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ONLINE FIXED TANK VOLATILE ORGANIC CONTENT QUANTIFICATION USING MACHINE LEARNING

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ABSTRACT

Tank emission calculation is typically performed offline, and manual data gathering from various tanks could be a timely and inefficient task. This paper presents iCON's first principal process simulation software to perform tank emission quantification by leveraging its extensive database of all process simulation models and chemical components' physical properties. Hence, a lot of operation cost is saved by eliminating the need for inventory sampling activity for each tank. This paper also will discuss online tank emission work processes to make them sustainable. iCON Tank Emission complies with the United States Environmental Protection Agency (USEPA) Compilation of Air Pollutant Emission Factors (AP-42) Fifth Edition Chapter 7 Liquid Storage Tanks that covers fixed roof tanks (vertical and horizontal) and floating roof tanks (internal, external, and domed) with a respective combination of the roof, shell, rim seal, fittings and breather vent settings. It is also linked to the monthly Malaysian Climate Condition covering domestic municipals' temperature (minimum and maximum), Solar Irradiance Factor, and wind speed that improve the tank emission calculation accuracy. iCON Tank Emission lets users calculate thousands of tank emissions simultaneously by using iCON Machine Learning feature and displays the monthly and yearly summary reports for report standardisation among multiple business units. The simulation convergence time is instantaneous, making it time efficient for HSE engineers to perform strict monthly calculations and reporting online. Case studies and what-if scenarios could also be run to reduce tank emission via the introduction of vapour recovery and optimising tank mechanical parameters, i.e., type of rim seal, colour, and fittings selection. iCON Online Tank Emission links the iCON model with real-time plant information data for real-time tank emission calculation, transparent to management and regulators. The findings from this compositional first principle thermodynamic base tank emission simulation study are considered more efficient, faster, and cheaper than the conventional method.

INTRODUCTION

PETRONAS is a member of the Oil and Gas Climate Change Initiative (OGCI), which strives to accelerate the reduction of greenhouse gas emissions in full support of the Paris Agreement and its aims. One of the OGCI guiding principles is to reduce the methane and CO_2 intensity of operations covering 11 methane emission sources [1].

The 11 methane emission sources are hydrocarbon storage tanks, fugitive leaks, loss of primary containment, hydrocarbon venting, hydrocarbon flaring, stationary combustion, gas dehydration, compressor seals, pneumatic control and pumps, well venting for liquid unloading, and well test. The quantification of the 11 sources is usually performed manually, including gathering site data and calculating using various standards.

This paper presents iCON's first principal process simulation software to perform atmospheric hydrocarbon storage tank emission quantification by leveraging its extensive database of all process simulation models and chemical components' physical property.

MATERIALS AND METHODS

The methodology is shown in Figure 1. Data gathering parameter includes Tank medium composition and tank temperature. Only atmospheric storage tank

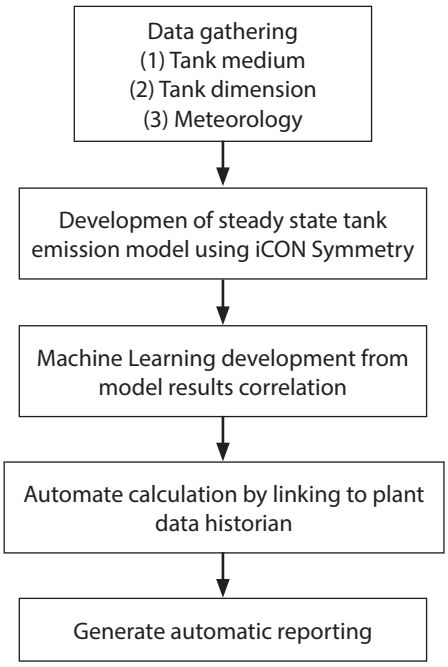

Figure 1 Work methodology

containing hydrocarbon and breathing directly into the atmosphere is selected based on OGCI sources. Tank dimension parameter includes tank type, height, diameter, volume, rim seal type, throughput, and turnover. Meteorology data includes atmospheric temperature (minimum and maximum) and solar irradiance factor.

