

Predicting and reducing sand erosion

CSIRO has developed capability and predictive tools for sand erosion challenges in the oil and gas industry. We assist industry to address their sand erosion issues and seek to predict, minimise or mitigate these hazards.

As part of our sand management program our erosion capability is strategically positioned, spanning CSIRO’s multiple-disciplinary expertise and facilities, to address issues related to sand erosion. We have developed unique models to predict the severity and extent of sand erosion damage on of industrial equipment subject to wear by sand particles.

As sand is liberated from the reservoir in the flow stream, it is transported through the producing system and over time is detrimental to the production tubing and downstream equipment. Our team uses state-of-the-art computational fluid dynamics (CFD) platforms, validated by physical experiments, to predict the location and severity of sand erosion for at-risk equipment. Physical models include multi-layer paint, actual material erosion tests and surface profile measurement techniques. We can tailor research programs to suit specific needs, and are experienced in the analysis and interpretation of sand-eroded equipment. Based on our analyses, we can also assist in formulating solutions to alleviate or mitigate risks associated with sand production.

Expertise

Our sand erosion capability comprises expertise drawn from cross-disciplinary areas including:

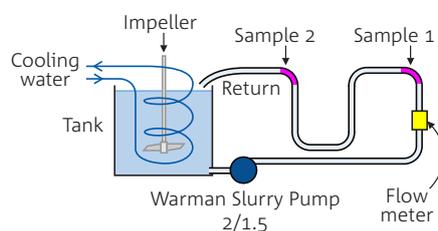
- ♦ fluid mechanics
- ♦ mathematics
- ♦ numerical modelling
- ♦ laser diagnostics
- ♦ material science
- ♦ measurement science
- ♦ mechanical design
- ♦ instrumentation design.

Due to the unique functional structure of CSIRO, wider-ranging expertise can also be accessed if required.

Facilities

Sand erosion is a multi-disciplinary topic and requires access to a suite of specialised facilities and instrumentation. CSIRO’s sand erosion facilities and capabilities includes:

- ♦ erosion flow loops in various physical states, including gas–solid, liquid–solid, and gas–liquid–solid
- ♦ scale-up facilities including various pressure vessels for elevated pressure testing, inclinable flow loops (various pipe sizes, 2” to 6”) and flexible pipe erosion testing facility (up to 6” internal diameter)
- ♦ instrumentation including surface metrology devices (coordinate measurement machine and linear variable differential transformer), Malvern particle sizer, particle image velocimeter, 3D laser doppler anemometer, focussed beam reflectance measurement and various high speed cameras
- ♦ microscopy services (multiple variants on both scanning and transmission electron microscopy)
- ♦ material and chemical analysis equipment – mass spectrometry (MS) and inductively coupled plasma-atomic emission spectroscopy (ICP-AES)
- ♦ parallel computing facilities for CFD simulations.



Liquid–solid erosion flow loop.

Applying the capability

Sand production is a common occurrence in most oil and gas fields. When sand ultimately encounters the completion equipment and enters the production tubing, it is transported to the platform and results in the erosion of production equipment to variable extents.

CSIRO’s sand erosion team can assess the effect of sand erosion on a given piece of equipment through physical and computational modelling campaigns. The ultimate goal is to create erosion models to predict the high-risk erosion areas under field conditions, and provide an indication of equipment viability as a function of surface degradation through continuous sand particle impacts. This approach enables operators to plan maintenance schedules of at-risk equipment more accurately.



Coordinate measurement machine for surface profiling measurements.

Our partners

We are actively engaged with major oil and gas producers and service providers including the Western Australian Energy Research Alliance (WA:ERA), Chevron Australia, Technip Oceania Pty Ltd, Petroliam Nasional Berhad (Petronas) and Woodside Energy Ltd.

Getting involved

Interested parties can contact us to address specific issues related to their particular sand erosion challenges. Parties can access our specialised capabilities (facilities, tools and equipment) and expertise developed over more than 10 years. Industry engagement can occur through partnerships, licensing arrangements and technical services agreements.

Key contacts

Dr Seng Lim

Group Leader

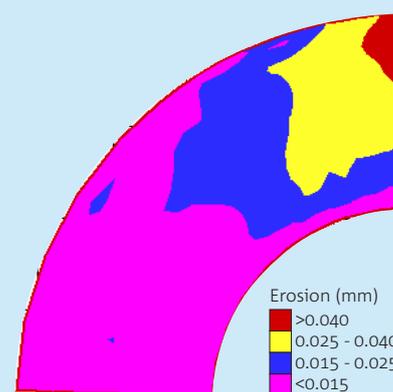
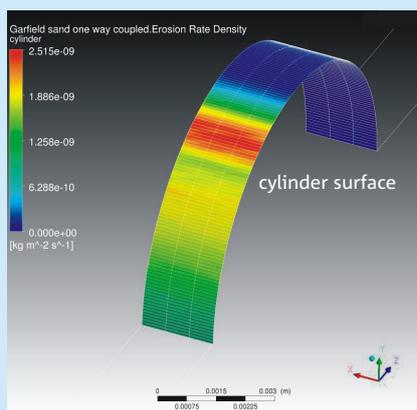
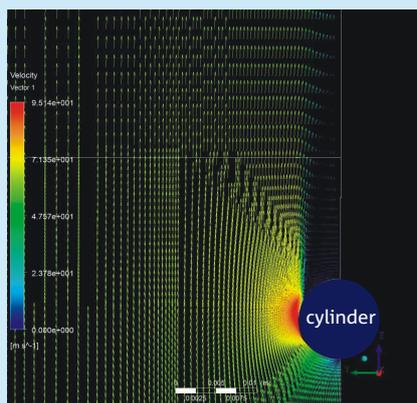
Oil, Gas & Fuels Program

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Case study

Sand erosion of annular cavities, hole shoulders and cylindrical intrusions pose inherent risks to oil and gas equipment. The sand erosion team has quantified erosion on these elemental configurations through physical experiments. We have also built empirical erosion sub-models and employed CFD techniques to predict the extent and severity of the erosion on these physical models. In the annular cavity case, we have designed configurations that minimise or eliminate erosion in annular cavities found in oil and gas facilities.



CFD case study of air-suspended sand eroding a cylindrical rod (Wong et al. (2010) SPE-132920-PP).

Multilayer paint erosion modelling on a pipe bend (J. Wear, 2011, 270:598-605).

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