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CERTIFICATE OF PARTICIPATION

The president of the **First National Conference on Science &Technology** (**1st NCST22**) certifies that:

BEKRENTCHIR Khalida

has delivered **a poster** communication entitled:

Numerical investigation of flow and mixing in a Full-Scale Surface Aeration Tank

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Conference Chair

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Numerical investigation of flow and mixing in a Full-Scale Surface Aeration Tank

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Abstract:

Surface aeration tanks are one of the main structures of wastewater treatment plants, especially in activated sludge treatment process. The main functions of the surface aeration tanks are to supply oxygen needed for all aerobic bacterial process and also ensure sufficient mixing of the sludge suspension with wastewater. Effective aeration in these bioreactors is achieved by placing a surface aerator close to the free surface of the liquid. The selection of a particular surface aerator is made according to consideration of efficiency of its oxygen transfer rate and its power consumption. Low-speed surface aerators are commonly used in activated sludge systems because they offer excellent oxygen transfer and mixing of the fluid, require little operational control, and able to handle environmental extremes such as high temperatures. In this study, the flow field in a full-scale square section tank fitted with a low speed surface aerator model Landy-7 developed and designed by WesTech and Landustrie is simulated using ANSYS Fluent software. This surface aeration tank is located at the wastewater treatment plant of El-Karma city in Algeria. The 3D k–ε turbulence model coupled with the multiple reference frames (MRF) approach were used to represent the particular flow induced by the Landy-7 surface aerator and the free surface deformation was modeled with the volume of fluid (VOF) method. After validating the numerical modeling of the surface aeration tank with the experimental measurements reported in the literature, the numerical tool is used to investigate the effects of surface aerator submergence depth on the main features of the flow field in the surface aeration tank, like volumetric power consumption, flow number rate, energy dissipation, shear rate, etc. Next, by solving numerical dispersion of a passive tracer, performance of the surface aeration tank is investigated in term of mixing time. The numerical results were presented for various rotation speeds and compared to predict the optimal submergence depth of surface aerator and to improve the energy efficiency of the wastewater treatment plants. Based on the simulation results of the flow field and mixing, an optimized operation scheme of the surface aeration was proposed.

Keywords: CFD, surface aeration tank, submergence depth, power consumption, mixing time.

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❑ Surface aeration tank

Fig.1 The sewage aeration tank of El-Kerma wastewater treatment plant in Algeria

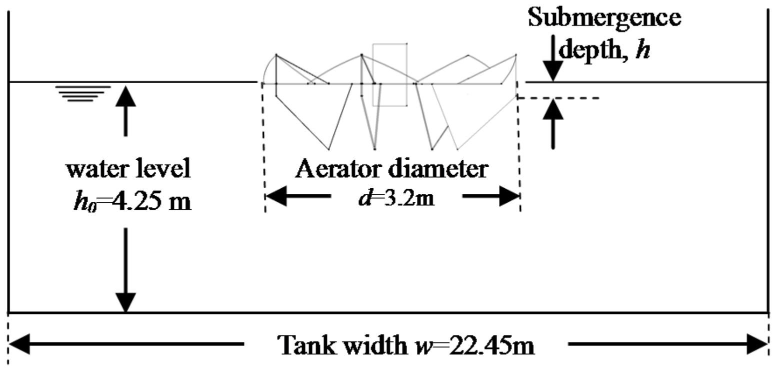

Fig. 2 Schematic representation of the surface aeration tank and the surface aerator Landy-7.

❑ Numerical methodology

▪ Computational domain and mesh consideration

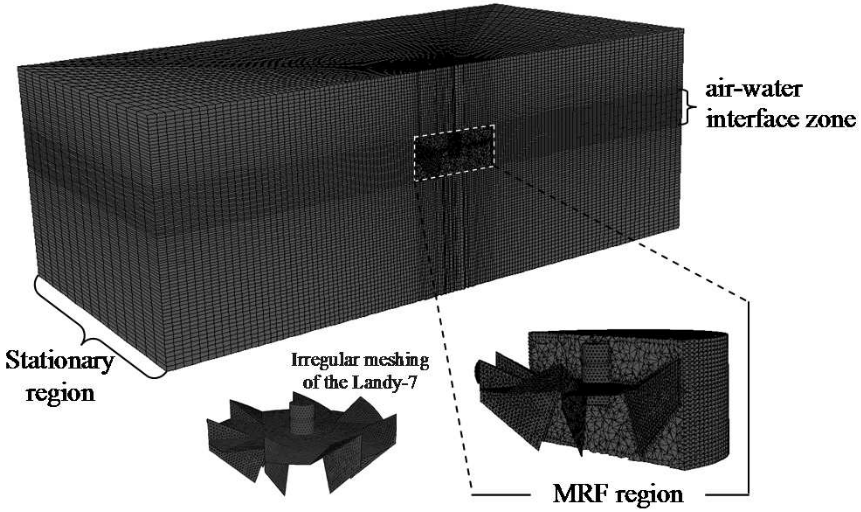

Fig.3 Computational grid details of the surface aeration tank and the Landy-7 surface aerator.

▪ Flow filed modeling

- The three-dimensionally meshed model;
- The Reynolds-Averaged Navier-Stokes (RANS) continuity and momentum conservation equations for the liquid-gas mixture;
- The VOF model to track the interface between water and air in the aeration tank;
- The k-ε turbulence model for turbulence modeling;
- The mass transport equation;
- The physical proprieties of the primary (Water) and secondary phase (Air);
- The boundary and initial conditions (surface aerator speed, gravity acceleration, reference pressure, surface tension coefficient, ….., etc);
- The segregated solver, the discretization scheme and the convergence criteria.

