EXPERIMENTAL DATA ON MICROWAVE DRIED CORN SEEDS

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Abstract

An analyze of the absorbed power, seed bed temperature and humidity was made using the microwave power of 0.4W/g. The dielectric material used during research was corn seeds, that were preliminary wetted, in the absence of fresh harvested seeds. The germination of the samples was also studied and compared with the witness sample.

Keywords: corn seeds, thermal field, germination, humidity, absorbed power

INTRODUCTION

The advantage of drying crops in the microwave field stands in the simultaneous heating and mass transfer through which takes place the decrease in humidity content to an optimum level for a good, appropriate storage. This new technology is used especially in the countries with wet climate, in the areas with dry-hot climate being used the solar energy (Eric St.Denis, 1998), (Campana, 1986), (Shivhare, 1991), (Hemis, 2012), (Rajagopal, 2009), (Varsányi, 2001) .

The use of microwaves at a frequency of 2.45 GHz for heating and drying corn seeds has been studied by many research people : Hall in 1963, Fanslow and Saul in 1971, Bhartia in 1973 and Shivhare in 1991 (Eric St.Denis, 1998), (Shivhare, 1991) .

Recent studies in the area of drying crops in the microwave field have been made by Wang in 2004, who studied the effects of microwave field on corn seeds at different power and temperature levels; in 2007 Manickavasagan made an important research on the quality of dried microwave seeds; in 2010 Leila Momenzadeha, Ali Zomorodiana, Dariush Mowlab used artificial intelligence, neural networks to predict the drying time for corn seeds at a high frequency field (Vadivambal, 2009), (Manickavasagan et. al., 2006), (Manickavasagan et. al., 2007), (Leila Momenzadeha et. al., 2010).

A great number of studies, important ones were made during many years by researches like S.O.Nelson and S.Trabelsi (Nelson S.O., 1987), (Nelson S.O., 1996), (Nelson S.O., 2008), (Nelson S.O. and S.Trabelsi, 2012), (Trabelsi S. and S.O. Nelson, 2006).

The storage of crops is being influenced by the post maturation period, when takes place the elimination of water from the bulk and in this way their surface becomes wet.

MATERIAL AND METHODS

The aim of drying granular products is to reduce the humidity content of fresh harvested crops to a proper value for a safe storage. If the humidity content of grains is too high, problems like mould appear and sometimes insects become a problem too. Some studies showed that the insects could be killed using the microwave power, the weevils being destroyed after two days from the microwave irradiation.

The present study was made on corn seeds, type Kornelius KWS, having an initial moisture content of 24 % and 26%. The initial and final moisture content of grains was measured with the humid meter type Multi Grain RO 089/97. The grains were dried using the microwave installation at a constant microwave power of 0.4W/g. For each sample was used a mass of 100 g of seeds. In the absence of fresh harvested grains, the seeds were preliminary pre wetted. The weight of the two samples was measured before drying (initial weight of both samples being 100 g) and the final one. With the two values, the initial and final weight of the seeds it was calculated the humidity eliminated from the seed bed. During the study there were analyzed and noted every 30 seconds the absorbed power (direct power) which represents the quantity of power absorbed by the seeds, the temperature measured in the grains and the humidity and temperature measured and the outside of the seed bed. The temperature in the seed bed was measured by introducing a temperature sensor in the applicator, type Pico Power Sens 6. The humidity and temperature was measured by placing a sensor above the cavity.

The samples were dried using the microwave installation for a period of time of 10 minutes.

RESULTS AND DISCUSSIONS

In the present study were dried two samples of corn seeds using the microwave power of 0.4W/g, for the first sample using the microwave power without airing the grains and for the second sample using the mixed heating - microwave power and hot air for the ventilation of the seed bed.

