De la chimie des monomères aux Polyamides chez Solvay

Laboratoire SPP, Lyon

M-L Michon
Solvay
Research & Innovation
We are a world leader in the chemical industry

- 26,000 employees
- 119 industrial sites
- 15 major R&I centers
- 52 countries
- €10,213 million of net sales
- €1,783 million of REBITDA

Created by Ernest Solvay in 1863, Solvay is a Global company, with historical anchorage in Europe, and headquartered in Brussels.

2014 figures
150 years of innovation and many to come

1863
Ernest Solvay invents the Solvay process for producing soda ash

1880
Solvay is the first industrial multinational operating simultaneously in the US and Europe

1878
Solvay innovates in social welfare (paid vacations, social security, 8-hour day)

1911 & 1927
The congresses bring together the greatest physicists of their day

1950
Solvay invents the plastic bottle

1990
Solvay invents precipitated silica for green tires

2011
Solvay acquires Rhodia

2015
2nd Chemistry for the Future Solvay Prize

2015
Solvay flies around the world with Solar Impulse

1990
Solvay invents precipitated silica for green tires

2015
Solvay invents plastic bottle
We adapt our product offering to **demanding markets**

**Differentiation**

**Regulation**

**Sustainable development**

**Distribution of 2014 net sales**

- **AUTOMOTIVE & AERONAUTICS**: 18%
- **BUILDING & CONSTRUCTION**: 12%
- **AGRO, FEED & FOOD**: 11%
- **ELECTRICAL & ELECTRONICS**: 7%
- **ENERGY & ENVIRONMENT**: 10%
- **INDUSTRIAL APPLICATIONS**: 16%
- **CONSUMER GOODS & HEALTHCARE**: 26%
Research & Innovation
Strong Research & Innovation Presence Worldwide

Solvay’s R&I close to markets, customers and trends

- North America: 222 people in Atlanta and Bristol
- Latin America: 82 people in Paulinia
- Europe: 1,219 people in Brussels, Paris, Lyon, Hannover, Dombasle, Milano
- Asia: 200 people in Seoul, Vadodara, Shanghai

1,700 R&I employees
12 major R&I centers
322 new patents

Major worldwide R&D centers
Collaboration with major academic institutions
Joint Labs - Connectors to scientific networks

LOF
Lab of the Future
Bordeaux, France

COMPASS
Complex Assemblies of Soft Matter Lab
Bristol, Pennsylvania, USA

Eco-Efficient Products and Processes Lab (E²P²L)
Shanghai, China

Polymers Advanced Lab
Lyon, France

Joint laboratories with French National Scientific Research Center and Universities – a strong link between fundamental and applied research
R&I Center – Lyon
LSPP Lab

Solvay
Research & Innovation
RIC – Lyon competencies

- 490 people
- ISO 9001

The RIC-Lyon has expertise in Organic Chemistry, Chemical Engineering, Material science, Analytical experience to provide answers and solutions to its customers.

Organic Chemistry
Aroma
Catalysis
Green Solvents
Inhibitors
Monomers & intermediates
Polymers synthesis
Pilots, scale-up

Material Science
- Bio-based polymers
- Engineering Plastics
- Functional Polymers
- Modeling
- Reinforcement fillers
- Structural Composites

Process & Technology Innovation
- Process engineering
- Eco-Efficiency evaluation
- Environment solutions
- Advanced Modeling
- Process Safety

Analysis Department
Organic Analysis
Material Analysis
Industrial Analysis

ML Michon
31/03/2015
Our Missions

- Define new polymers to fit the customer needs,
- Realize the development phases to validate the best industrial process to produce it.
- Optimize the industrial assets

From exploratory studies

To industrial polymers
Our skills

- **Polymer chemistry**
  Recognized knowledge in bulk **polycondensation**, **functionalization** and **solid-state post-condensation**.
  Polymer lots **production for customer sampling**.
  Comprehension of the **ageing mechanisms** (thermal & glycol ageing, hydrolysis).

- **Polymer process**
  Technology referent lab in **polycondensation** (polyamide and polyester).
  Develop **new polymer processes** (for existing or new polymers)
  **Spinning and filming** at pilot scale
Polywood – How to obtain new biobased polymers?

**ideation step**

*Polyamides bio-sourcés issus de la filière papetière*

14 partenaires

8 industriels, 5 labos académiques, 1 centre technique industriel

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**Biobased feedstocks: no competition with food**

- Lignine
- Hémicellulose
- Cellulose

**Valorization of side products of the paper industry**

**Biobased Monomer Synthesis**

**Biobased Polyamide Synthesis**

**Polyamide Formulation**

**WP 3**

Sugars production

**WP 4**

Monomer production

*Leader SOLVAY*

**WP 5**

Polymer production

*Leader SOLVAY*

**WP 6**

Polymer formulation

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ML Michon
RNJP 2015
PA 6.10 – an industrial polyamide

**Stabamid® 6.10**

<table>
<thead>
<tr>
<th>Property</th>
<th>Rating</th>
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</thead>
<tbody>
<tr>
<td>Temperature resistance</td>
<td>★★★★★</td>
</tr>
<tr>
<td>Fuel Barrier</td>
<td>★★★★★</td>
</tr>
<tr>
<td>Abrasion Resistance</td>
<td>★★★★</td>
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<tr>
<td>Chemical Resistance</td>
<td>★★★★</td>
</tr>
<tr>
<td>Easy Processing</td>
<td>★★★★</td>
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<tr>
<td>Moisture absorption (24h)</td>
<td>★★★</td>
</tr>
<tr>
<td>Impact Resistance</td>
<td>★★★</td>
</tr>
<tr>
<td>Mechanical</td>
<td>★★★</td>
</tr>
</tbody>
</table>

PA 610 = 63 % biobased content (carbon)
**Main drivers for (co)polymer development**

| Tg modulation (increase/decrease) |
| Flexibility/Stiffness (E’ modulation) |
| Adhesion to inorganic particles |
| Hydrophobic – dimensional stability |
| Thermo-oxidative stability |
| Fuel barrier properties |
| Gas barrier properties |
| Solvent resistance (acids) |
| Fire retardancy |
| UV stability |
| Hydrophobic |
| Elasticity |
| Stainability |
| Anti-bacterial |
| Processing : high viscosity |
| Processing : high flow |
| Biosourced |

- **Textile**
- **Fluid barrier**
- **Transport**
- **Automotive**
- **Industrial yarns**
- **Building & construction**
- **Consumer goods**
- **Electric & Electronics**

*For many markets*
Coherent Lab scale equipment to validate New polymer properties

Polymer Synthesis

Lab reactor: 80g to 80Kg
Solid state polycondensation 1-100kg

Evaluation of properties

Spinning & Compounding

Microcompounder

Twin screw extruder

10g - 10 Kg (soon 100 kg)

Evaluation of properties

Spinning line:
- to evaluate the spinnability of new polymers.
- to produce yarns to evaluate the initial properties
From day one and for ten years now, Solvay has been part of the Solar Impulse adventurous and daring project, which in 2004 many thought was inconceivable. Thanks to this “Flying Lab” Solvay could put into practice its expertise in advanced materials and sustainable energy, enabling Solar Impulse to fly day and night on the sun’s energy only.

This project has pushed the boundaries of innovation, technical know-how and an entrepreneurial team spirit that has made the impossible possible.
THANK YOU