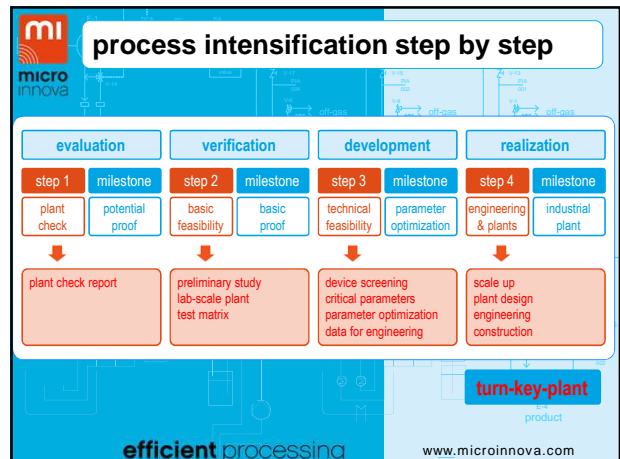


efficient processing

**Flow Chemistry and Microreactors
turn Process Performance
into Money?**

Continuous Flow Technology in Industry, York 2012

Dr. Dirk Kirschneck, Microinnova Engineering GmbH





content




- **efficient** flow processing
- **scale up & realization**
- **manufacturing** systems
- **flow miniplant** systems

