

THERMAL FOOD PROCESSING EVALUATION AND OPTIMIZATION SOFTWARE

Abakarov¹, A., Almonacid^{1,2}, S., and Simpson^{1,2}, A.

¹Universidad Técnica Federico Santa María, Departamento de Ingeniería Química y Ambiental, P.O. Box 110-V; Valparaíso, Chile.

²Centro Regional de Estudios en Alimentos Saludables, Blanco 1623 room 1402, Valparaíso, Chile.

alik.abakarov@usm.cl

Introduction

Thermal processing is an important method of food preservation in the manufacture of shelf stable canned foods, and has been the cornerstone of the food processing industry for more than a century. Mainly, thermal processing is concentrated on the following factors: final product safety and quality, total processing time and energy consumption. The diversity of thermal processing objectives impose different optimal requirements to sterilization processing, which can be determined by analytical or numerical procedures and based on these procedures sophisticated dialogue software. Therefore, the objective of this research consisted of developing the following thermal food processing software:

- “Process Evaluator” is software developed to carry out thermal process calculations based on the Ball's formula method (Holdsworth and Simpson, 2007).
- “OPT-PRO” is software for thermal food processing optimization based on variable retort temperature processing and global optimization technique.

Materials and methods

“Process Evaluator”

Time-temperature data loaded from Excel-file is used to evaluate the heat penetration parameters j_h and f_h , as well as to compute process lethality for given process time or vice versa (see Figures 1 and 2). The possibility of computing the process time and lethality for broken heating curves is included (see Figure 2).

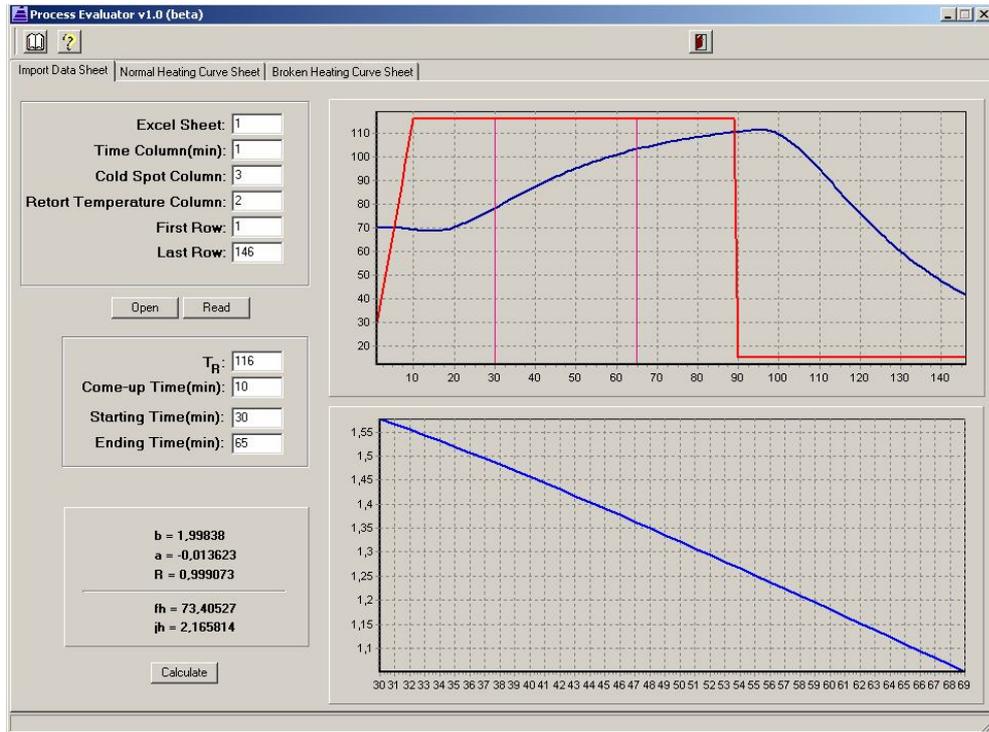


Figure 1. Time-temperature data loaded from Excel-file is used to evaluate the heat penetration parameters

j_h and f_h .

