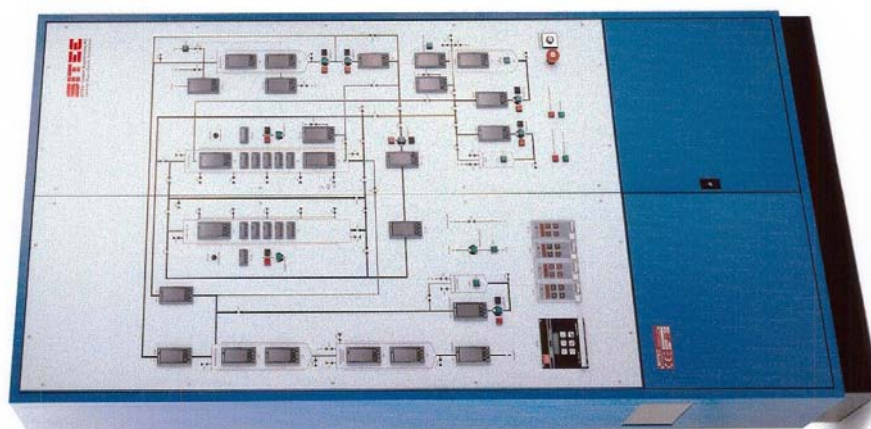
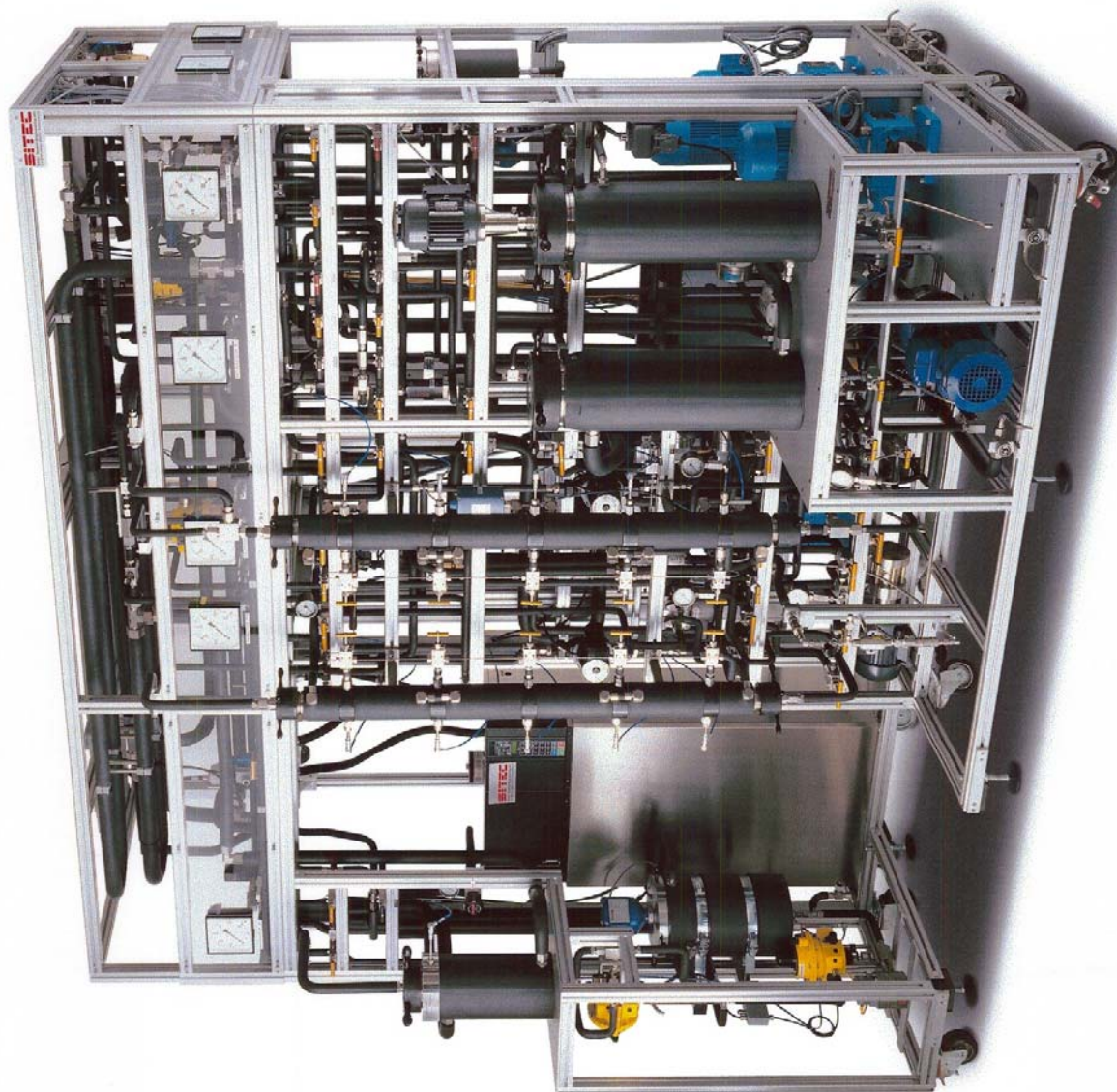