Tank emission was developed using iCON Symmetry Process Simulation Software. A specific thermodynamic property package is used for a specific tank medium. For example, the Advance Peng-Robinson property package is used for crude oil tanks, and the Urea property package is used for the urea-formaldehyde tank. iCON Symmetry is integrated into an online plant historian and laboratory system to retrieve the data periodically automatically. Meteorology data is updated automatically from the Malaysian meteorology website.

iCON Symmetry tank volatile organic content emission results are calculated in ton per month. Case studies parametric runs are then performed on the iCON Symmetry tank model to generate data by varying each independent variable. The generated data is then correlated into machine learning equations to act as an online tank emission calculator.

Every month, the iCON Symmetry Tank Emission program will automatically consolidate monthly tank medium, dimension, and meteorology parameters, calculate the emission and automatically generate a report. Hence, the term used is meter to report.

RESULTS AND DISCUSSION

Figure 2 shows the model developed for three gasoline tank terminals.

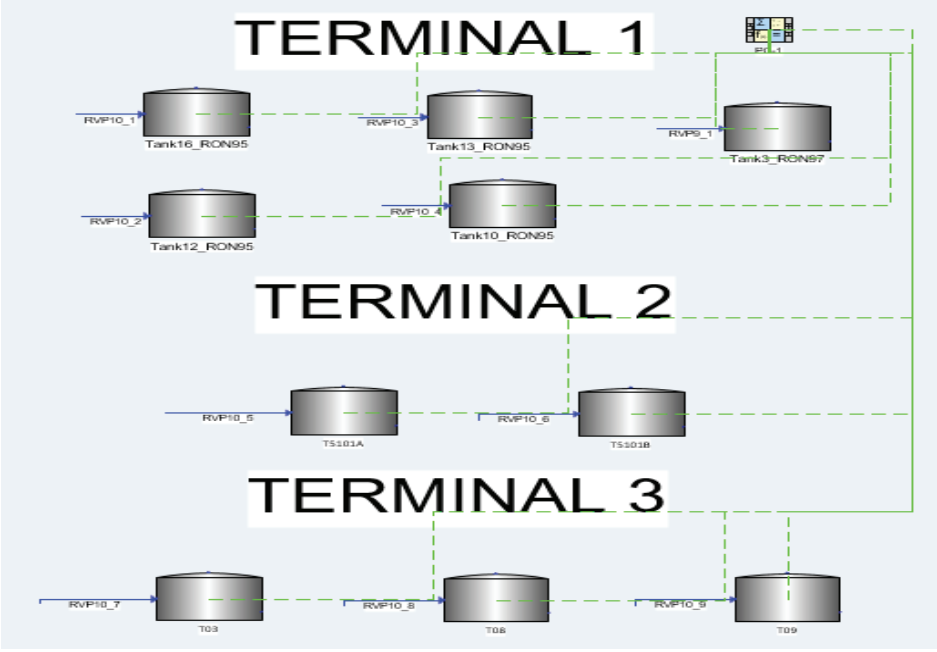

Figure 2 iCON Symmetry Tank Emission model

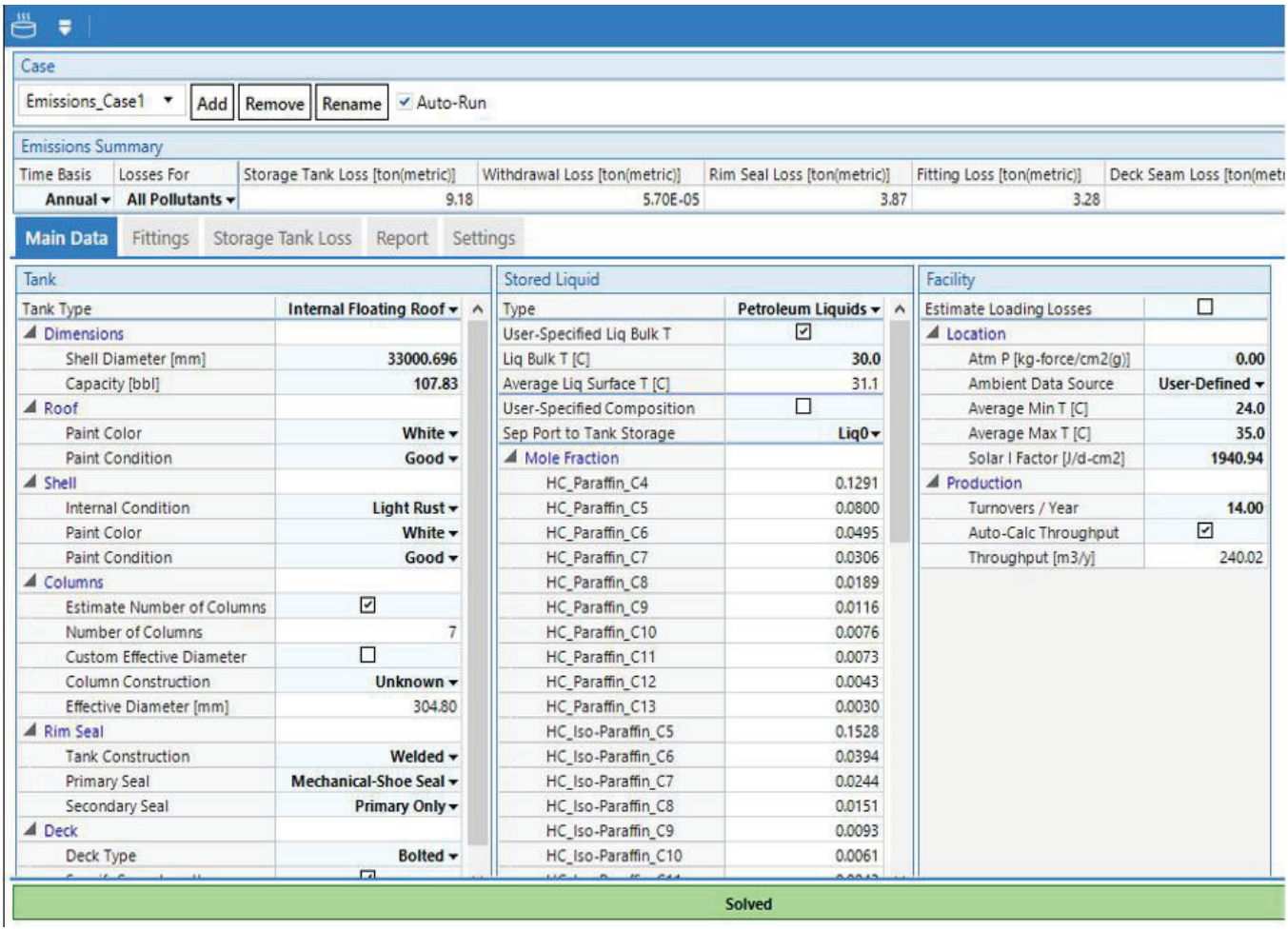

Figure 3 iCON Symmetry Tank Emission tank data layout

Figure 3 shows the tank data layout. All tanks at Terminal 1, 2, and 3 are internal floating roof types. Case studies and what-if scenarios were run to reduce tank emission via the introduction of vapour recovery and optimising tank mechanical parameters, i.e., type of rim seal, colour, and fittings selection.

IMPACT TO INDUSTRY

iCON Symmetry Online Tank Emission links the iCON model with real-time plant information data for real-time tank emission calculation, transparent to management and regulators. The findings from this compositional first principle thermodynamic base tank emission simulation study are considered more efficient, faster, and cheaper than the conventional method. A lot of operation cost is saved by eliminating the need for inventory sampling activity for each tank.

CONCLUSION

iCON Symmetry Online Tank Emission automatically linked and consolidated tank operational data to calculate monthly tank emission without manual intervention. This system will be integrated into a centralised environment data platform for dashboarding and data analytics.

ACKNOWLEDGEMENT

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Oil and Gas Climate Initiative. [Online]. Retrieved 28 September 2020 from https://oilandgasclimate initiative.com/about- us/#guidingprinciples.