NiTech® Technology Characterisation Academic Examples

These slides summarise cases where NiTech® technology has been characterised in academia.

Content

Academic Characterisation Work

- Ozone-Water Mass Transfer Study
- Air-Water Mass Transfer Study
- COBR Cleaning Protocol

Ozone Mass Transfer Study

A. Al-Abduly, P. Christensen, A. P. Harvey, and K. Zahng, **"*Characterization and optimization of an oscillatory baffled reactor (OBR) for ozone-water mass transfer*,"** Chemical Engineering and Processing 84 (2014), 82–89

Overview:

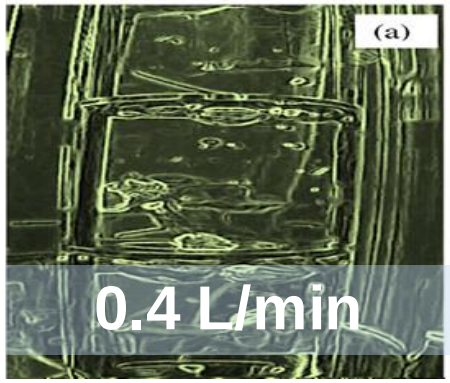
Ozone-water mass transfer was investigated in:

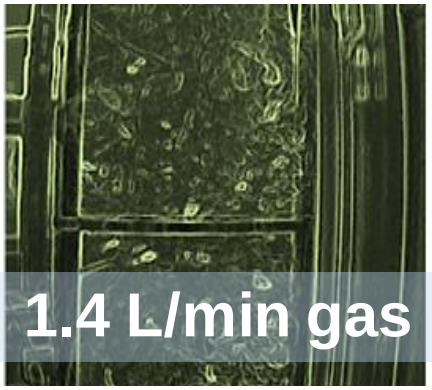
- A semi-batch OBR (continuous gas; batch liquid)
- A co-current, up-flow continuous OBR
- A baffled column (no oscillation)
- A bubble column (no baffles or oscillation)

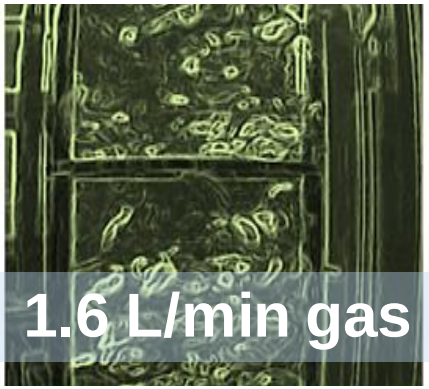
Result:

- Ozone-water mass-transfer in the OBR was 5 and 3 times more efficient than in the baffled and bubble columns, respectively, in semi-batch mode.
- Continuous mode was twice as efficient as semi-batch for the OBR.
- The enhancement decreases with increasing gas flow, due to changes in the flow pattern.
- The significant enhancements using an OBR under atmospheric pressure, using a short reactor length, and low gas/liquid volumetric ratios make this type of reactor one of the most effective contactors for ozone-water mass transfer.

