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Energy Bill: When the chips are down

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Patrick Raleigh, Editor

UK team advances measurement of gas bubbles in pipelines.

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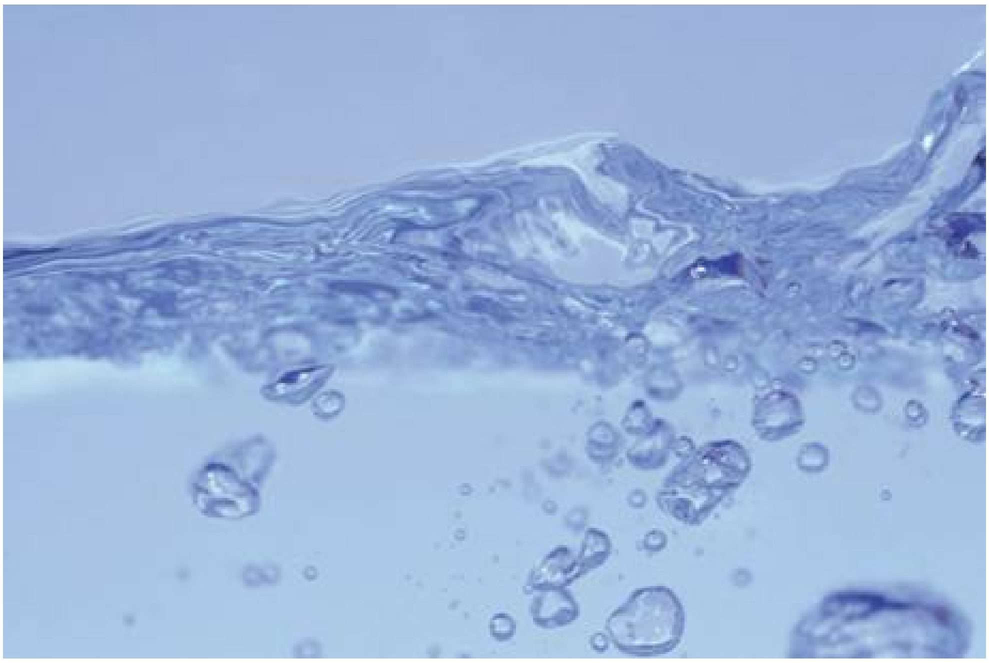

Southampton (URL=#) , UK – Researchers at the University of Southampton has devised a new method to more accurately measure gas bubbles in pipelines – an important process in the manufacturing, power, oil & gas and petrochemical industries.

For instance, the sharp reduction in pressure when bringing crude up from the seabed causes bubbles in the oil to expand and can lead to a ‘blow out’ and sudden release of hydrocarbons from a well.

Gas bubble size distribution (BSD) is usually estimated by sending sound waves through the bubble liquid and comparing the measured attenuation of the sound wave with theoretically predicted data.

The key problem is that the theory assumes that the bubbles exist in an infinite body of liquid. If in fact the bubbles are in a pipe, then the assumptions of the theory do not match the conditions of the experiment, leading to errors in the estimation of the bubble population.

A team led by professor Tim Leighton from the Institute of Sound and Vibration Research at the University of Southampton, has devised a new method, which takes into account (URL=#) that bubbles exist in a pipe.

Leighton and his team – post-doctoral research fellows Kyungmin Baik and Jian Jiang – were commissioned to undertake the work as part of an ongoing programme (URL=#) to devise ways of more accurately estimating the BSD.

The work centred on the mercury-filled steel pipelines of the target test (URL=#) facility (TTF) of the $1.4 billion Spallation Neutron Source (SNS) at Oak Ridge National Laboratory (ORNL), Tennessee – one of the most powerful pulsed neutron sources in the world.

The researchers explored how measured phase speeds and attenuations in bubbly liquid in a pipe might be inverted to estimate the BSD – which was independently measured using an optical technique. This new approach, appropriate for pipelines such as TTF, was found to give good BSD estimations if the frequency range was sufficiently broad.

The SNS facility was built with the expectation that every so often it would need to be shut down and the now highly radioactive container of the mercury replaced by a new one, because its steel embrittles from radiation damage.

However, because the proton beam impacts the mercury and generates shock waves, which cause cavitation bubbles to collapse in the mercury and erode the steel, the replacement (URL=#) may need to be more often than originally planned at full operating power. Indeed, achieving full design power is in jeopardy.

“With downtime associated with unplanned container replacement worth around $12 million, engineers at the facility are considering introducing helium bubbles, of the correct size and number, into the mercury to help absorb the shock waves before they hit the wall, so that the cavitation bubbles do not erode the steel,” said Leighton.

“[ORNL] commissioned us as part of their programme to devise instruments to check that their bubble generators can deliver the correct number and size of bubbles to the location where they will protect the pipelines from erosion.”

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