

Case Study: Immobilized biocatalysts in viscous reaction medium with rotating bed reactor

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Academic Research / Biocatalysis / Green Chemistry

Key results achieved:

- Research: Exploration of CalB in green solvents (ethanol, 2-methyl-THF, tetramethyloxolane, anisole, and eucalyptol) for the preparation of a defined mixture of bioactive fatty acid amides.
- Environmental impact: Faster and less energy-consuming reactions, together with the possibility of reusing the immobilized biocatalyst over multiple reaction cycles.

Alternative platform to flow chemistry

Prof. Martina Letizia Contente's research group at Università degli Studi di Milano faced a critical bottleneck in their biocatalysis work. They needed to process highly viscous substrates and products, involving microbial lipids and fatty acids, while contacting the substrates with immobilized enzymes (CalB).

The research team faced significant challenges:

Batch mode: Mechanical stirring can damage immobilized enzyme beads, and mixing is inefficient in viscous media.

Continuous processing: The high viscosity of the fatty acid mixtures led to tube blockage, preventing reliable operation of the system for this application.

"We tried to go to flow chemistry. And basically everything was blocked, stuck into the tubes. And at that point, we said, okay, we need to change something in our reactor shape."

— Prof. Martina Letizia Contente

Beyond simply completing reactions, the research team needed a system that would reduce reaction time and solvent waste, improve energy efficiency, handle multiple substrates at different concentrations simultaneously, and enable efficient catalyst recovery and reuse. These were essential requirements for advancing their research in sustainable chemistry.



Image 1. SpinChem rotating bed reactor set up in the laboratory at University of Milan

How Rotating Bed Reactor technology solved viscosity challenges and catalyst damage

Prof. Contente chose to implement the RBR technology as a complementary solution to their flow chemistry setup.

The team found the RBR setup remarkably simple. The process involved just three steps: placing the immobilized enzyme beads in the RBR, closing it up, and adding the viscous reaction mixture to the glass vessel before starting the rotation.



Image 2. Immobilized enzyme beads loaded into the SpinChem rotating bed reactor (RBR). The RBR protects the catalyst beads during reaction.

Immediate impact and ongoing value

"We were able to reach complete conversion of our reaction in a few hours, and we decided to explore more."

— Prof. Martina Letizia Contente

The first attempt with RBR technology delivered results that exceeded expectations, with immobilized enzyme beads maintaining perfect physical integrity throughout the reaction and multiple reuse cycles. This stood in sharp contrast to batch experiments where magnetic stirring completely destroyed the catalyst, leaving only powder residue.

The success extended beyond a single reaction. The RBR handled complex multi-substrate systems and enabled the research group to accelerate their exploration of different immobilized biocatalysts, green environments, and new reaction configurations.

Key benefits of SpinChem[®] rotating bed reactor:

- Complete conversion achieved in just a few hours
- Zero catalyst degradation leading to maintained bead integrity through multiple cycles
- Complex reaction success handling four different substrates at varying concentrations
- Simple setup with straightforward implementation

Conclusion

The implementation of SpinChem[®] rotating bed reactor technology at the University of Milan demonstrates how the right reactor configuration can transform challenging biocatalysis work.

By providing effective mass transfer in viscous liquids while protecting catalyst integrity, the RBR enables researchers to achieve results that conventional approaches could not deliver.

Related publications

Prof. Contente's research group has published multiple peer-reviewed papers using SpinChem RBR technology, demonstrating their expertise in biocatalytic process intensification:

- "Spinning Green: Lipase-Catalyzed Synthesis of Bioactive Fatty Acid Amides..." (ACS Sustainable Chemistry & Engineering, 2025), featuring the impressive 5-fold time reduction and enzyme reusability results

[Read the full publication](#)

- "Boosting the catalytic performance of a marine yeast..." (Reaction Chemistry & Engineering, 2023), demonstrating >90% conversion with immobilized whole cell biocatalysts

[Read the full publication](#)

Learn more about SpinChem's Rotating Bed Reactor technology



Case study based on an interview with Prof. Martina Letizia Contente, the Department of Food, Environmental and Nutritional Sciences (DeFENS), Università degli Studi di Milano.