



Standard Guide for Use of the Steam Stripping Process in Mitigating Chemical Spills¹

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1. Scope

1.1 This guide covers the considerations for the use of steam stripping in the mitigation of spilled chemicals (including hydrocarbons) dissolved in ground and surface waters. Aesthetic and socioeconomic factors are not considered; although, these and other factors are often important in spill response.

1.2 This guide addresses the application of steam stripping alone or in conjunction with other technologies.

1.3 In making decisions with regards to discharging treated water and operating a boiler, appropriate government authorities must be consulted as required by law.

1.4 *This standard does not purport to address all of the safety concerns, if any, associated with its use. It is the responsibility of the user of this standard to establish appropriate safety and health practices and determine the applicability of regulatory limitations prior to use.* In addition, it is the responsibility of the user to ensure that such activity takes place under the control and direction of a qualified person with full knowledge of any potential or appropriate safety and health protocols.

2. Terminology

2.1 Definitions:

2.1.1 *feed-to-steam ratio*—ratio of feed flowrate (by weight) to steam flowrate (by weight).

2.1.2 *foulants*—substances, such as clay or silt, microbial biomass, organic solids or film, inorganics, and naturally occurring compounds, that interfere with the desired process.

2.1.3 *Henry's law*—when a liquid and a gas are in contact, the weight of the gas that dissolves in a given quantity of liquid is proportional to the pressure of the gas above the liquid. The law holds true only for equilibrium conditions, that is, when enough time has elapsed so that the quantity of gas dissolved is no longer changing.

2.1.4 *Henry's law constant*—a function of the compound's solubility in the liquid phase and its volatility. A high Henry's law constant indicates equilibrium favoring the gas phase, that is, the compound is more easily stripped from water than one with a low Henry's law constant. Theoretically, Henry's law

constant can be estimated from vapor pressure, solubility, and molecular weight as follows **(1)**²:

$$HC = \frac{V_p \times MW \times 16.03}{sol \times T} \quad (1)$$

where:

HC = Henry's law constant (atm m³ water/m³ vapor),

V_p = vapor pressure (mm Hg),

MW = molecular weight (g/mole),

sol = solubility (mg/L), and

T = temperature (K).

2.1.5 *inorganic foulants*—compounds, such as those of iron, calcium, and manganese, which precipitate in a treatment unit, thereby reducing the throughput and efficiency of the process.

2.1.6 *packing*—is placed in a stripping column to increase the available surface area for mass transfer.

2.1.7 *pH*—a measure of the acidity or alkalinity representing the logarithm of the reciprocal of the concentration of hydrogen ions.

2.1.8 *purge and trap technique*—uses an inert gas (such as helium or nitrogen) to purge the compounds into a gaseous state.

2.1.9 *removal efficiency*—

$$\frac{[\text{inlet contaminant}] - [\text{outlet contaminant}]}{[\text{inlet contaminant}]} \times 100 \% \quad (2)$$

2.1.10 *semi-volatile organic compound*—a compound that is amenable to analysis by extraction of the sample with an organic solvent. It is used synonymously with Base/Neutral/Acid (BNA) compounds.

2.1.11 *steam stripping*—a separation process that utilizes differences in the thermodynamic properties of liquids. In this process, steam and organic-contaminated water are fed counter-currently to a packed column, causing the transfer of the contaminant(s) from the water phase to the vapor phase. The driving force for the separation is the concentration differential of the organic component(s) between the liquid and vapor phases. Two streams are generated in this process, namely: bottoms (treated effluent) and tops or overhead (concentrated contaminant).

2.1.12 *equilibrium vapor pressure*—the pressure at which, at constant temperature, a pure substance's vaporization, and

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² The boldface numbers in parentheses refer to the list of references at the end of this standard.