efficient processing

www.microinnova.com




efficient processing




specialists in process intensification

process development



engineering & plant



**Microinnova combines
process knowledge
with plant competence**

efficient processing

www.microinnova.com



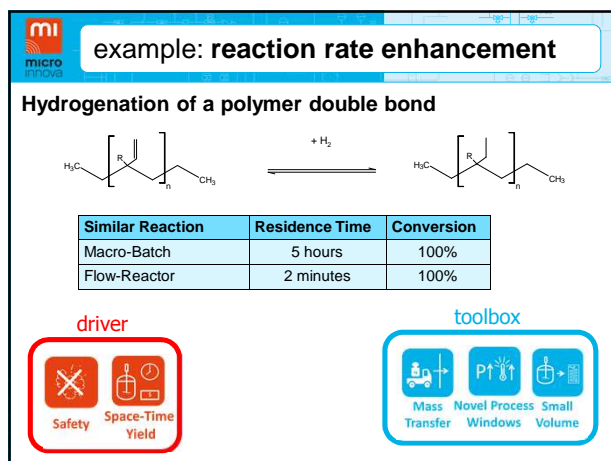
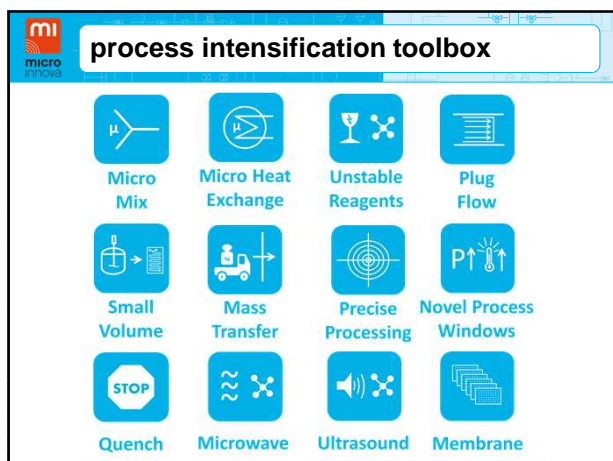
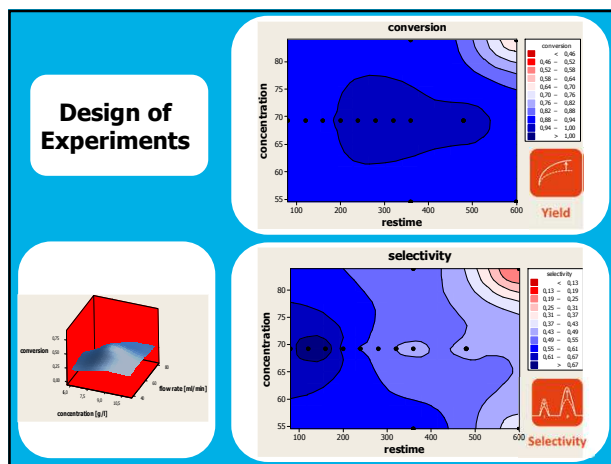
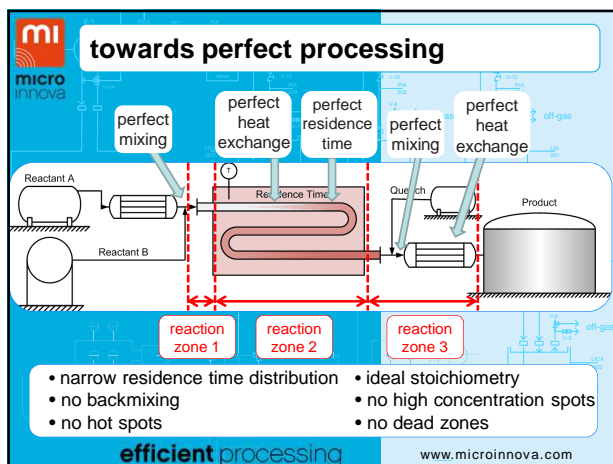
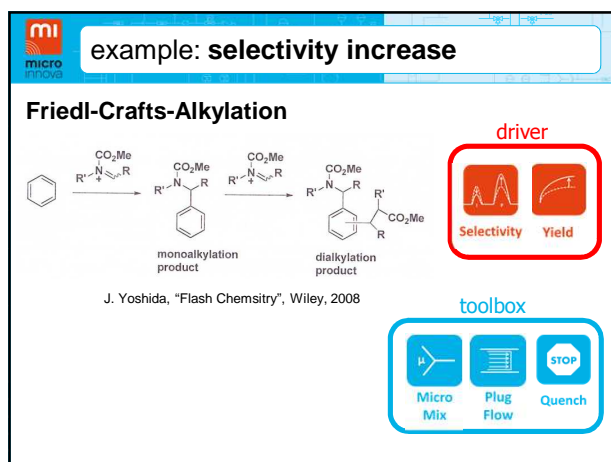
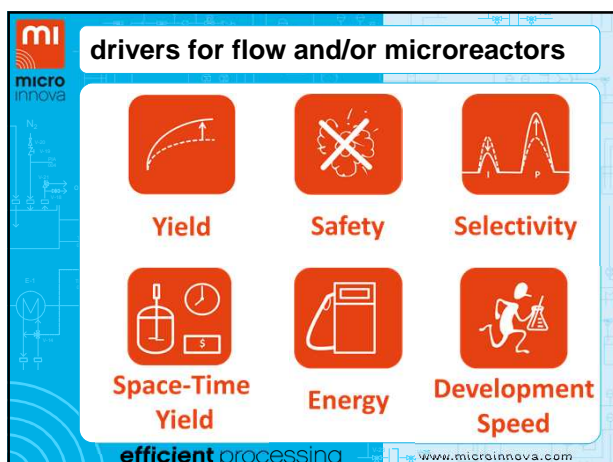
aim of microinnova



**make chemical
processing
more efficient**

efficient processing

www.microinnova.com



mi micro innova
efficient processing

realization considerations

mi micro innova **scale up of flow processes**

Exothermity
heat v time

Heat Release

Time

Interface
area v time

Interfacial Area

Time

Mixing
quality v scale

Mixing Quality

Plug flow
quality v scale

Tracer

t_{max}

S

mi micro innova **target area**

area of application

difficult

easy

1

100

total flow rate [litres / hour]

