MODELLING OF A FIBERWOOD MANUFACTURING PROCESS

Hicham El Bahja[1,2], César de Prada[1,2], Angel García[3], Alberto Vicente[3], Marina Melero[3], Jose Luis Pitarch[1], Fernando Tadeo[(*)1,2]

[1] Industrial Engineering School, Univ. of Valladolid, 47005 Valladolid, Spain

[2] Institute of Sustainable Processes, Univ. of Valladolid, 47005 Valladolid, Spain

[3] Sonae Arauco España, 47009 Valladolid, Spain

[(*)] Email: Fernando.Tadeo@uva.es

ABSTRACT

A model of a fiberwood panel manufacturing process is being developed. This model is developed to reproduce the evolution of unmeasurable variables within the mat (pressure, temperatures), in order to reproduce the operation of the process. For this, the main process (pressing) is modeled in detail to evaluate how energy and matter is transported through the process. Preliminary results demonstrate the possibility of simulating reproduce internal variables throughout the pressing process.

INTRODUCTION

This work focuses on developing a model from partial differential equations of the fiberwood pressing process to reproduce the evolution of internal variables of the process (pressures, temperature) throughout the pressing process (Ismail, 2012, Kavazović et al., 2012). These models would be used to develop computer simulators of the processes, using “Digital Twin” techniques.

A simplified representation of the cross-sectional structure of the press is given in Figure 1 (Pereira, 2006). The adhesive-treated wood-furnish mat is conveyed through the press between two endless steel belts. Heat and pressure have to be transferred from the press into the moving mat. The pressing force is exerted from closed frames onto the press beams and heating platens. The mix of fiberwood obtained by crashing wood and glue is pressed continuously at high temperatures so the glue reacts uniting the fibers and high densities are obtained at the lateral sides of the panel. To have estimators of internal variables, to improve the quality of the product and reduce the energy consumption it is fundamental to have detailed models of the process that reproduce the relations between variables, that are obtained by adapting models of the fiberwood process (Ismail, 2012, Kavazović et al., 2012).

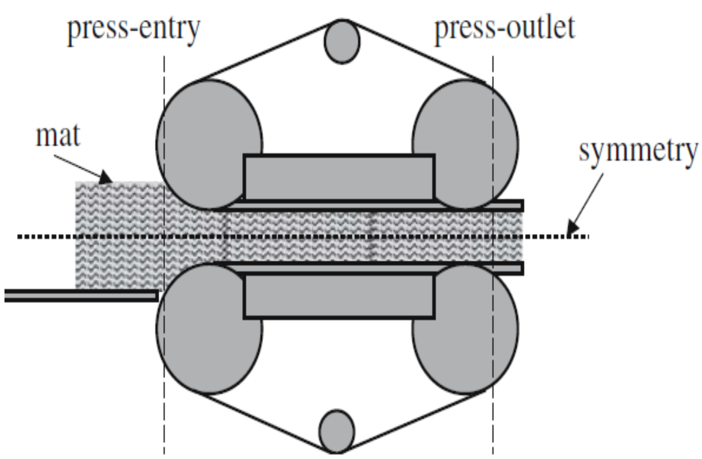

Figure 1: Panel pressing process (Pereira et al, 2006)

RESULTS AND CONCLUSIONS

A model was developed and written in the Matlab software using directly the equations. Some simulations results are now presented, with the mat divided uniformly into a grid of 4000 points (20x20x10). Figures 2 show the evolution of Temperature and Pressure through the press, at different depths. Initially all the layers have the same density but as the pressing proceeds, the density in the peak area increases much faster in comparison with the core region. The results are consistent with the information available from lab measurements and the operator's knowledge. They make possible to see the possibility of predicting distribution of internal variables throughout the pressed mat in different operating conditions (mat speed, applied pressures and temperatures, etc.)

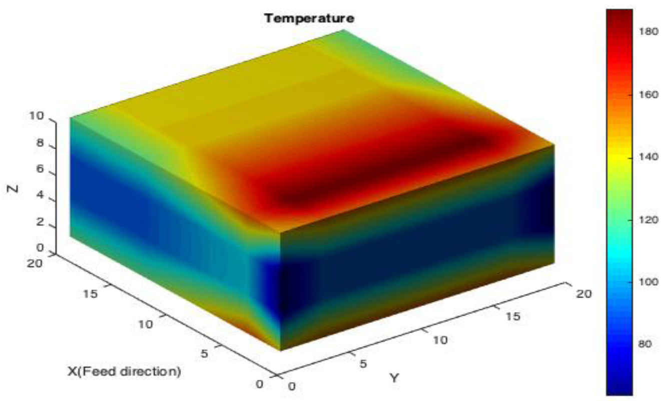

Figure 2: 3D results of temperature distribution using the developed models

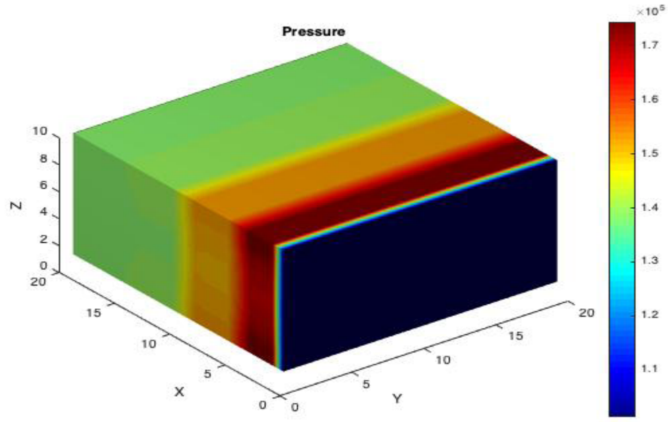

Figure 3: 3D results of pressure distribution using the developed models

ACKNOWLEDGMENTS

Funded by Junta de Castilla y León (CLU-2017-09, VA232P18, UIC 225) and EU-FEDER.

REFERENCES

[1] Pereira, C., Carvalho, L. M., & Costa, C. A. (2006). Modeling the continuous hot-pressing of MDF. Wood science and technology, 40(4), 308

[2] Kavazović, Z., Deteix, J., Cloutier, A., & Fortin, A. (2012). Numerical Modeling of the Medium-Density Fiberboard Hot Pressing Process, Part 1: Coupled Heat and Mass Transfer Model. Part 2: Mechanical and Heat and Mass Transfer Models. Wood and Fiber Science, Wood and Fiber Science, 44(2), 168-188; 44(3), 243-262.

[3] Ismail, F. S., & Bakar, N. A. (2012). Predicting fiberboard physical properties using multilayer perceptron neural network. Int. J. of Scientific & Engineering Research, 3(8), 1-4.