Shell Exploration & Production

EP Technology – No.4 2008

EP Technology

A global quarterly magazine highlighting
Shell E&P technology and projects

Meeting the energy challenge

Lean manufacturing opens up marginal fields

Smarter engineering

TAKING TECHNOLOGY FURTHER

Evolution – the key to sustainable innovation

Artist's impression of the Twister installation in the Okoloma field, Nigeria

TECHNOLOGY REPORT

- > REDUCED LIFE CYCLE COST
- > NO USE OF CHEMICALS
- > ZERO EMISSIONS
- > 64,000 SYSTEM-OPERATING HOURS
- > CONTINUOUS INNOVATION IDENTIFIES ADDED POTENTIAL

The design of the Twister Supersonic Gas Separator offers zero emissions, low or zero maintenance, and proven reliability, among other advantages. It is just one example of how Shell has used a technology originally developed for wind tunnels and made it suitable for natural gas processing

In 2000, responding to a need for a high-availability gas conditioning unit for continuous output, Shell commenced further development of its Twister™ supersonic gas conditioning technology, which had been around since the 1990s. The first commercial Twister system went into production in 2003 at the Shell-operated B-11 platform, offshore Sarawak, with over 99% availability. High availability was the major operational requirement, as the platform feeds the Bintulu LNG plant, where continuous feed gas is an absolute necessity.

Used for removing water and/or hydrocarbon dew pointing of natural gas, the initial Twister Supersonic Separator design was a compact tubular device. The gas was accelerated to supersonic velocities within a tube that is pinched in the middle (similar to the principle used in jet engines), making an hourglass shape. A downstream aerofoil section placed in the gas path initiates the vortex and centrifugally separates the water and liquids in the tube.

Hydrates did not form in the Twister tube, due to the very short residence time of the gas in the tube (around two milliseconds).

SIMPLICITY

The improvement concept, which went to trial in 2008, was simplicity itself: a change in sequence for the process. Instead of supersonic acceleration to cool the gas followed by rotation to separate out the condensed liquids, the process was modified to first rotate (or twist) the gas, and then expand the rotating gas to supersonic velocities using inlet guide vanes which spin the gas around a narrowing inner body creating the 'ballerina pirouette effect' (see diagram).

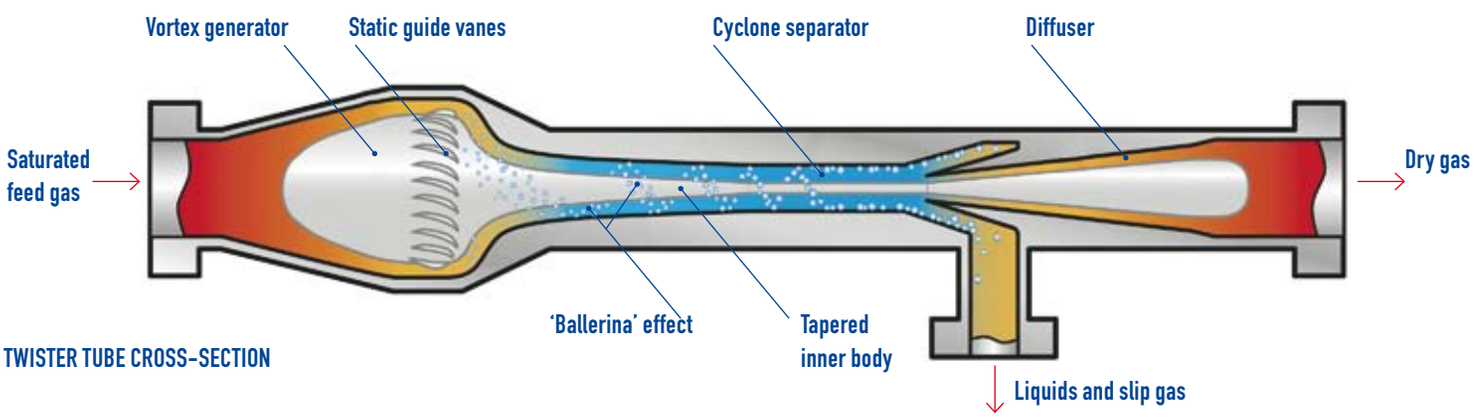
FROM MODELLING TO REALITY

A computer simulation identified:

- Improved separation with a stronger and uniform vortex generation
- Quicker acceleration of the gas, resulting in a shorter device
- Increased rotational speed of the gas, resulting in increased centrifugal forces
- Sharper separation interface
- Lower differential pressure.

Overall, there was a significant improvement in separation efficiency.

A closed pressure-loop, equipped with certified analysers and instruments, was built to verify >



TWISTER TUBE CROSS-SECTION

The Twister test facility located in Delft, the Netherlands

the computer simulation for the Mk2 Twister tube. After 18 months of extensive testing, it was confirmed that the simulation had closely predicted the behaviour of multiphase gas separation, as well as separation efficiencies.

FIELD TESTING

Following the experimental tests, Sarawak Shell Berhad and joint venture partner Petronas supported field tests on the B-11 platform. A Mk2 system was installed alongside the existing Twister system in order to compare the performance of the two Twister generations. The outcome exceeded all expectations.

The improved dehydration performance allows the Mk2 to dehydrate wetter gas on the B11-platform, and thereby maintain export gas-line pipeline integrity.

FUTURE DEVELOPMENTS

As the era of easily recoverable sweet gas comes to an end, Twister also enables new ways of processing sour gas. Simulations demonstrate that, when expanded through a Twister tube, H_2S and CO_2 gases condense and can be removed in the liquid phase. Twister can therefore be considered for pre-treatment of high concentration sour gases prior to conventional amine chemical-based sweetening processes, freeing up capacity and reducing size and cost.

Twister Sales Director, Hugh Epsom, comments: "We have recently secured a fourth Twister system contract, this time from Ecopetrol for a new onshore gas dew pointing plant in Colombia. This indicates an accelerating market interest in our technology."

Global deployment of proven Twister technology is expected to lead to further gas treatment solutions and cost reduction in the future.

TWISTER MK2 TEST RESULTS AND IMPROVEMENTS

- Dehydration: better performance with a lower pressure drop
- Dew pointing/natural gas liquid recovery: an equal or improved performance compared to other expansion technologies, including turbo-expanders.
- Improved gas dehydration of about 50%, nearly halving the water content in the primary outlet stream.
- A good safety margin for the avoidance of hydrate formation in the cold piping system leading to the gas-gas heat exchangers
- A stable operation with minimal control requirements
- Minimum use of hydrate inhibiting chemicals required under stable operating conditions