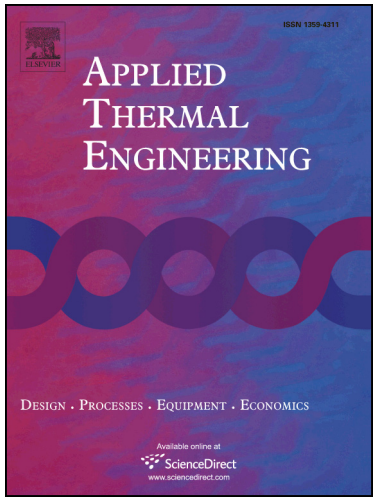

Research Paper

Steam batch thermal processes in unsteady state conditions: Modelling and application to a case study in the food industry

Alessandro Biglia, Lorenzo Comba, Enrico Fabrizio, Paolo Gay, Davide Ricauda Aimonino

PII: S1359-4311(17)31426-6
DOI: http://dx.doi.org/10.1016/j.applthermaleng.2017.03.004
Reference: ATE 10006

To appear in: *Applied Thermal Engineering*

Received Date: 2 September 2016
Revised Date: 4 January 2017
Accepted Date: 2 March 2017

Please cite this article as: A. Biglia, L. Comba, E. Fabrizio, P. Gay, D. Ricauda Aimonino, Steam batch thermal processes in unsteady state conditions: Modelling and application to a case study in the food industry, *Applied Thermal Engineering* (2017), doi: http://dx.doi.org/10.1016/j.applthermaleng.2017.03.004

Steam batch thermal processes in unsteady state conditions: Modelling and application to a case study in the food industry

Alessandro Biglia[1], Lorenzo Comba[1], Enrico Fabrizio[2,1]*, Paolo Gay[1], Davide Ricauda Aimonino[1]

[1]*Di.S.A.F.A. – Università degli Studi di Torino, 2 Largo Paolo Braccini, 10095 Grugliasco (TO) - Italy*

[2]*DENERG – Politecnico di Torino, 24 Corso Duca degli Abruzzi, 10129 Torino - Italy*

*Corresponding author. Tel: +39-011-0904428; fax: +39-011-0904499
E-mail address: *enrico.fabrizio@polito.it*

Abstract

Many industrial processes require high amounts of steam. Design and operation of steam plants are particularly complex when the steam supply is required for short periods and with a varying time schedules. To fulfil the discontinuous needs of steam users, avoiding the steam boiler oversizing to the peak value of the steam request, a thermal energy storage (TES) system can be adopted. The proper sizing of TES systems, which, in this application, is constituted by a steam accumulator vessel installed between the steam generator and the consumer, cannot be based on the sole initial and final state conditions of the steam storage, since a performance prediction of the process time-evolution is also required.

In this paper, a model of steam batch processes for industrial thermal treatments, able to describe unsteady operative conditions, is presented. More in detail, a three-stage steam plant, with a sequentially interconnected steam boiler, steam accumulator and processing tank, has been considered. The dynamic model of the charging and discharging processes of the steam accumulator has been applied to a real case study in the food industry: the batch debacterisation process of cocoa beans. Nevertheless, the obtained results can be profitably employed in the design and the performance assessments of a wide set of applications involving the steam processing fluid, such as desalination plants, solar thermal power plants, retorts, steam ovens and others.

Keywords: *Steam batch process; Steam accumulator; Tank steam filling; Unsteady process; Food industry*