

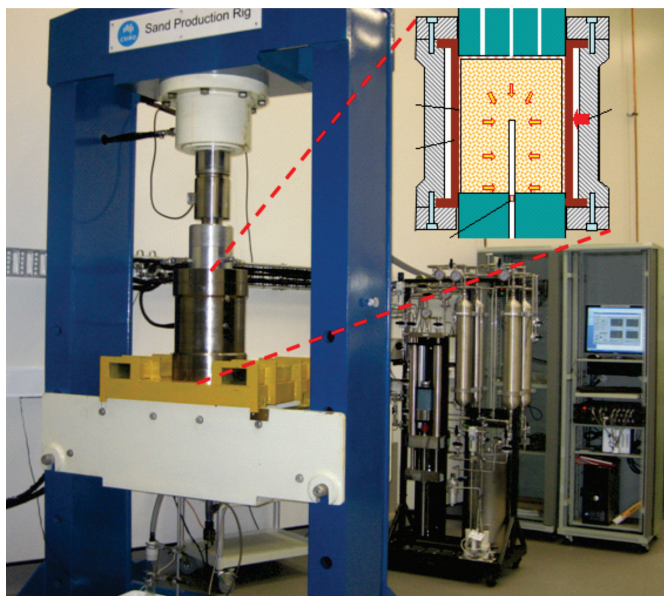
Sand production prediction

Sand production is a serious problem in many petroleum basins worldwide. It costs the oil and gas industry tens of billions of dollars annually. CSIRO has developed capability and unique models to predict sand production and its severity – a key step in tackling sand production problems.

The process of sand production can be divided into three stages:

- ♦ sand failure at grain scale in the formation surrounding a perforation or borehole
- ♦ mobilisation and detachment of sand particles and/or aggregates in the failed rock due to hydrodynamic force of the producing fluids
- ♦ transportation of the sand particles and/or aggregates to the surface via wellbore or settlement at the bottom of the well.

The sand production prediction model developed at CSIRO captures the fundamental mechanisms of this process. This enables sand production severity as well as sand production onset conditions to be quantified. This information is critical in making an informed decision on whether to manage sand production on topside or to control sand production downhole.



Sand production rig.

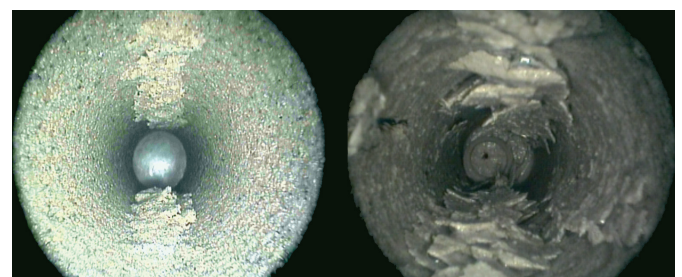
Expertise

The expertise of the sand production team is drawn from relevant disciplines, such as geomechanics, rock mechanics, numerical modelling, mathematics, geology and production and reservoir engineering. Other expertise can also be deployed if required due to the multi-disciplinary nature of CSIRO.

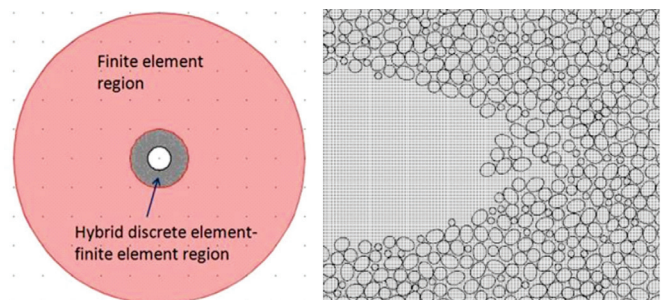
Facilities

In order to address issues related to sand production, a suite of facilities and analytical equipment at CSIRO are made available and form part of the sand production prediction capability. These include:

- ♦ autonomous triaxial cells (70 MPa)
- ♦ high pressure triaxial cell (300 MPa)
- ♦ HPHT triaxial cell (150 MPa and 200oC)
- ♦ Hoek cell (70 MPa)
- ♦ polyaxial cells (cubic samples with 300mm and 400mm side dimensions respectively)
- ♦ sand production cells (sample diameter 86mm and 200mm respectively)
- ♦ ultrasonic transmission and acoustic emission measurement systems
- ♦ particle sizing instrumentation – Malvern particle sizer
- ♦ microscopy services – such as SEM
- ♦ micro x-ray CT scanner
- ♦ XRD.