benchtop systems

flow mini-plant

manufacturing systems

Idea Verification

Scalable Development

efficient processing

www.microinnova.com

mi micro innova **scale out concept**

a) internal numbering up

b) smart dimensioning

increase

constant

increase

increase

efficient processing

www.microinnova.com

mi micro innova **heat release characteristics**

Heat Release

Zone1

Zone2

Zone3

Zone4

Point of Mixing

Time

t_1

t_2

t_3

t_4

\dot{Q}_1

\dot{Q}_2

\dot{Q}_3

\dot{Q}_4

Providing Perfect Environment for the Chemical Reaction

efficient processing

www.microinnova.com

mi micro innova **scale up of flow processes**

Corning
AFR

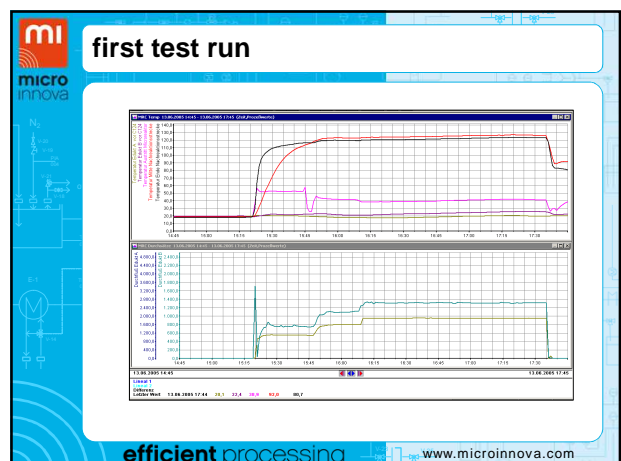
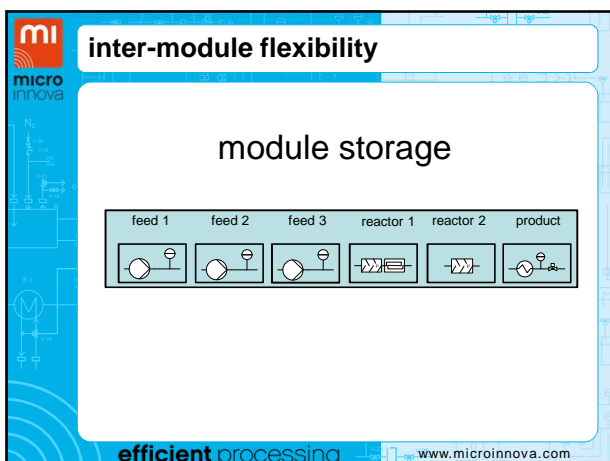
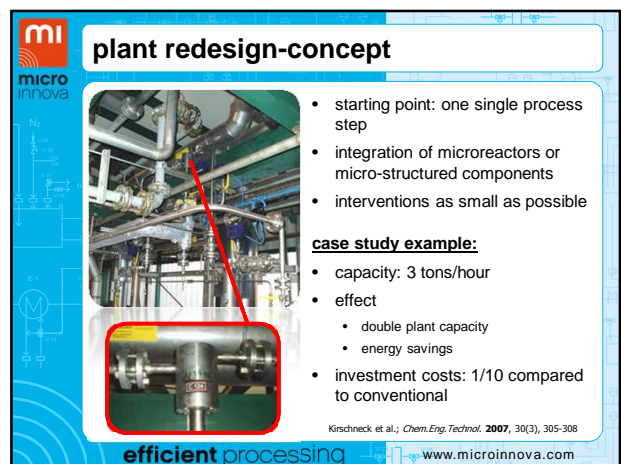
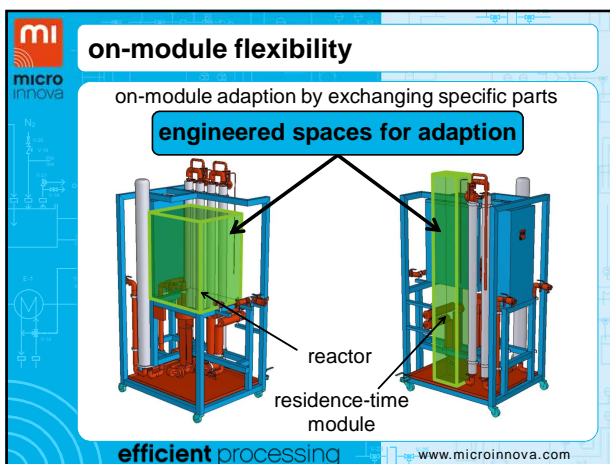
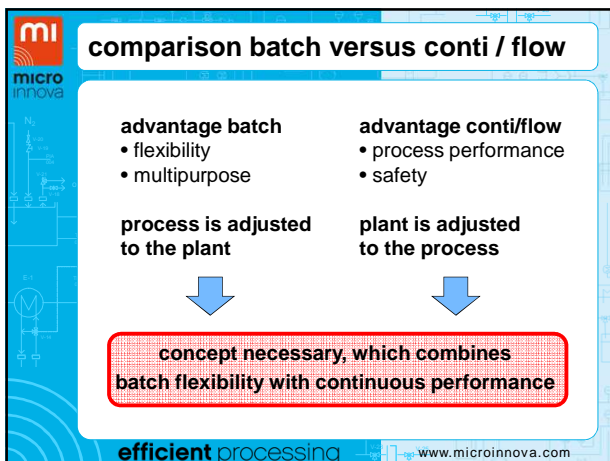
Alpha Level
ART

