Biobased Performance Materials Symposium
14 June 2018, Wageningen, The Netherlands

Session: Welcome and Opening
Presentation by: Wout Ludema, *Brightlands Chemelot Campus*

Title: **Update on BPM Polymerization initiatives**

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Curriculum:
Wout Ludema is Operation Manager Pilot Plants at the Brightlands Chemelot Campus. As Operations Manager he supervises the activities of various users of the Pilot Plant Area at the Brightlands Chemelot Campus to make sure that their programs will progress without intervening the activities of the other users or the environment. As experienced chemical-, mechanical- and material engineer he supports users with advice and support in "scaling up" process installations and/or activities. The Brightlands Chemelot Campus operates a purification plant for obtaining polymer-grade raw materials and the MultiPurposePilotPlant. As plant manager he represents Brightlands in these activities, in addition to managing the operation he also takes care of the realization of new process installations and the modification of existing installations. For the own Brightlands installations and for the installations that are customer properties.

Abstract:
After a short introduction of the Brightlands Chemelot Campus the focus will be on the activities in the MultiPurposePilotPlant. In addition to the existing activities, the activities that are in the implementation phase will be monitored. Special attention will be given to the Polymerization Installation which is now under construction and will be Ready To Operate in March 2019.

Multi-Purpose Pilot Plant at Brightlands Chemelot Campus

Brightlands
Chemelot Campus

The Smart Materials Community

Brightlands Chemelot Campus is a private/public innovation initiative in the area of materials and (sustainable)processes, hosting many companies, education and knowledge centers (facilities and services) and connecting them

Corporates	FIBRANT, AnQore, SEKISUI, ARLANXEO Performance Elastomers, sabic, DSM Bright Science. Brighter Living., sappi
Startups	Isobionics Biotechnology, dbsl, XILLOC Patient Specific Implants
SMEs	avantium, Basic Pharma, KRIYA MATERIALS, PharmaCell
Education Partners	Maastricht University Chemelot Innovation and Learning Labs, ZUYD, leeuwenborgh vakmensen in opleiding, ARCUS COLLEGE
Scientific Centers	AMI Biobased Materials, Chemelot InSciTe, Brightlands Materials Center, TU/e, RWTH AACHEN UNIVERSITY

