# Activities at MateriaNova

## *Green chemistry, bioplastics and reactive extrusion*


***FEDERPLAST***

*"Collaborer pour mieux innover"*

January 19th 2011

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1. MateriaNova general activities
2. Green chemistry
3. Bioplastics
4. Compounding & extrusion equipments
5. Reactive extrusion

# 1. Activities at MateriaNova

## *Locations*

MateriaNova
MATERIALS R&D CENTRE

Mons


Ghislenghien

# 1. Activities at MateriaNova

*Goals*

- **R&D projects for and with industry**
- **Technical guidance for tests of analysis of materials for the industry**
- **Analysis and punctual expertise**
- **Promote the results :**
  - **Seminars**
  - **Publications**
  - **Patents**

# 1. Activities at MateriaNova

## *Interactions / collaborations*

MateriaNova
MATERIALS R&D CENTRE

UMONS
Université de Mons

Université de Liège

ULB

gembloux
faculté universitaire
des sciences agronomiques



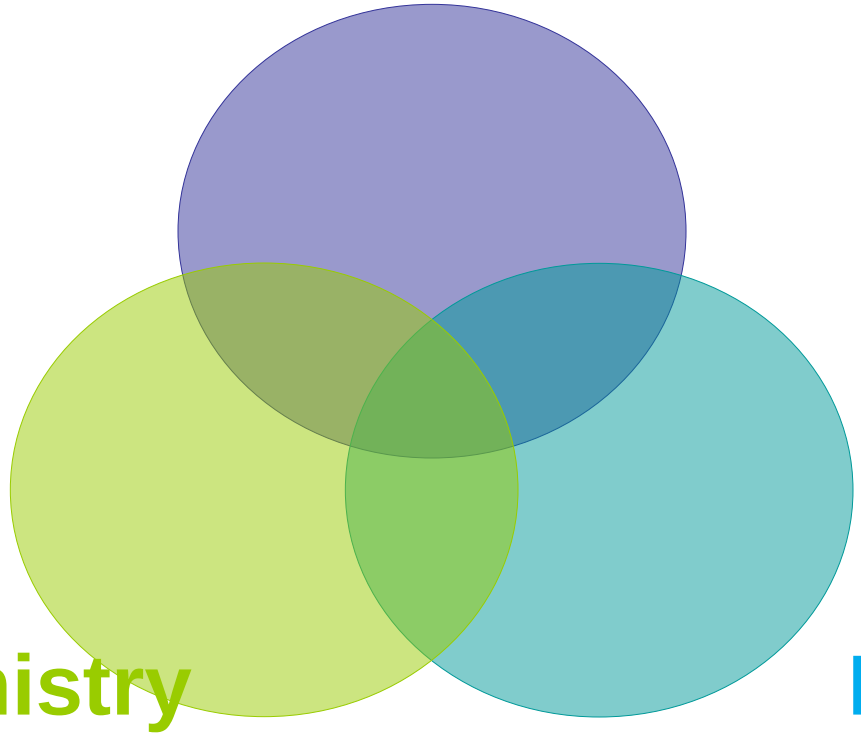


Le Fonds Européen de Développement Régional et la Région Wallonne investissent dans votre avenir

