

# Comparative Study on Tank Cleaning Simulation

ADVITEC Informatik GmbH in Dresden developed the ADVISIM<sup>3D</sup> software for cleaning simulation of complex tanks and machines in collaboration with the Fraunhofer Institute for Process Engineering and Packaging IVV. The liquid distribution from cleaning nozzles is thereby projected and displayed on arbitrary geometries.

Two completely different simulation methods were examined using a common test case in the comparative study conducted by the Dresden University of Technology. The wetting problem in a process tank with several connection ports and a rapidly rotating spray cleaner was recreated and virtually simulated. In a study<sup>1</sup> conducted by the Pharmaceutical Manufacturing Technology Centre (PMTC) at the University of Limerick, this was achieved using the most advanced hybrid simulation methods (Fig. 1). This involves calculating a wide range of influences in a physically accurate and high-resolution manner, such as gravity, drop flight and reflection, and film flow on walls. The calculation time for a physical time of one second was approximately one month. The simplified approach of ADVISIM<sup>3D</sup> is based on light beam projection and has been expanded to include relevant influences. Simulation results are available within seconds.

The qualitative comparison revealed only minor differences between the results of the high-resolution simulation and ADVISIM<sup>3D</sup>. In both simulations, spray shadows were identified in the critical-to-clean internal surfaces of the process ports, and reduced liquid application was demonstrated in the dome of the tank. Minor differences are evident in the characteristics of the non-wetted areas, which can be attributed to aspects of drop reflection and liquid drainage.

A concluding quantitative comparison of the wetted sub-areas confirms the high similarity of the simulation results. The PMTC study indicates that 96.2% of the surface area is wetted. The evaluation of the results from ADVISIM<sup>3D</sup> yielded a wetted surface area of 96.8%.

The results show that both simulation approaches identified the wetted areas in a largely similar manner, both qualitatively and quantitatively. No significant distinguishing factor could be found that would prevent a direct comparison of the two simulation results. For the design of the nozzle positioning in the tank, all areas critical for cleaning were identified using both simulations. ADVISIM<sup>3D</sup> has the decisive advantage for engineering applications of being capable of operating in near real time, and the validity of this simulation method is further enhanced by the comparison carried out here with a physically high-resolution simulation.

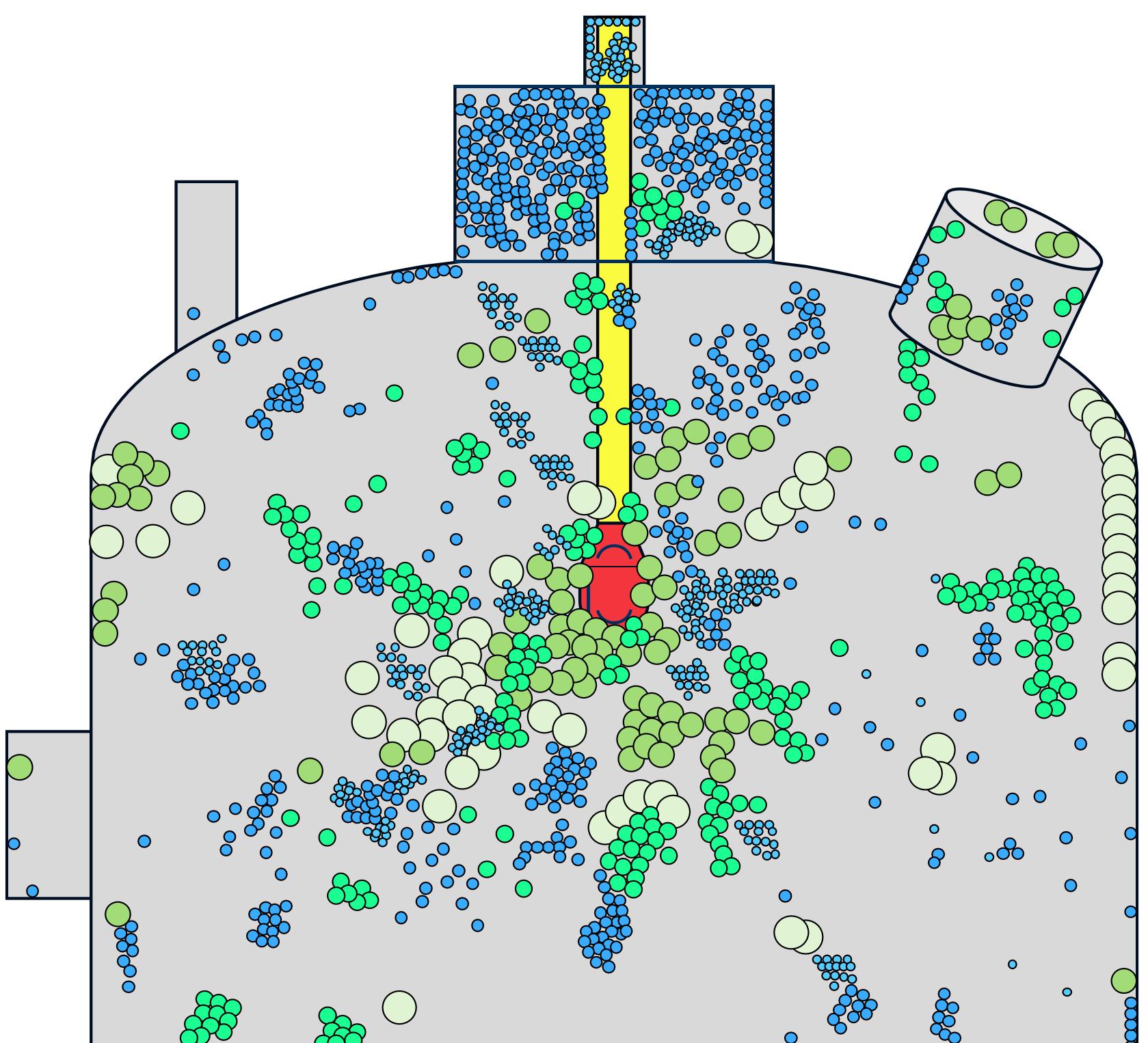


Figure 1: Schematic representation of the drop flight and liquid accumulation on the container wall according to the PMTC simulation<sup>1</sup>

<sup>1</sup> Moghimi, M.H., Karimi-Jafari, M., Shardt, O., 2025. Simulations of sprays in vessels and the effects of key variables for understanding cleaning processes. In: *Chemical Engineering Research and Design*, vol. 217, pp. 128-151. <https://doi.org/10.1016/j.cherd.2025.03.027>

