Customer satisfaction is our main goal

RELIABILITY
REPRODUCIBILITY
INNOVATIVE
VERSATILITY
FLEXIBILITY
SAFETY
About Us

✓ Process Integral Development Eng & Tech was founded in 2003 as a spin-off company of Catalist and Petrochemistry Institute (ICP) of Spanish Council for Scientific Research (CSIC) with 25 years of previous accumulated experience.

✓ The company has a total of 1400m2 available for offices, laboratory and production.

✓ More than 200 satisfied customers all over the world.
PID ENG & TECH PROFILE

Exclusive Patents

- **Automatic Reactor for Catalytic Microactivity Studies:**

- **Servo-Positioner for a Micro-Regulating Valve:**

- **Gas/Liquid Separator Comprising a Capacitive Level Sensor:**

- **Integrated Modular Elements for Process Control:**
  ES-2032182

- **Liquid1-Liquid2-Gas Separation at real time with no dead volume:**
  (Patent Pending P200930603, PCT/ES2010-070559)
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| MAT | MICROACTIVITY TEST FOR FCC ASTM D3907 |
|     | CSTR CONTINUOUS TANK PILOT PLANT    |
|     | GS GASIFICATION PILOT PLANT        |
|     | PL POLIMERIZATION PILOT PLANT      |
|     | SC SUPERCritical EXTRACTION        |
The MICROACTIVITY-Reference catalytic reactor (WO-2006008328 / EP-1757930 / US-2008063565) is a modular, automatic and computerized laboratory reactor designed to study reactions of catalytic microactivity.

Consists of a basic unit and some series of extra packages that improve or modify its efficiency.

A wide variety of reactions can be carried out in our reactors: Hydrocracking, Hydrotreating, Isomerization, Hydrogenation, Hydrodesulphurization (HDS), Oxidation, Hydrodenitrogenation (HDN), Polymerization, Reforming (aromatization), steam reforming, GTL (Fisher-Tropsch), etc.
First Modular catalytic reactor system

The basic unit can be upgraded and expanded with different configurations and options that modify or customize each unit according to the research project neededs or type of reaction.

The know-how acquired during the execution of more than 260 equipments enables us to configure a unit tailored to each user and process’s specific needs.
## PID Eng&Tech MICROACTIVITY-Reference Reactors 1991-2010

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**Catalyst and Petrochemistry Institute - CSIC (Spain)**
A MICROACTIVITY REACTOR EQUIPPED WITH THE HIGHEST TECHNOLOGY IN PROCESS CONTROL AND USING DIGITAL COMMUNICATIONS

REPETITIVE AND REPRESENTATIVE RESULTS IN REAL TIME

THE LABORATORIES REFERENCE INSTRUMENT IN CATALYST SCREENING
Patent nº P200401347
Automatic Reactor for Catalytic Microactivity Studies

WO-2006008328
EP-1757930
US-2008063565
BASIC UNIT

√ Tubular reactor with 20 µm porous plate, ID 9mm or highest, L=300mm
√ Low thermal inertia reactor furnace
√ 180ºC hot box to full preheating
√ 6 Port VICI reactor bypass valve
√ High pressure L/G separator without dead volume & with thermoelectric effect
√ Mass Flow Controllers for gas feeding and HPLC pump for liquids

AND HIGHLIGHTS...

√ Stable pressure control and flows
√ Dead Volume at L/G separator less than 1cc imply real time results in high pressure reactors at first time worldwide
**MICROACTIVITY-REFERENCE**

**MA-REF HIGHLIGHTS**

- **QUASI-ZERO DEAD VOLUME: RECOVERY OF GASES & LIQUIDS PRODUCTS ALMOST IN REAL TIME**

- **200°C HOT-BOX SYSTEM AVOID CONDENSATIONS**

- **HIGH PRECISION MICROMETRIC SERVOCONTROLLER VALVES BASED**
  FOR ACCURACY PRESSURE AND LEVEL CONTROL

- **AUTOMATIC LEVEL MEASUREMENT IN CONDENSER WITH DEAD VOLUME LESS THAN 1cc BASED IN PATENTED CAPACITIVE LEVEL SENSOR**

- **LOW THERMAL INTERTIA REACTOR FURNACE WITH 1050°C CERAMIC FIBERS**

- **FULLY AUTOMATIZED AND PROGRAMMABLE REACTOR, WITH DISTRIBUTED CONTROL STRUCTURE, ETHERNET COMMUNICATIONS AND REMOTE CONTROL**
LEVEL CONTROL IN THE LIQUID/GAS SEPARATOR

- Quasi-Zero dead volume (0.5 to 1 ml liquid volume)
- Capacitive sensor based on dielectric measurement of liquid
- Liquid condenser based in Peltier thermoelectric effect

