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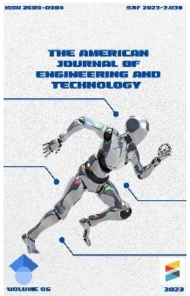

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Research Article

NEURAL NETWORK MODEL FOR CALCULATING THE PRODUCTIVITY OF DRYING SUNFLOWER SEEDS IN A COMBINED DRUM

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ABSTRACT

This article describes a neural network model for calculating the drying productivity of sunflower seeds in a combined drum dryer. Neural network modeling was performed in the Neural Networks Toolbox in Matlab. The adequacy of the constructed model to the experimental values was checked and compared.

KEYWORDS

Drying productivity, sunflower seeds, neural network modeling, drying process, Matlab system.

INTRODUCTION

Fast and high-quality drying of sunflower seeds grown in agriculture is one of the pressing issues. The types and capabilities of devices for drying sunflower seeds are increasingly increasing. Each dryer has its own drying modes and drying productivity, which means it has a model that reflects the drying process. Mathematical models, determined by summarizing the results of experiments, make it possible to predict the values of the measured quantities at the outlet of the dryer. Analysis of dryer performance and development of a mathematical model of drying productivity in the traditional way shows that a large amount of computational work is required. The number of factors influencing drying productivity complicates the modeling process. With proper planning of the experiment, a mathematical model is developed based on varying the input parameters. However, the process of developing a mathematical model based on traditional methods is not fast. Currently, research is being effectively carried out based on neural network modeling of drying processes [1-10]. Neural network modeling differs from traditional methods in speed, convenience, and the ability to work with many values of input parameters. In our article we consider the

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process of predicting the productivity of drying sunflower seeds in the combined dryer using the Matlab system based on neural network modeling. The modeling process was carried out based on the results of an experiment conducted to study the productivity of drying sunflower seeds in the combined dryer.

Materials and methods

A structural design of the combined drum drying device for drying grains and seeds with the possibility of additional use of solar thermal energy was developed and a pilot copy of the device was made [11, 12]. Experiments on drying sunflower seeds were conducted in this drying device. The dryer has a concentrator solar collector that collects and stores solar thermal energy. The influence of solar thermal energy on the drying process is evaluated by changing the value of the air temperature in the solar collector. During the drying process, the activity of the sun is also taken into account when calculating the efficiency of the dryer. Experimental work was carried out to determine the productivity of drying sunflower seeds in the drying device [13, 14]. The following were taken as the input parameters affecting the drying productivity of the dryer:

1) drying agent temperature, ºC.

2) initial moisture content of sunflower seeds, %.

3) air temperature in the solar collector, ºC.

4) drying period of sunflower seeds, min.

Based on the variation of these input parameters, the drying productivity of sunflower seeds at the outlet of the dryer was taken as the output parameter.

Results of experiments based on planning are presented in Table 1.

Experimental results obtained

based on input parameters.

Table 1

№	Drying agent temperature, ºC	Initial moisture content of sunflower seeds, %	Air temperature in the solar collector, ºC	Drying period of sunflower seeds, min	Drying productivity, kg/h
1	78	38	55	36	19,9
2	82	38	55	36	21,5
3	78	46	55	36	21,25
4	82	46	55	36	22,65
5	78	38	65	36	20,5

6	82	38	65	36	22,5
7	78	46	65	36	21,85
8	82	46	65	36	24
9	78	38	55	72	25,35
10	82	38	55	72	27,9
11	78	46	55	72	31,35
12	82	46	55	72	37,25
13	78	38	65	72	26,95
14	82	38	65	72	28,5
15	78	46	65	72	35,6
16	82	46	65	72	38
17	76	42	60	54	27,35
18	84	42	60	54	30,5
19	80	34	60	54	22,75
20	80	50	60	54	33,45
21	80	42	50	54	21,9
22	80	42	70	54	26,5
23	80	42	60	18	14,35
24	80	42	60	90	35,1
25	80	42	60	54	30,4
26	80	42	60	54	27,1
27	80	42	60	54	29
28	80	42	60	54	27,3
29	80	42	60	54	30
30	80	42	60	54	27,4
31	80	42	60	54	30,85

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Based on the experimental results presented in Table 1, we will build a neural network model that evaluates the drying productivity of the dryer in the Matlab (Neural Networks Toolbox) system. We use the Levenberg-Marquardt algorithm of neural network modeling to build the model. Figure 1 shows the structure of a simple-looking single-layer neural network model based on this algorithm. The number of neurons in the hidden layer was taken as 30 to make the calculations quick and easy.

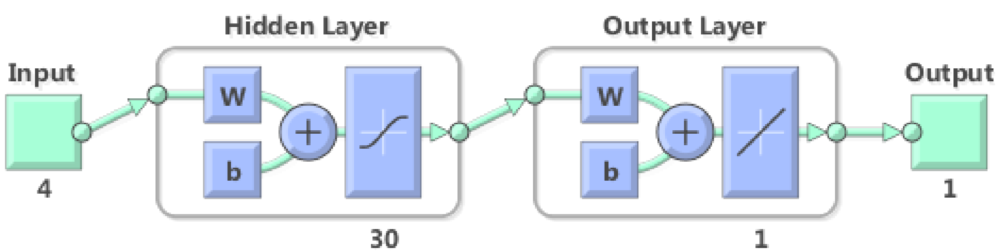

Figure 1. Neural network architecture.

The training efficiency of the constructed neural network is shown in Figure 2.

