



SINTEF

Fact sheet - VOCSim

VOC - Volatile Organic Compounds Simulation

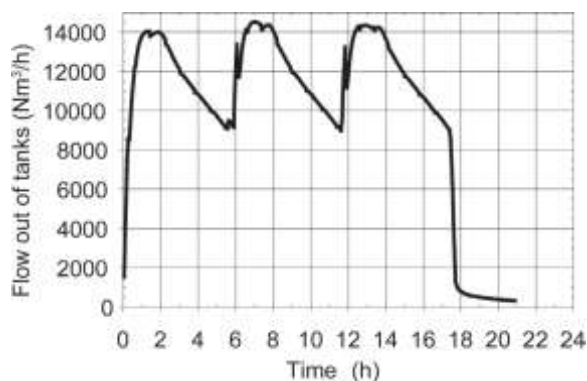
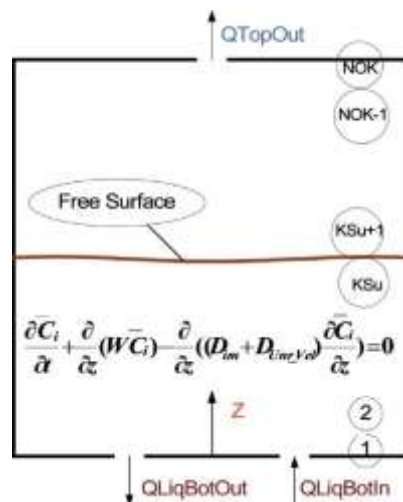
During storage, loading and transport of crude oil, Volatile Organic Compounds (VOC) may be emitted to the atmosphere. The in-house program, VOCSim, is used to simulate the state inside a cargo tank as function of time with main focus on:

- The transport of the components of interest in both the liquid and gas phases
- The equilibrium at the free surface between the phases
- The gas flow out of or into the tank

VOCSim provides, as function of time, data that includes:

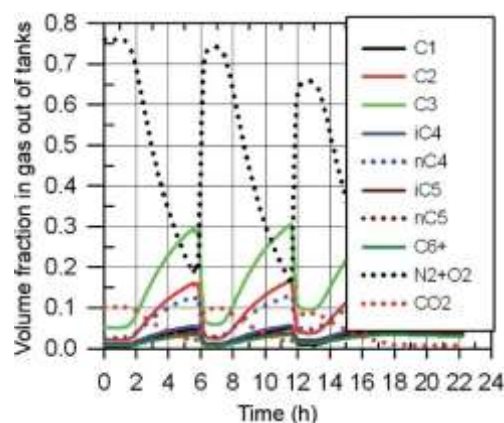
- flow rate of gas out of or into the tank
- temperature of gas out of the tank
- composition of gas out of the tank; typical gas components are: C1, C2, C3, iC4, nC4, iC5, nC5, C6, C7, C8, C9, C10+, N2, CO2 and O2
- mass rate of each emitted component
- accumulated emission of VOC, methane and inert gas
- the composition of the liquid and the gas phases as function of vertical position inside the tank

SINTEF performs simulations that assist oil companies and vessel operators in the design of VOC emission reduction measures and the assessment of the present situation with respect to the quantities and composition of VOC emissions.



Examples of typical simulations are:

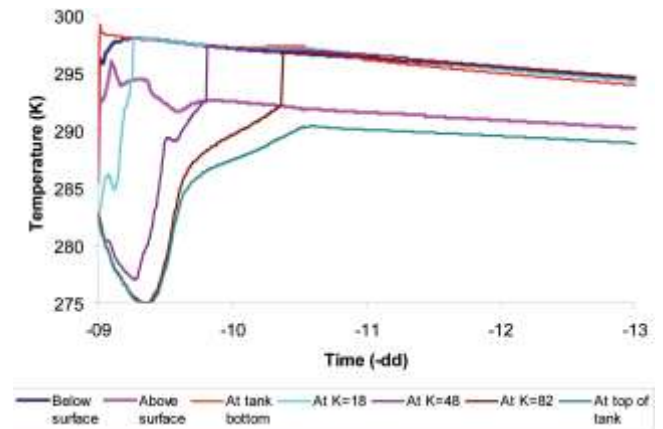
- mean emission at a particular crude oil loading site
- emission in the future due to change in oil composition
- the effect of changing the temperature of the loaded crude
- the effect of changing the loading rate for each tank, e.g. by loading fewer tanks simultaneously
- the effect of changing the tank pressure
- the effect of sequential transfer of tank atmospheres during discharge and loading
- the effect of gas return to an FPSO/FSO



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- how the use of hydrocarbon blanket gas changes the mass transfer between the liquid and the gas phases in a cargo tank, and as a consequence, the gas emitted from the tank
- the increased emission from the cargo tanks due to application of a VOC recovery plant of the absorption type (recovered VOC is absorbed in the cargo)
- determination of operational parameters for VOC recovery plants
- the emission from a storage cavern for crude oil, including exchange of the gas phase with a vessel that discharges to or loads from the cavern.



VOCSim is a software tool that simulates emission of methane and other VOCs from tanks containing crude oil or condensate under different operating conditions. VOCSim is based on 40 years of research and data from over 100 field measurements. It is being further developed in the KSP VOCSimPRO project.

