

# Infrastructure & data analysis

Characterization equipment

What we can offer - SPOT





## FTIR Spectroscopy



- Identification and quantification of chemical compounds
- Temperature-dependent measurements possible
- Solid as well as liquid materials (few mg)

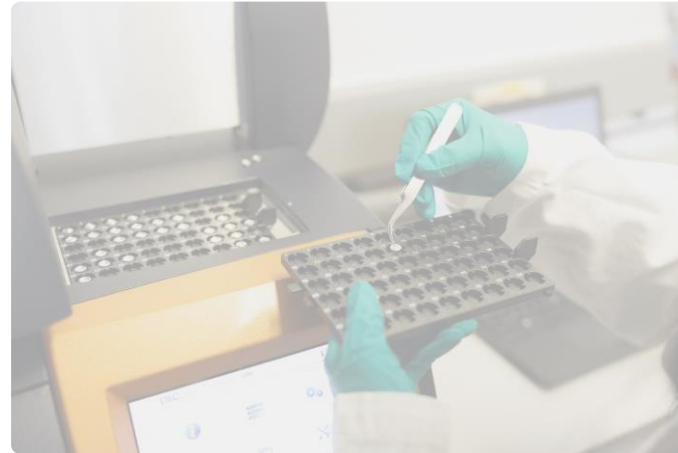
## Benchtop NMR spectroscopy

- Identification chemical structure of compounds
- $^1\text{H}$ - and  $^{31}\text{P}$ -NMR
- Soluble samples (10-30 mg)





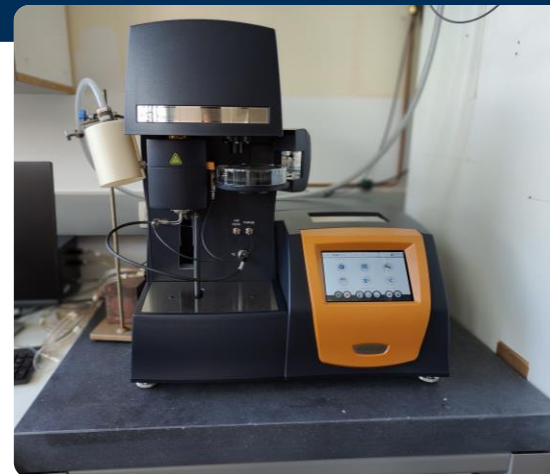
## Dynamic scanning calorimetry (DSC)



- Identification of thermal transitions (-90 °C – 550 °C)
  - Melting, crystallization, glass transitions,...
- Kinetic studies
- Curing
- Solid as well as liquid materials (4-8 mg)

## Thermogravimetric analyser (TGA)

- Thermal degradation profile (40 °C – 1000 °C)
- Ash content
- Solids as well as liquid materials (1 mg)





## Rheology



- Viscoelastic properties of soft solids and liquids
- Viscosity (also possible via viscometer)
- Creep/stress relaxation
- -160 °C – 600 °C
- Liquid samples: 2 g
- Rigid samples: 8 mm disks\* (3 replicates)
- Soft samples: 25 mm disks\* (3 replicates)

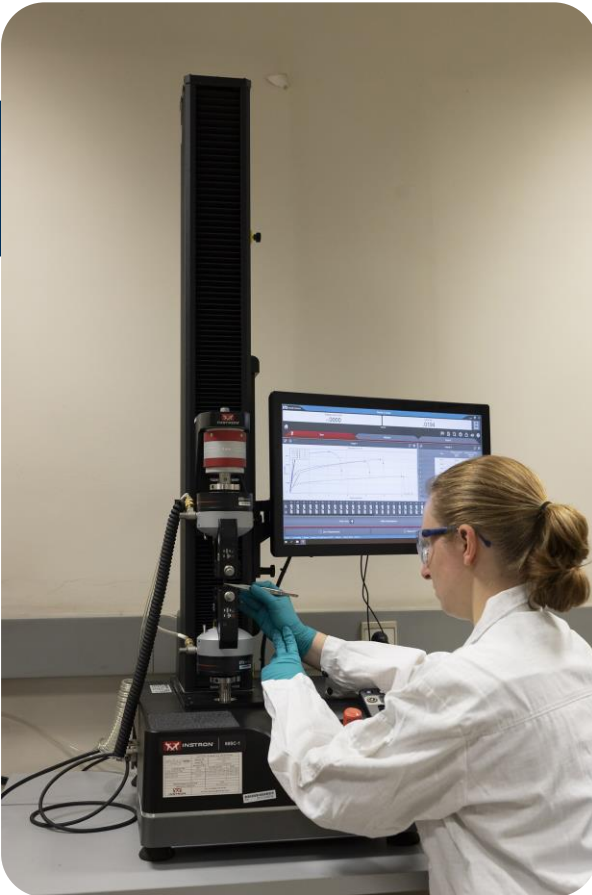
## Dynamic mechanical analyser (DMA)

- Viscoelastic properties of soft solids
- Creep/stress relaxation
- Tensile, 3-point bending & cantilever clamp
- -160 °C – 600 °C
- Rectangular bars\*; max 60 x 10 x 1 mm but dimensions depend on type of material (3 replicates)



