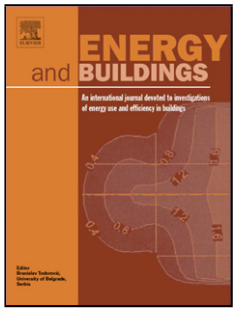

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PII: S0378-7788(16)32066-7
DOI: http://dx.doi.org/doi:10.1016/j.enbuild.2017.06.012
Reference: ENB 7675

To appear in: *ENB*

Received date: 29-12-2016
Revised date: 19-4-2017
Accepted date: 10-6-2017

Please cite this article as: Ignacio José Moncho-Esteve, María Gasque, Pablo González-Altozano, Guillermo Palau-Salvador, Simple inlet devices and their influence on thermal stratification in a hot water storage tank., Energy and Buildingshttp://dx.doi.org/10.1016/j.enbuild.2017.06.012

Simple inlet devices and their influence on thermal stratification in a hot water storage tank.

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HIGHLIGHTS:

- Stratification and hydrodynamics of a hot water tank during charging are studied.
- A 3D-CFD model was used to supplement previous experimental analyses.
- A high degree of correlation with experiments and versatility was achieved.
- New inlet configurations and two inflow rates were simulated and compared.
- The role of some inlet characteristics on stratification is clarified.

ABSTRACT

Thermal energy storage is a technology used mostly in buildings and industries in order to preserve thermal energy so that the stored energy can be used at a later time. Thermal stratification during the charge process in a cylindrical water tank was investigated using tools of Computational Fluid Dynamics (CFD). Simulations were validated by means of experimental measurements of time-dependent temperature profiles. The results showed that the model was able to adequately capture the experimental temperature evolution in the tank for all the validation cases. Once validated the model, simple modifications of the usual inlet devices and inflow rate by CFD techniques were accomplished with the intention of improving the tank performance. It was found that the modifications of the simulated inlet devices affected the stratification level. This could lead to improve designs and optimize system efficiency. The analyses confirmed numerically the results obtained experimentally, and it was evidenced that a sintered bronze conical diffuser can improve stratification compared to a conventional bronze elbow inlet. Therefore, CFD techniques proved to be quite a valuable complement of experimental studies. The use of low inflow, smooth out inlet velocity and operate inflow upwards near the top of the tank enhanced stratification.

Abbreviations

a = face area vector

Keywords: Hot Water Storage Tank; Water Stratification; Inlet Parameters; Thermal Charging Efficiency; Unsteady Reynolds-Average Navier-Stokes (URANS).