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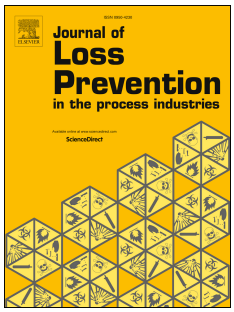

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Long term emission measurements at a floating roof tank for gasoline storage

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Abstract

In our paper we present the results of a long-term emission measurement of volatile organic compounds emitted by a single-hull floating-roof tank. The tank has a capacity of 12,000 m^3 and is used to stock commercially available gasoline. Due to imperfect seals and the formation of lubricating films during withdrawal, subsequent emissions of volatile compounds have to be expected. Therefore, a non-zero probability has to be assumed for the formation of ignitable concentrations of flammable gases, resulting in according an explosive gas area classification. Here a representative single-hull floating-roof tank is monitored using an appropriate network of infrared (IR) detectors, accompanied with measurements using a high resolution photoionization detector (PID). Measured values have been compared to the expectations estimated applying the API 2517/2519 and the VDI 3479 standards.
The aim is to record data for an explosive gas area classification based on actual emissions, potentially allowing for a regrading of zone 1 to zone 2 classified locations.

Keywords: floating-roof tank, VDI 3479, API 2517/19, long-term emission measurement, emission estimation

1. Introduction

For the intermediate storage of refinery products, typically fixed-roof or floating-roof tanks are used. In contrast to fixed-roof tanks, the roof of floating-roof tanks is lifted or lowered depending on filling or withdrawal procedures and is floating effectively on the stored liquid. For leak and emission tightening special seals have to be used. However, for highly volatile compounds as e. g. gasoline, floating-roof tanks can exhibit less emissions, unless extensive vapor balancing, buffering and recovery is used to reduce emissions of fixed roof tanks. Since floating roof tanks are not closed systems, emissions, even if they are tiny, have to be expected in principle. In this project we investigated the emission behavior of a tank having a capacity of 12,000 m^3 for commercially available gasoline. The emissions are caused by evaporation of lubricating films at the inner side of the hull and emissions at different deck fittings caused by imperfect leak tightness. In the case of gasoline the emissions are flammable between a lower explosive limit (LEL) of 0.6 vol % and an upper explosive limit (UEL) of 8.0 vol %. Thus, a nonzero probability of the formation of ignitable concentrations of flammable gases must be taken into account. Therefore regulations exists, which give a normative basis for explosive gas area classification at the tank and in the area around. This zone classification is of relevance for selecting appropriate safety engineering and explosion protection.
The process of zone classification depends on national standards, but is uniform in the European Union (EU), cf. e.g. [1] to which this paper holds.
Related to the zone classification around and including the tanks themselves, is the selection of adequate lightning protection. According to the relevant German regulation [2] not only the tank-body itself but also the area around (retention pond and dike) has to be protected as a consequence of the conservative assignment of classified locations. Nevertheless, measured emissions from tanks are quite often found to be small. The emissions are not necessary according to the expectations from the definitions of classified locations. Therefore the operator of the tank may use a different zone classification by making a safety assessment. In case actual emissions allow for a regrading, additional efforts for equipping lightning protection in the retention pond and at the dike may become obsolete.
For investigating the actual emission behavior of a representative floating roof tank, long-term emission monitoring was done using appropriate measuring instruments. In addition, an emission expectation was esti-

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