IMM
Caterpillar

IMM
Star-Lam

Flow Miniplant Level up to 10 l/hour

Manufacturing Level up to 10.000 l/hour



mi micro innova
efficient processing

**manufacturing solution
unit operation**

mi micro innova
efficient processing

fast track realization

first lab-experiment launch of the plant at the customer site

October 2009 May 2010

case study example

efficient processing www.microinnova.com

mi micro innova
efficient processing

unit operation - solution

- typical for one process step
- typical solution for inefficient or difficult process steps
- implements individual reaction steps in a continuous process
- no modification of remaining process steps
- dedicated or limited multipurpose
- on-module flexibility
- savings:
 - higher yields
 - less energy consumption
 - less raw material input

efficient processing www.microinnova.com

mi micro innova
efficient processing

**manufacturing solution
modular multipurpose**

mi micro innova
efficient processing

case study unit operation-concept

one of the biggest cGMP plants with microreactor

case study example:

- mixing-sensitive reaction
- barely feasible in batch mode
- microreactor plant results: 30 % higher yield compared to batch
- total throughput is 200 l/hour
- the pilot/production plant has been started up successfully in May 2010
- yield difference (lab-manufacturing): 0.1%

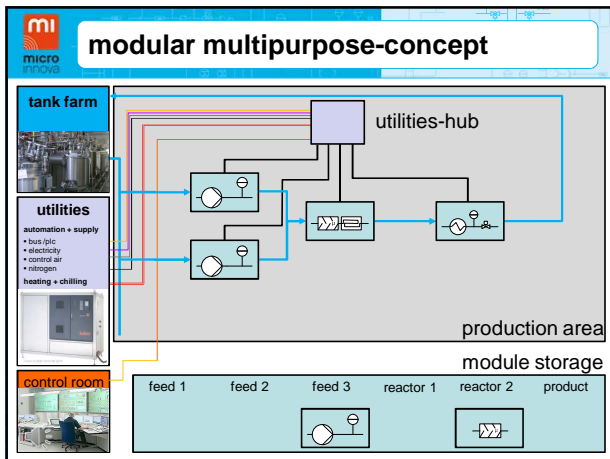
efficient processing www.microinnova.com

mi micro innova
efficient processing

modular multipurpose-concept

- combines advantage of batch technology (**flexibility**) with advantage of continuous processing (**process performance**)
- **interchangeable** modules temporarily assembled and variably combined
- functional units, which can be combined individually according to the process
- **fast adaption** to new processes and easy plant extension
- optimization of plant utilization
- **totally new plant concept** in chemical industry

efficient processing www.microinnova.com



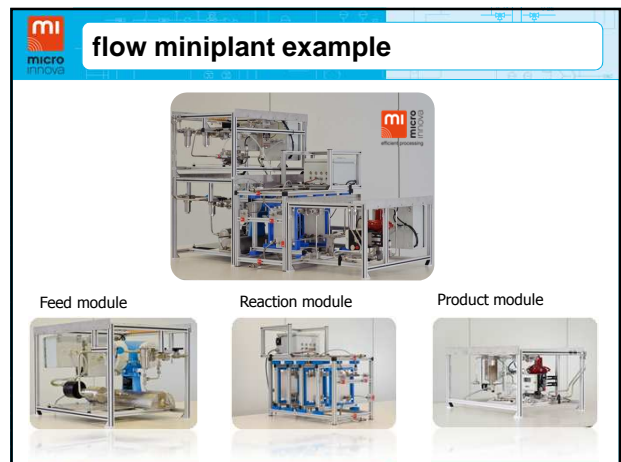
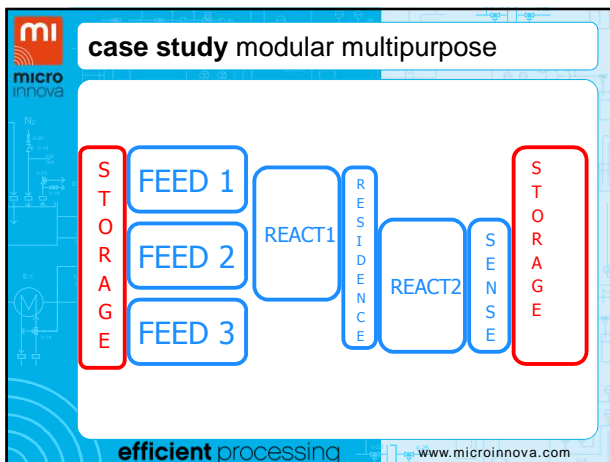
flow mini-plant

