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CEREAL STORAGE TECHNOLOGIES FOR AGRICULTURAL PRODUCERS

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ABSTRACT

By storing the cereals immediately after harvesting in warehouses, or silos, in layers with a height of 2-3 m, the phenomenon of heating inevitably occurs, which leads to a decrease in quality and even to the degradation of the products in a relatively short time. Proper aeration is one of the most important processes in a grain storage system and is essential for maintaining the quality of stored products. A properly used aeration system helps control insect infestations and moisture migration, reducing grain damage and saving money. The paper will present the results of experiments for storing grain in bulk, in a warehouse with floor ventilation channels, for different products, depending on the variable elements: layer height for various seeds, product humidity, air flow speed, etc.

INTRODUCTION

Field crop production is the core area of agriculture, not only in the area occupied by contributing to food and population, but also in that it is the foundation that ensures the development of zootechny and a good part of the food industry. Before recovery, agricultural products must be stored in optimal storage conditions to ensure maximum nutritional keeping quality on time and to remove depreciation characteristics of biological value. Farms are the main suppliers of agricultural commodity production for consumption. Storage of cereals and industrial crops in them is made differently from manufacturer to manufacturer due to technical and economic problems arising from major changes in agriculture and how the recovery of grain production as seeds from the manufacturer. Analysis of current situation of the agricultural sector in Romania on storage systems and storage, indicating the need to accelerate the processes of restructuring and modernization of the countryside in the area addressed [6]. This can be achieved through the project system for storing grain, which will contribute to the structural adjustment of agricultural holdings, the continuity of agricultural activities and competitiveness farms by establishing efficient farms, improving crop structure for effective use of specific crops each area of production and not least the development and consolidation of storage systems and storage. Length preservation of agricultural products depends on several factors: technical, economic and strategic, all of whom are related to weather conditions, location, quality and degree of thermal insulation technical ness of storage space and storage [2,3,5]. Storage conditions are closely related form of canned product, the stored crop species, its future destination, and the geographic area in which these systems are located (climatic and soil conditions that make the products reaching the optimum humidity and temperature of storage).

MATERIAL AND METHOD

The main part of the system for storing grain which was tested is a cell with control system. The cell with control system, is cylindrical, removable, with walls of corrugated galvanized metal. Lateral surface of the cell connections are provided for the collection of samples and for temperature control. Load cell is on the top. To discharge the product in the cell, the floor is fitted with two discharge outlets provided shutter. When food is not the product inlet in the cell membrane is coated with rubber having a protective role. Similarly, the coupling connection to the installation of aeration will be plugged if the plant failure, thus allowing the penetration of cell within the animal rodents or other sources of impairment of the stored product. Cylindrical body is made of quality galvanized corrugated board FeE350G coverage Z350NA and Z450NA (EU rules). The cell with control system CCS (figure 1) consists of the following components: floor assembled galvanized corrugated metal walls, door access cell, roof, exhaust funnel, inner scale, outer scale, platform access cell, shutter assembly, control system.

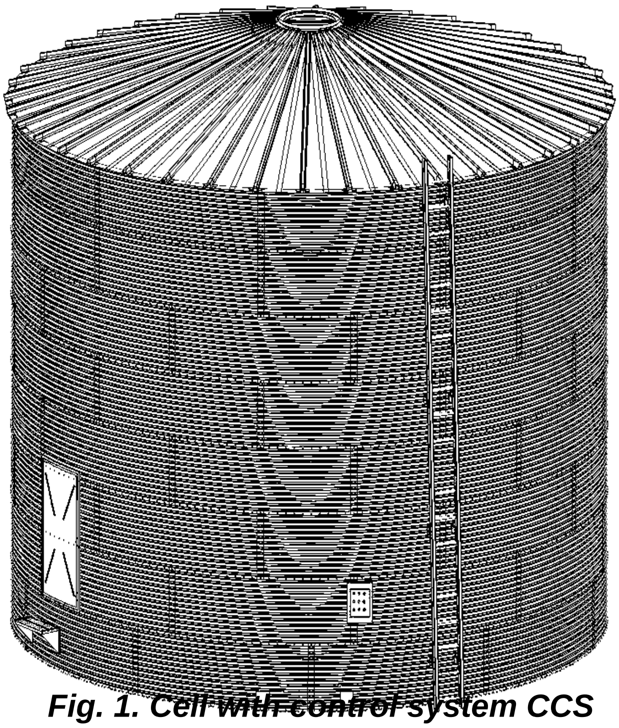

Fig. 1. Cell with control system CCS

Corrugated panels forming the walls are made of high strength steel, and assembled together with bolts, nuts, flat washers and rubber washers. Sealing between corrugated panels, (connection between tables) is made with mastic type BOSTIK in cords and tight with screws. Galvanized wall panels are drilled in a single operation providing a perfect alignment of the holes for a perfect installation. The panels are precisely rolled from high strength steel. The roof has 40 panels - providing a good insulation against the weather. Roof panels with stiffening ribs offer outstanding strength characteristics at loads of snow and ice, beeing resistant to the effects of extreme temperatures. The model is designed for a fast installation on site, each roof panel being secured by screws. The roof cell is provided with 6 vents with key access and an access mouth for the inclined conveyer hopper. After loading the cell this mouth is sealed with a lid. The control system provides control of temperature and aeration of the seed from the cell.