High Pressure Reactions

- ☛ Pilot units for continuous reactions
- ☛ Stirred high pressure high temperature reactors
- ☛ Bertly type reactor (magnetic stirrer; catalyst basket)
- ☛ Fixed bed tube reactors
- ☛ Tube reactor with static mixing elements
- ☛ Slurry and recirculation reactors



Advantages of Reactions in or with Supercritical Fluids

- high selectivity
- enhanced conversion rates
- smaller reactors
- homogeneous reactions because of unlimited solubility of the reactants
- precipitation of product from the reaction mixture as the reaction proceeds
- higher catalytic activity

Investigated Types of High Pressure Reactions

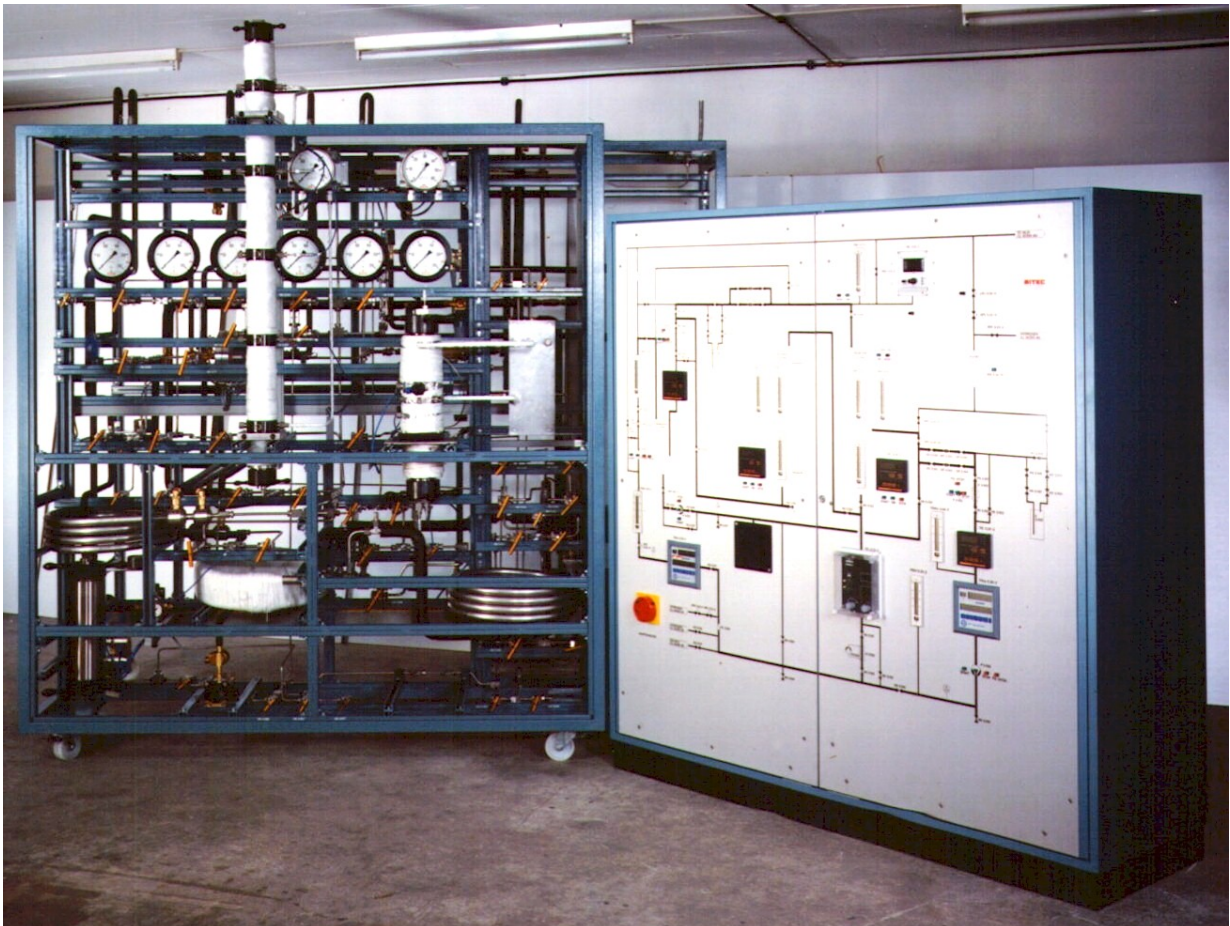
- Hydrogenations
- Polymerisations
- Isomerisations
- Oxidations
- Catalytic reactions
- Enzymatic reactions
- Synthesis reactions
- Hydrolysis
-

Picture page 1:

High Pressure Pilot Unit for Ethynylation Reactions (300 bar, 200 °C, 30 kg/h NH₃/C₂H₂, 2 x 0.8 litre fixed bed reactors, fluid cyclone separator 2 litre)

