Modern American Journal of Engineering, Technology, and Innovation
ISSN(E): 3067-7939
Volume 01, Issue 07, October, 2025
Website: usajournals.org

EXPERIMENTAL EVALUATION OF WHEAT GRAIN MOISTURE RESPONSE TO AERODYNAMIC REGIMES

Azizjon Isomidinov
Fergana State Technical University, Fergana, Republic of Uzbekistan

Abdullox Abdulazizov
Fergana State Technical University, Fergana, Republic of Uzbekistan

Alisher Abdukadirov
Fergana State Technical University, Fergana, Republic of Uzbekistan

Abstract
This paper presents the results of an experimental investigation into how changes in wheat grain moisture content depend on aerodynamic drying conditions. The experiments were carried out in a vertical cascading dryer, using air heated to 60–80 °C (preheated up to 90 °C in a calorifier) as the thermal agent. The main parameters examined were air velocity (υ = 5–20 m/s), dryer productivity (Q = 0.06–0.07 kg/s), and the number of cascade stages (4, 6, and 8). The dryer contained five heat-exchange zones, and the initial grain moisture content was 22%. The findings demonstrated that the moisture reduction process in wheat grains is strongly influenced by changes in the aerodynamic regime. The obtained results are of practical importance for optimizing the parameters of thermal agents and improving the overall efficiency of the drying process.

Keywords: Wheat, drying, aerodynamic regime, heat agent, moisture, cascading dryer, efficiency.

Introduction

The process of drying wheat grains plays a crucial role in ensuring food quality and extending storage life. During drying, it is essential not only to reduce the

Modern American Journal of Engineering, Technology, and Innovation
ISSN(E): 3067-7939
Volume 01, Issue 07, October, 2025
Website: usajournals.org

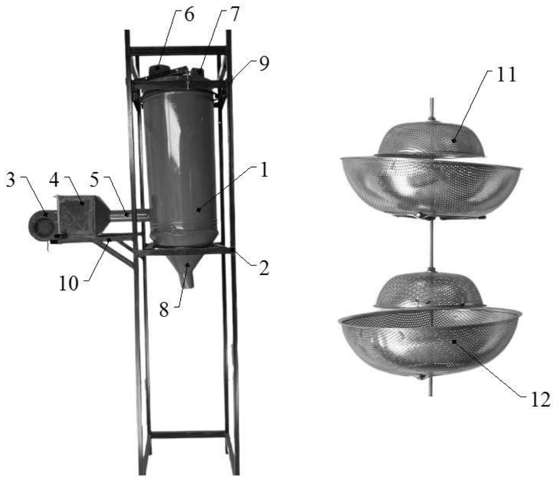
grain's moisture content to the required level but also to minimize energy consumption by efficiently managing heat and mass transfer processes.

The efficiency of drying largely depends on the design of the drying equipment, the temperature and velocity of the heating agent, the operational productivity of the unit, and the physical properties of the grains. Therefore, this study investigates how variations in aerodynamic parameters affect moisture reduction in wheat grains when using a vertical cascading dryer.

The rate of drying during the initial stage is strongly influenced by the design of the dryer — as the system's structural complexity increases, the drying rate tends to rise. However, this also causes a rise in aerodynamic resistance, which reduces the system's productivity. Hence, this research focuses on achieving high-intensity drying under minimal resistance conditions. The investigation examines how grain moisture changes depending on the air velocity of the drying agent, providing insights for optimizing the process.

Material and methods:

The physical model of a cascade drying device, developed based on MatLab sequence analysis, was chosen as the object of research (Figure 1).



1- Cascade vertical dryer body; 2- Support frame; 3- Fan; 4- Cooler; 5- Hot air flow distribution pipe with a slide; 6- Drying material inlet pipe; 7- Heat agent outlet pipe; 8- Dried material outlet pipe; 9- Ring fastener; 10- Fan and cooler mounting frame; 11- Small cascade nozzle; 12- Large cascade nozzle

Figure 1. Physical model view of cascade dryer

Modern American Journal of Engineering, Technology, and Innovation
ISSN(E): 3067-7939
Volume 01, Issue 07, October, 2025
Website: usajournals.org

The following limits of variable factors were used for the research: the temperature of the heat agent was 60-80°C (air heated to 90°C in the calorifier), the number of main cascades was 4; 6 and 8 (the cascades were located at 90 degrees to the vertical body of the device), the number of heat exchange zones was 5, the speed of the heat agent (air) leaving the calorifier was υ= 5÷20 m/s (the intermediate step increased by 5 m/s), the working efficiency of the device was Qunm =0.06÷0.07 kg·s (the intermediate step increased by 0.005 kg/s). During the experiments, the moisture content of wheat at the inlet to the dryer was 22%. [1,2,3].

Result discussions

The above variable factors were changed sequentially and the change in material moisture content depending on the speed of the heating agent was experimentally determined. Each experiment was repeated 5 times and the arithmetic mean values were selected. The MD-7822 hygrometer was used to measure material moisture content. The experimental results are presented in Tables 1; 2 and 3.