Response obtained from 0.5 ml of many different fluids (Hz vs. $\varepsilon$) is linear

Changes in frequency response vs $\varepsilon$

The capacitive sensor response (Hz) is directly proportional to the dielectric constant ($\varepsilon$) of the condensed liquid inside the L/G separator

PCT ES/2005/070081
Capacitive level sensor for very reduced volume systems
EASY CONFIGURATION: THE TOUCH SCREEN

**Friendly control of:**

- Mass Flow controllers control and configuration
- Alarms and safety system configuration
- Level sensor calibration
- Cooling or heating of traces, condenser and others
- Control of on/off elements
- Some acquisition process values
AUTOMATED AND PROGRAMMABLE REACTOR

Microactivity-Reference MA-REF Highlights

Process@ software for Windows:

- Digital communications & Ethernet control

Friendly Supervision and Distributed Control Software in Real Time

Experiments Designed by Sessions That Run Sequentially
## MICROACTIVITY-REFERENCE

### AUTOMATION CAPABILITIES

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**Note:** The table above represents the automation capabilities with session times, conditions, and process variables. Each session has specific times, conditions, and values associated with them for process control.
MICROACTIVITY-REFERENCE

AUTOMATION POSSIBILITIES
**Kinetics studies with fast-deactivation catalyst processes**

This unit, in combination with the fast Micro-CG analysis techniques, allows to collect reaction data at times never before obtained in other catalytic reactors, particularly in high pressure reactions involving liquids products.

![Graph showing reaction data at various temperatures](Varian Micro-CG)

**Heterogeneous reaction - CaCeO$_2$-FD catalyst**

\[ C_{2}H_{6}:CO_{2}:He = 10:20:170 \text{ ml/min} \]
SERIAL PRODUCTION = HIGH QUALITY CONTROL

- Non stop testing protocols at different working pressures, temperatures & flows
MICROACTIVITY-REFERENCE

CONFIGURATION:

BASIC UNIT MAXXXM3

- **AE tubular reactor with 20 µm porous plate:**
  - I.D= 9.12, 13.1, 17.5 or 23.2 mm, L=305 mm
- **Low thermal inertia radiant type furnace**
- **Hot box preheat & to avoid condensations**

- **6-port bypass valve**
- **L/G condenser/separator based on thermoelectric effect**
- **Hi-Tec Mass Flow Controllers for gas feeding**
MICROACTIVITY-REFERENCE

CONFIGURATION:

PRESSURE CONTROL MAPXXM3

MAPXXM3 - PRESSURE CONTROL

- High Pressure Control System: Up to 100 bar
- Stability and precision in pressure control of ± 0.1 bar
- This UNIVERSAL micrometric control valve can be used with gases, liquids and mixtures, and also in low or high flows with low or high pressures, without any modifications in the system
MICROACTIVITY-REFERENCE

CONFIGURATION:

400 bar HPLC PUMP FOR LIQUIDS MAPGXM3

- HPLC liquid pump, 0.01-5 ml/m, 400 bar. Micro-back pressure for avoid pulsing flow
MICROACTIVITY-REFERENCE

CONFIGURATION:

LEVEL CONTROL IN L/G SEPARATOR MAPGLM3

- L/G SEPARATION IN CONTINUOUS MODE (REAL TIME OUTLET)
- Real time recovery of liquid products in 100 bar high pressure systems
- Level control in L-G separator: 0.3 to 1 ± 0.1 ml
- Based on capacitive sensor and micrometric servocontrolled valve

MAPGLM3 - LEVEL CONTROL IN L/G SEPARATOR

- Capacitive effect micro-level sensor
- Condenser/separator
- Condenser with Peltier effect cell & level sensor
- Micrometric valve for level control
MICROACTIVITY-REFERENCE

OPTIONS:

TWO HPLC PUMPS FOR LIQUIDS FEED

- Two HPLC pumps and evaporators can be installed simultaneously
INSTALLING A 2nd AUTOMATIC 6 PORT VALVE

FOR BY-PASSING THE L/G SEPARATOR

MAPGL2M3
WITH 2nd AUTOMATIC 6 PORT VALVE FOR BY-PASSING L/G SEPARATOR

FOR SELECTING THE REACTOR FLOW (UP/DOWN)

MAPGL1M3
WITH 2nd AUTOMATIC 6 PORT VALVE FOR SELECTING REACTOR FLOW (UP/DOWN)
INSTALLING 3 AUTOMATICS 6 PORT VALVES

MAPGL1M3
WITH 2nd AUTOMATIC 6 PORT VALVE FOR SELECTING REACTOR FLOW (UP/DOWN)
1 OR 2 EVAPORATORS WITH TEMPERATURE CONTROL

- Liquid evaporators with temperature control, up to 400ºC
OPTIONS:

SPECIAL INSTALLATIONS: SOLID FEEDING SYSTEMS

- Automatic solid feeding system for high pressure reactors
SPECIAL EXECUTIONS

- Different customized automatic multivalve systems
MICROACTIVITY-REFERENCE

OPTIONS:

HPLC PUMP: 80°C HEATING SYSTEM

- For feeding high viscosity liquids.
- Temperature control in liquid vessel.
- Temperature control in pump lines and head.
- N2 pressure regulator in heated liquid vessel for easy pump priming.
MICROACTIVITY-REFERENCE
AND OTHER OPTIONS...

