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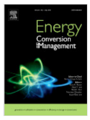

Heat transfer study on open heat exchangers used in jaggery production modules – Computational Fluid Dynamics simulation and field data assessment

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Highlights

- Heat transfer modeling and simulation between flue gases and sugar cane juice.
- Use of Computational Fluid Dynamics to get thermal parameters of a jaggery furnace.
- Data acquisition system installed in the jaggery production module.
- Parametric analysis changing the flue-gases velocity to represent temperature drops.

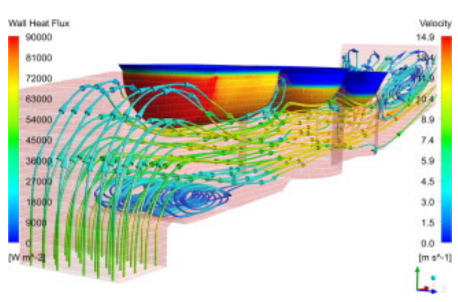
Abstract

Jaggery (also called organic sugar) is a concentrated product of sugarcane juice that is produced in rural communities in the highlands and jungle of Peru. In the last few years there has been an increase in the exports of jaggery and higher volumes of production are required driving this activity from a rural process with small production to an industry seeking greater productivity. In this framework, optimization of the use of energy becomes essential for the proper development of the process of production and the correct performance of the involved equipment. Open heat exchangers made of stainless steel are used in the production of jaggery. These heat exchangers containing sugarcane juice are placed over a flue gas duct. The thermal energy contained in the gas is used to evaporate the water contained in the sugarcane juice thickening the juice and after evaporating almost all the water, a pasty crystalline yellow substance is left in the boiling pan which becomes solid after cooling, this is the jaggery.

The modeling and simulation of heat transfer between the combustion gases and the juice is very important in order to improve the thermal efficiency of the process. It permits to know with a high level of detail the physical phenomena of heat transfer occurring from bagasse combustion flue gases to sugarcane juice. This paper presents the results of the numerical simulation of heat transfer phenomena in the open heat exchangers and those results are compared to field measured data. Numerical results about temperature drop of flue gases in the several locations of the jaggery furnace are in good accordance with field measurements, validating the predictive capacity that Computational Fluid Dynamics model offers in the detailed representation of the fluid flow and heat transfer characteristics of such furnace, ensuring the design of future

jaggery installations with higher thermal efficiency and sugarcane production.

Graphical abstract



Keywords

Pans; Jaggery; Flue gases; Computational Fluid Dynamics; Nucleate boiling heat transfer

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