molding

Coating

~ 36 min

Conventional Process

Thermoset Process

Cutting

Function adding

Surface priming

Coating

~ 120 min

#ProcessEfficiency

#CostSavings

#MassProductionCapable
Cost reduction up to 60% due to an efficient process

<table>
<thead>
<tr>
<th>Volume (n)</th>
<th>Costs (%)</th>
<th>Saving (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>StyLight</td>
<td>Thermoset</td>
</tr>
<tr>
<td>100</td>
<td>663</td>
<td>100 (REF)</td>
</tr>
<tr>
<td>1,000</td>
<td>82</td>
<td>49</td>
</tr>
<tr>
<td>5,000</td>
<td>30</td>
<td>45</td>
</tr>
<tr>
<td>10,000</td>
<td>24</td>
<td>44</td>
</tr>
<tr>
<td>50,000</td>
<td>18</td>
<td>43</td>
</tr>
</tbody>
</table>

* Cost analysis considered investments

StyLight’s economic advantage above ~ 2300 parts
StyLight Applications

**AUTOMOTIVE**
- Carbon decorative parts
- Seat component
- Local reinforcement
- Door component
- Body panels
- Center consoles
- Spoiler
StyLight Applications

CONSUMER GOODS
- Sport helmet
- Extrusion profiles
- Housings
- Bicycle parts
- Luggage

ELECTRONICS
- Backcover for tablets, notebooks, mobile phones
- Mobile phone casing
- Loudspeaker cones
- Drones
Summary

- High surface qualities close to class A
- Interior automotive OEM standards have been passed
- Cycle time is reduced up to 70%
- Production costs reduction up to 60%
- Efficient for a production volume above 2,300 parts
Aroused Your Interest? - Let's Meet at our Booth!

ARRK: 6 R72
INEOS-STYROLUTION: 6 C55

Martin KOHLER
INEOS|STYROLUTION
Business development manager composites
martin.koehler@ineos.com
Tel +49 (0) 151 16235088

Pierre AUDIC
ARRK|SHAPERS
R&D Innovation Engineer
pierre.audic@arrkeurope.com
Tel +33 (0) 663 955 494

JEC World - Paris - 2019 March 13