Numerical results

Investigation of the mixing time

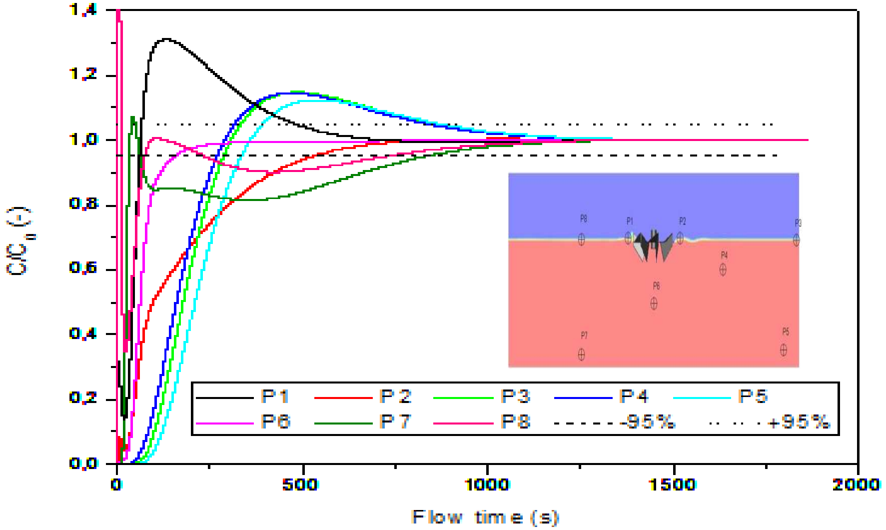

Fig. 5 Normalized tracer concentration as a function of time at the different monitoring points (N = 24 rpm and immersion depth of +100 mm).

Validation

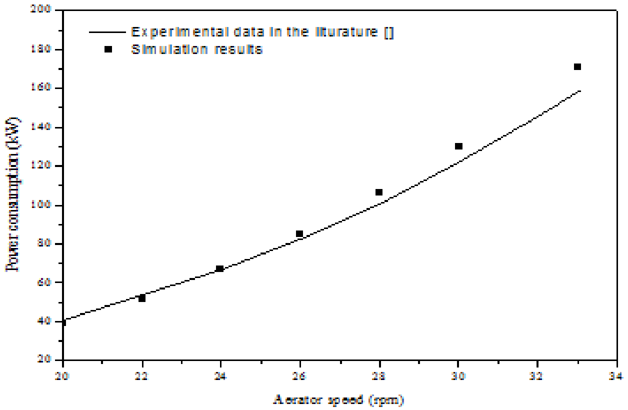

Fig. 4 Power consumption as a function of the surface aerator rotation speed.

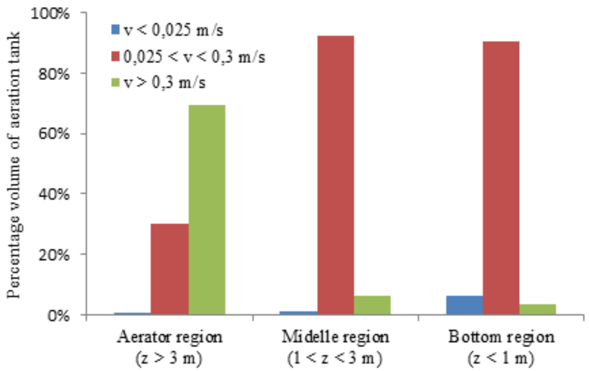

Fig. 6 Change in proportions of magnitude velocity in different zones of the aeration tank at rotation speed of 26 rpm.

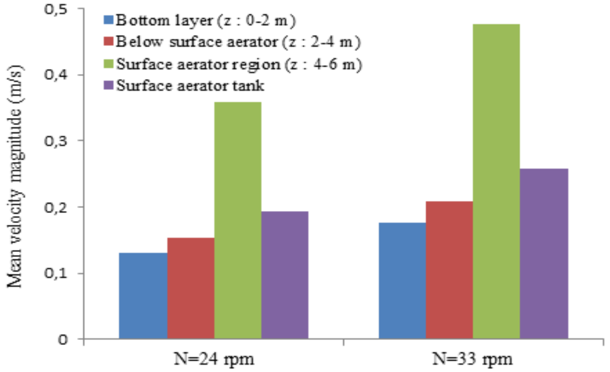

Fig. 7 Mean velocity magnitude in different zones and in aeration tank overall at rotation speed of 24 rpm and 33 rpm.

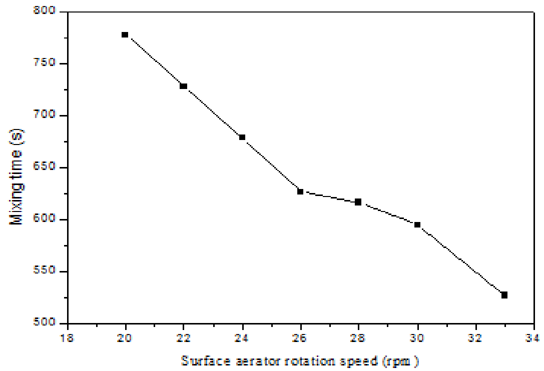

Fig. 8 Mixing time as a function of the surface aerator rotation speed