Chemeca2026
Innovate. Integrate. Impact.
28 – 30 September 2026
Melbourne, Australia

Hazards Australasia 2026

Chemeca 2026 and Hazards Australasia
28 – 30 September, Melbourne, Australia

Buoyancy-driven droplet collisions in oil-water systems

Dinesh S. Karra[1], Abdul R. V. Rasheed[1,2], Dalton J. E. Harvie[1], Raymond R. Dagastine[1] and Joseph D. Berry[1]

[1] Department of Chemical Engineering, The University of Melbourne, VIC 3010, Australia

[2] School of Engineering, University of Newcastle, NSW 2308, Australia

berryj@unimelb.edu.au

ABSTRACT

Understanding whether droplets coalesce or bounce under realistic liquid–liquid conditions is critical for processes such as solvent extraction. Accurate prediction of droplet collision outcomes, e.g. coalescence or bounce, is crucial for process design, yet liquid–liquid studies remain scarce despite their direct relevance to solvent extraction.

Existing experimental approaches either eject droplets at high speed from opposing needles, which produces poorly controlled collision locations and significant background flow, or bring a droplet on a needle slowly into contact with another on a substrate, which does not represent industrial conditions.

We report controlled experiments on oil–water droplet collisions driven by buoyancy, considering two configurations: a fixed collision where a released drop impacts a second droplet pinned to a needle, and a free collision where both drops are released and interact away from needle influence. Numerical modelling accompanies the experiments, employing a sub-grid thin-film drainage model coupled to a volume-of-fluid (VOF) method to resolve droplet deformation and film dynamics.

Our results reveal that, unlike in liquid–air systems, off-centre collisions at low Weber numbers tend to coalesce. These findings clarify collision behaviour in liquid–liquid systems under more realistic industrial conditions and provide validated modelling tools for predicting outcomes relevant to extraction processes.

KEY WORDS

Coalescence, Droplet collisions, Thin-film drainage, Modelling, Solvent extraction

BIOGRAPHY

A./Prof. Joe Berry is an ARC Future Fellow in the Department of Chemical Engineering at the University of Melbourne. His research focusses on the development and application of numerical models to solve complex, multi-disciplinary engineering problems to yield quantitative understanding directly relevant to industry. He has extensive experience in model development for research and industry, and was awarded the 2021 Barry Inglis Medal from the National Measurement Institute of Australia (an annual award recognising outstanding achievement in measurement research and excellence in practical measurements in Australia).

CONFERENCE PROGRAM

Please indicate which conference program your abstract relates to:

☐ Hazards Australasia

☒ Chemeca