Examples of SITEC Pilot Units

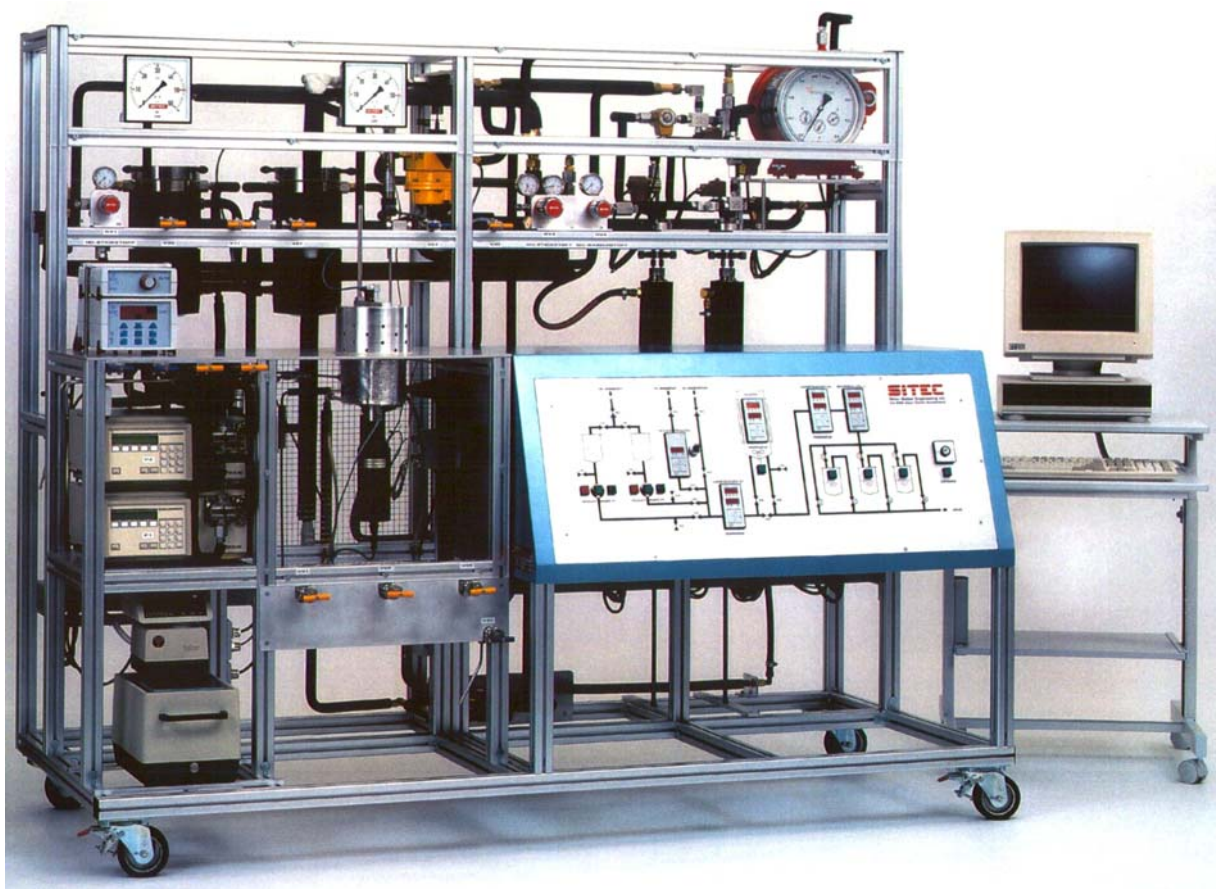
Catalytic Synthesis Reaction



High Pressure Reaction Pilot Unit for continuous Catalytic Synthesis Reactions with the following features:

- Reaction conditions 300 bar, 250 °C
- External recirculation of liquid and gas phase
- Measurement of recycle mass flows
- Continuous tapping of product
- Automatic compensation of educt losses
- Ex-proof design
- Several exchangeable reactor types, like slurry reactor, recirculation reactor and down flow column reactor