Development orientated:
S-Class 1-10 l/h

Manufacturing orientated:
M-Class 10-100 l/h

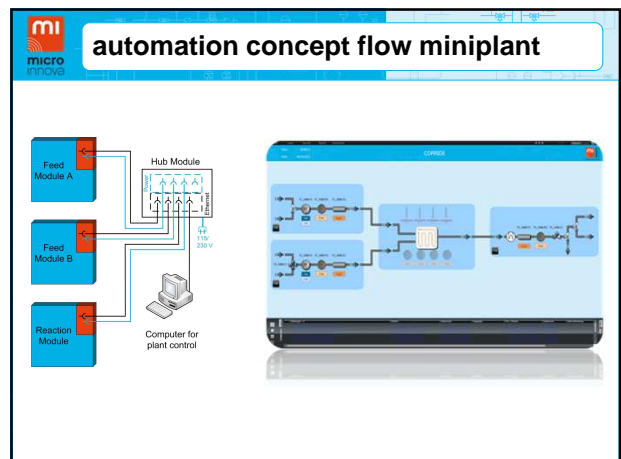
- **link** between development and manufacturing
- maximum **flexibility** by ready modular units
- **simple adjustment** to new processes
- **easy operation**
- freely **selectable** level of **automation**
- GMP or non-GMP kilo laboratory use
- applicable for **small scale manufacturing**

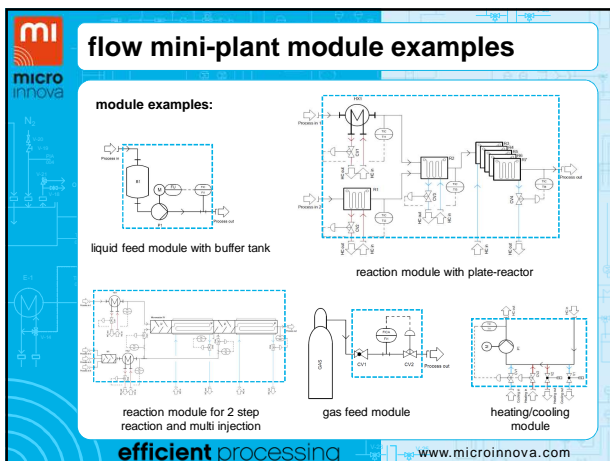
efficient processing www.microinnova.com



mi micro innova
efficient processing

flow mini-plant technology





Meet some people who make it happen

Dipl.-Ing. Walter Linhart, perfectionist

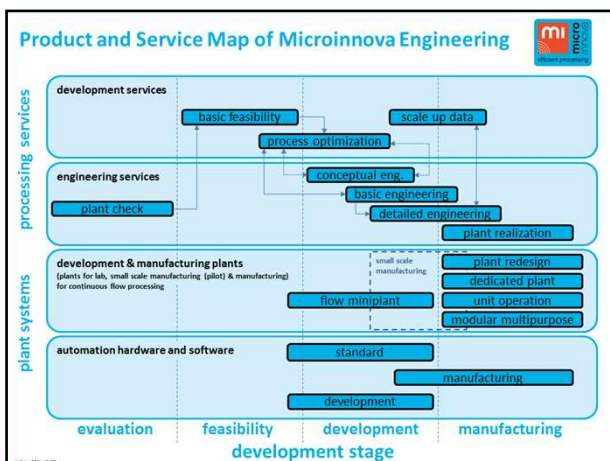
"We set up modular manufacturing systems that will allow our customers to transfer their competences into productivity in the highest degree."

Dr. Günter Tekautz, puzzle freak

Yield and process stability increases to the same extent as the number of possible synthesis routes can be expanded by flow and other intensification technologies.

The research leading to these results has received funding from the European Community's Seventh Framework Programme [FP7/2007-2013] under grant agreement no. CP-IP 22853-2

CoPIRIDE



efficient processing

micro innova

process design
engineering
manufacturing plant

Please contact me:

+43-316-908606-110

dirk.kirschneck@microinnova.com

