DRYING BARLEY SEEDS USING DIFFERENT LEVELS OF THE MICROWAVE POWER

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Abstract

Microwave power of 0.4 W/g and 0.6 W/g was used to dry samples of Barley seeds. The samples were divided as follows: using the energy power with hot, cold or no air stream. The temperature in the mass of the seeds was noted every 30 seconds, during the period of drying (600 seconds. The succeed of the experiment was reflected through the germination rate.

Key words: microwave power, agricultural products, humidity, germination

INTRODUCTION

The use of microwave energy in the process of drying foods has become an important tool in the food industry (Gupta and Eugene, 2007). Farmers are even now skeptical about the use of microwave energy in the process of drying the grains (Hemis, Choudhary and Watson, 2012). Their concerns stand on the possibility of damaging the structure of the seeds, changing the nutritional substances content and the high costs.

Many researchers dedicated their work on studying the effect of the high frequency field on the grains, being focused also on the change of dielectric properties during heating. Their studies represent a very important base for the companies that produce industrial microwave equipments (Metaxas, 1981), (Nelson, 1987), (Nelson, 1995), (Nelson, 1996), (Eric, 1998).

MATERIAL AND METHOD

The research developed within this study followed the parameters that interfere in the process of drying Barley seeds, using different input data.

The samples were made using the microwave installation from the Center of Research and Technological Engineering in Conversion of Electromagnetic Energy, Electrical Engineering Faculty, University of Oradea. Because of the lack of fresh harvested grains, the Barley seeds were soaked a day before, in order to achieve a final humidity of 25%.

Each sample was weighted before and after drying, in order to calculate the removed humidity from the amount of seeds. The removed

humidity is being calculated using the difference between initial and final humidity, divided to final humidity and multiplied with 100 (Vicas and Mintas, 2011), (Vicas G. and Vicas S., 2011).The initial weight used within all the experiments was set to be 50 g of seeds.

The variables used in the experiment are the power of the microwaves, with the value of 0.4W/g and 0.6 W/g and the air stream which was set to be cold, hot or to not exist. For each of these cases, every 30 seconds, were followed: the temperature measured in the see bed and the humidity measured at the output. During the experiments the reflected power was observed in order to be null.

As stated before, the temperature was measured and noted every 30 seconds by introducing a fiber optic sensor (type Pico Power Sens 6) in the seed bed. The humidity at the output was measured placing a humid meter (type Lutron YK - 90 HT) above the seed bed. The time of processing was established for 10 minutes, 600 seconds.

The samples were divided as follows:

- Case 1 - using the power of the microwaves of 0.4W/g, without air stream;
- Case 2 - using the power of the microwaves of 0.4W/g, with cold air stream;
- Case 3 - using the power of the microwaves of 0.4W/g, with hot air stream;
- Case 4 - using the power of the microwaves of 0.6 W/g, without air stream;
- Case 5 - using the power of the microwaves of 0.6W/g, with cold air stream;
- Case 6 - using the power of the microwaves of 0.6W/g, with hot air stream;

RESULTS AND DISSCUSIONS

In the first case of drying, at the end of the process, the weight of the seeds was less with 5 g, the humidity removed from the mass of the seeds being 11.11%. In the first 2 minutes, the temperature measured in the mass of the seeds grew to 121.2 [°C] (see Fig.1).The humidity measured at the output had an important fluctuation too, reaching 85.1 [%], and then decreasing to 47.6 [%], at the end of the experiment (see Fig.2). The fluctuation of temperature and humidity is explained by the fact that because no air stream was used, the water formed on the surface of the seeds absorbed a larger quantity of power, and in this way, overheated spots appeared.

When using cold air stream, the temperature measured in the mass of the seeds didn't pass over 42 [°C] and the humidity at the output had a rise at the beginning and then decreased constantly (See Fig. 1 and 2). The removed humidity was 19.04 [%], value explained through the use of cold air stream.

In the third case, when using the power of the microwaves with hot air stream, the weight of seeds after drying was 41g, so 9 g of water evaporated. The removed humidity was in this case 21.95 [%]. As presented in Fig.1, the temperature measured in the grains, had a constant growth, to 44.3[°C] in minute 10. The humidity at the output increased fast in the first minute and then decreased constantly to the value of 15 [%] (See Fig.2).

