

**МІНІСТЕРСТВО ОСВІТИ І НАУКИ УКРАЇНИ  
ОДЕСЬКИЙ НАЦІОНАЛЬНИЙ ТЕХНОЛОГІЧНИЙ УНІВЕРСИТЕТ**

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## **GRAIN DRYING AND TECHNIQUES FOR MEASURING GRAIN QUALITY**

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In most years and in most countries grain is dried to safe storage moisture content using different drying systems, i.e. natural air drying, near-ambient (low temperature) drying, high temperature drying, and dry ration. During natural air and near ambient drying detrimental effects on grain quality can be avoided if drying can be completed within the allowable safe storage time which depends on the initial moisture content of grain and weather conditions. During high temperature drying detrimental effects on grain quality can be avoided if grain is not heated beyond critical temperature. If grain is heated beyond critical temperature due to dryer type or improper functioning of dryer then end use characteristics of grain can be severely affected. Dryeration combines high temperature drying with low temperature cooling and results in better quality grain than high temperature drying for the removal of the same amount of moisture. Further research is needed to develop effective control strategies to optimize dryers for grain quality, uniformity of drying, and energy efficiency. Research is also needed to develop dryers which operate quietly, discharge less pollutants, and are economic.

Grains are usually harvested at a high moisture level to avoid shattering losses and to reduce the growing season where two or more crops are grown in a year. Sometimes, undesirable rain also forces the farmers to harvest the grains at high moisture level. Therefore, drying is a most common practice to artificially remove the moisture from the harvested grain to attain a moisture content for safe storage. Drying of grains prevents microbial growth and slows enzymatic changes and considerably increases the storage life. It also reduces grain mass; thus, facilitating its transportation, and handling. Drying of grains is commonly accomplished by forcing air through the bulk grain at different temperature: natural (ambient) temperature, near-ambient temperature, low temperature, and high temperature. In the natural-air drying, ambient air is used without heating to remove the excess moisture from the grain. Excessively high temperature kills the germ and results in reduced germination capacity. Poor germinating seeds have detrimental effects on their end uses (e.g., in malting of barley or for seed purposes). Safe drying temperature can be decided based on the initial moisture content of the grain and the residence time in the dryer. Recommended drying temperature range to maintain seed

viability is about 38-43 °C. Seed damage usually occurs when grain temperature exceeds the critical grain temperature. The highly moist kernels can retain their viability when dried in a concurrent-flow dryer even at a higher temperature drying since the kernels do not reach the high temperature. Maximum temperatures of grain during drying for different end uses are given in Table 1.

Table 2 - Maximum safe temperature (°C) of grain during drying for various end uses

Crop	Seed	Sold for Commercial Use	Animal Feed
Ear Corn	43	54	82
Shelled corn	43	54	82
Wheat	43	60	82
Oats	43	60	82
Barley	41	41	82
Sorghum	43	60	82
Soybeans	43	49	-
Rice	43	43	-
Peanuts	32	32	-

Grain drying has significant effects on the quality of grains (e.g., head yield of rice, cracking of corn, milling and baking qualities of wheat, and oil content from oilseeds). To maintain the grain quality after drying and to maximize throughput at optimal energy efficiency, different control strategies have to be adopted for the operation of different dryers. In near-ambient air drying, amount of airflow needed to dry grain depends on grain type, grain volume, harvest date and initial moisture content of grain. The airflow can be controlled using simple on-off switch based on the time of the day to more sophisticated systems taking into consideration the progress of drying and the changing weather conditions. Since intermittent airflow can cause severe increase in the dry matter loss, continuous airflow is recommended until the drying front reaches the surface of the grain bed after which airflow can be controlled to maintain the grain moisture content.

Although grain dryers have been developed over several decades and are used around the world, there is still a need to further improve the dryers. For example, theoretically the mixed-flow dryers should give more uniform final moisture content but it is not the case in practice. This could be because dryers are not designed as they should be for airflow distribution and for dryer control. Further research and better understanding of drying process is needed. Unfortunately, most agricultural engineering programs are moving away from grain drying research because funding for such

research is not easy. There is a need for the grain industry to come forward to work with academic community to further research in this area.

Computer simulations of different grain drying models play a significant role in optimizing the dryer control strategy with efficient drying.

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## **EVALUATION OF THE PROSPECTS FOR PRELIMINARY COOLING OF NATURAL GAS ON MAIN PIPELINES BEFORE COMPRESSION THROUGH THE DISCHARGE OF EXHAUST HEAT OF GAS-TURBINE UNITS**

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For the transportation of natural gas through pipelines, gas pumping units (GPU) are installed at numerous compressor stations (CS), the energy carrier for which, in most cases, is transported natural gas. 0.5...1.5 % of the volume of transported gas is consumed (burned) by the pumping unit drive.

The situation with the replacement of existing equipment with modern equipment is associated with significant investments, on the one hand, and the uncertainty with the transit of Russian natural gas through gas transmission systems of Ukraine in the near future. More promising is the way to increase the efficiency of the GPU cycle through the use of circuits with preliminary cooling of the compressed gas.

The aim of this research is studying the prospects for the application of technology for pre-cooling technological natural gas before compression in a gas pumping unit based on heat-using absorption refrigeration machines.

To analyze the effect of pre-cooling of technological natural gas on the compressor stations of main gas pipelines, gas pumping units – GTK-10I were selected.

The calculation of GPU power consumption and fuel gas consumption at various temperatures of the process gas at the inlet to the supercharger was performed.

The calculation of the operating parameters of the gas pumping unit is performed and the energy and financial prospects of the technology

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