This control system uses as parameters the outside air temperature, grain temperature and relative humidity. The system allows the use of outside air for drying the grain, so that products can be stored safely for a longer period. This system automatically cools the grain at correct temperature and moisture content.

Proper aeration is one of the most important processes in a grain storage system and is essential for preserving the quality of the stored products. An aeration system used properly help to control insect infestation and moisture migration, reducing grain damage, saving money in this way [7].

Conservation through active ventilation is necessary when the grain storage duration is more than a few weeks. Actually the aeration means moving a small relatively volume of air through the grain mass to control grain temperature and reduce the risk of product degradation. In commercial practice has been mostly eliminated the grain transfer method (moving the grain from one silo to another) for temperature control and hot spots elimination.

The purpose of aeration is to achieve the following objectives related to:

 Control the grain temperature

The two main objectives of aeration are to maintain an uniform temperature in the grain mass and at the same time the temperature must be as small as possible in practical terms. With certain exceptions to be mentioned the discussions refers to dry grain to an optimum level for storage. Normally, aeration does not mean the movement of an air volume to ensure also the cereals drying. Cell control system CCS is equipped with a ventilation system.

 Low temperature storage

Cooling the grain to temperatures up to 17°C inhibits fast enough the development cycle of harmful insects to the grain, so that they can not multiply and do not degrade the quality of cereals. The micro-organisms development is usually accelerated by increasing temperature.

 Moisture migration

The uneven temperatures from the grain mass leads to the formation of convection air currents which causes moisture migration.

 Removal of foreign odors

The smell of mold and those associated with the use of chemical preservatives may be removed or their intensity reduced by aeration. Some odors can be quickly dissipated with a minimum aeration, while more persistent odors required a longer aeration. Unfortunately, mold smell removal by aeration did not lead to the removal of defects produced by these.

To achieve aeration products subject to storage processes and storage in warehouses, beton silos or metal cells may be used more aeration systems: aeration through the central column (figure 2), aeration through the floor (figure 3).

Fig. 2. Aeration through the central column

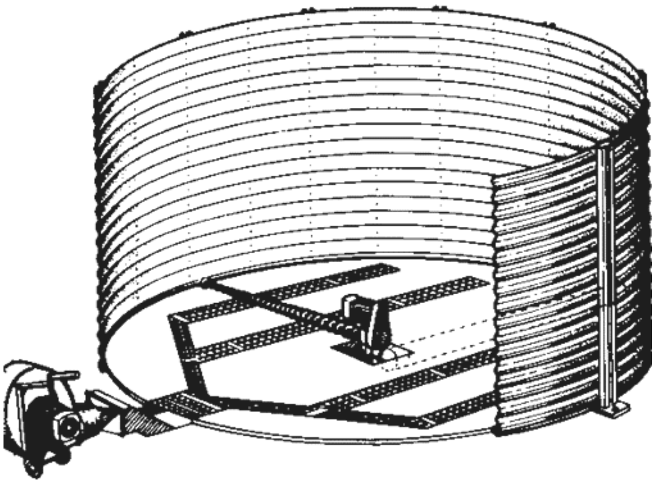

Fig. 3. Aeration through the floor

This aeration can be achieved through the channels made in beton foundation or through channels made of perforated sheet metal, semi-circular canals mounted directly on the cell floor.

The cell with control system CSC (figure 1), is provided with flat floor, made of perforated panels with round holes of ø 1.5 mm, to minimize obstruction.

The constructive solution adopted for perforated panels (figure 4), provide an efficient ventilation and a fast installation on the site. The panels have a special construction which allows a precise and strong assembly with metal brackets placed on the entire surface of the cell as shown in Figure 1.

