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Abstract Title: Is Coefficient of Variation a Realistic Index for Characterizing Mixing Efficiency in Ozone Applications?

Abstract: A stable ozone residual is one of the most common requirements for any in-line or off-line ozone contacting system, both in pipeline contacting and in traditional over-under basins. In recent years, a target coefficient of variation (COV) of ozone residual is written into project specifications in order to compare and contrast the mixing and mass transfer efficiencies of different ozonation systems. A true mixing COV calculated from validated multiphase computational fluid dynamics (CFD) analysis is an indication of spatial variability of secondary phase (gas or gas-liquid mixture) across a representative cross-sectional plane that spans the entire diameter of a pipeline contactor or area in an over-under contact tank. In contrast, the COV that is measured in the contactor is a temporal index, typically calculated from samples taken from a single point in the pipeline or contact tank.

COV as an index may be more appropriate to characterize the extent of mixing in laminar to turbulent mixing/blending of two or more miscible fluids or for solid-liquid mixing and might be less applicable to turbulent gas-liquid mixing. In addition, even when complex, localized flow phenomena are taken into account with validated, multiphase flow analysis, COV derived from CFD analysis might not translate directly to measured COV due to incongruent/inconsistent measurement or sampling methods in practice.

To investigate this, a multiphase mass transfer CFD model is developed and compared with experimental data to investigate any correlation between mass transfer efficiency, a corresponding spatial mixing COV, a corresponding temporal COV, and a normalized gamma uniformity index for mixing. Sampling methodologies for ozone residuals are reviewed and general guidelines for sampling are suggested.