# 1. Activities at MateriaNova

*R&D activities*

**Surface treatment**



**Green chemistry**

**Plastics**

# 1. Activities at MateriaNova

*R&D activities*

## Surface treatment

- Vacuum plasma
- Anticorrosion treatments & measurements

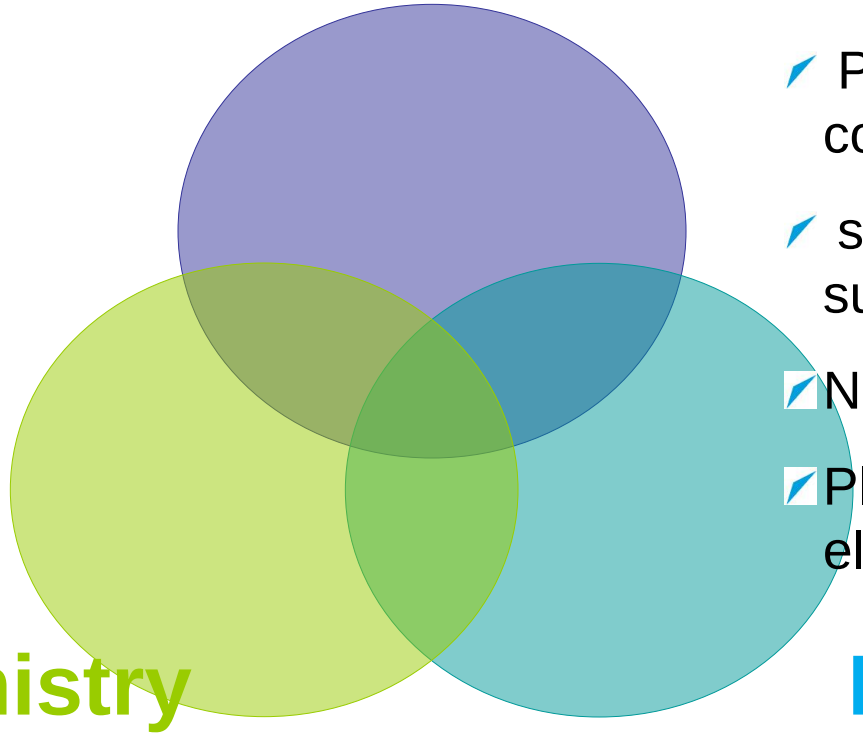
**Green chemistry**

**Plastics**

# 1. Activities at MateriaNova

*R&D activities*

## Surface treatment



- Polymers & composites
- structured surfaces
- Nanotechnology
- Plastics electronics

