Batch Reactor Systems

Our Focus

ILS-Integrated Lab Solutions GmbH is a provider of state of the art custom-tailored research & development equipment.

By combining the skill sets of our experienced team with the needs and desires of our clients, we focus on designing and constructing world-class R&D systems for the petroleum, bulk- and fine-chemical and pharmaceutical sectors.

"Designing the System for Your Chemistry, Not the Other Way Around"
Experience in Batch Reactor Engineering

Reactor Design
ILS has extensive experience in the design and construction of a variety of different autoclave reactor technologies with volumes as low as 2 ml and as high as 100 liters. We can provide the following types of batch systems:

- Batch Reactors
- Semi-Batch Reactors (with gas and/or liquid feed)
- Continuous-flow reactors (continuous in one or more reagents)
- Internal-recycle reactors (for performing kinetic studies in the gas, liquid and slurry phase)
- Stirring-basket reactors (for performing kinetic and/or aging studies)

At ILS a great deal of attention is paid to the design of batch reactor systems. Each system is optimized for the following properties:

- Excellent mass transfer
- Isothermicity
- Ease of handling

In addition, we have extensive experience in working with air and moisture sensitive systems, such as polymerization.

We have provided autoclave based batch and CSTR systems for a wide variety of different chemistries. Validated applications include:

- Gas-to-Liquids, Fischer-Tropsch Synthesis
- Side-chain oxidation
- Standard hydrogenations
- Asymmetric hydrogenations
- Polyolefins
- Olefin Oligomerization
- Polyimide Synthesis
- Supercritical CO2 and H2O oxidations
- Hydrothermal zeolite synthesis

High-Throughput Testing
Maximizing Throughput without Sacrificing Data Quality
One of ILS's core competences is in the area of medium- and high-throughput experimentation. We have designed and validated a wide variety of systems with clients in the chemical and petrochemical industries. The numbers of reactors typically range from 2 to 16 and sample volumes for heterogeneous catalyst applications range from 100 mg to 10 grams.

Our medium- and high-throughput systems are designed to provide kinetic-quality data and not just approximate trends, allowing researchers to accurately differentiate between similarly performing catalysts; a common challenge in heterogeneous catalyst development.

Extreme Operating Conditions
During the last 4 years, we have worked closely with our clients to design a number of systems, which are capable of efficiently performing under difficult conditions, including:

- High Temperature Applications (850°C)
- High Pressure Applications (500 Bar)
- Handling of difficult materials such as paraffin and abrasive slurries (mixed-metal oxide slurries with high solids content)
On-Line Analytics
Many of our systems employ on-line analytics and gas and liquid sampling. The analytical devices are completely integrated into our reaction systems from both a hardware and software perspective. The user can configure the device via the system control software, and the system software automatically integrates process and analytical information, producing a single report from multiple sources in an export friendly format.

We can offer on-line liquid sampling, which enables the user to remove small liquid sample amounts (microliter to ml range) during reaction, without disturbing the reaction. The liquid may then either be manually collected or collected using an on-line liquid handler or liquid-phase GC.

We have extensive experience in on-line sampling (gas and liquid) with the following types of analytical devices.
- Gas Chromatography (gas & liquid, fast and normal)
- Mass Spectrometry
- Infrared
- Near-Infrared
- On-line liquid fraction collection

Automation-Combining Robustness with Flexibility
At ILS we only employ industry-recognized process-control systems for system automation. These systems conform to the highest industry standards of process safety and reliability.

All systems employ industrial-process control systems for system control, combined with a PC for user interaction.

Our standard solution uses Eurotherm process-controllers combined with Eurotherm's "In-Touch" SCADA package.

Other systems can also be implemented if required, we have extensive experience with the following process-controllers and SCADA systems:
- Eurotherm operating on Wonderware/In-Touch
- Honeywell
- Siemens
- Delta-V
- I-Fix

By employing a number of custom-designed software tools in combination with these robust process control solutions, we can provide added functionality such as analytical integration, gas/liquid sampling and recipe generation.

Our "Recipe Engine" tool allows the user to create multistep experimental recipes, which can then be stored and modified with ease. Implementation of the Recipe Engine enables the execution of long, multistep experiments with a significantly higher degree of accuracy and reproducibility than is possible when performing fully manual operation.
**Safety and Environmental Impact**

The initial engineering phase of our projects includes a detailed safety assessment using established, harmonized European norms and directives, including:

- HAZOP analysis
- EN1050 Machine safety analysis
- SIL analysis when process control safety systems are employed

External auditors (e.g. TüV Süd) are employed when required. Our safety systems can be adapted to meet the toughest on site requirements.

All heated components employ separate sensors (PT100 or thermocouples) operating on redundant, separate processors to maximize system reliability. In instances where poisonous and/or explosive gas atmospheres may be present, gas sensors and controllers are provided.

**Quick Delivery and Reliable Support**

One of our key strengths is our ability respond to clients’ individual wishes and realize these in system planning.

All ILS systems are drawn completely in 3D CAD prior to construction and nothing is built without agreement from our clients. This ensures that the system will fit well into existing infrastructure and provides a valuable tool for communicating technical ideas.

After-sales support is one of the most important aspects in the product lifecycle of a custom-designed reaction system. ILS places a great deal of emphasis on developing a close working relationship with our clients. This results in rapid commissioning of the system after delivery and reliable operation over time.

At ILS we pride ourselves on having experienced, knowledgeable and friendly staff who enable us to provide world-class R&D equipment at extremely competitive prices.

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