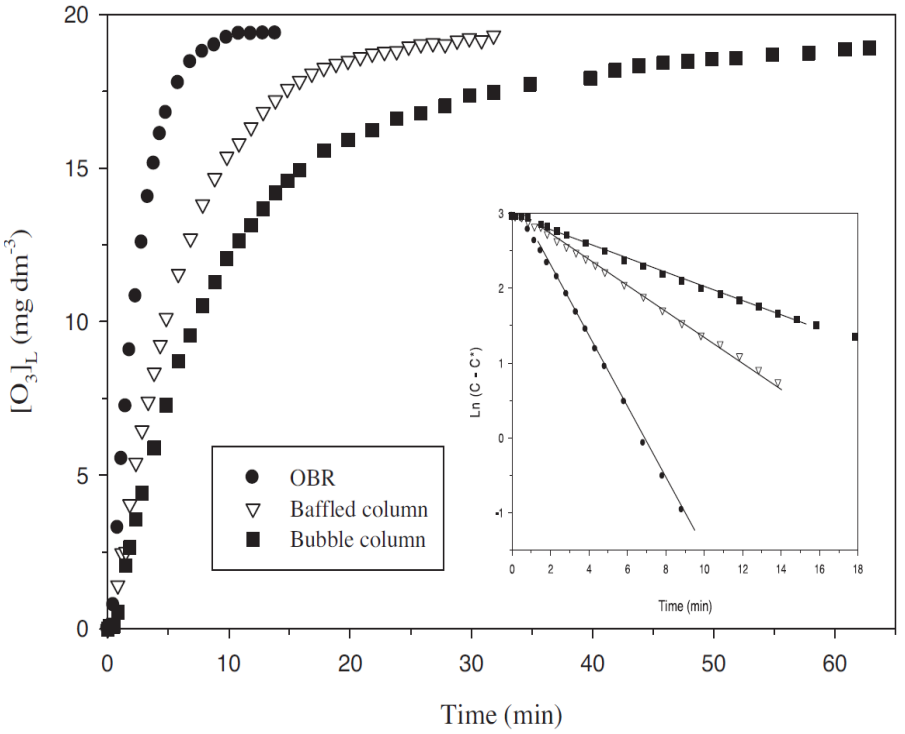
Ozone Mass Transfer Study







Ozone dissolution as a function of time and graphic representation of mass transfer constant



Air-Water Mass Transfer Study

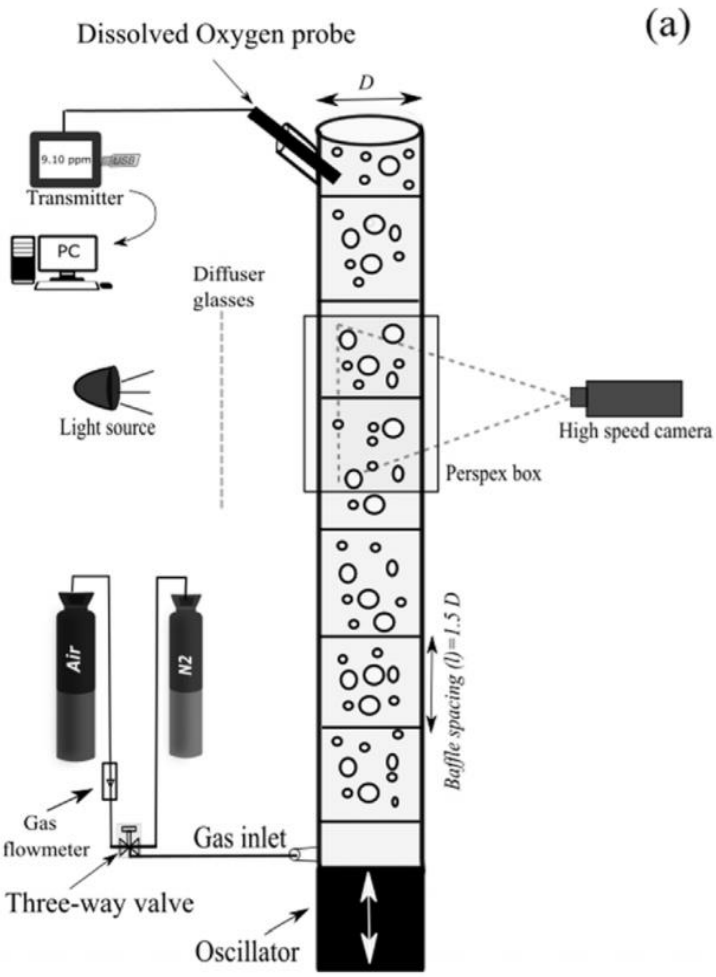
S. M. R. Ahmeda, A. N. Phana, and A. P. Harvey, ***"Mass transfer enhancement as a function of oscillatory baffled reactor design,"*** Chemical Engineering & Processing: Process Intensification 130 (2018), 229-239

Air-water flow regimes were investigated for semi-batch OBRs (continuous gas; batch liquid).

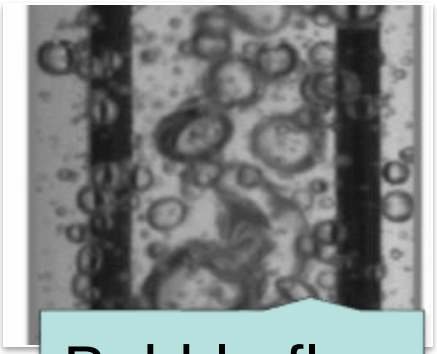
3 flow regimes (bubbly flow, slug flow, and churn flow) were identified, like in conventional bubble columns, but the **bubbly flow regime**, which exhibits the **highest rates of mass transfer, was observed over a wider range of conditions.**

The flow patterns caused by the interactions of the oscillatory flows and the baffles resulted in coalescence and breakage of the bubbles.

