Safety management of atmospheric storage tanks by the modelling of bottom corrosion

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Corrosion is a critical issue of atmospheric storage tanks, often it is the cause of fuel releases with serious consequences for humans and the environment. The goal of this work is to elaborate a solid procedure for the management of the safety of storage tanks, focusing on understanding corrosion in terms of pits number and their depth growth. Currently, to ensure the equipment safety, multiple and costly inspections are required, rising the managing cost. An optimized managing procedure is useful for planning inspections at right time intervals. The study was carried out with various testing of steel samples, representative of the storage tank bottom, which were submerged in a commercial gasoil mixed with some additive solutions with a 4/1 ratio (Table 1).

Table 1: Characteristics of the additive solutions.

Solution ID	Additive	pH
A	Aqueous solution of NaCl, $NaSO_4$ and acetic acid	4
B	NaCl, glacial acetic acid and $Na_2S_2O_3$	2.5

To monitor the trend of the pitting corrosion on the samples, their depth was measured across the entire surface over one year. These measurements were done by using a laser scan. Each sample was divided into several parts and for each of them the maximum corrosion depth was calculated. By means of data set, a probabilistic model based on the extreme values theory was developed in order to model the distribution of the corrosion depth. The model, combined with the Bayesian Inference, aims to predict the distribution parameters at a different time, building a simple time dependence with a linear regression and allowing to determine the expected bottom perforation probability. By an accurate prediction of failure probability, the residual useful life of the tank can be precisely estimated, thus, lowering the risk of fuel release while optimizing management costs.

Keywords: *Failure probability, storage tank, corrosion, safety*