Brightlands Innovation Factory

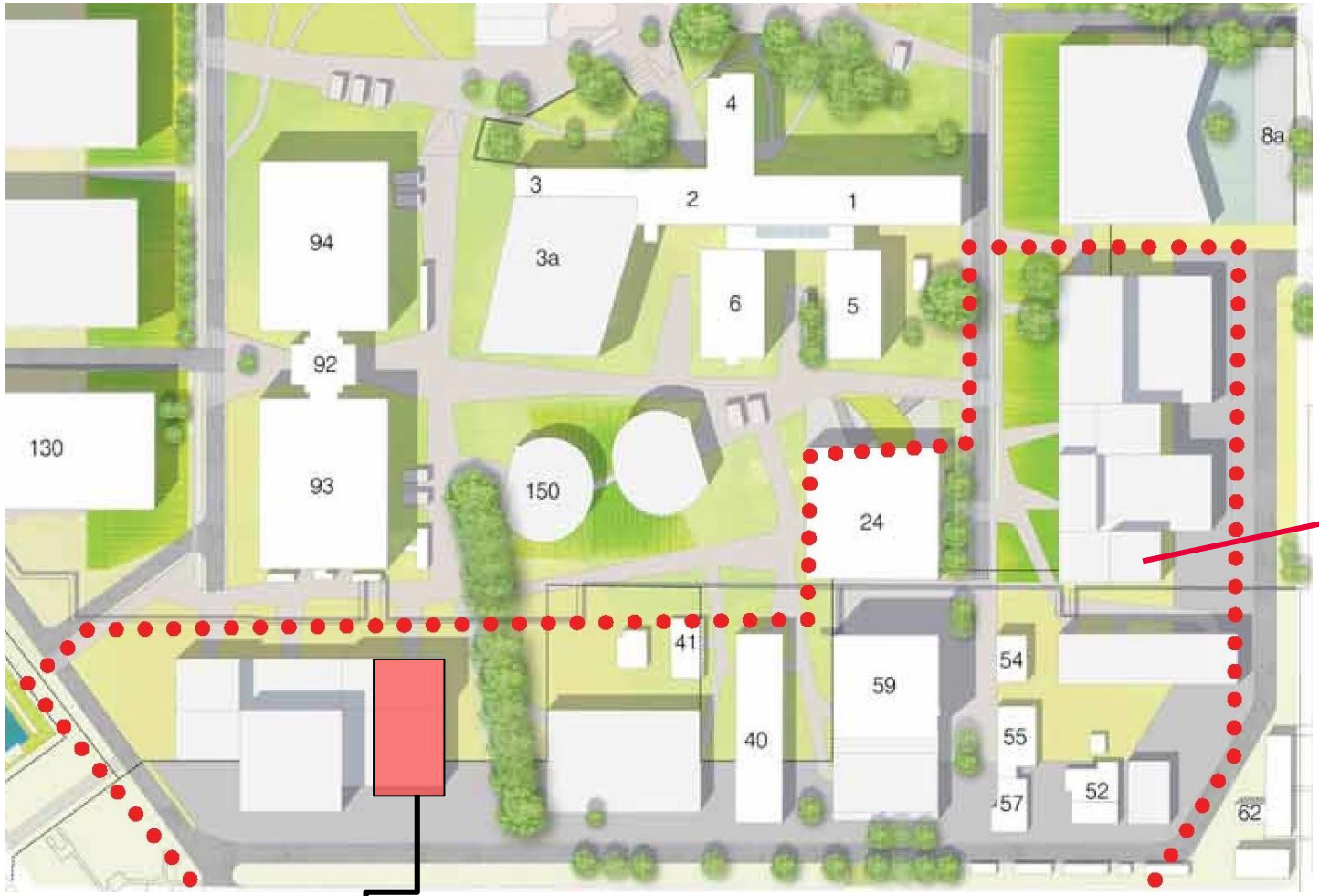
official opening Multi-Purpose Pilot Plant 25 May 2016

What is the Multi-Purpose Pilot Plant?

- **Flexible concept** for short term piloting projects
- Suitable for **process development**, **pilot** and **small-scale production**
- Fully **skid-based**
- Operated by **Brightlands** operators
- **520 m²** pilot hall with laboratory, project offices

- ✓ *Batch and continuous operation processes up to 500 kg/day*
- ✓ *Integrated data monitoring and control systems*
- ✓ *ATEX2 certified, 24/7 operations*
- ✓ *On-site analytics laboratory, confidentiality ensured*