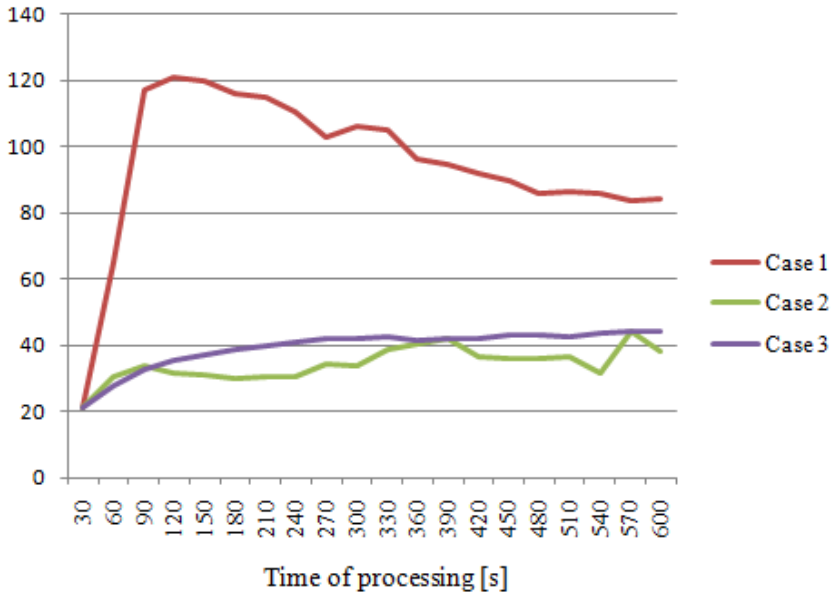

Fig.1 Variation of temperature measured in the mass of the seeds for the first three cases

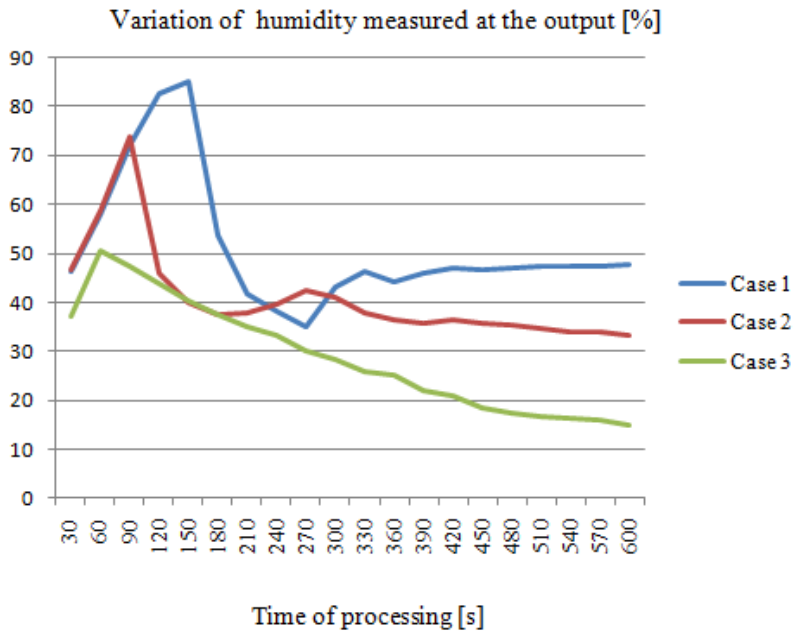

Fig.2 Variation of humidity measured at the output for the first three cases

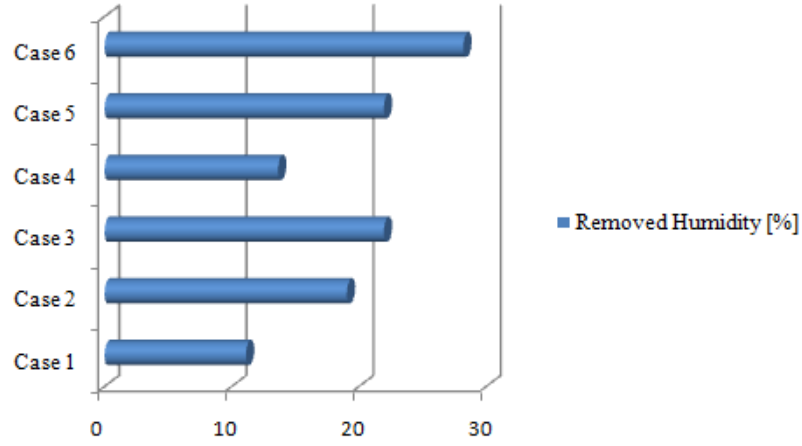

Fig.3 Variation of removed humidity from the mass of the grains for all drying cases