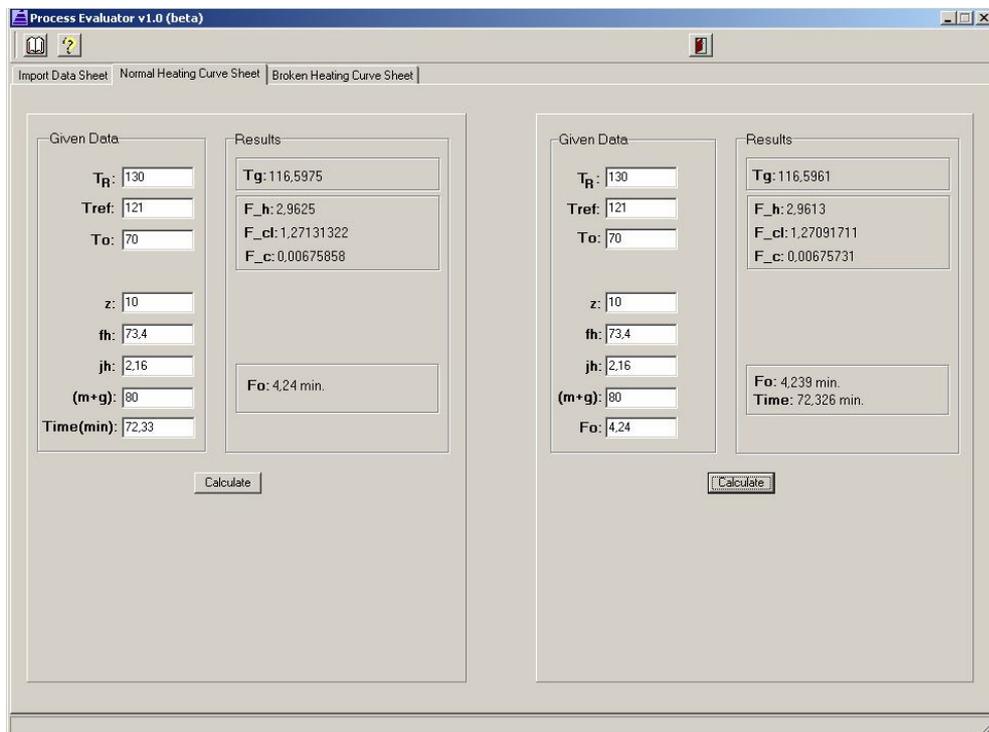


Figure 2. Time-temperature data loaded from Excel-file is used to evaluate the heat penetration parameters

$$j_h \text{ and } f_h.$$

“OPT-PRO”

The diversity of thermal food processing optimization problems with different objectives and required constraints are solvable by “OPT-PRO” software. The adaptive random search algorithm (Abakarov et al., 2009) coupled with penalty functions approach, and the finite difference method with cubic spline approximation are utilized by “OPT-PRO” for simulation and optimization thermal food processes. The possibility of estimating the thermal diffusivity coefficient based on the mean squared error function minimization is included.

Results and discussion

The “OPT-PRO” software was successfully tested on the real thermal food processing problems, namely in the case of process time minimization with a constraint for average and surface retentions the “OPT-PRO” demonstrates significant advantage over the traditional constant temperature processes in terms of process time and final product quality. Testing results have shown that “Process Evaluator” software basing on the Ball's formula demonstrates required abilities in estimating an actual thermal lethality value.

Conclusion

The developed user friendly dialogue and used numerical procedures makes the “*Process Evaluator*” and “OPT-PRO” software extremely useful for food scientists (research and education) and engineers (real thermal food process evaluation and optimization).

References

Abakarov A, Sushkov Y, Almonacid S and Simpson R, (2009) Thermal processing optimization through a modified adaptive random search. *Journal of food process engineering*, 93, 200-209.



Holdsworth, S.D. and Simpson, R. 2007. Thermal processing of packaged foods. 2nd Edition. Springer. New York. USA.