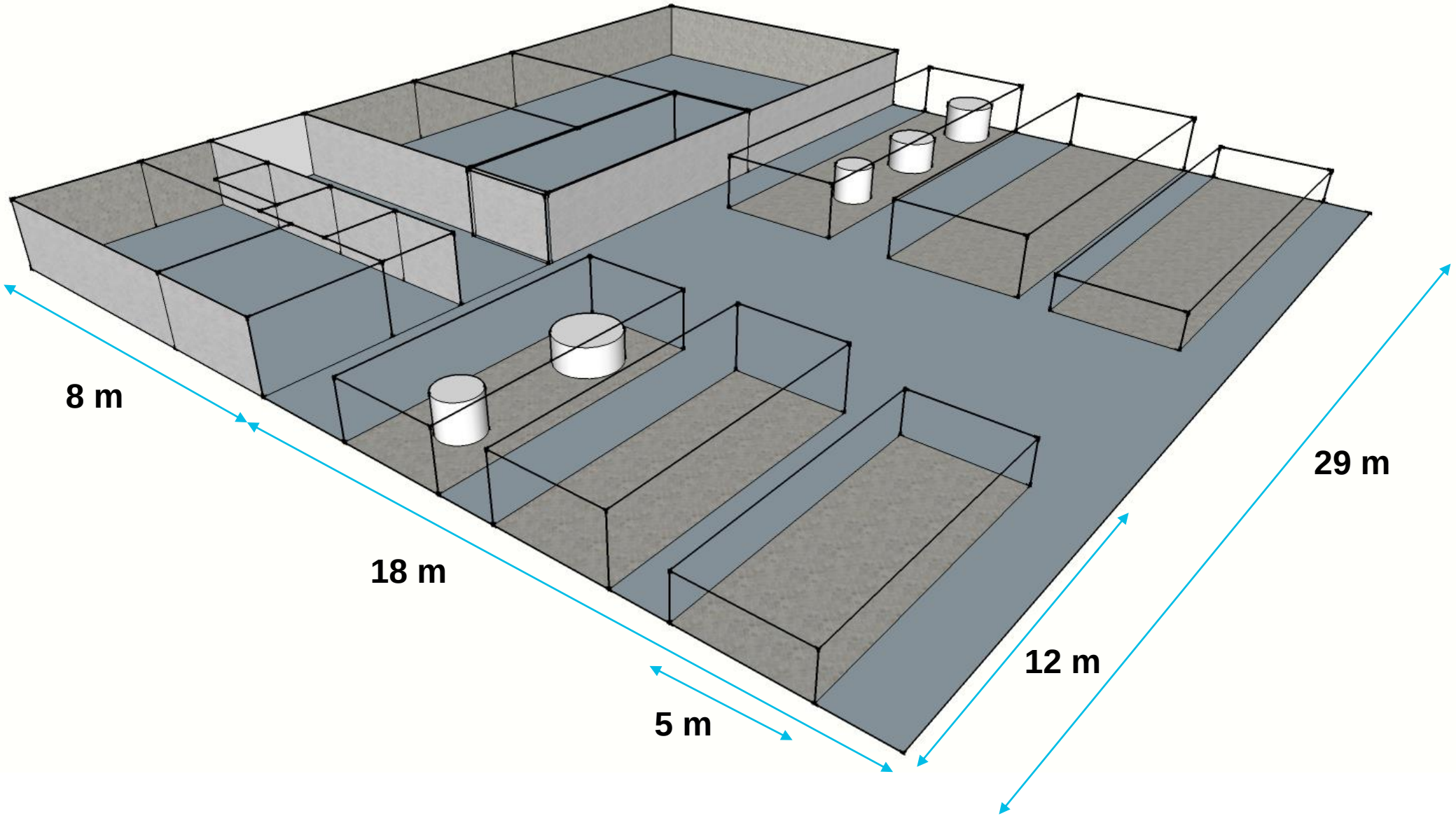
Located in Brightlands Chemelot Campus Pilot Zone



Secured Pilot Plant Zone

Multi-Purpose Pilot Plant

A skid-based piloting hall



Available utilities and services

Nitrogen	110 bar, reduced to 25 bar or 3 bar
Hydrogen	110 bar, reduced to 65 bar
Water	Drinking water, demineralized water, process water, heated water
Steam	12 bar, 3 bar
Waste water	Sewage and treatment
On request:	Polymergrade → Ethylene, Propene, Heptane, Isobutane, Toluene, Hexane, Isododecane.
Gasstorage	8 separate units for gascilinder incl reducers

Initiation of the
“Polymerisation-skid”- project

- In a time frame of 3-4 month Brightlands received from 2 entities the request to have research facilities for Polymerization program.