Table 1 Experimental results on the effect of variable parameters on material moisture content Qunm =0.07 kg/s const:

Heat agent speed, m/s	Heat agent temperature, °C	The initial moisture content of the material being dried, %	Moisture content of heated material, %	The temperature of moist air, °C	Heat capacity of water contained in the material, kJ/kg*K
When the number of cascade nozzles in the heater is 4 pcs					
5	70	22	20	419	3,8
10	70	22	19	419	3,8
15	70	22	17	419	3,8
20	70	22	16,5	419	3,8
When the number of cascade nozzles in the heater is 6 pieces					
5	70	22	19	419	3,8
10	70	22	16	419	3,8
15	70	22	15,2	419	3,8
20	70	22	14,3	419	3,8
When the number of cascade nozzles in the heater is 8 pieces					
5	70	22	18	419	3,8
10	70	22	17,2	419	3,8
15	70	22	16,4	419	3,8
20	70	22	15,3	419	3,8

Table 2

Modern American Journal of Engineering, Technology, and Innovation
ISSN(E): 3067-7939
Volume 01, Issue 07, October, 2025
Website: usajournals.org

Experimental results on the effect of variable parameters on material moisture content Qunm =0.065 kg/s const:

Heat agent speed, m/s	Heat agent temperature, °C	The initial moisture content of the material being dried, %	Moisture content of heated material, %	The temperature of moist air, °C	Heat capacity of water contained in the material, kJ/kg*K
When the number of cascade nozzles in the heater is 4 pcs					
5	70	22	19,24	419	3,8
10	70	22	18,28	419	3,8
15	70	22	16,36	419	3,8
20	70	22	15,88	419	3,8
When the number of cascade nozzles in the heater is 6 pieces					
5	70	22	18,28	419	3,8
10	70	22	15,39	419	3,8
15	70	22	14,62	419	3,8
20	70	22	13,76	419	3,8
When the number of cascade nozzles in the heater is 8 pieces					
5	70	22	17,32	419	3,8
10	70	22	16,55	419	3,8
15	70	22	15,78	419	3,8
20	70	22	14,72	419	3,8

Table 3 Experimental results on the effect of variable parameters on material moisture content Qunm =0.06 kg/s const:

Heat agent speed, m/s	Heat agent temperature, °C	The initial moisture content of the material being dried, %	Moisture content of heated material, %	The temperature of moist air, °C	Heat capacity of water contained in the material, kJ/kg*K
When the number of cascade nozzles in the heater is 4 pcs					
5	70	22	18,26	419	3,8
10	70	22	17,34	419	3,8
15	70	22	15,52	419	3,8
20	70	22	15,06	419	3,8
When the number of cascade nozzles in the heater is 6 pieces					
5	70	22	17,34	419	3,8
10	70	22	14,6	419	3,8
15	70	22	13,87	419	3,8
20	70	22	13,05	419	3,8
When the number of cascade nozzles in the heater is 6 pieces					
5	70	22	16,43	419	3,8
10	70	22	15,7	419	3,8
15	70	22	14,97	419	3,8
20	70	22	13,97	419	3,8

Modern American Journal of Engineering, Technology, and Innovation
ISSN(E): 3067-7939
Volume 01, Issue 07, October, 2025
Website: usajournals.org

Studies have shown that as a result of changes in the temperature, speed and number of cascades of the heating agent in the device, the dynamics of wheat moisture decrease was observed. Studies have shown that the efficiency of the drying process mainly depends on the air speed and the temperature of the heating agent, and the selection of their optimal values significantly reduces the drying time and energy consumption.

When the temperature of the heating agent is increased from 60 °C to 80 °C, the rate of loss of wheat moisture increases, but at temperatures above 80 °C, the release of internal moisture slows down due to the rapid hardening of the outer layer of the grain. This situation requires the correct selection of heat balance and air movement during the drying process.

When the air speed υ = 5 m/s was increased to 20 m/s, the drying efficiency increased steadily, but in the speed range of 15–20 m/s this increase became almost constant. This is explained by the increase in aerodynamic resistance in the device.

The number of cascades also affects the drying process: if in a 4-cascade device a uniform moisture release was not ensured, then in 6 and 8 cascades this indicator improved significantly. In an 8-cascade system, moisture release and heat distribution showed the most stable results.

On this basis, it was found that the most effective modes for wheat drying are those with a heat agent temperature of 70–75 °C, an air speed of 10–15 m/s and a number of cascades of 6–8. Under these conditions, the energy consumption during the drying process is minimal, and the quality indicators of wheat grains are preserved[4,5].

Conclusion

It was found that the moisture content of wheat grains is directly related to the parameters of the aerodynamic regime. Increasing the heat agent temperature and air velocity improves the drying rate, but at higher values there is a possibility of reduced grain quality. An increase in the number of heat exchange zones and the number of cascades in a vertical cascade dryer increases drying stability and energy efficiency. According to the experimental results, the temperature of the

Modern American Journal of Engineering, Technology, and Innovation
ISSN(E): 3067-7939
Volume 01, Issue 07, October, 2025
Website: usajournals.org

heat agent is 70–75 °C, the air speed is 10–15 m/s, and the number of cascades is 6–8.

References

1. Klimpel, R.R. *Particle Technology and Processing.* Elsevier, 2013.
2. Hsiau, S.S. & Yang, Y.T. *Powder Technology and Refractory Processing. Journal of Materials Engineering*, 2016.
3. Mirsharipov, R.X. *Barabanli quritgichning gidrodinamik rejimlarini tadqiq qilish. Farg'ona politexnika instituti ilmiy-texnika jurnali*, №1, 2020, B. 268–272.
4. Yusupbekov N.R., Nurmuhamedov H.S., Zokirov S.G. *Kimyoviy texnologiya asosiy jarayon va qurilmalari.* Toshkent: Fan va texnologiyalar, 2015.
5. Dretschler, M., & Löffler, R. *Drying Technology and Industrial Energy Efficiency. Chemical Engineering Journal*, 2017.