So, the first experiment was made using 100 g of corn seeds that were dried for 10 minutes using the microwave power of 0.4W/g. After the drying period finished the final weight of the seeds was 94 g of grains. The humidity eliminated from the seed bed was calculated with the relation between the initial m_i and final weight- m_u of the grains:

$$U\ [\text{Humidity}] = \frac{m_i - m_u}{m_u} \times 100[\%] \qquad (1)$$

The value obtained for the humidity eliminated from the grains is U_1=6.38%.

For the second study, the final mass of the seeds was 90 g, 10 g of water evaporated from the seed bed. The value is higher than on the previous sample because of the ventilation with hot air in the grains during the period of drying, that favored the evaporation of the water. The humidity eliminated from seeds is U_2=11.11%.

Analyzing the data presented in figure 1 it is observed that the absorbed power is even higher that the direct power, having values of 75 W in the first 30 seconds, and decreasing afterwards to values between 45W-25W. This variation is explained by the fact that when drying dielectric materials without airing it forms on the surface of the material a film of water and absorbs the energy and creates areas of different temperature values.

For the second sample, in the case of using a microwave power of 0.4W/g with ventilation, hot air, the values are more constant, especially from minute 5 to 10. Due to the fact that there was used air stream, the seeds were dried better, without any film of water creating on their surface, and no variation of the absorbed power was observed (see Figure 1).

Because there was used no air ventilation for the first sample, in figure 2 can be observed the variation of the output air humidity and output temperature. Analyzing the second samples, we can see that the parameters have constant values, without important changes.

The affect of boiling water in the grains can be noticed in figure 3, where for the first sample the seed bed temperature increased to a very high value, of 118.4°C. The film of water that formed during drying began to boil, in this way creating areas with high values of the temperature.
For the second study, the highest value of the temperature measured in the grains was noticed to be 59.3°C. By analyzing the temperature we can say that a high value like 118.4°C for certain destroys the seeds.

The germination made in the Seed Center, in Oradea, proved the above statement.

The rate of germination for the first sample was only 50 %, and for the second study it was G=90%. The germination percentage of the witness sample was G=95%.

The final humidity of the seeds was: for the first experiment U_{fin1}= 19% and for the second sample U_{fin2}= 16%.