Photos of borehole failure, Castlegate sandstone under an anisotropic stress (left), and downhole sandstone under an isotropic stress (right).

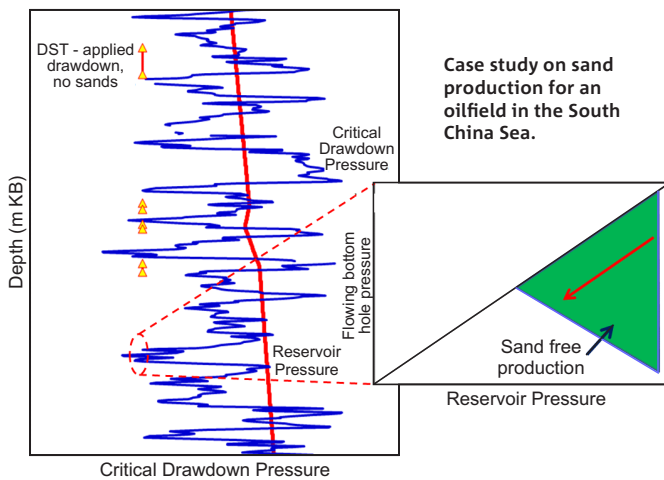


Modelling sand production processes using a hybrid continuum/particulate approach, showing the Finite Element Method (FEM) and hybrid Discrete Element Method/FEM regions (left) and cavity development (right).

Applying the capability

Sand production technology developed at CSIRO can be utilised to:

- ♦ calculate the maximum drawdown pressure for sand-free production
- ♦ determine the lowest reservoir pressure at which sand-free production is not possible
- ♦ optimise well trajectories and perforation orientation for avoidance or minimisation of sand production risks
- ♦ evaluate sanding tendency from openholes, and cased and perforated wells
- ♦ assess sanding tendency for all reservoir formation intervals to identify selective perforation opportunities
- ♦ quantify sand production severity using a hybrid DEM/FEM approach, including estimates on sanding amount and rate
- ♦ evaluate well/completions integrity for entire well life
- ♦ evaluate sand screen performance using a coupled DEM/CFD approach and predict particle size distribution of produced sands.



Our partners

Over last 15 years we have been actively engaged with some of the major oil and gas producers such as Chevron, CS Mutiara Petroleum, JOGMEC, JVPC, Newfield, PETRONAS, Santos, Shell Australia, Shell Sarawak and Woodside.

Getting involved

Interested parties can contact us to address specific issues related to their particular scenarios of sand production. Parties can access our specialised capabilities (facilities and equipment) and expertise developed over more than 15 years. Industry engagement can occur through partnerships, licensing arrangements and technical services agreements.

Case studies

An oilfield in the South China Sea experienced variable sand production. There was considerable concern regarding sand production on well performance in the existing and new wells. CSIRO performed a sand production study for the field, including laboratory sanding experiments on full diameter cores and calculation of critical drawdown and critical reservoir pressures. The study identified a specific depth for the field that separated high risk from low risk sand production reservoirs. New wells were completed based on the sanding risks identified in the study.

Prior to field development, a study on sand production risk for an oilfield in Turkmenistan was conducted using CSIRO's sand production technology. The study concluded that the sanding risk for the field was high and recommended installation of downhole sand control. Due to issues with logistics, no downhole sand control was installed in early production wells. Significant erosion in production equipment was observed after producing for a couple of years, which resulted in costly well intervention.

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