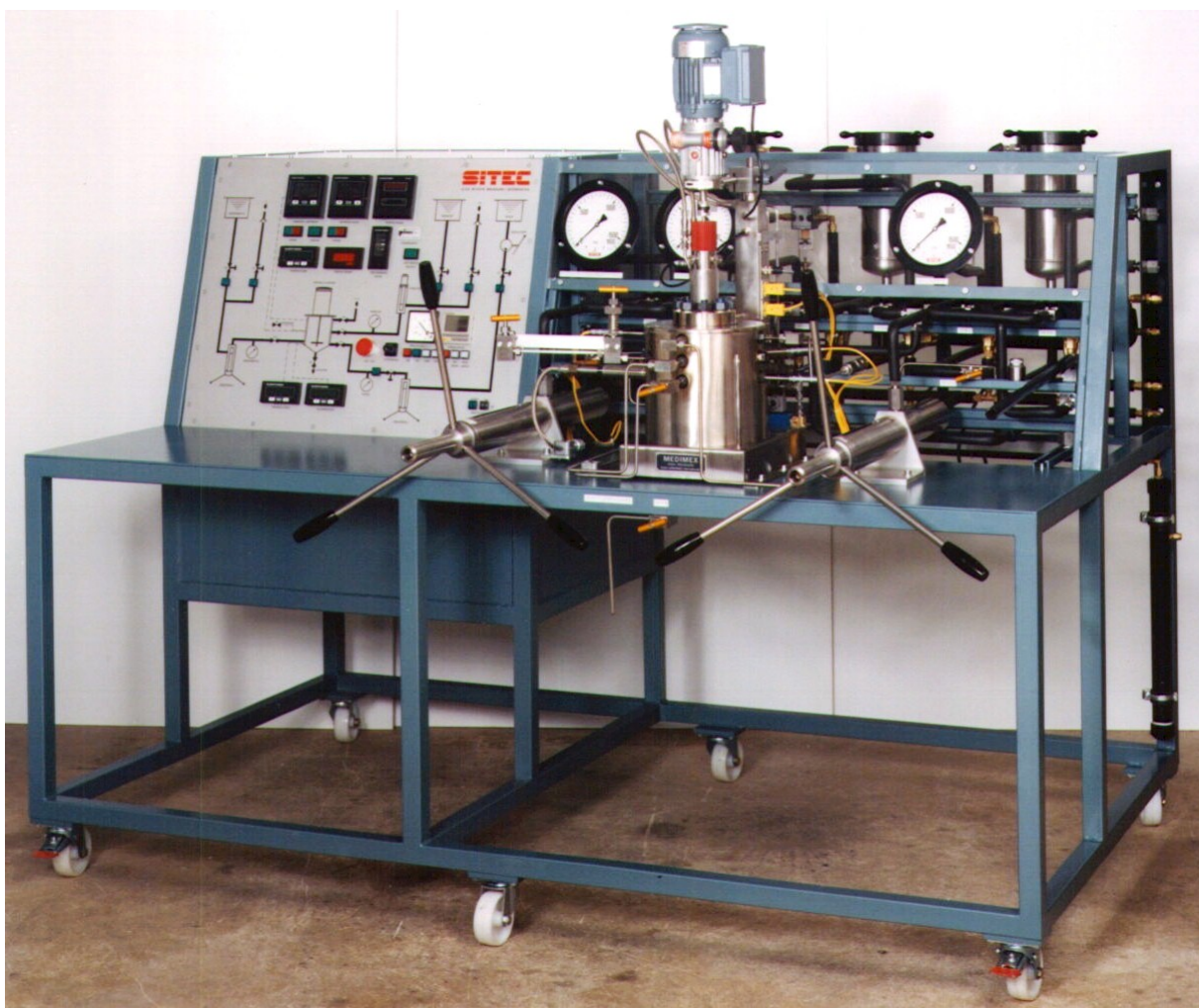
Reaction System with Bertly Type Reactor



High Pressure Reaction Pilot Unit for Catalytic Reactions with the following features:

- Reaction conditions 40 bar, 450 °C
- 2 gas supplies and 1 liquid supply (HPLC pump)
- Bertly type reactor (volume 120 ml) with magnetic stirrer and catalyst basket
- Time controlled product collecting system
- Data acquisition system for on-line visualisation and data recording

Supercritical Water Oxidation (SCWO)



High Pressure Reaction Pilot Unit for the investigation of supercritical water oxidation reactions (SCWO) with model substances. The main features are:

- max. reaction conditions 1000 bar / 700 °C
- Stirred high pressure high temperature reactor with water cooled magnetic drive
- Windows (optical width 6 mm) for the observation of the reaction volume
- Continuous metering of educts without any pulsations

Concluding Remarks

Apart from high pressure reaction pilot units SITEC also offers laboratory and pilot units for the following applications:

- Supercritical Extraction
- Phase Equilibria Measurements
- High Pressure Micronisation and Spray Drying (GAS and RESS process)
- High Pressure Sterilisation

Not only but especially in the field of high pressure reactions, there is a big demand for customised solutions. SITEC looks back on a 15 years experience in the design and construction of high pressure units and will tackle every problem that arises concerning high pressure applications.

Please let us know your specific requirements and fill in the attached questionnaire. We will do our best in order to find a customised solution.