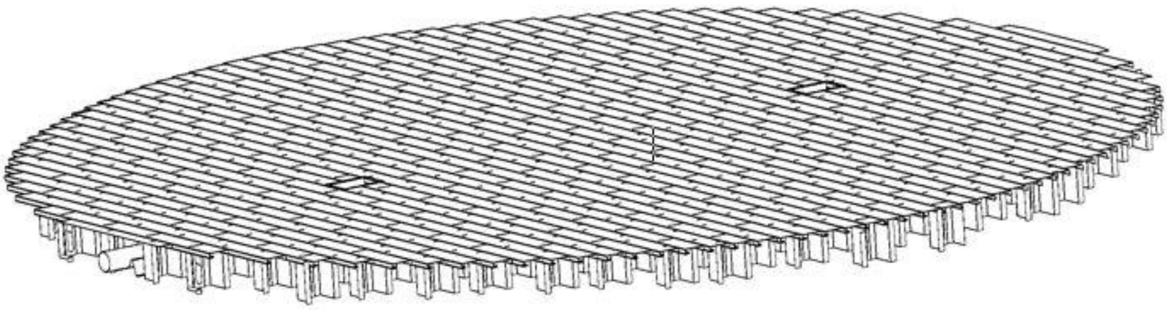

Fig. 4. Assembled floor

Due the special construction these supports allows routing of the airflow through the perforated panels in grain mass. Structural elements of the floor are designed for easy installation on site.

RESULTS AND DISCUSSIONS

Laboratory modelling of storage conditions cannot fully re-produce storage conditions in an industrial volume grain terminal. The reason of it is an insufficient knowledge of the distributed and combined physical processes occurring in a large volume grain terminal under the influence of variable external conditions with heterogeneous initial conditions and, as a result, the complexity of their full formalized description. In this regard it is planned in the future to develop methods, prepare tools and conduct a similar kind of research on industrial volumes of stored grain.

To enable remote monitoring of the parameters of grain mass during experimental storage, a special set of measuring instruments has been prepared, which can be used both for research purposes and for arrangement of monitoring of the grain state in industrial production conditions. Instruments for hygrothermic control allow determining the water activity of grain mass thus characterizing the stored grain mass from the point of view of its moisture state [6].

Table 1 and Table 2 show the data obtained during the experimental storage of wheat grain samples. The general list of monitored parameters of wheat grain samples: FAV - Fat Acidity Value (mg of potassium hydroxide required for neutralizing the free fatty acids in 1 g of fat), gluten (%), moisture (%), vitrescence (%) and germination (%).

Table 1

The results of soft wheat grain storage of harvest in a cell with controll system CCS

Period of storage [month]	FAV [mg KOH per 1 g of fat]	Gluten [%]	Moisture [%]	Vitrescence [%]	Germination [%]
Starting material	11.5	25.6	13.4	68	92
3	11.6	25.8	8.8	68	93
6	11.6	25.4	7.8	67	92
Starting material	7.3	22.0	11.8	60	97
1	7.3	22.0	11.3	60	96
3	7.5	22.2	10.8	61	94
6	7.6	21.6	8.0	61	97
9	7.6	21.8	7.6	62	94

Table 2

The results of soft wheat grain storage of harvest under natural conditions

Period of storage [month]	FAV [mg KOH per 1 g of fat]	Gluten [%]	Moisture [%]	Vitrescence [%]	Germination [%]
Starting material	11.5	25.6	13.4	68	92
3	11.7	25.6	12.0	73	95
6	12.1	25.4	11.6	70	93
Starting material	7.3	22.0	11.8	60	97
1	7.8	22.2	10.8	60	96
3	8.2	22.2	9.8	58	94
6	8.5	21.4	11.0	68	96
9	8.6	22.0	10.4	62	95

So, as shown in Table 1, there were no significant changes in FAV value of wheat stored for 6 months. Other parameters of product classification also remained practically unchanged. Wheat of the other class under the same conditions showed slightly different but close results: the value of the FAV parameter during storage increased insignificantly. The situation here is similar to the other parameters of product classification.

Analysis of the data in Table 2 shows that the FAV values have a tendency to increase. At the same time slightly higher moisture values than in CCS were observed.

It can be emphasized that the intensity of microbiological and biochemical processes in the grain is affected by the amount of bound moisture or the moisture state of the grain. One of the main factor which affects the potential deterioration in the quality preservation of grain mass under real industrial conditions is the redistribution of moisture inside the grain mass [1]. This results in local drying of some zones and the concentration of moisture in other zones of the grain terminal capacity. However, such a redistribution of moisture is caused by the moisture transfer under the influence of external factors, mainly by the temperature gradient and condensation effects that occur on the inner surface shells.

CONCLUSIONS

The system for storing grain proposed aims to achieve strategic objectives in the development of science, service, cutting-edge technologies and applications view to connect at national and European priorities and research objectives.

It aims also to promote sustainable agriculture to improve the entire food chain (from soil to table ,, from farm to fork”) by:

- providing storage facilities and storage for farmers, at low prices;
- providing optimal storage conditions (temperature, humidity according standards) of the consumption of seed grain needed, sowing and for the obtaining concentrated feed for their own livestock sector;
- ensure the availability of advanced technologies needed agriculture in preserving seed

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