  – Facility to produce various polyesters for research and product development purpose, and production pre-marketing mater

  – Upscaling uncharted performance polycondensate;
  on the intimate relationship of water and polyamides

Progess in the project:

Step 1

A conceptual engineering is done by Brightlands for each seperate application

OUTCOME → it was not possible to finance 2 separate Pilot Plants

Step 2

Brightlands has conducted a study for the possibility of combining equipment for both needs

OUTCOME → It turned out to be possible to accomodate both installations in one setup and to construct this installation at <u>65% of the costs</u> for two seperate installations

It could be combined to chose the equipment that is required for the PE Pilot Plant as the basis for the combined installation

MAY 2018 → start of "realization phase"

Progess in the project:

Step 3

Conceptual and Basic enginering is completed

- P&ID / Technical Requirements / Estimate for realizationbudget

Step 4 start june 2018

Execute tender proces, several selected construction companies

Step 5 july/august 2018

Commissioning

Step 6 march/april 2019

Ready To Operate

SPECIFICATION

PROCESS MAIN EQUIPMENT

- Salt preparation vessel
- Pre- or Copolymerization reactor, incl. ring opening
- Polycondensation reactor
- Tumble dryer / Granulator

PARAMETERS

batch size	8 – 40 kg
temperature	ambient – 320 °C
pressure	0,001 – 30 bara
viscosity	up to 110 Pa.s

Equipment in the Multi-Purpose Pilot Plant

Under construction

“HORIZONTAL H_2” Pilot Plant

Hydrogenation of hydrocarbons

RTO	**Februari/March 2019**
Reactor	**5ltr continuous, with catalyst cartridges**
Material	**Hastelloy / Kalrez**
Pressure	**ambient – 100bara**
Temperature	**ambient - 330°C**

“Riches” Pilot Plant

RTO	**Februari/March 2019**
Reactor	**250ltr batch, with catalyst cartridges**
Material	**Hastelloy / Kalrez**
Pressure	**ambient – 100bara**
Temperature	**ambient - 330°C**

Equipment in the Multi-Purpose Pilot Plant

already in production

Packed Bed reactor

- Packed bed reactor set-up
- Heterogeneous catalytic gas phase reactions
- Both fluids and gases with solid catalyst supported
- Example applications: dehydration, hydrogenation, isomerization
    - T = r.t. – 500 C
    - P = atm – 16 bar
    - 4 reactor beds in series or parallel
    - V = 3 L (4 x 0,75 L)

Homogeneous Catalysis Autoclave

- High-pressure autoclave set-up for continuous homogeneous catalysis reactions
- Catalyst recycling via vacuum distillation and nanofiltration recycling loops
- Example applications: carbonylation, hydrogenation, hydroformylation

V = 1 L autoclave

P = 100 bar max

T = 180 °C

Feed up to 1 kg/h – gas and liquid

Staged nanofiltration system of flatbed units with flexible filter system

Distillation (wiped film evaporator) up to 1 kg/h

Multipurpose distillation column

- Multipurpose glass distillation column

Capacity 25 L / h

P = atm - 2 mbar

Reboiler 4 kW, 0.4 m height

Oil-heated wiped film evaporator, T_{max} 240 C

Column: 3 m length 50 mm diameter

18 seperations trays; extension possible

Sulzer BX packing

Condenser 1.95 m (water-cooled)

Off gas cryostatic cooling with liquid N_2 cold trap

Multifeed: reboiler, 1 m and 2 m

Multisampling: condenser, cryostat, liquid N_2 vessel

Spinning disc reactor and spinning disc extractor

- Spinning disc reactor
- Spinning disc extractor
- Broad range of chemicals and conditions possible (Hastelloy, ATEX2)
- Reactor: T_{max} 180 ºC, P_{max} 80 bar
- Throughput 40 - 250 liter / hr
- Suitable for exothermic, mass transfer and/or heat transfer limited conversions

FLOWID

Business model and Business Development

- Operated by Brightlands operators
- Open for third parties:
  - Use of Brightlands skids
  - Installing and operating own skid
- Project duration: from 1 week to 1 year+
- Performing conceptual engineering up to total realization and operating of Pilot Plant installations

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