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Computational Fluid Dynamics Analysis of a Biomass Burner Gas Chamber in OpenFOAM

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Abstract : The global climate crisis has affected different aspects of human life, and in an effort to reverse the effects generated, we seek to optimize and improve the equipment and plants that produce high emissions of CO_2, being possible to achieve this through numerical simulations. These equipments include biomass combustion chambers. The objective of this research is to visualize the thermal behavior of a gas chamber that is used in the process of obtaining vegetable extracts. The simulation is carried out with OpenFOAM taking into account the conservation of energy, turbulence, and radiation; for the purposes of the simulation, combustion is omitted and replaced by heat generation. Within the results, the streamlines generated by the primary and secondary flows are analyzed in order to visualize whether they generate the expected effect, and the energy is used to the maximum. The inclusion of radiation seeks to compare its influence and also simplify the computational times to perform mesh analysis. An analysis is carried out with simplified geometries and with experimental data to corroborate the selection of the models to be used, and it is obtained that for turbulence, the appropriate one is the standard k - w. As a means of verification, a general energy balance is made and compared with the results of the numerical analysis, where the error is 1.67%, which is considered acceptable. From the approach to improvement options, it was found that with the implementation of fins, heat can be increased by up to 7.3%.

Keywords : CFD analysis, biomass, heat transfer, radiation, OpenFOAM
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