NORWAY'S LEADING ROLE IN CRUDE OIL VAPOUR RECOVERY

The experts at Cool Sorption take a closer look at Equinor's innovative Njord Bravo Floating Storage Unit and its vapour recovery system

MOST PEOPLE familiar with the term 'vapour recovery' associate it with systems for handling vapours from refined products, mainly gasoline on fuel depots. For good reason; this has been the main focus in most countries. This is due to the three main benefits:

1. Financial return on the investment by value of the recovered product
2. Safety for personnel and surroundings
3. Global environment

Most VRUs are also able to handle a wide range of associated chemicals, such as benzene, MTBE, ETBE, ethanol, methanol, etc. but the volume of these products are typically limited, compared to gasoline and diesel.

CAPTURING VAPOURS TO MAXIMISE PROFITS

When it comes to crude oil, Norway was very early to realise and capitalise on the recovery of vapours that would be otherwise lost. Through bold but realistic regulations and cooperation between oil companies, VRU suppliers, classification agencies and other marine and environmental experts, Norway has pushed the limits for recovery of crude oil vapours for decades.

The dedicated effort has resulted in very large amounts of recovered product. It is estimated that Norway now captures more than 80% of its potential for recovery. But Norway only ranks as number 13 among the oil producing countries, and to our knowledge, no other country is anywhere near in this degree of utilisation.

Looking at the USA and based on a daily oil consumption of around 19 million barrels, the potential for recovered product is enormous – probably in the order of 2,600 tons (2,359 tonnes) per day! A very large part of this potential is still not captured.

Recovery of crude oil will typically not have the same attractive direct pay-back scenario as recovery of refined products, simply because of crude oil being a less valuable product. But in terms of safety for the people working at, or living close to, the terminal, vapour recovery will make lots of sense.

And for the global environment, capture of the VOC from crude oil handling is considered to be very low hanging fruit, compared to almost all other green investments. And very importantly – installation of vapour recovery will have a major positive effect on any company's ESG reporting (the disclosure of Environmental, Social and corporate Governance data for improving investor transparency).

DESIGNING A CRUDE OIL VAPOUR RECOVERY SYSTEM

The traditional VRUs for gasoline and diesel have become almost synonymous with the process of adsorption onto activated carbon followed by regeneration under vacuum. In some cases, this process is also the best choice for crude oil vapours, but since crude oil covers a wide variety of different oil compositions, it will never be a one-process-fits-all. Each crude oil type has unique molecular and chemical characteristics. No two crude oil types are identical and there are crucial differences in crude oil quality.

Designing VRUs for crude oil is, therefore, much more complex. It is essential for the designer to have a clear understanding not only of the product(s) being handled, but also of the loading process and the way vapours are generated. On that background, all Cool Sorption's more than 20 crude oil vapour recovery projects has started with one or more studies, often in cooperation with external experts, authorities, classification societies and ship builders – and obviously the client.

One example is the fully automatic, unmanned and remote-controlled crude oil vapor recovery system operating permanently offshore at Equinor's Njord Bravo Floating Storage Unit in the North Sea. The VRU module was delivered in 2020 and is designed to recover vapours

from different fields with very different characteristics in terms of temperature, wax content, sulphur content and VOC composition. For example, one particular crude oil processed here is both warm, volatile and has a high wax content.

Cool Sorption has supplied many crude oil VRUs to Equinor (former Statoil) in the past, but when approached by Statoil in late 2017 and after having analysed the requirements for this VRU, the team was sceptical because of the extreme demands. However, two conceptual studies showed a path forward by combining pressurised absorption (a process previously used successfully by Cool Sorption in the Persian Gulf) and the adsorption/absorption process, also used on many of Cool Sorption's off-shore installations in the past.

This resulted in a VRU which is probably the most complex and flexible in existence, able to use either one or both processes (in different orders) and with or without a guard-bed for handling of sulphur components. The VRU can handle any flow up to 2,500 Nm³/h with an efficiency of 90%.

In rare, extreme weather conditions, vapour generation simulations from marine experts SINTEF showed that the flow peaks can be much higher, so the VRU is designed for up to 3,600 Nm³/h but with a reduced efficiency of 80%.

Another key example of Cool Sorption's VRU units in action is Euronav's testimonial. The Antwerp-based industrial group includes a shipping division that transports bulk, crude oil, hydrogen and ammonia. '[We are] operating VOC recovery systems from Cool Sorption on board of our FSO units since 2010. The VRUs are in service since [then] and functioning very well with a very high availability (100% recorded uptime).'

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01 Cool Sorption's VRU in situ

02 Njord Bravo Floating Storage Unit