ABOUT THE NUMERICAL SIMULATION OF THE HEATING PROCESS IN A MICROWAVE FIELD

Lucaci Codruţa*, Cheregi Gabriel, Lustun Liana, Galis Ioan, Fetea Marius

University of Oradea, Faculty of Environmental Protection, 26 Gen. Magheru St., 410048 Oradea, Romania e-mail: lc_codruta@yahoo.com

Abstract

This paper presents a simulation of the heating process in the microwave field. This simulation is performed using the program Ansoft HFSS (High Frequency Structure Simulator). This program allows viewing the basic electromagnetic field quantities.

Key words: High Frequency Structure Simulator, waveguides, electromagnetic field, rotating turntable

INTRODUCTION

In the promotion of electro-technology based on microwave energy, an important step is the realization of experimental models, in laboratory, allowing a real analysis of phenomena in any time and all conditions, the heating process in a microwave field and with it the determination of specific parameters in the problem.

Software allows corporate existence, however, that before you make a practice facility, it can be studied and modeled numerically. When the practical realization will already know, some of the phenomena that characterize the device, so they will be removed a number of unknowns of the problem.

MATERIALS AND METHODS

For the numerical simulation of the heating process was used Ansoft HFSS program.

The software package Ansoft HFSS (High Frequency Structure Simulator) is an interactive software that allows the determination of the electromagnetic field within the passive structures at high frequencies. Post-processing software includes commands useful to analyze in detail the functioning of the structures considered. Using algorithms based on finite elements, Ansoft HFSS to calculate and view some sizes that:

- Basic electromagnetic field quantities, and for problems with open borders and reflected radiated fields is determined;
- Characteristic impedances of ports and the propagation constants;
- Generalized parameters S and re-normalized impedance parameters S for different ports;
- Resonant frequencies or frequency range for a given structure.

The heating in the microwave field is undergoing tests with two waveguides with dimensions:

• Guide with interior width of 30 X 90 [mm] which was introduced several radiating slots

• Guide with interior width of 10 x 90 [mm] without radiating slots which are located in figure range.

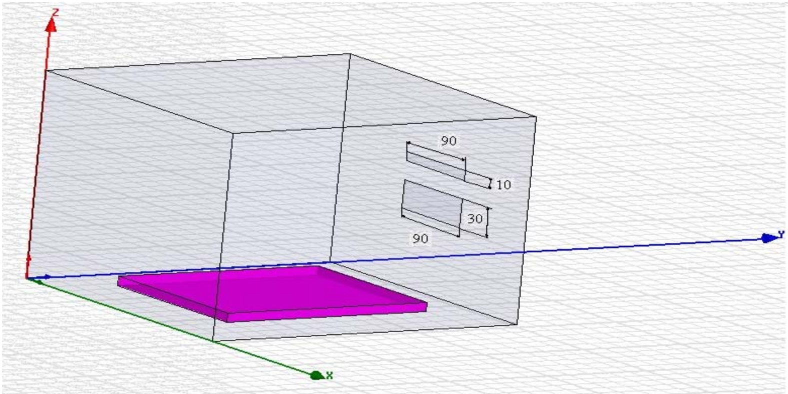
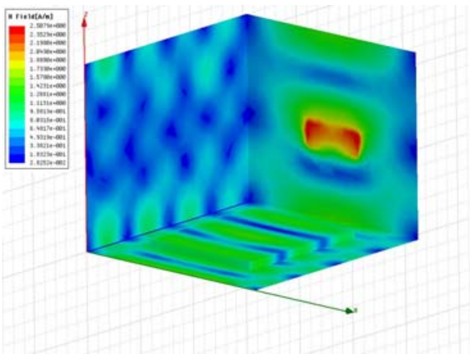


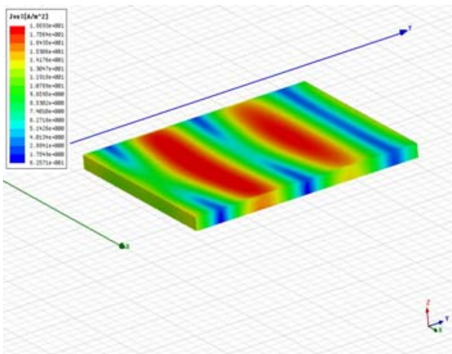
Fig.1 - Location and size guides

Two practical cases are considered:
a) If the guide was introduced several radiating slots;
b) If the user has introduced several radiating slots.

