Proceedings of the Canadian Society for Mechanical Engineering International Congress 2021
CSME Congress 2021
June 27-30, 2021, Charlottetown, PE, Canada

Investigation of the flow behavior in a channel with PCM-integrated columns, subjected to a sudden temperature rise

Kira Toxopeus [1], Kamran Siddiqui[1]
[1]Mechanical and Materials Engineering, Western University, London, Canada

ABSTRACT

Thermal energy storage is an active area of research as it has found to be an effective medium to conserve energy as well as to facilitate the integration of solar thermal energy as a reliable energy source. Among thermal energy storage types, latent heat-based thermal energy storage has shown to be the most effective due to higher energy storage density, narrow operating temperature range and compact design. Phase change materials or PCMs are the materials used as the thermal storage media in latent heat thermal energy storage systems.

Beside being used as the thermal energy storage, another emerging application is the use of PCM for the thermal regulation of the fluid medium. That is, to store excess heat from the fluid as its temperature increases above the operating range and release the energy back to the fluid as its temperature drops below the operating range. An important application of such system is the photobioreactor to grow microalgae, which can be used as alternate energy resource. Microalgae are sensitive to the temperature variations and the temperature beyond a certain threshold could be fatal.

The present research is a part of a long-term project focused on the design and development of a PCM-integrated photobioreactor to regulate the reactor temperature to maximize the growth of microalgae. The photobioreactor considered in the project comprised of a channel with offset columns (to serve as thermal energy storage). The specific objective of the present research is to investigate the flow behavior in a channel with PCM storage columns, as the fluid experiences a sudden increase in the temperature.

Particle image velocimetry (PIV) was used to measure the velocity field in the channel. Rubitherm RT-26 was used as the PCM. The thermal storage columns were instrumented with thermocouples to characterize the heat transfer. Experiments were conducted at different flow rates and different temperature rises. Detailed results will be presented and discussed.

.