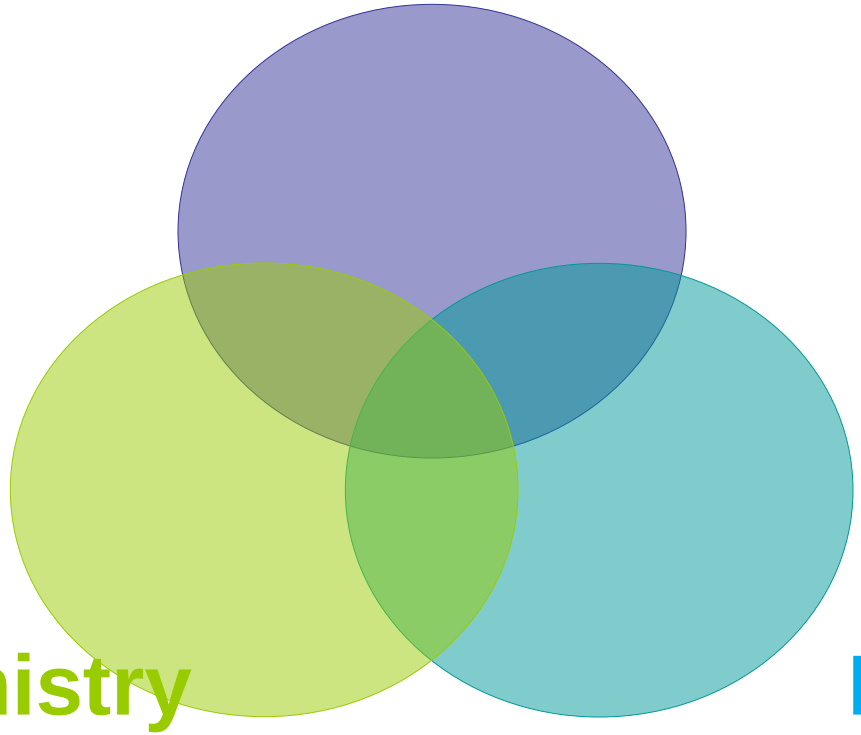
**Green chemistry**

**Plastics**

# 1. Activities at MateriaNova

*R&D activities*

## Surface treatment



- White biotechnology
- Bioplastics
- Biodegradation

## Green chemistry

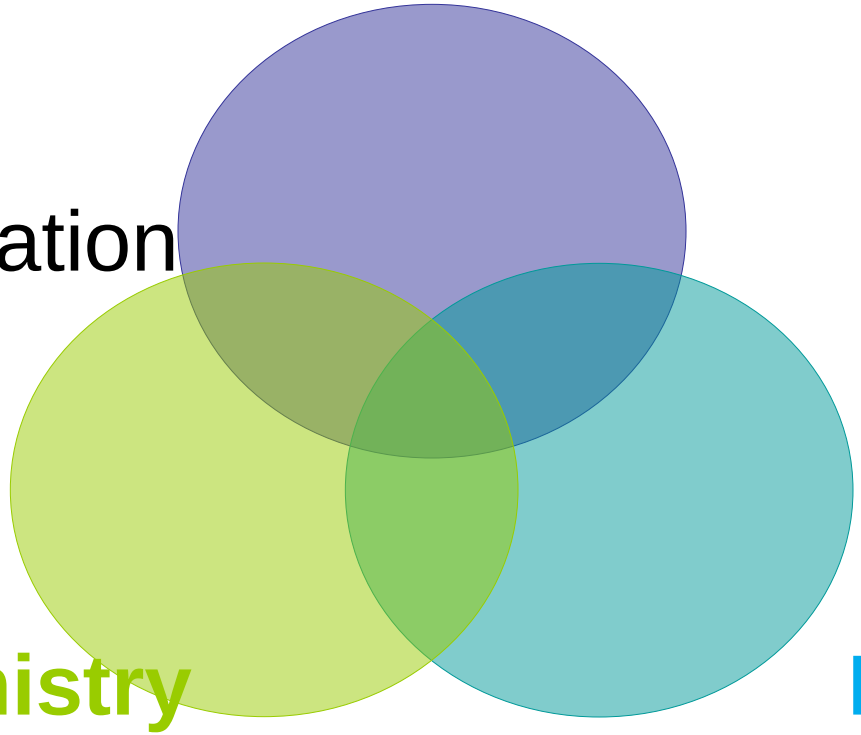
## Plastics

# 1. Activities at MateriaNova

*R&D activities*

**Surface treatment**

+ Characterization

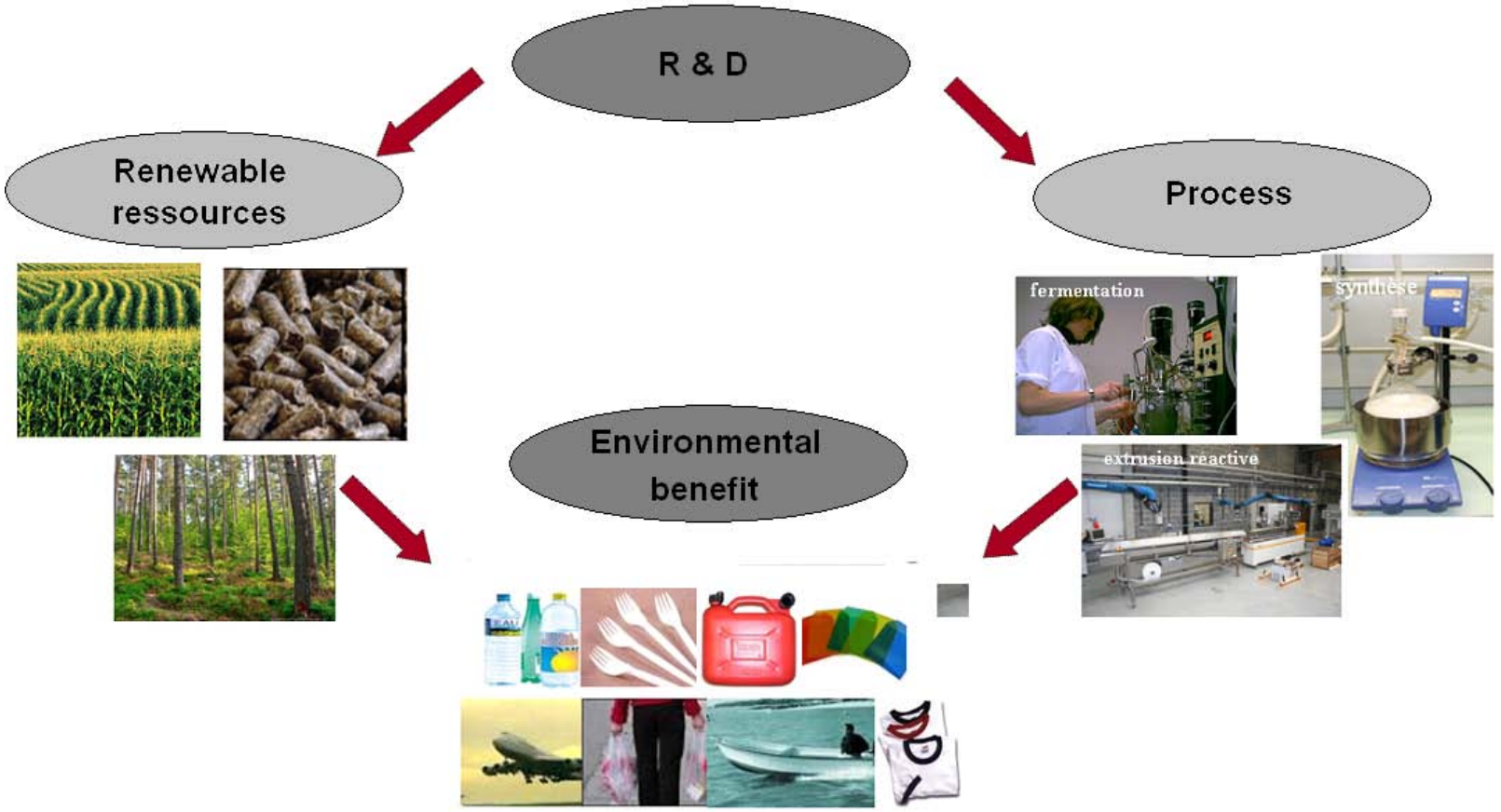


