# 70 million barrels are lost yearly



Oil majors, cargo owners and transporters face a unique window of opportunity. Minimizing losses of Volatile Organic Compounds (VOC) during crude oil storage and transport will benefit the environment whilst saving billions of dollars.

#### **BAY VALVES**

## **Evaporation costs billions of dollars**

Around 70 million barrels of hydrocarbons are lost yearly due to evaporation of Volatile Organic Compounds (VOCs) during loading, storage and transportation of crude oil on ships. This is an environmental problem as well as a significant economic cost. The lost amount represents a value of 3.0 to 3.5 billion USD annually.





## Why curb VOC emissions?

VOCs are a large group of organic compounds. Several light hydrocarbons, such as methane, ethane and propane, are VOCs. Due to high vapor pressure, VOCs can easily evaporate. To the oil industry, evaporation of hydrocarbons equals economic loss. VOCs can also cause oil spill on a ship's deck, as severe VOCs generation can cause oil entrainment into the mixture of inert gas and VOCs.





## 40,000 USD lost during a standard voyage

For a standard ship such as an Aframax tanker, the economic loss from VOC evaporation during a single voyage with full tanks amounts to more than 40,000 USD.

Further, VOC emissions have devastating effects on human health and the environment. Especially methane is a potent greenhouse gas, contributing to climate change. Several other VOCs including ethane, propane, butane, pentane, and hexane react with NOx to form ground level ozone which has harmful effects on human health and on plants.





## Tank pressure is key

A little more than a decade ago, scientific studies demonstrated that by maintaining a high pressure inside cargo tanks, the VOCs are contained within the liquid hydrocarbon phase and are unable to evaporate.

As a consequence of the new insight, loading systems for tankers were modified so under-pressure was replaced by a positive pressure. Over the following years, several tankers were equipped with such new technology and VOC emissions fell significantly (by 70-90 % depending on the exact volatility and composition of the crude oil). The SuperSat valve improves VOC emission control further.







### Protecting a range of volatile cargo types

The studies went on to estimate that as much as 9 million tons of VOC could be emitted annually from global crude oil transport, with about 5 million tons emitted during the actual transport. The figure corresponds to about 70 million barrels of light end hydrocarbons representing a value between 3.0 and 3.5 billion USD annually.

Further, emissions of other volatile cargos such as chemical products, LPG (Liquified Petroleum Gas) and LNG (Liquified Natural Gas) were reduced similarly, while emissions of H2S and other environmentally harmful compounds were also brought down.





#### Introducing the SuperSat

The first generation of Saturated Vapor Pressure systems (or VOCON systems) allow considerable fluctuations (shown in light blue) in tank pressure and do not handle loading operations at all. These are weight loaded systems that initiate venting at a preset setting and continues far beyond what is necessary and thus closes at a much lower pressure, venting an unnecessarily large amount of VOC and inert gas into the atmosphere.

Therefore, Bay Valves has invented an improved version of the SvP technology. The SuperSat valve (Sat is for Saturation) consistently maintains tank pressure at a steady high (shown in darker blue).







## **Saturated Vapor Pressure**

In past days, loss of cargo through evaporation (left) was viewed as a necessary evil since prevention was considered too costly.

Fortunately, recent scientific studies have demonstrated how an elevated pressure inside tanks can prevent evaporation as VOCs are contained in the liquid phase (right). This is known as the Saturated Vapor Pressure (SvP) concept.



### Integrating VOC control with safety

VOC emission control is obviously not the only concern for a crude oil transporter. Safety will always be a top priority. High Velocity Valves have long been established as the industry standard in regard to safety due to the ability to respond extremely fast to occurring pressure fluctuations. The SuperSat valve integrates the excellent safety properties of our High Velocity Valve (approved to the latest and most strict standards) with pressure control and thus efficient VOC emission control associated with Saturated Vapor Pressure (SvP) concept.





## **VOC losses were overlooked for decades**

For many years did VOC emissions receive little focus. In 2004, a study by Bhatia and Dinwoodie, University of Plymouth, UK, changed the scene. The study demonstrates how the tiny, yet constant leakages will amount to significant total losses. As a consequence of this and other studies, several countries and organizations began to look into the problem. For instance, the Norwegian Marine Technology Research Institute (MARINTEK) concluded that storage and loading of crude oil on ships was responsible for more than 50 % of Norway's non-methane VOC emissions.





## A greener shipping industry

Following the increased focus on VOC, the International Maritime Organization (IMO) and several countries, regions and cities with harbors have adapted or are considering schemes to curb VOC emissions.

This presents oil majors with a unique window of opportunity: by investing in VOC emission control, they can save millions of dollars while adapting to upcoming environmental standards for the industry.







The SuperSat valve integrates the excellent safety properties of the High Velocity Valve with pressure control and thus efficient VOC emission control.



In traditional SvP systems, fluctuations in pressure increase the instability of the liquid, causing evaporation. In contrast, the SuperSat valve maintains pressure at a steady high.



As the price is comparable to traditional venting systems, there is really no reason not to implement this technology.

Α Addressing an urgent environmental problem in a highly cost-efficient manner, the SuperSat valve is set to become the new industry standard.





## Please fell free to contact us

Please note that this publication is an easy-read version of our White Paper on VOC control "Curbing seaborne VOC emissions". The white paper unfolds the inspiration for the SuperSat solution, summarizing the most important findings in the open scientific literature and major background reports. Follow this link for download:

"Curbing seaborne VOC emissions". [hyperlink]

Bay@bayvalves.com +45 7022 1892

Baybayvalves.com