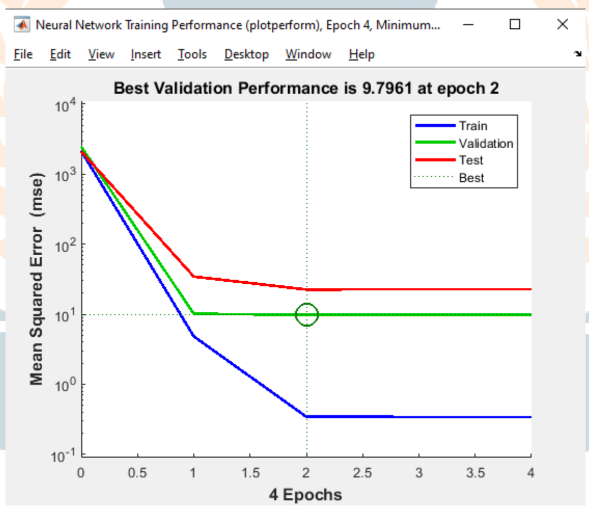

Figure 2. Efficiency of training neural networks.

RESULTS AND DISCUSSION

Based on the model found in the Matlab system, we calculate (predict) the drying productivity of the dryer for sunflower seeds (Fig. 3).

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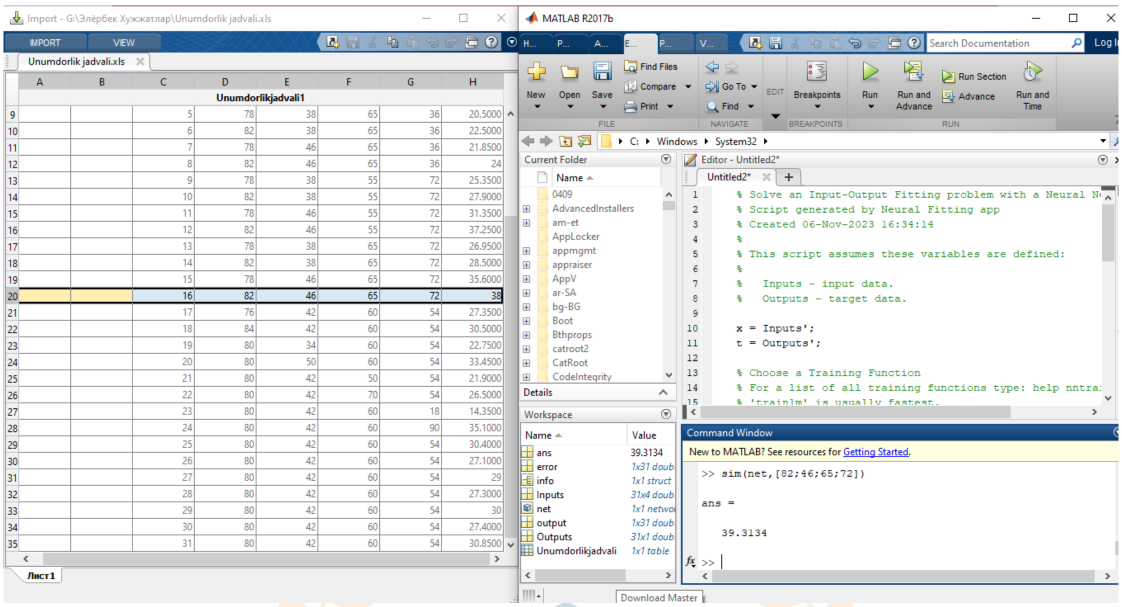

Figure 3. Calculation of drying productivity using the found model.

Figure 3 shows that the difference between the value obtained in the experiment and the value predicted by the model is small.

The difference between the values found based on the experiment and the model was calculated, and it was determined that the found model was similar to the experimental values. The drying productivity values calculated using the found model and determined experimentally were compared. Figure 4 shows the result of this comparison graphically.

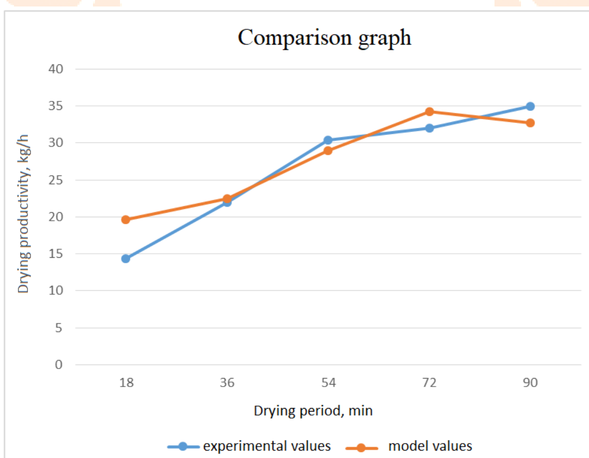

Figure 4. Comparison graph of drying productivity values found by the model and experimentally determined.

Figure 4 shows that the drying productivity values predicted by the found model are very close to the

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experimentally determined drying productivity values. So, we can use this discovered neural network model to determine the drying productivity.

The neural network model is important because it is easy to construct based on the results of the experiment. Using the neural network model found, we can predict values close to the experimental values. The more input values a neural network model is trained, the more accurate it becomes.

CONCLUSION

The neural network model was built using the Neural Networks Toolbox package of the Matlab system based on the results of the experiment to determine the drying productivity of sunflower seeds. Such modeling, built on the basis of typical algorithms, does not require long calculations. Adequacy of the built model to the experimental values can also be seen in the graphical representation. It is desirable to use neural network modeling in the Matlab system to quickly and easily perform discovery modeling based on experimental results.

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