**Green chemistry**

**Plastics**

# 2.Green Chemistry

## *Global approach*



# 2.Green Chemistry

## *White biotechnology*

- Liquid and solid fermentation
  - bacteria and fungi
- Screening of enzymes
- Biocatalysis

**Micro-fermentors**

**Bioreactor 140 L**

**High throughput screening**

# 2.Green Chemistry

## *Biodegradation*

**“OK compost” AIB-Vinçotte**

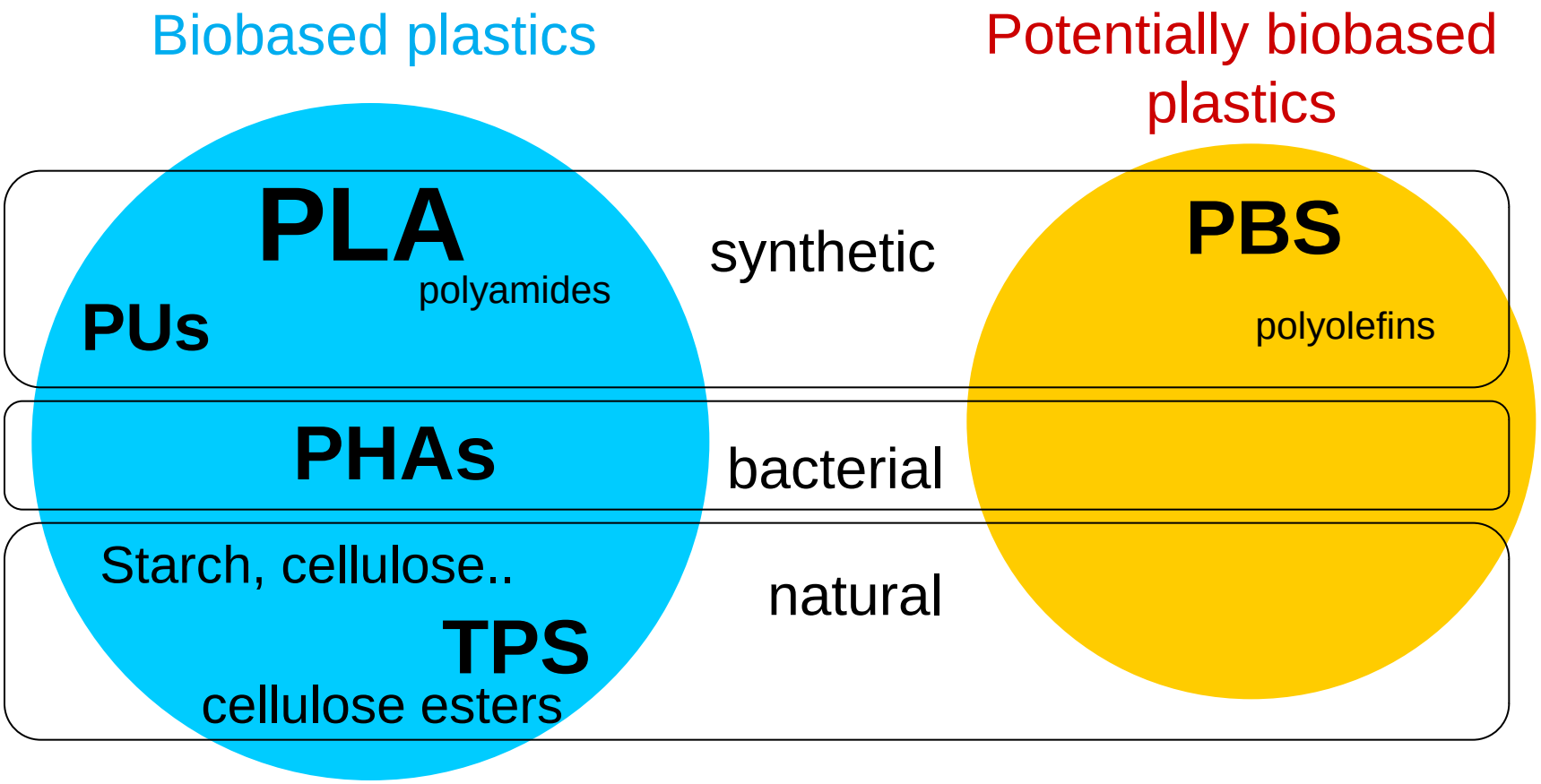
- Fragmentation
- Biodegradation
- Ecotoxicity