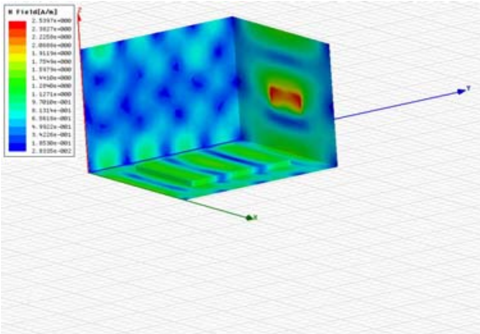
RESULTS AND DISCUSSION

a) In the following we present the results of numerical simulation of the microwave heating process of humectants potato flakes where the guide was introduced several radiating slots;
According to material taken from literature values of relative permittivity and loss factor for humectants potato flakes at a temperature of 20^0 C are $\varepsilon' = 0{,}62$ $tg\delta = 0{,}354$.

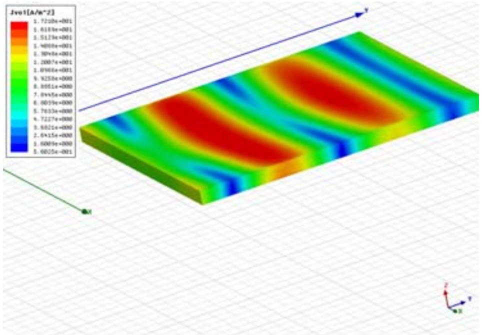

Magnetic field distribution


Electromagnetic field distribution

At temperature of 30^0 C values relative permittivity and loss factor for potato flakes are humectants $\varepsilon' = 0{,}61$ $tg\delta = 0{,}32$.

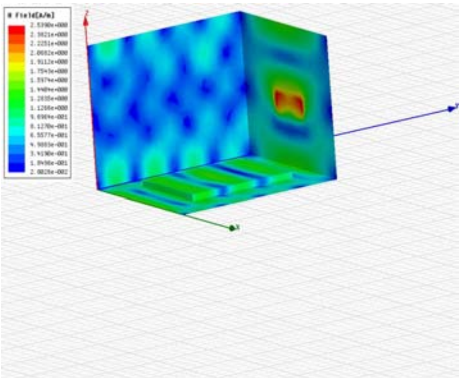


Magnetic field distribution

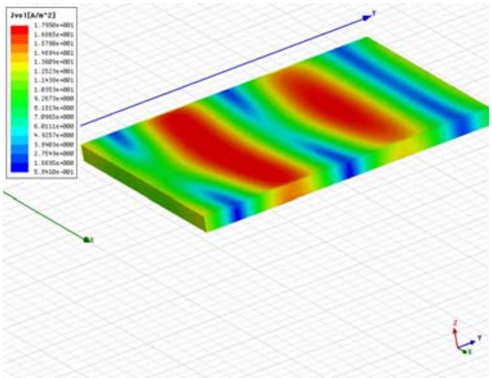


Electromagnetic field distribution

For a temperature of 40^0 C values relative permittivity and loss factor for potato flakes are humectants $\varepsilon' = 0{,}6 \quad tg\delta = 0{,}35$.

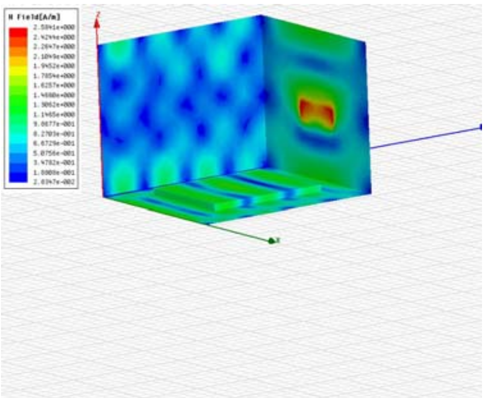


Magnetic field distribution

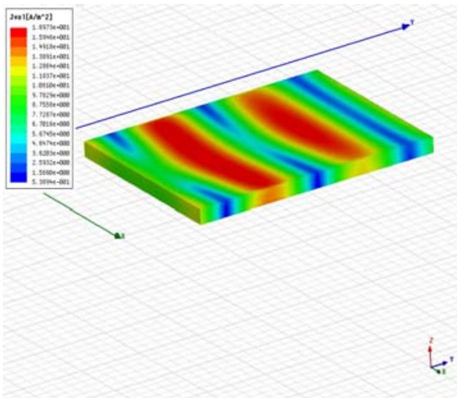


Electromagnetic field distribution

At temperature of 50^0 C values relative permittivity and loss factor for potato flakes are humectants $\varepsilon' = 0{,}59 \quad tg\delta = 0{,}33$.

