Factsheet 6

Twister
Supersonic Gas Solutions

Twister Hydrate Separator

The Hydrate Separator™ is a green technology that can be used to separate hydrates and liquids from natural gas without using chemicals. Hydrates are melted using heating coils. Cyclonic separation ensures a compact and low-weight design with high separation efficiency. Operating benefits include the elimination of chemical logistics, storage, regeneration and environmental emission recovery systems.

Hydrates

Perhaps the world's best-known example of a phase transition occurs when water at atmospheric pressure is cooled to a temperature of 0°C (32°F). At that point, the energy in the system is no longer sufficient to prevent the water molecules from bonding together. The liquid water restructures itself into a rigid solid, called ice. However, it turns out that in nature, this process is not always so clear-cut.

When pressures are suitably high, water molecules will begin to form complex solid structures at temperatures significantly above the normal freezing point. Unlike ice, these clathrate structures are characterised by regular networks of large, open cavities and are therefore inherently unstable. As cooling continues, the normally compact and stable ice structure will ultimately form, unless some outside (guest) molecule of appropriate size enters the structure and supports the cavity. In nature, the most abundant guest molecule is methane (CH_4). The resulting stable, solid compound is commonly called "hydrate".
Other gas constituents such as C2, C3 i-C4 and CO_2 are also well known for forming gas hydrates.

Figure 1 Hydrate Plug (insert shows methane hydrate)

In natural gas processing applications, hydrates will typically form around 15-25°C (59-77°F), depending on the operating pressure and gas composition. Hydrates blockage is a nuisance to the natural gas industry; the cost of hydrate prevention is estimated to be billions of dollars each year.

Conventional LTX technology

One solution to manage hydrates in natural gas processing applications is Low Temperature Extraction (LTX) technology which has been available since the early 1950s and widely applied mainly onshore in the Americas. The principle is based on a Low Temperature Separator (LTS) with heating coils in the liquid section to melt hydrates. This allows operation below the hydrate formation temperature without the use of chemicals.

Conventional LTX technology today is rarely used and has been superseded mainly by glycol-based LTS technology. The principal limitations of conventional LTX technology are the relatively bulky vessel design, poor separation performance, relatively low liquid (NGL) yield and high pressure drop. Whereas gas/vapour separators today are fitted with internals to enhance separation efficiency and reduce vessel size, such internals would freeze-up with hydrates inside an LTX separator.

Twister BV has revisited the conventional LTX technology to enable chemical-free gas processing in combination with the Twister Supersonic Separator.

Twister Hydrate Separator for Shell Nigeria

Twister Hydrate Separator

Twister Hydrate Separator

Twister BV has developed an enhanced version of the conventional LTX technology, the Twister Hydrate Separator. A key feature is the tangential in-flow nozzles swirling the feed stream. The resulting centrifugal forces separate the heavier liquids and hydrates from the vapour, resulting in a high separating efficiency without internals. Liquids and hydrates are collected in the bottom section, where hydrates are melted by heating coils. An additional improvement is segregation of the top separation section from the bottom liquid heating section by means of a deflector, minimising re-evaporation and thereby optimising dewpointing performance and NGL extraction. CFD modelling, field testing and commercial operation have confirmed a very high separating efficiency (>99%) and stable operation without chemicals. The Hydrate Separator can be designed as either a 2 or 3-phase separator to suit the specific requirements of each application.

Twister BV has been granted a patent for the Twister Hydrate Separator design.

Figure 2 installed Twister Hydrate Separator for JT-LTX system

Applications

The Hydrate Separator can be used in combination with the innovative Twister Supersonic Gas Conditioning technology to condense and separate water and heavier hydrocarbons from natural gas. Principal applications include any combination of the following:

- Water Dewpointing (dehydration)
- Hydrocarbon Dewpointing
- Natural Gas Liquids Recovery

The Hydrate Separator can also be applied to manage hydrates downstream of a pressure let-down valve.

Benefits

A Hydrate Separator in combination with Twister offers a unique combination of benefits for natural gas processing applications. Cyclonic separation ensures a compact and low-weight design with a high separating efficiency. Further benefits include the elimination of chemical logistics, storage, regeneration and environmental emission (BTX) recovery systems. The simplicity and reliability of a static device, with no rotating parts, operating without chemicals, ensures a simple facility with a high availability, suitable for unmanned operation. These benefits result in significant capital and operating cost savings as well as safety and environmental performance improvements, in particular for offshore applications.

Figure 3 shows a Twister Hydrate Seperator with six Twister tubes attached

System design

Figure 4 shows a typical Process Flow Diagram of a Hydrate Separator integrated within a Twister dewpointing system. Inlet cooling is achieved by ambient cooling and gas/gas heat exchange. Free liquids are removed in an inlet separator. Twister tubes dewpoint the gas. The Hydrate Separator receives a mixture of hydrates, liquids and gas from the Twister tubes and delivers separated gas and liquid streams free of hydrates.

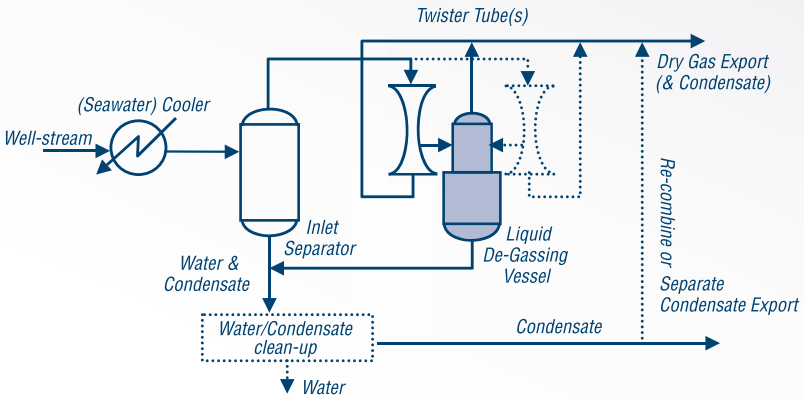

Figure 4 shows a typical Process Flow Diagram of a Hydrate Separator integrated within a Twister dewpointing system

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