+ UV aging

**Normalized Tests (ISO, EN, ASTM, …)**

# 2.Green Chemistry

## *Bioplastics*



# 3.Bioplastics

## *Competences*

### Synthesis

**ROP**
- Batch
- REX

***Chemical modification***
- Batch
- REX

**Polycondensation**
- *Lab scale → 20 L*
- PBS, PU…

### Formulation

- *Ajustement (Brabender)*
- *Series : 1 – 300 kg/h*

### Characterization

- *Mechanical properties*
- *Thermal properties*
- *Biodegradability*
- *Microscopy*

# 3.Bioplastics

## *From lab scale to pilot scale*

**Lab scale**

**Batch reactors** *(cc, 2L, 20L)*

**Pilot scale**

**Continious** *(7 cc, 5, 10, to 300 kg/h)*

# 3.Bioplastics

## *Examples of applied research*

### Sinopliss

- *Synthesis of PBS*
- *New biopolyesters*
- *Control of biodegradability*
- *Flax fibers*

- *TPS*
- *Cellulose ester*
- *Antibacterial polymers*

### Biowall

- *Demonstration Unit PLA FUTERRO*

Techflax (Vandeputte…),

bioPVB (AGC)

…

# 3.Bioplastics

## R&D support for PLA production

*Futerro*

- **Joint-venture Total – Galactic**

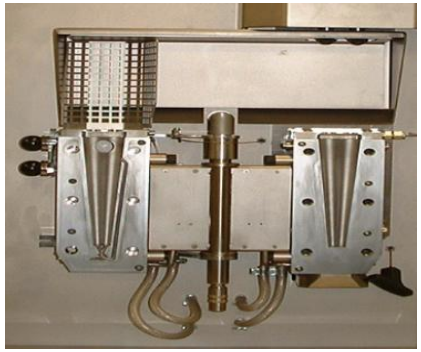
- **1st pilot european factory for P(L)LA production**
  - **30 km from Lille**
  - **1500 t/year**
  - **production started in march of 2010**
  - **30 million euros**
    - **70% industries**
    - **30% region**

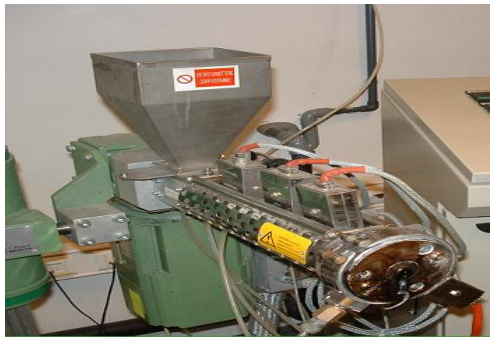
- **MateriaNova : support R&D, 4 years project**
  **4 Researchers + 1 technician**

# 4.Compounding & extrusion

## *All size extruders: from mini to pilot scale*

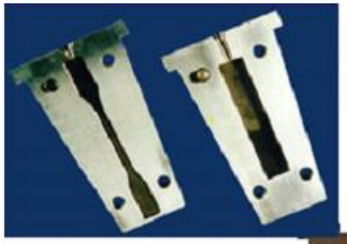
**Batch from 7 cm$^3$ to continuous 1, 10, 30 and 300 kg/h, tandem configuration …**