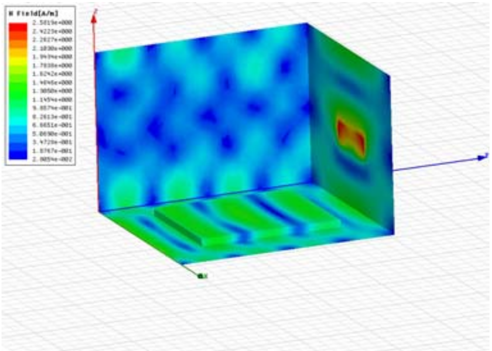


Magnetic field distribution

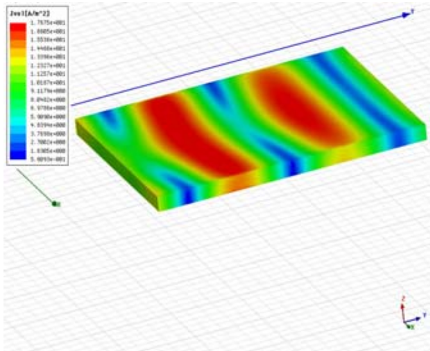


Electromagnetic field distribution

For a temperature of 60^0 C values relative permittivity and loss factor for potato flakes are humectants $\varepsilon' = 0{,}58$ $tg\delta = 0{,}36$.



Magnetic field distribution

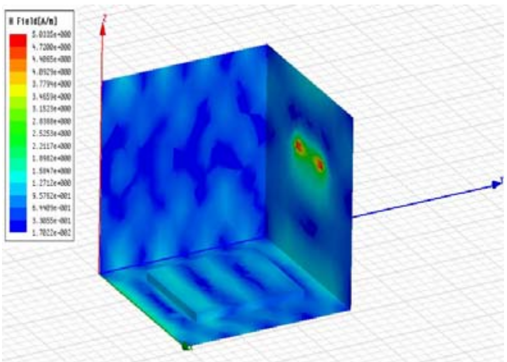


Electromagnetic field distribution

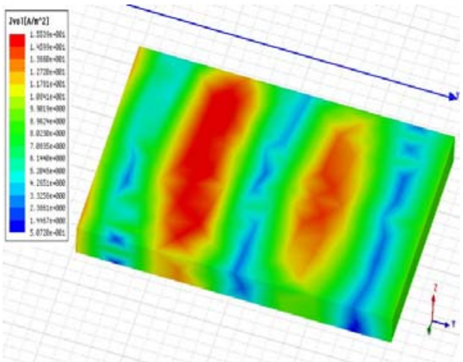
a) In this case the guide slots radiating series was not introduced.

Simulation was performed for the same values of permittivity and loss factor as for a.

For the temperature 20^0 C.

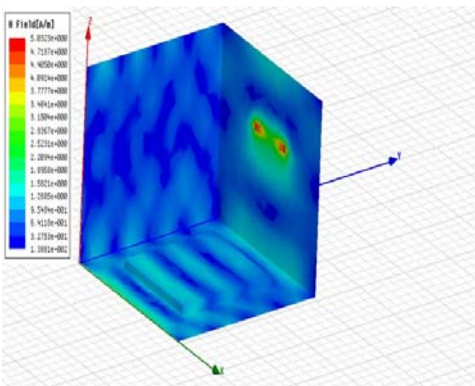


Magnetic field distribution

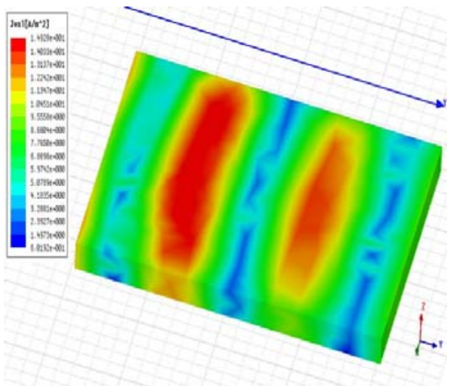


Electromagnetic field distribution

For the temperature 30^0 C.