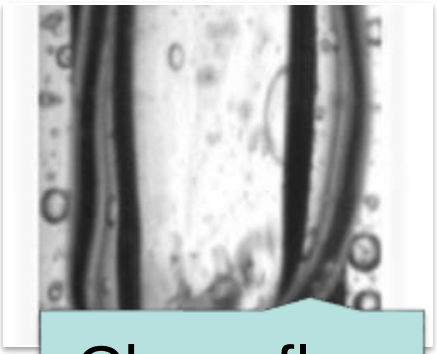
Volumetric mass transfer coefficients were significantly increased compared with that for no oscillatory flow in an unbaffled column.



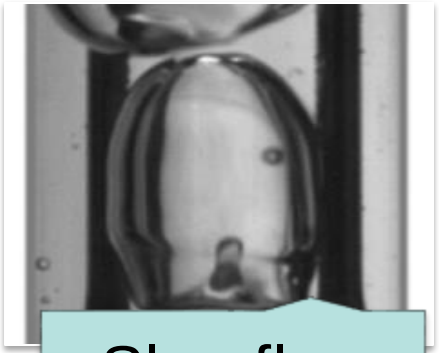
Air-Water Mass Transfer Study



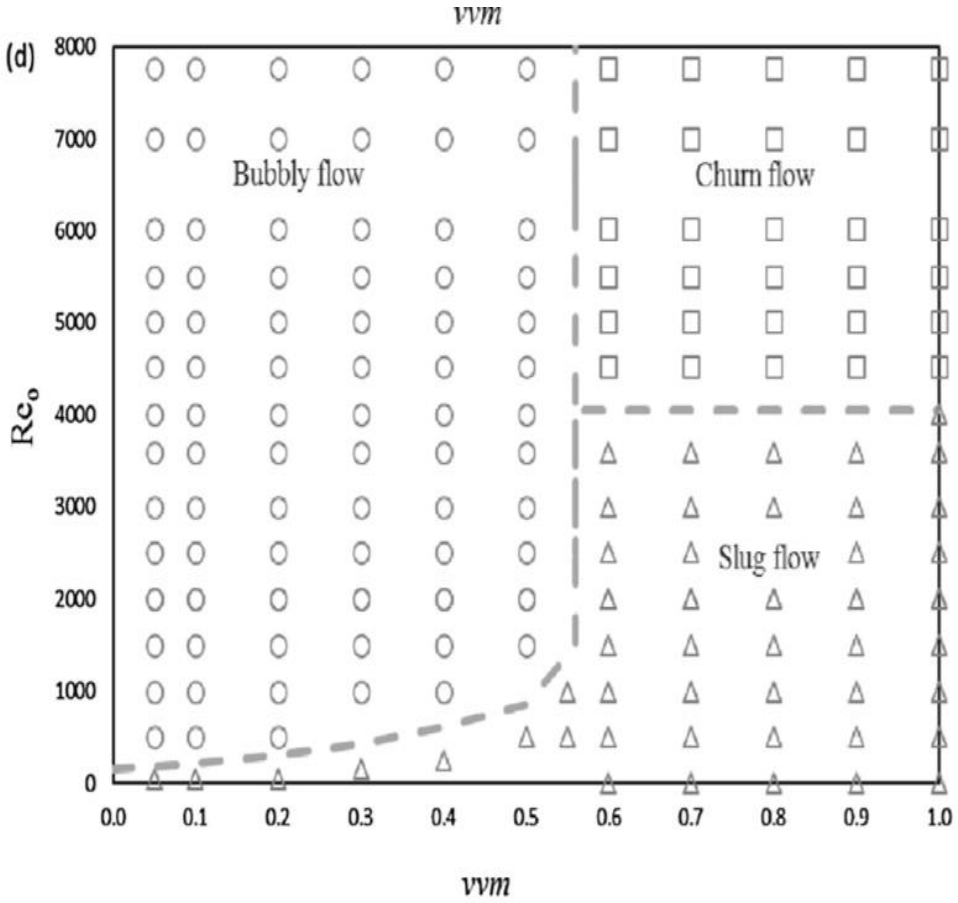
Bubbly flow



Churn flow



Slug flow



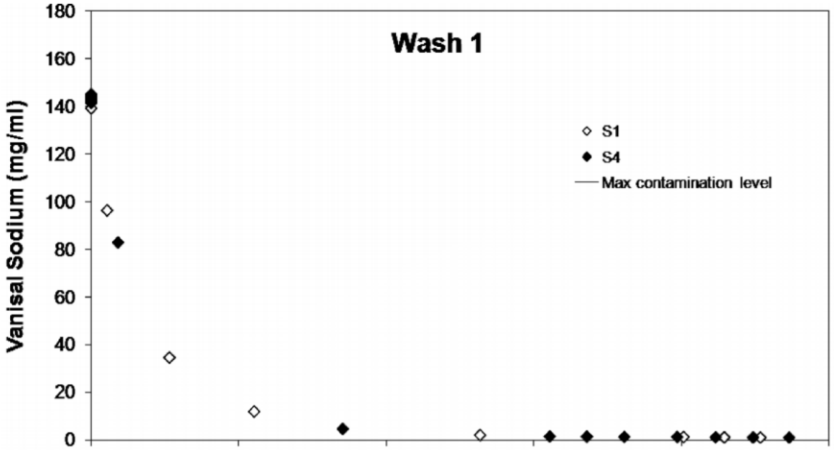
COBR Cleaning Protocol

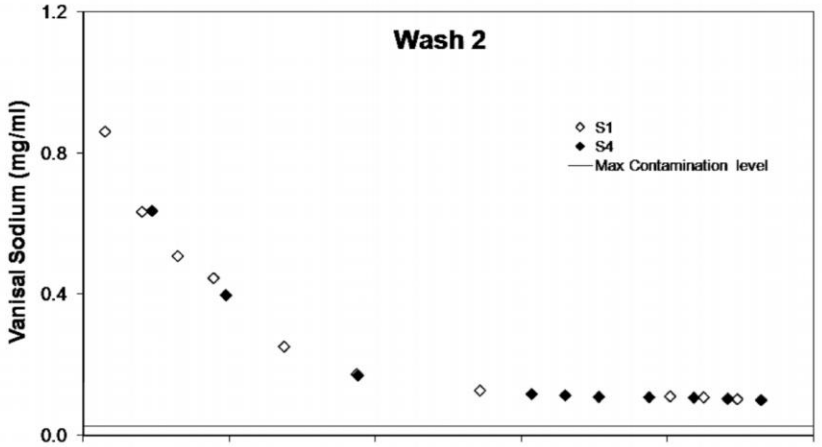
- *R. Caldeira and X. Ni,* ***"Evaluation and Establishment of a Cleaning Protocol for the Production of Vanisal Sodium and Aspirin Using a Continuous Oscillatory Baffled Reactor"*** *Organic Process Research & Development 13, 2009, 1080–1087.*

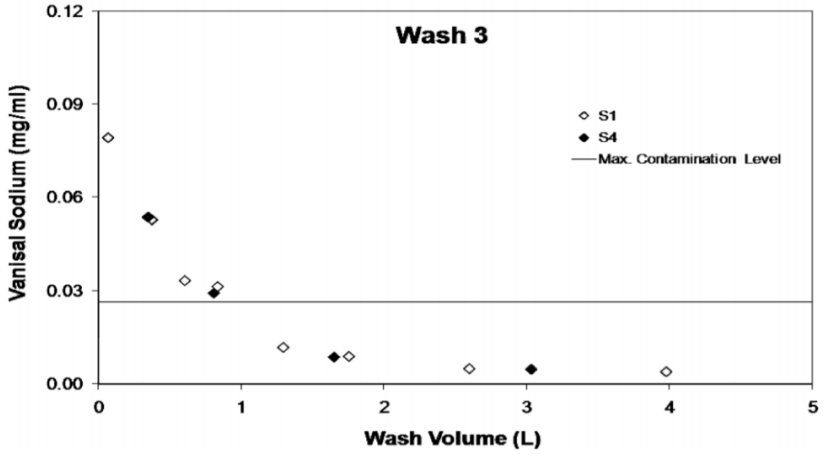
- Studies were carried out to determine the robustness and adaptability of a COBR by analysing:
  - A week-long production run of vanisal sodium (achieved 99.94 % product purity)
  - A week-long production run of aspirin (achieved 99.57 % product purity)
  - A cleaning process following each production run (which minimised losses to 0.001 % and 0.005 % for vanisal sodium and aspirin, respectively; industrially norms were cited as 0.1 – 0.2 %)

- Reliable running and effective + efficient cleaning were shown.

COBC/R Cleaning Protocol: Reagent concentration vs wash volume for vanisal sodium cleaning







COBC/R Cleaning Protocol: Reagent concentration vs wash volume for aspirin cleaning