We are looking forward to your inquiries, also for specialities.

Reference List for Pilot Plants

Rhône Poulenc, France	Chemical
University of Delft, Holland	Process Engineering
University Wageningen, Holland	Agricultural Research
BASF Ludwigshafen, Germany	Chemical
Salzgitter, Germany	Chemical
Hüls Chemie, Germany	Chemical
ENI, Italy	Petrochemical
Givaudan, Switzerland	Flavours and Fragrances
Research Centre Karlsruhe	Environmental
Reemtsma, Hamburg, Germany	Tobacco
CNRS, France	Food Research
TUBITAK, Turkey	Food Research
SASOL, South Africa	Waxes
DEGUSSA-SKW, Trostberg, Germany	Hops, Spices
Guinness, Ireland	Brewery Research
English Hop Products, Great Britain	Hops
Fraunhofer Institute Pfinzthal, Germany	Process Engineering
University of Bremerhaven, Germany	Food Research
Novartis, Switzerland	Chemical
Firmenich, Switzerland	Flavours and Fragrances
Haarmann & Reimer, Germany	Flavours and Fragrances
University of Messina, Italy	Chemical Engineering
MERCK, Germany	Chemical
University of Bari, Italy	Research
LIPI, Indonesia	Natural Products
F.Hoffmann-La Roche, Switzerland	Reactions
University of Tübingen, Germany	Pharmaceutical Research
National Technical University of Athens, Greece	Research
Inst. for "Nichtklassische Chemie", Leipzig, Germany	Research
University of Halle-Wittenberg, Germany	Research
Janssen Pharmaceutica, Beerse, Belgium	Drug Delivery Research
MAINELAB, Angers, France	Drug Delivery Research
Semnan University, Semnan, Iran	Research
JSC "Interbridge", Moscow, Russia	Research
Ecole des Mines d'Albi, Albi, France	Research

Additional units in following countries:

