Clearer outlook with vapour recovery

Simon Shipley, Aker Solutions, Oslo, Norway

Increased measures to reduce volatile organic compounds (VOC) emissions during the loading operations for crude oil, both offshore and onshore, are being required by the Norwegian Pollution Control Authority (SFT) and international environmental agreements.

The Norwegian oil and gas industry accounts for approximately 39 per cent of national VOC emissions, of which approximately 90 per cent are believed to be attributable to offshore crude oil loading operations.

The current SFT emission requirements for crude oil loading operations require a minimum recovery efficiency of not less than 78 per cent of non-methane VOC (NMVOC). This particular recovery efficiency requirement is applicable to shuttle tankers operating in the Norwegian sector of the North Sea. The laws and regulations for onshore sites require that facilities apply for independent concessions under which to operate.

Recovery efficiencies, rather than mass based emission rates, are commonly used for defining crude oil emission requirements because of the very wide range and complexities of crude oil compositions. As the reader may know, crude oils from different areas in the world and indeed within the various sectors of oil producing areas can vary significantly, some high in light VOC compounds others high in heavy compounds and so on.

Because of the wide range of compositions, it has now become an accepted practice to design crude oil Vapour Recovery Units (VRU's) on a recovery efficiency basis.

StatoilHydro – Mongstad

One case, by way of example, is the recently commissioned crude oil vapour recovery system at StatoilHydro's Mongstad facility. The VRU is required to recover VOC from all the different crude oil types, with wide ranging compositions and vapour pressures. The vapour recovery system has been designed to recover vapours resulting from each of the crude oils loaded at the terminal. However, for each of the crude oils loaded, a separate recovery efficiency applies, reflecting the varying composition.

In June 2006, Aker Solutions signed a contract for the design and delivery of a VRU to the Mongstad terminal; the contract was completed in June 2008. The contract party for the VRU in Mongstad is Aker Cool Sorption A/S in Denmark, a fully owned subsidiary of Aker Solutions.

The main benefits of using these systems are to reduce the discharge of environmentally hazardous substances and minimise what would be a significant loss of a potentially valuable energy resource represented by the evaporation of the oil. In addition, significant safety and operator health risks in the distribution and handling of oil vapour are gained.

The Mongstad terminal, located near Bergen in Western Norway, is jointly owned by StatoilHydro and Petoro, the state company responsible for commercial aspects of the government's involvement in petroleum activities on the Norwegian continental shelf. Crude oil is delivered to the terminal by shuttle tanker and pipeline. Mongstad provides an intermediate storage facility for more than one third of the crude oil produced by StatoilHydro.

At any one time the terminal has a capacity to store 9.4mbbls (1.5million-m^3) of crude oil in up to six rock caverns. Exports to customers in North America, Asia and Europe are loaded from one of two jetties, each capable of accommodating tankers up to 380,000dwt. In an average year the terminal loads up to 450 tankers.

The Mongstad VRU's peak capacity is a vapour rate of 36,000 m^3/hr (vapour rate) emissions that were previously released into the air, reflecting positively on the environment.

Over view of the Mongstad terminal and VRU, also an ACS VRU on the deck of the tanker in the background.

Mongstad VRU under construction.

VOC vapour movement and piping systems

In addition to designing and supplying the VRU, Aker Solutions unit in Denmark provided advice relating to the VOC vapour movement and piping systems. The VRU employs conventional carbon bed technology, considered the Best Available Technology (BAT) for the process. Vapours displaced from the tankers during the loading process are fed to the VRU where the hydrocarbons are recovered from the vapour stream. Methane and inert components pass through the carbon beds and are allowed to vent to atmosphere.

Activated carbon is used in the system to adsorb the hydrocarbons in the vapour stream. The mineral-based activated carbon used in this VRU has an extremely high surface area, relative to its volume, up to 1,500 to 1,600m^2 per gram, allowing the hydrocarbons to be adsorbed on the surface of the carbon in a very thin layer. The activated carbon can only adsorb a given mass of hydrocarbon before it approaches saturation.

If saturation of the activated carbon were to occur throughout the bed, the vapours would pass through untreated. Consequently, the carbon must be regenerated in order to restore its working capacity, so that it can effectively adsorb hydrocarbons in the following adsorption cycles. For the Mongstad system, the carbon beds are designed with an adsorption cycle time, relative to the high vapour flow and hydrocarbon inlet concentration. Regeneration of the carbon beds is accomplished using a vacuum pump system.

Dual carbon bed absorber vessels

To handle the high volume of vapour displaced during the ships loading, four sets of dual carbon bed absorber vessels have been installed, covering an area of 40m x 38m and rising to 15m. Aker Solutions also supplied the separators, absorber vessels and crude oil feed pumps, valves, piping and structural platforms as well as the installation of the system at the terminal. To prevent damage to the carbon beds from the hydrogen sulphide, a component of the crude oil, vapour inlet carbon bed guard beds are installed.

The recovered vapours are returned in an absorbent stream of crude oil to the ships being loaded. As a result of the high crude oil loading rates, the vapour recovery system was designed to recover the 11,500 tonnes of VOC emissions annually. These are vapours that the terminal had previously discharged into the atmosphere. The completion of the oil vapour recovery capture and recovery plant confirms Aker Solution's position as a world-class supplier of VOC recovery units. It is also a demonstration of our commitment to the environment.

Aker Solutions is one of the leading suppliers of crude oil vapour recovery systems. During the course of the past 10 years, over 40 systems have been supplied, a sizeable number for installation on FSO's and shuttle tankers operating in various locations around the world. The most recent systems, presently under-construction, are two systems for operation in the Al-Shaneen oilfield in Qatar. Each of these units are designed to recover vapours during the transfer of crude oil from the production platform to the FSO's.

ABOUT THE COMPANY

Aker Solutions is a leading global provider of engineering and construction services, technology products and integrated solutions. The business within Aker Solutions comprises several industries, including Oil & Gas, Refining & Chemicals, Mining & Metals and Power Generation.

Aker Solutions is part of Aker (www.akerasa.com), a group of premier companies with a focus on energy, maritime and marine-resources industries.

Aker Solutions supplies a wide range of vapour recovery units (VRU) for the recovery of gasoline, crude oil and chemical vapours, to reduce emission of environmentally hazardous substances (VOC).

ENQUIRIES

Simon Shipley

Tel: +45 4345 4745
Fax: +45 4343 0090
Email: simon.shipley@akersolutions.com
Web: www.akersolutions.com/VOC