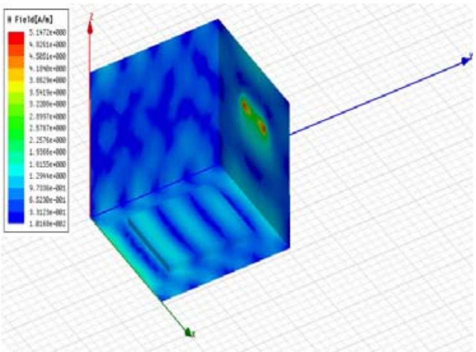


Magnetic field distribution

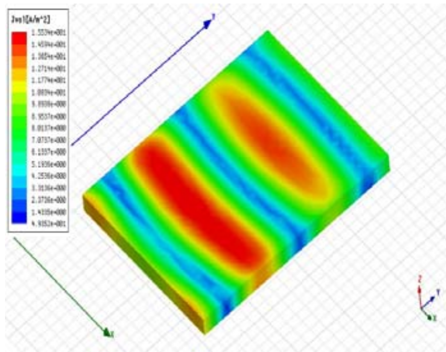


Electromagnetic field distribution

For the temperature 40^0 C.

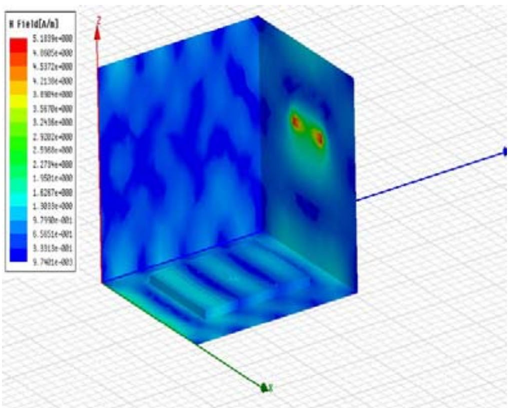


Magnetic field distribution

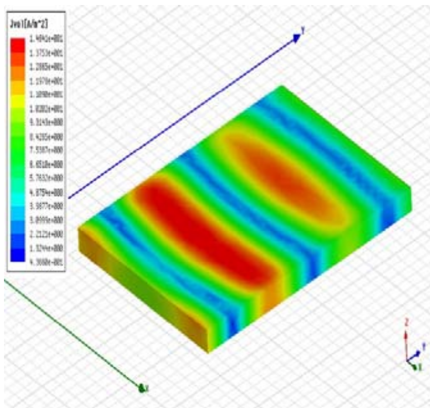


Electromagnetic field distribution

For the temperature 50^0 C.

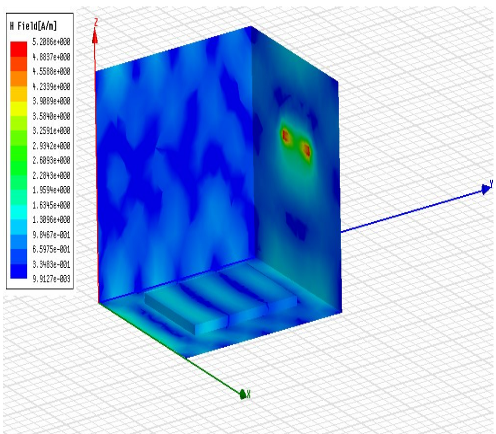


Magnetic field distribution

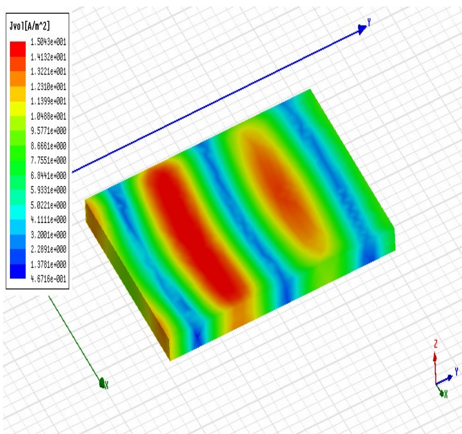


Electromagnetic field distribution

For the temperature 60^0 C.



Magnetic field distribution



Electromagnetic field distribution

CONCLUSIONS

With the analysis of numerical results, we want to make a homogenization of field and the thermal field and we wish to eliminate the rotating turntable to use large containers so can be heat as smooth and efficient. In this sens, the dimensions are processed material and the dielectric properties are known. We can observe in finally that there is at least one geometric parameter of the applicator into which the plant can be optimized.

Analyzing the obtained results with the electromagnetic field distribution on the dielectric surface, it appears that there are enough non-uniformity of the field. However, the stipulated conditions, are likely due to the radiating slots this series to the electromagnetic field distribution is more uniform than if no slots radiating series.

After interpreting the results, we note that when the electromagnetic field is uniform, the distribution of the thermal field is not uniform on the material surface. So the smooth processing of these materials only in the microwave field without radiating slots and rotating turntable is not fully satisfied, therefore it will find new solutions to standardize the thermal field and eliminate the rotating turntable and use the large containers which are to be carried out in future research..

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