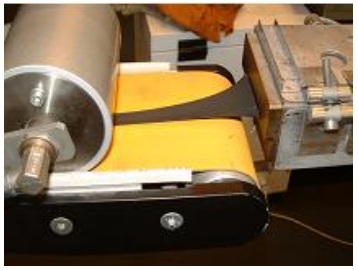


# 4.Compounding & extrusion

## *Molding equipments*



- Injection



- calendering

- Thermopressing

# 4.Compounding & extrusion

## *Tandem Extrusion*

Development of more efficient processes

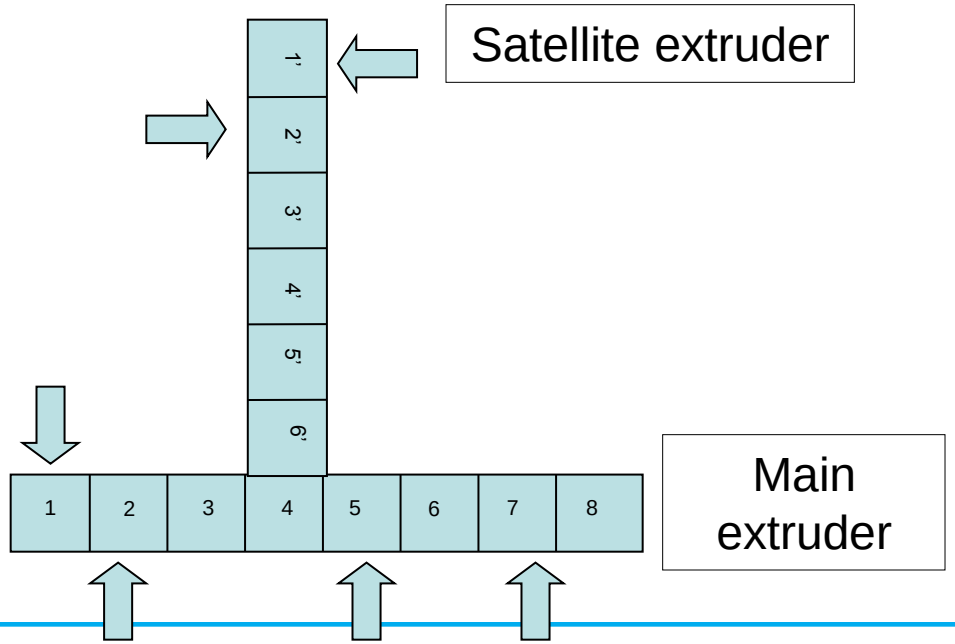
In-line n-IR probe

In-line rheometer

Control of process

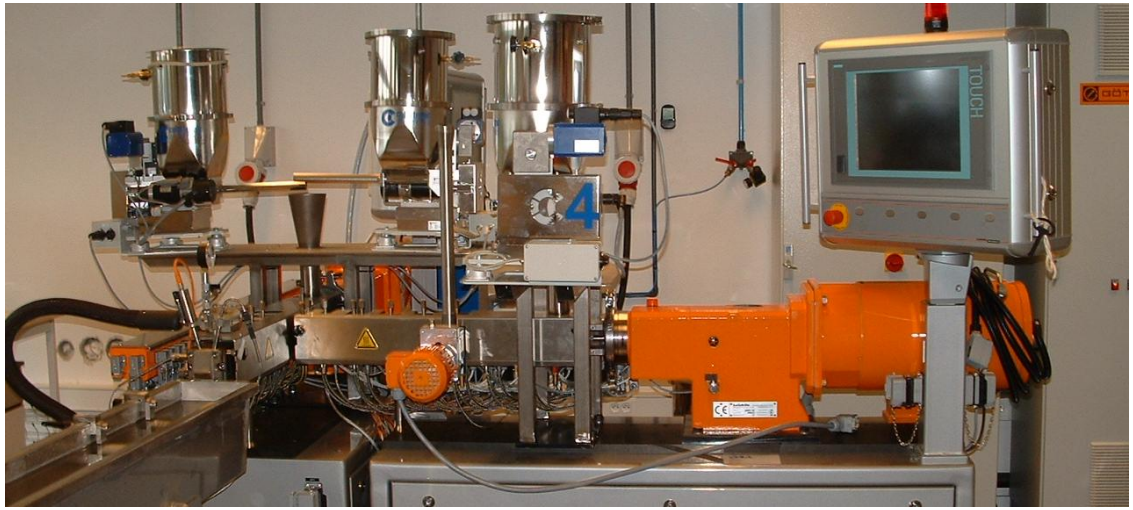
Combination of different chemistry from the lab scale