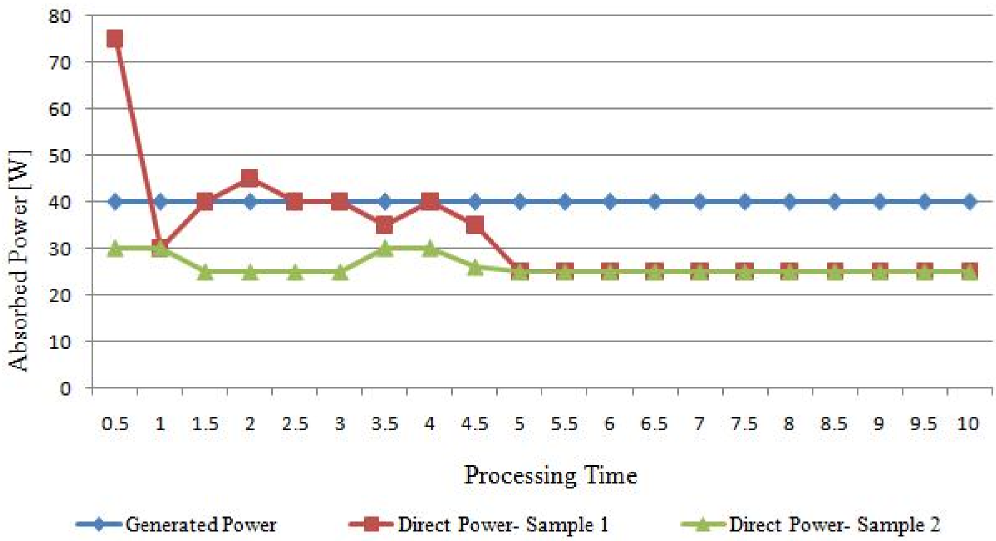

Figure 1. Variation of the absorbed power

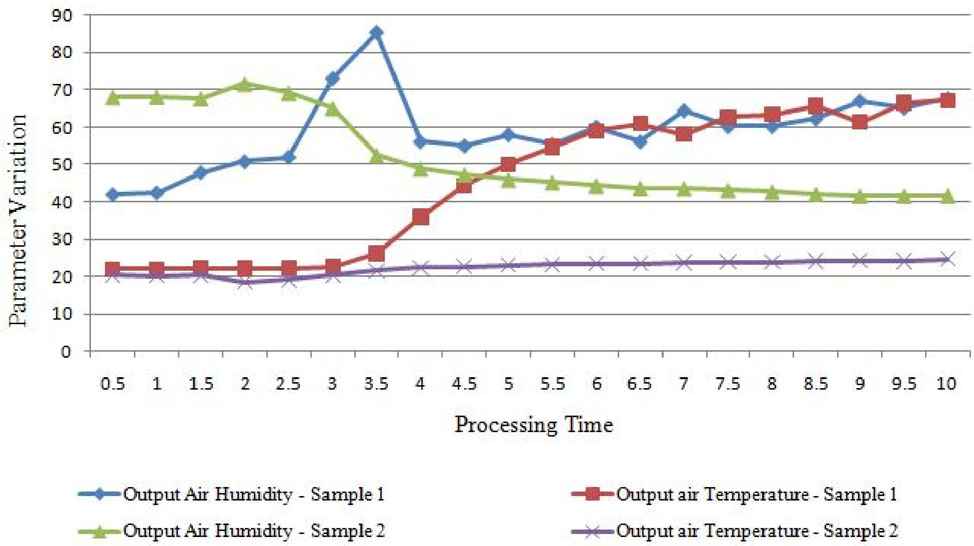

Figure 2. Variation of the drying parameters

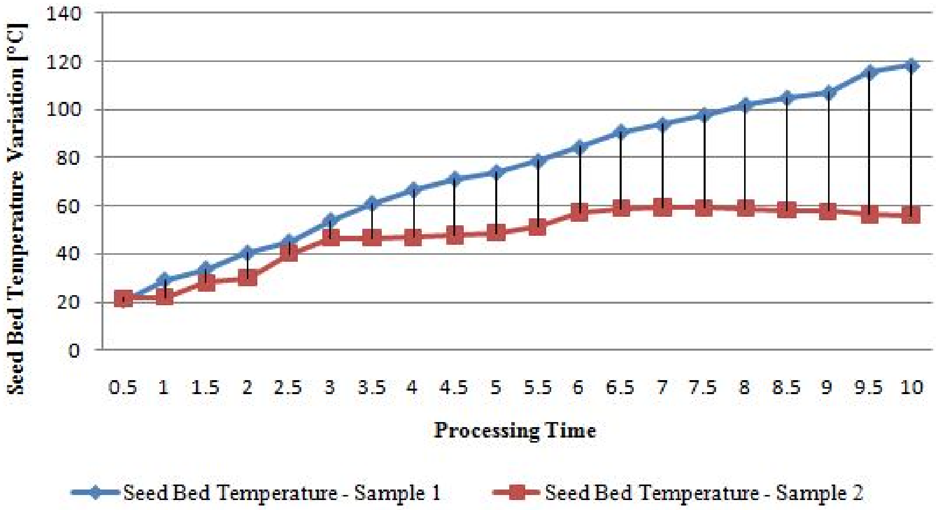

Figure 3. Variation of the temperature

CONCLUSIONS

Analyzing the results obtained during drying of corn seeds was concluded that the most appropriate drying procedure implicates airing the seed bed, using hot air. This procedure would lead to a higher rate of germination, a higher value of the humidity eliminated from the see bed and with constant variation of the drying parameters.

Future experiments of drying crops in the microwave field will include using ventilation in seed bed with hot air stream and a comparison of the two procedures.

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