Curtin Oil & Gasbag

The Quarterly Newsletter from Curtin Department of Petroleum Engineering

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Head
Brian Evans
Tel: 9266 7092

Faculty
Akim Kabir
Vamegh Rasouli
Reza Rezaee
Robert Amin
Ebenezer Sholarin
David Pack
Colin Williams
Robert Johnson

Adjunct Faculty
Jim Peden
Jorge Sampaio
Rodney Haliburton

M Pet Eng
21 students
M Well Eng
20 students

PhD students
Charlie Gao
Reza Taheri
Ali Saeedi
James Underschultz
Stuart Weston
Affonso Lourenco

Administration
Lisa Smith
Tel: 9266 7857

Since our last newsletter in March, there have been many changes and new initiatives within the department. Major changes from 2009 onwards include:
1. The Masters in Petroleum Engineering will be operated on a conventional university semester basis rather than block taught as it presently is.
2. We are introducing a new 2-year award "MSc in Petroleum Engineering", which will allow students to take an industrial research project which will link them with industry.
3. We will be co-teaching collaboratively with UWA through the use of *Tele-teaching* over the web ACCESS grid. Using iVEC and WAERA funding, the ARRC building Auditorium has been converted to run 4 cameras and 12 microphones, so that students at UWA and Curtin can sit in the same class with the one lecturer (who can be at either location).

Since the last newsletter, the Industry Advisory Committee met and thanks go to Ian Sylvester (Woodside), Frank Descant (Chevron), Edwin Quint (Shell), Miles Ponsonby (Halliburton), Dave Manning (VRMT), Ron Horner (Chevron), Simone Pettorino (AWT), Stephen Thatcher (ConocoPhilllips), Marie Malaxos (ARC Energy), Tim Quinlan (Schlumberger), Phil Huizenga (Carnarvon), and Keith Dowling (Apache) for their support.

We are building a new teaching lab and two new research labs- with a focus on geomechanics and wellbore fluid dynamics.

We are modifying the three-phase core flooding laboratory so that we can record sonic and resistivity data while flooding at HPHT conditions. We are expanding our research profile to enable us to increase our research capabilities. This has included commencing Friday afternoon seminars with the Woodside Research Facility (WRF), and linking with UWA, University of Adelaide and UNSW to develop future joint research projects. We are developing JVs with companies, which will allow our research staff to work on industry problems, alongside their industry colleagues.

We are also pleased to announce that PhD student Charlie Gao had his PhD approved last week and he received an award from the Chinese Embassy in Canberra for his contributions to engineering by an overseas Chinese student.

Finally, we would like to congratulate PhD student Reza Taheri for winning the SPE best postgraduate student award at the Muscat regional conference. The award was presented at the SPE conference in Dubai.

Please see the Technical Paper by PhD student Charlie Gao over the page.

Any comments- please contact Brian on b.evans@curtin.edu.au
Course enquiries- contact Akim on a.kabir@curtin.edu.au
Administrative enquiries- Lisa on lisa.smith@curtin.edu.au
Core flooding enquiries- Ali on saeedia@gmail.com

Technical Paper

Down-hole separation and produced water re-injection

PhD student Changhong Gao **email:** cnusau@yahoo.com.au

Background

Produced water presents economical and environmental challenges to oil producers. Down-hole separation technology is able to separate oil or gas from produced fluid and inject waste water into deeper formations, saving energy and reducing waste emission. A system with ESP and hydrocyclone separator is shown in Figure 1.

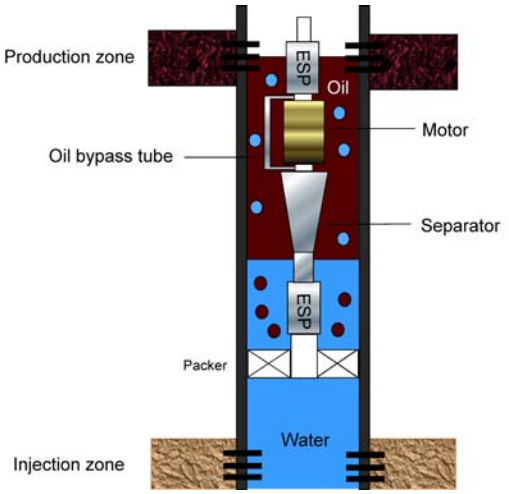

Fig 1. Down-hole separation system

More than 120 down-hole separation systems have been installed worldwide, but only about 60% of the installations have been successful. Most failures have been due to the injectivity decline under the invasion of impurities in the injected water, such as suspended particles and oil droplets. A reliable method of modelling these effects is needed as a tool to screen and optimize the choice of formation for down-hole separator installations.

Previous Work

Previous experimental studies reveal that high particle concentration, low fluid velocity, and large particle size lead to more severe damage. The damage mechanisms are attributed to surface interception, bridging and size exclusion of particles in porous media, as shown in Figure 2. Empirical correlations with key parameters determined by core flooding data are widely applied to the simulation of permeability decline under invasion of particles and droplets. These correlations have been developed using characteristics of chosen rocks and fluids. Therefore their applications are very restricted.

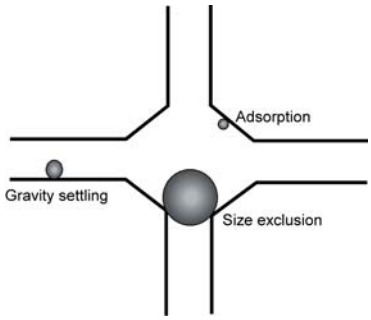

Fig 2. Damage mechanisms

A New Approach

A more scientific method is to model the flow and capture of particulates at pore level. Reservoir rocks are porous media composed of pores of various sizes. Pore network models employ certain assumptions to imitate real porous media, and have been proved realistic in simulating fluid flow in porous media. A two-dimensional square network model is used to simulate capture of particles and droplets in porous media (Figure 3). The network model is adjusted to match the porosity and permeability of a certain rock, and serves as the infrastructure where the capture process takes place.

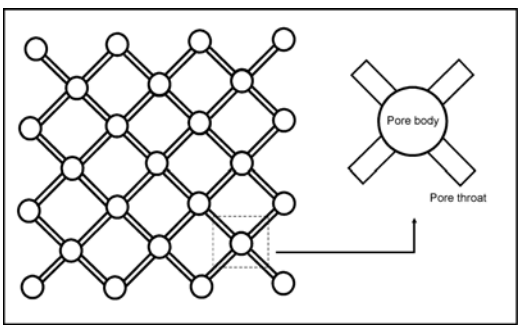

Figure 3. 2-D square network

Simulations on capture of Brownian particles, non-Brownian particles and oil droplets in the network are carried out according to their respective capture mechanisms. The proposed model is validated with test data and reasonably good agreements are obtained. This model provides more insights into the capture process and greatly reduces the dependence on core flooding data.