- *Synthesis*
- *Modification*
- *Strengthening …*



# 4.Compounding & extrusion

## *Tandem Extrusion*




**Leistritz Extruders**

**(Ø=18 mm, L/D = 50)**

**(Ø=18 mm, L/D = 40)**

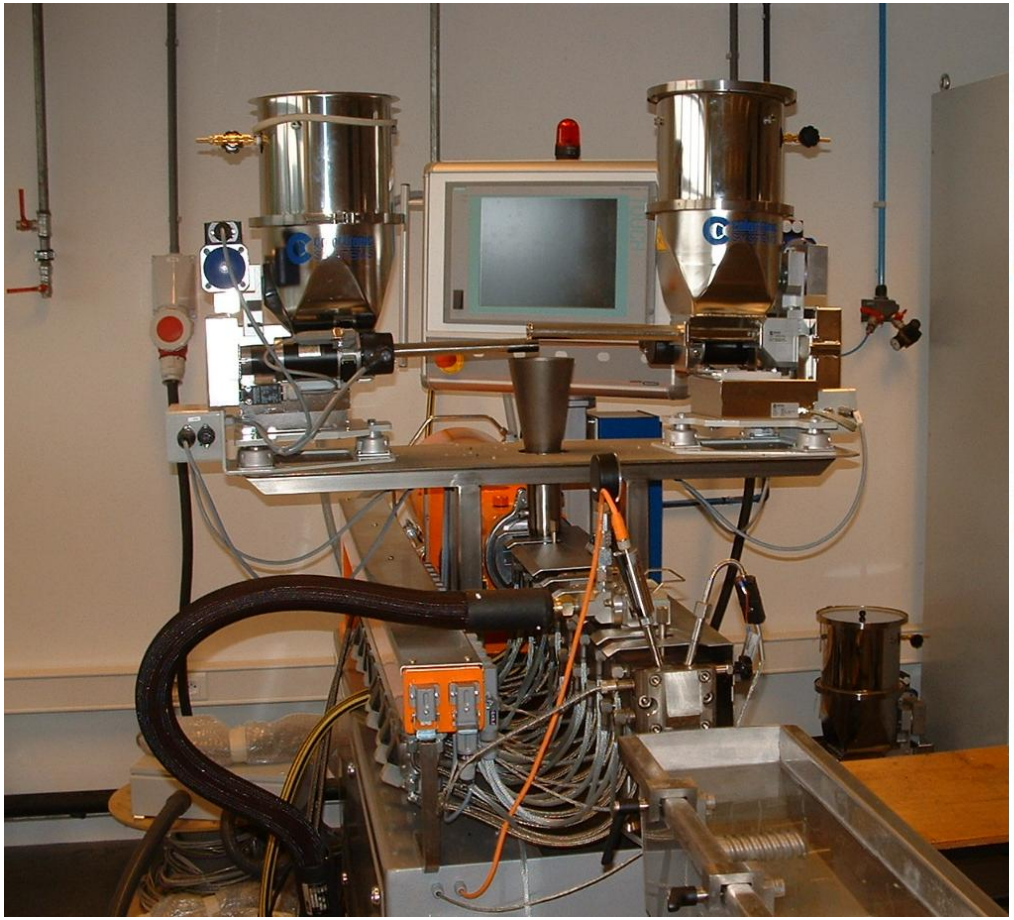
**Twin screw co-rotating**

**V ~ 60-600 rpm**

**~100 g/h to 1 kg/h**

# 4.Compounding & extrusion

## *Tandem Extrusion*



# 4.Compounding & extrusion

**Krauss Maffei Berstoff**

ZE-60

Twin screw co-rotating

**D = Ø 65 mm**

**L/D = 56**

max: 300 kg/h

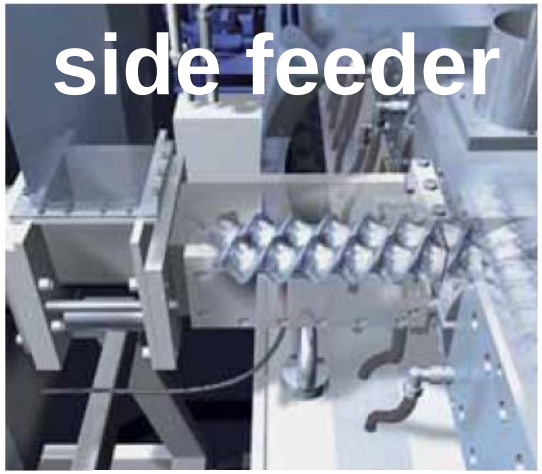
*Largest extruder*

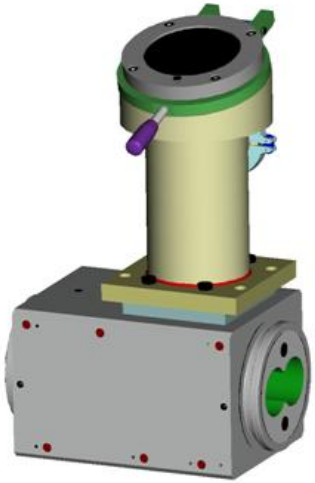
**High flexibility** of screw and barrel elements + side feeder