For the next three cases, the value of the microwave power was changed to 0.6W/g. When no air stream was used, from the total mass - 50 g, 6 g of water evaporated from the grains and the calculated removed humidity was 13.63 [%] (Fig.3).Unexpectedly, the temperature measured in the grains didn't have important fluctuations in the first minutes (like in the case of the first sample), only in minute 4 increased and then decreased constantly (Fig.4). Fig.5 shows the high increase of the humidity at the output, in minute 4-5, and then levelling off till the end of the period of

drying. In the fifth case, the temperature had important fluctuations, but didn't pass over 71.4 [°C] and the humidity at the output was constant for the whole processing time (Fig 4 and 5). When using hot air stream, the temperature grew fast in the first minute to 40.2[°C], and then grew constantly to 56.6[°C] (minute 10). The humidity at the output performed the same like in the previous case, showing a constant fluctuation (Fig 5).

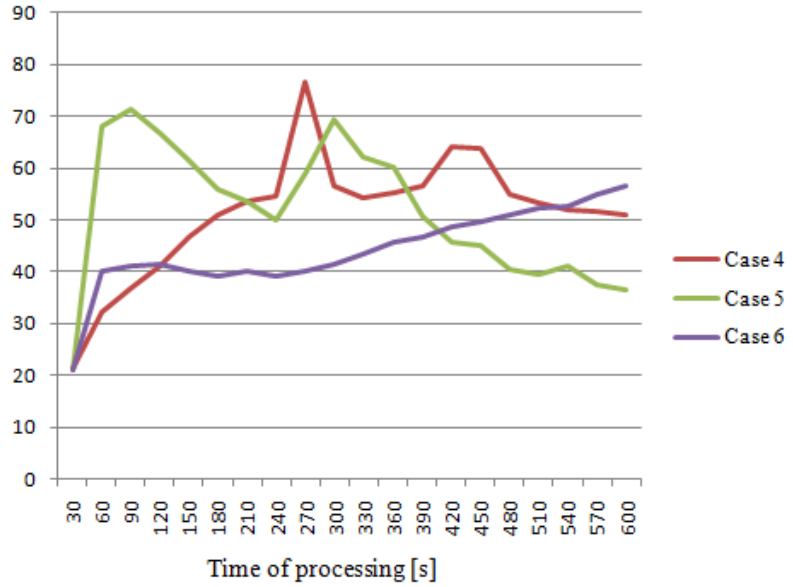

Fig.4 Variation of temperature measured in the mass of the seeds for the last three cases

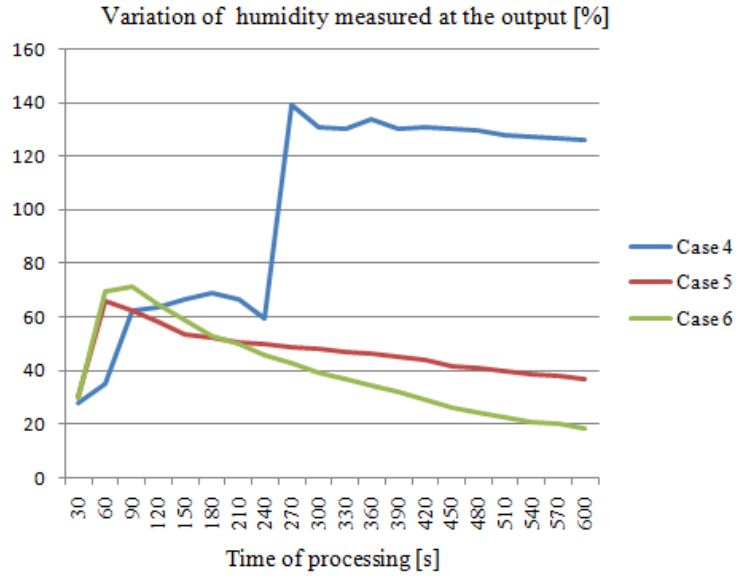

Fig.5 Variation of humidity measured at the output for the last three cases

CONCLUSIONS

The best germination percentage - 85% - was achieved for the fifth sample, were was used the power of the microwaves of 0.6W/g with cold air stream. The rate of germination was compared with the witness sample - 87%. The other samples had the next percentage of the germination: Case 1 - 11%, Case 2 - 79%, Case 3 - 65%, Case 4 - 20%, Case 5 - 85% and Case 6 - 80%. In conclusion it may be said that using air stream is important to evaporate the water from the grains and creating a homogeneous field. The power of microwaves of 0.6W/g is high enough to dry the seeds and not effect its structure.

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