\*specimen punches available to obtain right dimensions

## Tensile testing machine



- Mechanical testing of solid samples
  - Tensile mode
  - Compression mode
- Identification of Young's modulus, stress, strain, break, toughness, ...
- Max force: 1kN
- Tensile bars of different sizes and thicknesses possible: at least 5 replicates

## Extruders and injection molding

### Small-scale twin screw extruder

- Blending
- Polymerization reactions
- Max 5 g



### Reactive extruder

- Blending
- Polymerization reactions
- From 20 g/h to 1.5 kg/h



### Injection molding

- Tensile bars (ISO527-2-1BA)
- DMA bars (60x10x1 mm)



## Pressing and drying

### Hot press

- Molding, laminating, bonding
- Max temp: 343 °C
- Max clamping force: 15 tons
- Plates 15 x 15 cm



### Vacuum oven

- Max 200 °C
- Different sizes



## Material application testing

### Fire retardancy

#### UL94 chamber:

- Testing of Flammability
- burner in compliance with ASTM D5025
- with simple angle adjustment and gas control system.



### Coating equipment

- Coating analyses like Disperser, Thickness & Cross Hatch Test
- Impact test (coating metal)
- Washability Test
- Abrasion Test
- Glossy/Reflection Test
- Adhesion test (concrete)





## Material preparation

### Grinder

- Grinding of (soft to medium hard) solids to powder
- Max feed size of 15mm
- with simple time and speed control



### Pelletizer

- Converting polymers/plastics into uniform pellets (SP50 EN)
- Guarantee standard quality
- Throughput of 30 to 1000 kg/h



# Infrastructure & data analysis

Reactor equipment & Pilots

What we can offer



## High pressure reactors (batch)



### Screening reactor 4x10 mL

- N<sub>2</sub>, H<sub>2</sub>, Ar, (NH<sub>3</sub>) atmosphere
- Hastelloy C276

### 7 reactors of 100 mL

- N<sub>2</sub>, H<sub>2</sub>, Ar, NH<sub>3</sub> atmosphere
- SS 316, liners available

### Single set-up (2x)

- 200 °C, 250 bars

### Double set (parallel operation possible)

- 200 °C, 250 bars

### Triple set (parallel operation possible)

- 300 °C, 250 bars

## High pressure reactors (batch)



### 1 reactor of 200 mL

- N<sub>2</sub>, H<sub>2</sub>, Ar atmosphere
- 600 °C, 400 bars

### 1 reactor of 2 L

- N<sub>2</sub>, H<sub>2</sub>, Ar atmosphere
- 350 °C, 200 bars
- Heavy duty motor (1/2 hp), tachometer, bottom drain valve
- SS 316, liners available

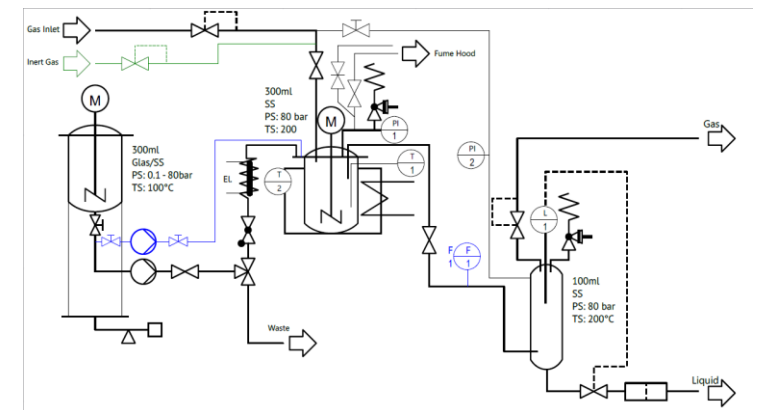
## High pressure reactors (continuous)

### Fixed bed reactor (L, G/L)



- Two feeds
  - Solvent solution
  - N<sub>2</sub>, H<sub>2</sub>
- 300 °C, 140 bars
- Catalytic bed
- Fully automated control

### CSTR-reactor (S/L, L, G/L)



## Glass reactors



**Shakers for parallel reactions**

→ 150 °C, pressure less

**ASE tubes for parallel reactions**

→ Up to 6 bars

**6L reactor**



## Downstream processing



### Pressurized hot filtration unit

- 205 °C / 138 bars
- RT / 172 bars,
- Stirred
- SS 316

### Other types of DSP

- Rotary evaporators
- Ovens
- Traditional DSP



## Pilot site & quality control lab

- A flexible, multi-purpose pilot site,
- all permits in place and safety measures,
- gasses (hydrogen, nitrogen low and high pressure); compressed air; cooling water, power supply, storage facilities
- a quality control lab.





## Pilots: Continuous processing

- Multi-purpose extraction unit (Stainless steel, PILLAR II)
- CSTR reactor, 67L; powder input
- design capacity: max 191 kg/h\*
- Solvents
- Design temperature: 290 °C; design pressure: 90 barg
- Solvent recovery
- Feeding system to supply solid material (< 500  $\mu\text{m}$ ) to the reactor



## Pilots: Continuous processing

- Multipurpose flexible pilot unit (Hastelloy C, Lignoalue)
- 4 catalytic fixed bed reactors, 100L
- design capacity: 4 kg/h – 125 kg/h
- Hydrogen atmosphere
- Solvents
- Design temperature: 290 °C; design pressure: 90 barg
- Solvent recovery



# Infrastructure & data analysis

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