# The contribution of thermodynamics in determining the parameters of elaboration and energy efficiency

Corinne Claireaux*[1] and Ankith Santosh

[1]CelSian – Netherlands

**Abstract**

A glass melter fulfills two main functions: it enables heat exchanges between the energy source (combustion and electric boosting), the raw materials, and the melt. It is the vessel for the chemical reactions transforming the raw materials into a melt. Following the principle of energy conservation, the energy balance of a furnace can be established. Its performance can then be evaluated by benchmarking it against other furnaces.
Once the relative position of a furnace is established, a new set of questions arise: how could the energy efficiency of the furnace be improved? Could the pull rate of the furnace be increased? Are these improvements possible while maintaining sufficient glass quality, and without shortening the furnace lifetime?

A large part of these questions can be answered by using a 1-dimensional thermodynamic approach well described in Pr R. Conradt's papers. The efficiency of this elegant approach will be demonstrated to show, for example, the influence of changing the raw material selection, cullet fraction, electrical boosting, and pull rate on the energy efficiency of a glass melter.
This approach is however limited when it comes to ensuring glass quality, and especially bubble removal. In production, bubble upsets are often related to a wrong temperature and glass flow management, which allows poor-quality glass melt to exit the furnace. Industrial examples of how such issues are observed and solved using Computational Flow Dynamics will be shown.

**Keywords:** energy efficiency, thermodynamics, glass melting

*Speaker