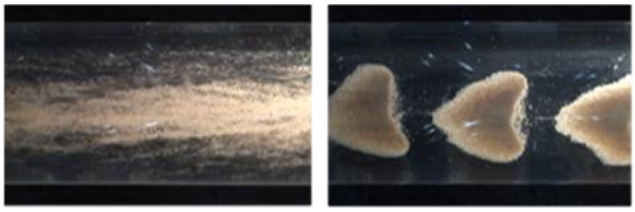
Sand Particle Behaviour in Multiphase Pipeline

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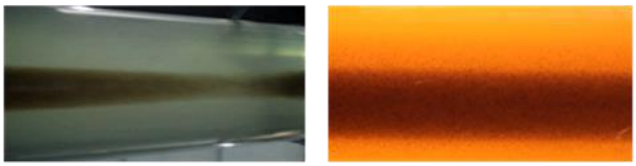
Solids transport in oil and gas pipeline is organized under the umbrella of ‘‘flow assurance’’. Unlike issues such as waxes and hydrates. Solids problems have received relatively little interest to date; this is especially true for solids transport in high-viscosity fluids. Operators are to face technical issues some time during crude oil production from a reservoir. There are three technical issues that are critical to sand production for oil and gas operating companies need to address in order to maximize reservoir production while maintaining the integrity of the production facility. These are sand erosion due to high velocity, sand settling due to low velocity and sand monitoring.
In conjunction with oil companies, Cranfield University has embarked on a programme of research to investigate sand transport issues in single and multiphase pipelines. The effects of fluid properties and pipe orientations are being quantified.

Sand Transport Test Facilities



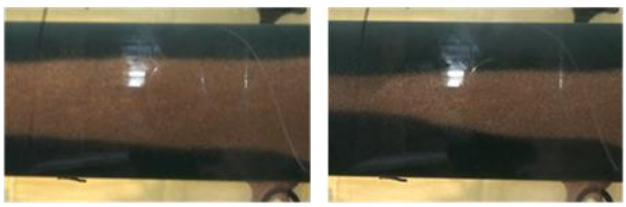


Water velocity at V_{Water}= 0.5 ms^{-1} Water velocity at V_{Water}= 0.3 ms^{-1}
Sand flow pattern in water flow with sand (top view)



Sand dune at CMC solution of 20cP, V_L= 0.7ms^{-1}, Re=3524 (bottom view)

V_{Oil}=0.35ms^{-1} Sand transport behaviour in 200cP at 25^{o}C for 200lb/1000bbl (bottom view)



Voil =0.10 ms^{-1} Voil =0.15 ms^{-1}
Lower and upper limits for sand concentration of 5% (bottom view)
Oil viscosity 4000 cP

In single phase flows, for low viscosity liquid, sand exhibits different flow patterns, from stationary bed, moving dunes to dispersed flow, as liquid velocity is increased. It was found that as the fluid viscosity increases, the transport mechanism changes. Most existing transport models developed from hydraulic conveyance consideration failed to predict the observed results.

Sand behaviour in two (gas liquid) and three phase (gas, oil, water) flows is an order of magnitude more complex because the existence of different gas liquid flow patterns (e.g. bubble, stratified and slug). Pipe inclination also plays an important role particularly in two phase flows as gas liquid phase flow regimes is inclination dependent.

A correlation to predict transport condition for different sand concentration has been established. Work is on going to develop computational models which will be validated using the data collected.

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