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Dynamic response of a modified water tank exposed to concentrated solar energy

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Power generation by using concentrated solar thermal energy on liquid enclosures is one of the most promising renewable energy technologies. In this work, a developed liquid enclosure fitted with various number and configurations of horizontal metal rings have been analyzed, fabricated and tested. The influence of adding metal rings arrangement is investigated for its potential to enhance radial heat conduction to the center-line of the enclosure from the side-walls. Experiments were carried out for fluid in both static and dynamic modes of operation inside the enclosure that subjected to high heat flux. A developed two-dimensional CFD model to predict the transient flow and thermal fields within liquid enclosure subjected to heat flux has been developed and tested. The developed numerical model takes into consideration energy transport between the liquid inside enclosure and the solid material of the enclosure. The numerical simulations have been compared with experimental measurement. The computational code has been found in a good level of agreement with the experimental data except for liquid at the peak part of the enclosure. The results indicate that adding metal rings produce significant impact on the transient temperature difference inside enclosure during both static and dynamic modes. The six-ring model is found to be more effective for enhancing radial heat transfer than other three models that have been tested. The in-line arrangement is found to provide better thermal effect as compared to the staggered rings. Two new correlations for natural heat transfer inside liquid enclosures subjected to high heat flux have been formulated (one for no-ring model and the other for six-ring model). The natural Nusselt number is found to be around a constant value for Rayleigh number less than (5x108). The recommended use of metal rings inside liquid enclosures subjected to heat flux, and the predicted Nusselt number correlation, will add to local knowledge a significant mean to gain more heat in large scale concentrated solar power plants.

Biography

Mohammed H Alhamdo is a Professor of Mechanical Engineering departmen in College of Engineering - AlMustansirya University, Baghdad, Iraq. He is working in AlMustansirya University from past 21 years. As a Professor credits him with many publications in national and international journals. He is committed to highest standards of excellence and it proves through his authorship of many reserach papaers.

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