# 4.Compounding & extrusion

- Dryers
- **4 solid feeders** (pellets, *powders, fillers, fibers …)*
  - *0,15 – 8 kg/h*
  - *4 – 170 kg/h*
  - *10 – 300 kg/h*
- 2 liquid feeders
  - *0,1 -20 L/h*
- **Vacuum unit**
- Degassing unit

*Largest extruder*



# 4.Compounding & extrusion

Drying belt

Water cooling bath

Pelletizer

*(20-300 kg/h)*

Under water pelletizer

*(1-80 kg/h)*

*Bagging system*

# 5. Reactive extrusion

## *Reactive extrusion – So what ?*

Polymerization

- *Polycondensation*
- *Ring opening polymerization*
- *High molecular weights*

Grafting reaction

- *Using functional oligomers*
- *(aliphatic polyesters, starch ..)*

Controlled degradation

- *Rheological control*

Functionalization

- *Reactive group modification*

Reactive blending

- *Compatibilization*
- *In situ-blending*

# 5. Reactive extrusion

## *Advantages*

Access to different reactive continuous processes

*Screw configuration, atmosphere, equipments*

Residence time accessible

*5, 10, 25 min…*

Solvent free

**Low energetic cost**
***(T + shear)***

**New polymeric structures**

**High level of blending**

- Natural fiber composites
- Improved fire resistance biomaterials
- Recycling – fire resistance
- Compatibilization of nano-composites based on blends

# Thank you for your attention

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## Contacts

- Berstoff extruder: Vincent Berthé
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  068/27.47.74

- Projects director: Karl Berlier
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  065/55.49.04

- Valorization: Eusebiu Grivei
  Eusebiu.grivei@materianova.be
  068/27.47.71

- WebSite : http://www.materia-nova.com

# 1. Activities at MateriaNova

## *Goals and resources*

- Bilateral contracts : Materia Nova – industry
- European projects . e.g. Interreg IV
- RW and Europe : Convergence
- For France: CIR
- CR : RW
- Plan Marschall : RW

-**Materia Nova :** financement 65% privé et 35% public

-Recherches
- Proactives (sur fonds propres / publics)
- Réactives (financement industriel)
  - •Activité de support RD
  - •Extrusion à façon, tests de biodégradation….

-Volonté politique de renforcer les collaborations transfrontalières

- **Agréé crédit d'impôt à la recherche**

-Création d'un 6ème pôle de compétitivité (développement durable)
Chimie verte - Energie - Construction

# 4.Compounding & extrusion

## *Field of application*

## Compounding

### Processing of Plastics

- Melting and Alloying of Polymers
- Filling and Reinforcing
- Production of Masterbatch
- Incorporation of Additives
- Cable compounds
- Stabilizing and Coloring of Powder-Pellets (Powder-Pellet-Conversion)

### Chemical Industry

- Processing of Hot Melts
- Processing of TPE (-V, -S,-O)
- Production of Catalysts
- Production of Electrode Materials
- Production of Fertilizers

## Reaction / Degassing

### Reaction

- Polymerization
  TPU, POM, PA 6/66, PS, PET
- Reactive Extrusion
  PP + MSA, PP + Peroxide, PE + Silane

### Degassing

- Residual Monomer Degassing
  PC, ABS, PMMA, PS
- Concentration of Polymer Solutions (Flash Degassing)
  LDPE, HDPE, PS
- Degassing of Reaction Products
  e.g. PA 66, PET

# 3. Compounding equipments

## *Field of application*

### Additives

#### Reinforcements (abrasive)

Glass Fibres
Graphite Fibres
Carbon Fibres
Boron Fibres
Whiskers
Titanium Fibres
Synthetic Fibres
Glass Beads
Polymeric Hollow Beads

#### Reactive Additives (abrasive+corrosive)

Antioxidants
Heat / UV Stabilizers
Plasticizer
Process Aids
Color Pigments
Static Inhibitors
Microbicidal Additives
Blowing Agents
Primer
Peroxide / Silane
Flame Retardants
(halogenes & halogene-free)
Acids

#### Fillers (abrasive)

Calciumcarbonate
Kaolin
Wood Flour
Wollastonite
Barium Sulphate
Silica
Carbon Black
Mica
Talcum
Metallic oxide/ metallic powder