The revolutionary SwirlSep – a compact controllable separator – successfully tested at Sappemeer.

NAM and Twister B.V., together with their contractor Frames, have tested a revolutionary new concept of a very compact in-line separator at the Sappemeer gas location. The aim was to prove that this compact mobile unit can be used to clean out wells in a safe and environmentally acceptable manner. The project was commissioned by Samenwerkingsverband Noord-Nederland (SNN).

Dick Lont, NAM’s Project Manager, says ”The test at a real-life gas facility served as a reality check for SNN, NAM and Twister, giving confidence in the performance of this new type of separator. In this instance, the SwirlSep produced test results that exceeded expectations and validated the safe and efficient use of the SwirlSep concept for end-users”.

Figure 1: Compact mobile SwirlSep Module operated at NAM production location
The SwirlSep

is an inline separator in combination with a SwirlValve invented and developed by Twister B.V. In-line separators are well-known in the industry but not used commonly due to its relatively limited turndown performance.

In order to enhance the in-line separator turndown performance Twister developed the idea to combine the in-line separator with the SwirlValve, creating a separator capable of handling a wide range of flows.

The combination also results in a far smaller flexible configuration, saving both space and cost.

- retains the same vorticity in the flow even at reduced throughput;
- lowers shear forces on liquids → less break up of droplets;
- causes minimal mixing of gas and liquid phases;
- has small droplets coalescing into larger ones;
- removes fine particles.

The result is excellent separation capabilities independent of the flow.

The SwirlValve was previously used in gas treatment operations at NAM’s Oponde and Anjum gas plants to improve the performance of the existing plant.

In the SwirlSep unit as shown on the left the SwirlValve is used to create a rotational flow centrifuging the liquids to the outer perimeter leaving outlet 2, while the dry gas core is exiting outlet 1.

Its compactness is not only relevant in current upstream oil & gas facilities at surface (on- and offshore), but may well be adding value for sub-sea operations.

The role of NAM

Proving new prototypes requires testing in operational gas fields, as computer simulations alone will never be able to qualify new concepts. NAM is looking into ways to reduce costs of their operations by using mobile compact test units, whilst at the same time improving its HSE performance. For that purpose NAM
started a joint development project with Twister. Frames Separation Technology was contracted for the manufacturing of a mobile **WellSep Module**, that could be easily transported and operated in a safe manner.

SNN originally commissioned a joint development between Twister and NAM for UGS applications. This was adapted during 2012 to cover the well cleaning WellSep project. After a number of changes in test location it was finally tested at well-215 at Sappemeer.

**The Test**

Mid-October a joint NAM/ Twister team, together with their contractor Frames, tested an 8” 900# WellSep unit which was built into a vertical skid of container dimensions. The test was very successful and results were above expectations.

The WellSep test skid is transported horizontally and, as a new feature, can be erected into a vertical position making use of a container tilting trailer. An example of the erection is shown below:

![Image of WellSep test skid]

*Figure 3: Delivery of SwirlSep module at location Sappemeer*

The results met or even exceeded expectations (separation efficiency of over 98% for both liquids and sand) at various flow rates and varying pressure drops.

At design conditions the measured removal efficiency amounted to:

1. Sand separation > 99.4% efficiency, with sand levels far below the required 240 g/ mln Nm³ gas (in fact <35 g/mln Nm³)

2. Liquid separation > 99% efficiency:
   - at 30% flow (the well was limiting production)
   - and low liquid load of 4 m3/d
   - and 10 bar pressure drop

At (initial) high flows the efficiency was shown to be higher. The maximum capacity of this unit is 2.1 mln Nm³/d.
For a very low pressure drop, the efficiency dropped to just above 98% for similar conditions at only 0.3 bar pressure drop.

All other parameters being equal we observed that the separation efficiency:
- increases when the valve is closed (at least down to 25%).
- increases when mass flow goes up.

![Figure 4: Measured liquid efficiencies](image)

**Figure 4: Measured liquid efficiencies**

Turndown: the liquid efficiency drops below 98% when the flow becomes lower than 21% (actual flow) of the maximum design flow. The smallest flow tested at 13% still achieved a liquid separation efficiency of 94.7%. This can be further improved by amending the piston design (protrusion).

The noise levels measured were acceptable (~ 84 dB at 1m). At the perimeter of the test site, the noise levels had subsided to around 50 dBA.

The SwirlValve operated well and the newly applied internal coating held against erosion. Though the tungsten carbide coating eroded approximately 50 [μm] during initial testing due to a non-smooth finish of the coating - resulting in a brittle and weak top layer – but as soon as the solid layer was reached, the coating withstood the erosive action of the sand.

The tests demonstrated that the separation efficiency is not sensitive with respect to the position of the internal cone. This makes a fixed cone design possible for future applications.
Future Applications

The idea behind this concept is that the particles are subsequently being removed from the liquid stream which can then be recombined with the gas flow to the treatment facilities.

These tests at Sappemeer have proven that the WellSep skid (see figure 5: blue skid in the background) can indeed potentially replace the 4 black skids (foreground) plus the storage vessel on the right in future well service operations in combination with a number of HSE improvements.

The SwirlSep technology can also be applied for separation of gas-liquid, oil-water and oil-gas (degassing) but in future also sub-sea applications are foreseen.
SAMENWERKINGSVERBAND
NOORD-NEDERLAND

Hier wordt geïnvesteerd in uw toekomst.

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