Numerical Modelling of the Original and Advanced Version of the TEMKIN-Reactor for Catalysis Experiments in Laboratory Scale

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Introduction
Many industrial, especially heterogeneously catalysed, processes are characterised by a strong interaction between the reaction kinetics and transport phenomena. Because experiments in laboratory scale can be very time- and cost-intensive, Temkin and Kul’kova developed a new reactor design for the direct testing of industrial catalysts.[1] Based on this concept of linearly alternating catalyst and inert pellets inside a small tube, our working group developed an advanced version of this reactor where the catalyst pellets are aligned in the centre of separate small cavities.[2] The performance of the two TEMKIN reactor designs regarding catalysis experiments is evaluated and compared by using COMSOL Multiphysics®.[3,4]

Overview
TEMKIN reactor design
- Original version
- Advanced version

Computational Method
Mass, energy and momentum balances
- Distinguishing between different domains:
  - Original version
  - Advanced version

Validation
Pulse tagging experiments
- Fast pulse detection using a thermal mass flow meter

Performance Evaluation regarding Catalysis Experiments
Residence time distributions
- Simple CSTR cascade models fail due to complex intraparticular mass transport

Influence of mass transport
- Minimising transport limitations by reducing dead zones

Thermal conditions
- Isothermal behavior in both reactor types

References

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