Manual of Petroleum Measurement Standards Chapter 19.6

Part 1—Evaporative Loss from Storage Tank Floating-roof Landings

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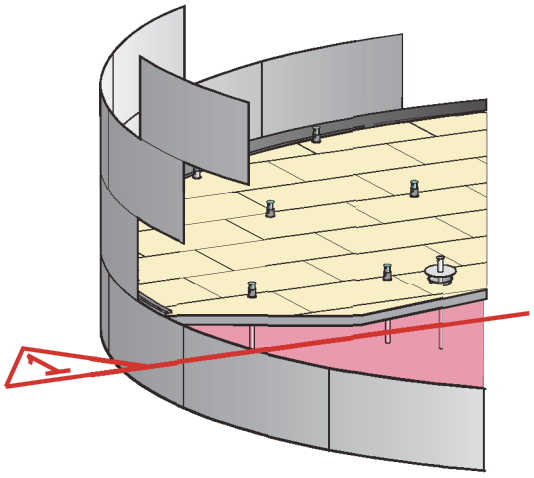
Introduction

The purpose of this study was to investigate storage tank emissions that may result from landing and subsequently refloating a floating roof. The existing emission factors for floating-roof tanks [2],[22] are based on the assumption that the floating roof is continuously floating on the stored stock liquid. Additional emissions may occur, however, if the tank is emptied such that the floating roof is no longer floating.

When the liquid level approaches the bottom of the tank, the floating roof lands on deck legs or other supports that prevent it from dropping any further as the stock liquid continues to be removed. Further withdrawal of stock liquid could then potentially form a partial vacuum beneath the landed floating roof. If the receding liquid were to create an excessive partial vacuum, the floating roof could collapse. To avoid this condition, a vacuum-breaker vent on the floating roof opens automatically as the floating roof lands (see Figure 1). The vapor space created under the floating roof is thereby freely vented to the space above the floating roof. Even in the case of a self-closing vacuum-breaker, the vapor space beneath the floating roof is vented via the other deck fittings and the rim seal, which is effectively rendered vapor mounted once the liquid level drops below the bottom of the rim seal.

Vapor loss (and the corresponding emissions to the atmosphere) may occur while the tank remains nominally empty and the floating roof continues to stand idle in this landed condition (see Figure 2). Additional emissions may occur during the refilling of the tank, as the vapor space beneath the floating roof is displaced by the incoming stock liquid (see Figure 3). This study sought to quantify these floating-roof landing loss emissions.



Evaporative Loss from Storage Tank Floating-roof Landings

1 Scope

The emissions characterized as floating-roof landing losses in this study are those that would be expected to occur if a floating roof is landed in the course of normal operations and subsequently refilled. This study does not address emissions that may result from additional activities, such as degassing or tank cleaning, that may occur while the tank is empty.

The model is intended for use with any petroleum liquid. The inclusion in the model of the stock liquid's physical properties (i.e. true vapor pressure, vapor molecular weight, and liquid density) appears to effectively differentiate crude oil from gasoline, and therefore no further differentiation was made in the form of product factors or other product-specific adjustments.

The model does not directly address standing idle losses for partial days, but it would be reasonable to estimate the emissions for a partial day by estimating the standing idle emissions for a single day and then prorating that estimate by the number of hours that the floating roof was actually landed.

Any emission factor is properly understood as representative of the actual emission rates that are typical for a population of emission points. For a non-uniform population, however, there is an inherent level of uncertainty associated with the application of the general emission factor to any individual emission point. Some of the critical sources of uncertainty in this model of floating-roof landing losses are addressed in the comments on the confidence associated with each step of the model. As noted in these comments, some of the variables have not been well defined, and the values shown are intended to serve only as placeholders—pending further research.

2 Normative References

The following documents are indispensable for the application of this document. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

API *MPMS* Chapter 19.1, *Evaporative Loss from Fixed-roof Tanks*

API *MPMS* Chapter 19.2, *Evaporative Loss from Floating-roof Tanks*

API *MPMS* Chapter 19.4, *Evaporative Loss Reference Information and Speciation Methodology*

API *MPMS* Chapter 19.5/EI Hydrocarbon Management HM 65 [1], *Atmospheric Hydrocarbon Emissions from Marine Vessel Transfer Operations*

API Technical Report 2568, *Evaporative Loss from the Cleaning of Storage Tanks*

3 Variables and Symbols

Symbol	Description	Units	Source
B	constant from Antoine's equation	°R	from Table 2 (for historical purposes only)
C_{sf}	filling saturation correction factor	dimensionless	$= 1 - \frac{[\text{Equation (19)} - \text{Equation (5)}]}{[\text{Equation (5)} + \text{Equation (25)}]}$ (29)

[1] Energy Institute, 61 New Cavendish Street, London W1G 7AR, UK, www.energyinst.org.