- MASS FLOW METER: For gas outlet

- SCALE: For liquid outlet
SPECIAL EXECUTIONS:
2 UNITS – PARALLEL OR SERIAL WORKING MODE

Microactivity-Reference Nº 1

Microactivity-Reference Nº 2
2010 NEWEST CONFIGURATION: HIGH PRESSURE LIQUID1-LIQUID2-GAS SEPARATOR

F-T REACTIONS (GTL), LOOKING FOR THE RESEARCHERS NEEDEDS

- PCT/ES2010-070559 Liquid1 – Liquid2 – Gas separation in real time without dead volume for application on Fischer-Tropsch reactions (patent pending: P200930603)
“During the experiments and catalytic reactions we carried out with the Microactivity-Reference reactor, we could observe a totally satisfactory functioning and could appreciate the high friendliness of its use”  Dr. Jean Thivolle-Cazat, National Center of Scientific Research, SOMC, France

• “The after-sale support at PID Eng&Tech is probably the best, most professional kind of support that I have experienced so far in my career. The people at PID Eng&Tech have helped me and my group numerous times with any modifications, improvements and changes that we need to make in our equipments. They always answer promptly and they always deliver within reasonable time. They are fast and effective”  Prof. Costas N. Costa, Deputy Coordinator, Cyprus University of Technology

• “PID Eng&Tech is a fascinating company. It is like a dream come true for the applied researcher, enabling him to overcome many of the challenges related to the development of sophisticated experimental equipment in the area of Chemical Engineering”  Dr. José J. Pis, Carbon National Institute, CSIC
PID Eng&Tech ASTM MAT reactor is a fully automatic and computerized laboratory reactor (described in our ES2011993 patent) for the analysis of Fluid Catalytic Cracking Catalysts.

This MAT reactor is design to perform four independent and consecutive FCC test, following all the norms described by the standard method ASTM D3907, in automatic mode without the presence of operator.
This automatic MAT ASTM unit performs four consecutive experiments **without operator presence**.

With **excellent reaction temperature control**, and making use of an accurate HPLC pump for delivering diesel feed, even for reaction times as low as 10 seconds, **the unit performs consecutive onsite reaction and regeneration stages with a coke and reaction gas analysis**.

The 4 liquid samples are kept refrigerated until the end of the experiment sequence.
These Pilot Plants produce synthesis gas through the gasification of biomass, carbon or plastic waste.

PID Eng & Tech has also worked in the subsequent phases of reforming, gas-shift, COprox., ...

Features: Fluidized Reactor, Gasifying agent inlets, Precise Solid Feeding system (patent pending), Heated Cyclones, Scrubbers, Automatic control system.

The design of the system prevents hot gases from entering in the feeding hopper, which would ruin the experiment.
PID Eng & Tech has worked for several years in collaboration with industrial research centers to develop and implement several projects for polymerization pilot plants in both batch and **continuous** mode. This had led PID Eng & Tech to a high level of **knowledge**.

PID Eng & Tech, the leader in micro-scale technology, **has manufactured the first micro-scale plant in the world** for obtain bimodal polymers in **continuous mode** (patent pending).
Polymerization in Continuous Mode Pilot Plant
Supercritical extraction with CO2 at max 400bar.

Dosing pump 4L/h CO2 with cooling system and co-solvent addition.

2 Extractors from 350cc until 2 liters with pressure and temperature control.

Two 40cc separators with pressure and temperature independent controls.

Automated and Computerized control system.

Modular concept in his design.
LOCAL DISTRIBUTORS

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www.sinc.com.br

www.equilabo.com

www.techniksoconsultants.com
25 years of experience in designing computerized processing plants.

What means working with PID Eng & Tech:

- Reliability
- Reproducibility
- Innovative
- Versatility
- Flexibility
- Safety...and Satisfaction!

Improving competitiveness in the industry is sharply marked by developing new products with high quality features and a high added value.
CUSTOMER SATISFACTION IS OUR MAIN GOAL

PID Eng & Tech has implemented an Integrated Quality and Environmental management since 2006 certified according to Standards ISO 9001 e ISO 14001.
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Thank you