Denmark
Turkey
Belgium
Italy
Canada
Greece

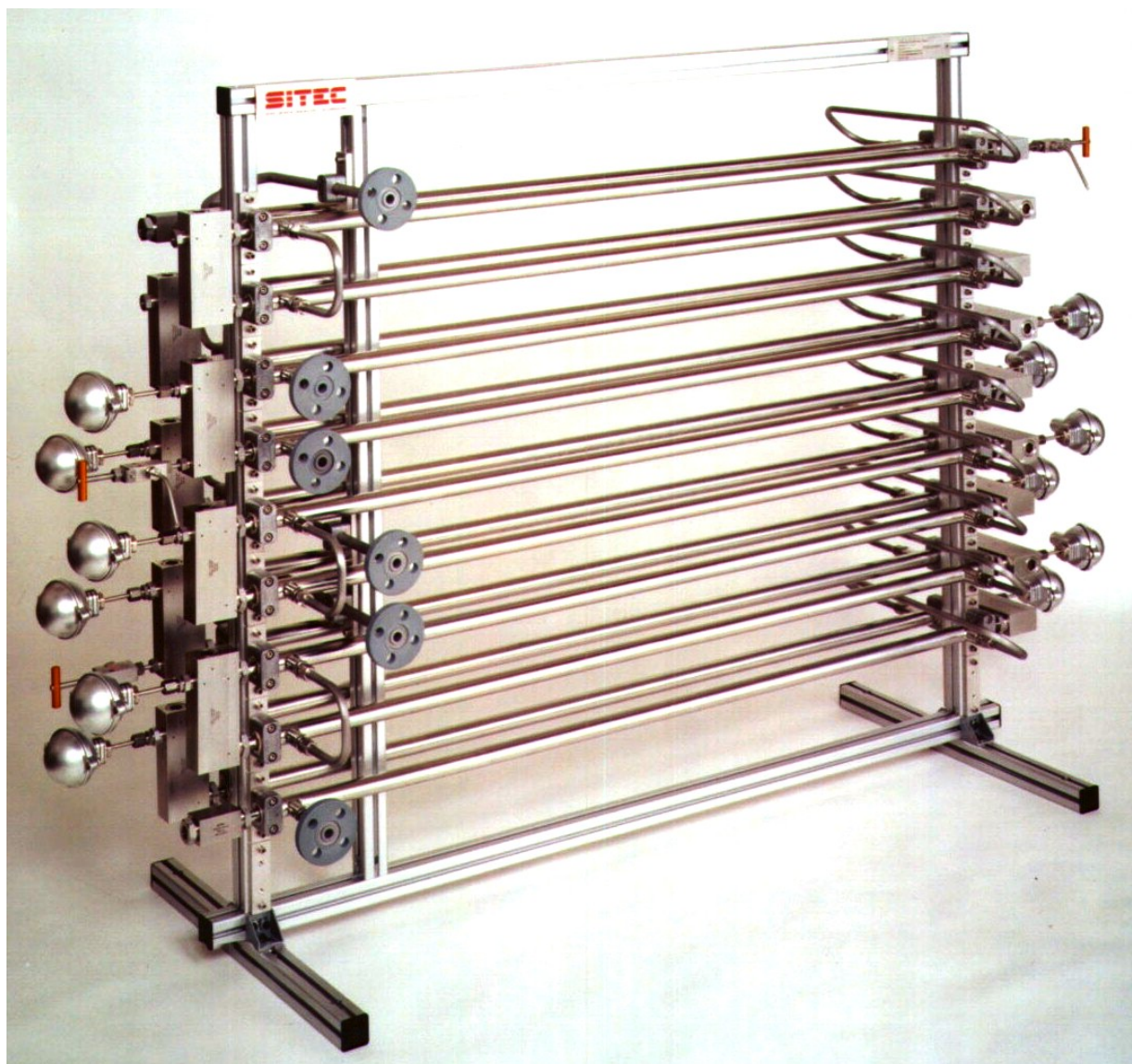
Germany
Holland
Switzerland
India
Bulgaria
Iran

South Africa
France
Great Britain
Ireland
Indonesia
Russia

Activities:

Flavours and Fragrances
Biotechnology
Chemical Industry
Coal Industry

Food Industry
Pharmaceutical Industry
Oil/Gas Industry



Continuous high pressure tube reactor with static mixing elements (200 bar, 300 °C, inner diameter 12 mm)

Standard Design and Options (Please mark required data)

Max. reaction pressure: **300 bar** 500 bar (700 bar)

Max. reaction temperature: **80 °C** 120 °C 150 °C 200 °C
 450 °C

Reactor type: Fixed bed tube reactor
 Reactor vessel with catalyst insert
 Berty type reactor

Reactor capacity: 100 ml with 60 ml catalyst basket
 200 ml with 120 ml catalyst basket

Gas supplies:	gas name	gas capacity	pressure generation required
		NI/h	<input type="checkbox"/> Yes <input type="checkbox"/> No
		NI/h	<input type="checkbox"/> Yes <input type="checkbox"/> No
		NI/h	<input type="checkbox"/> Yes <input type="checkbox"/> No
		NI/h	<input type="checkbox"/> Yes <input type="checkbox"/> No

Liquid supplies:	liquid name	capacity	capacity of supply tank	options
		l/h	litre	<input type="checkbox"/> heating up to°C <input type="checkbox"/> stirrer
		l/h	litre	<input type="checkbox"/> heating up to°C <input type="checkbox"/> stirrer
		l/h	litre	<input type="checkbox"/> heating up to°C <input type="checkbox"/> stirrer
		l/h	litre	<input type="checkbox"/> heating up to°C <input type="checkbox"/> stirrer

Options:

- Mass-Flowmeter for all gases all liquids
 Data acquisition system by PC
 PLC control with batch documentation