Evaluation of Convective Mixing Losses in Aboveground Storage Tanks

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This report is presented as part of a multi-year study being conducted in cooperation with Carleton University to develop improved algorithms for estimating average and instantaneous emissions from petroleum storage tanks. While the work presented in this report is specific to underground storage tanks, the broader initiative also considers aboveground fixed roof storage tanks and floating-roof tanks.
The need for improvements to the methods used to estimate evaporation losses (e.g., due to working, breathing, flashing and unintentional gas carry-through effects) from storage tanks has been identified by both industry and regulators, and is seen as particularly important in Alberta given the predicted rapid expansion of the oil production sector and downstream oil transportation system in the coming decades. If successful, such methodological improvements are expected to ultimately lead to new verifiable, practical and implementable strategies for managing tank emissions, which would directly and indirectly benefit a broad range of stakeholders,

domestically and internationally, including federal, provincial or regional air quality administrators and operators of storage tank farms throughout the upstream oil and gas industry and downstream refined products distribution sector. Moreover, federal and provincial regulators, as well as industry operators, would be equipped with more representative data concerning the quantification of fugitive inorganic compound (IOC) (e.g., CO2 and some reduced sulphur compounds like H2S, COS, CS2), volatile organic compound (VOC), odour (primarily reduced sulphur compounds, particularly H2S and mercaptans), and greenhouse gas (GHG) emissions from liquid storage tanks.

The focus herein is evaporation losses from a special case of fixed-roof storage tanks, namely: underground storage tanks involving volatile products having reasonably consistent properties such as gasoline. A review of the existing American Petroleum Institute (API) algorithms for estimating evaporation losses from this type of tank has been conducted and specific unaccounted-for effects have been identified. To help evaluate the significance of the emission contributions from these unaccounted-for effects, a detailed monitoring program has been conducted on an underground gasoline storage tank at a retail gasoline station. The compiled monitoring results and initial recommendations for enhancement of the existing evaporation loss algorithm for fixed-roof tanks are presented. The intent of other projects being

conducted under the broader tanks initiative is to build on these results and consider progressively more complex cases involving other types of storage tanks.

Final Report