STORAGE AND DRYING OF GRAIN IN ROMANIA

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Abstract

Most Romanian grains around 65% of harvests are stored nowadays on the farms. In the past there was slightly different because state storage infrastructure was in 85% cases the location of storage. More than that the private harvests in considerable parts goes to the same storage due to allowance requested by state from private farmers.

Last decade 1980s was increasing the storage in centralized areas because of the deviation of communist leadership. In the same time there was an important increasing of conditioning equipments presence in those areas. The capacity of the storage and drying equipments become industrial. This was possible by developing of domestic Romanian machineries constructing sector and wide spread of reinforced concrete silos.

The aim of the study is to preset the storage infrastructure and drying in use in Romania and also evolution of this kind of equipments and buildings during time.

Also there will be compared efficiency of storage of wheat grains from the yield point of view in following storage buildings: concrete silo, warehouse, warehouses with active ventilation and metallic bin. In the same time there will be assessed the efficiency of drying of wheat grains by a gas dryer and a diesel dryer.

Key words: Grain storage; Drying; Hot air drying; Aeration systems.

INTRODUCTION

The Romanian average production of wheat was recovering after a long decline since 1992, in 2009 and 2010 was reaching 5202,2 and respectively 5811,8 thousands tone. The previous productions were lower with the exception of 2008 when was bigger due to an excelent agricultural year. This was possible by restitution of land take over by state in force during cooperativisation in the years of 60s and developing the new generation of farms supported by European Union since 2007.

The storage and drying demands also increasing because of this. Fortunately part of the storage infrastructure was still existing in the years after 1989, but the drying equipments become soon obsolete due to high energy consumption, lack of spare parts due to disappearing of producing companies and also the capacity not adapted to new conditions of the Romanian agriculture after joining European Union.

The wheat grains need to be stored safely until consumed and in this way most of the farmers from ancient time use bulk storage.

A stored grain bulk is a system constructed according with main issue related with grains storage - stopping or slowing deterioration of the stored product by optimization of controlling of physical, chemical, and biological factors.

The factors that are currently under monitoring and control nowadays in storage areas are the following according with Jayas, 1995:

- temperature,
- water content,
- carbon dioxide (CO2),
- grains specie,
- pests,
- location,
- storage type.

In the following we are presenting some of the storage systems that we find during our researches.

In the beginning of storage concerns the there were improvised storage areas as areas and pits were combustibles materials were burned. This provide destruction of the pests and also reinforce the soil. The losses were high but this kind of storage provide cover even against other humans. The top was covered with grass or straw and soil. Around there were tranches to drain the water from precipitations. Location was chosen on high levels to avoid water infiltration.

In Antiquity new and more elaborated storage systems appears. In this way ceramic pots and granaries were built. The ceramic pots were housed in granaries.

Figure 1. Ceramic pots for grains storage in Pompei

Figure 2. Roman Granary with air circulation channels

In Middle Age there was an regress of the storage of grains due to low availability of labor force, construction materials and low demands of storage.

Figure 3. Helsingor underground grain storage

The storage was conducted in underground buildings, barrels, boxes and sacs

Figure 4. Reinforced concrete platform for grain storage in Biharkeresztes

The Modern Age recorded huge developing of grains storage because of population increasing, global trade and advance in technology.

In this way the following pictures present modern storage infrastructure technology elements.

For temporary storage were developed reinforced concrete platforms sometime covered by roofs or plastic foils.

Other approach were in buildings. The first evolution was Warehouses, made from bricks of concrete. The use of panels from reinforced materials and air circulation mobile channels were the last improvements that occur.

Figure 5. Warehouse made from panels and equipped with air circulation channels

The state of the art in grain storage was developed in 19 century when building materials allow construction of big storage infrastructure.

The Silo become emblematic and everywhere were constructed from bricks and later reinforced concrete. The metallic silos appears become of the farmers demands and medium storage needs at the production sites.

Most of the new silos were constructed near ports or processing facilities. Also state reserves were hosed in this kind of silos.

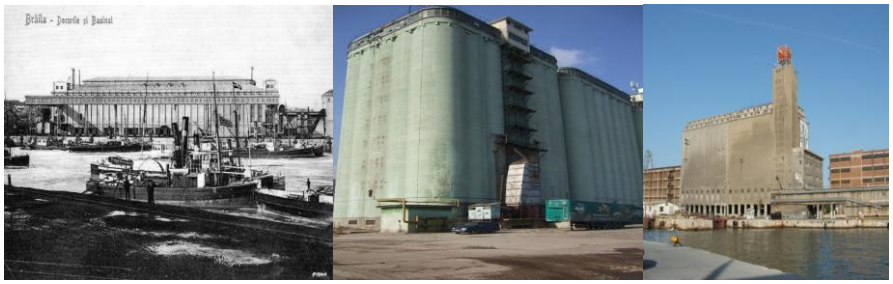

Figure 5. Reinforced concrete silos in Braila, Codlea and Pireus ports

The advantage of this kind of constructions are the following: Air properties better control, Pest control, Easy loading and unloading, lower soil footprint, etc.

The main issue of this kind of storage are related with investment cost and operating costs. Despite of this solution is recommended by researches and practice. In Romania there was an extensive infrastructure of

this kind of storage centralized in a state own company but also big state own mills and fodder producing companies build up such kind of storage systems.

Figure 6. Metallic silos in Vinga

MATERIALS AND METHODS

Current paper was focused on two experiences:

1. Experience 1 - drying the wheat grains,
2. Experience 2 - storage of wheat grains.

The wheat grains taken in to study was a mix of cultivars (Alex, Ariesan and Dropia) with unknown percentage

Experience 1 was evaluating the wheat grains drying by two dryers:

- Dryer that was using natural gas,
- Dryer that was using diesel.

For bought dryers the duration of the passage of grains was the same minutes. The dryers had same capacity.

Experience 2 was asses the changes that occurs in the following storage systems:

- Metallic bin,
- Warehouse.

The grains were stored after the drying from first experience. The storage was conducted for six months and the quality parameters were recorded monthly.

The quality parameters evaluated are presented below.

For Experience 1 the studied parameters were:

- Protein content before and after drying,
- Gluten content before and after drying,
- Mineral content before and after drying,
- Water content before and after drying,
- Zeleny index before and after drying.

For experience 2 the studied parameters were:

- Protein content before and after drying,
- Gluten content before and after drying,
- Mineral content before and after drying,

- Water content before and after drying,
- Zeleny index before and after drying.

The methods used for parameter analysis were:

- Protein content before and after drying, NIR spectroscopy with Agricheck from Bruins Instruments,
- Gluten content before and after drying, NIR spectroscopy with Agricheck from Bruins Instruments,
- Mineral content before and after drying, Nabertherm
- Water content before and after drying, NIR spectroscopy with Agricheck from Bruins Instruments,
- Zeleny index before and after drying, NIR spectroscopy with Agricheck from Bruins Instruments.

All analysis were done in five repetitions and data from tables are the average.

RESULTS AND DISCUSSION

Results were recorded in tables form and grafic represented to see the trends and direction of the changes.

For Experience 1 the results are presented in table 1, 2, 3 and 4.

Table 1. Results regarding Protein content before and after drying

Sample	Protein content, %	
	Before drying	After drying
Dryer that was using natural gas	12,84	11,98
Dryer that was using diesel	12,84	12,22

Table 2. Results regarding Gluten content before and after drying

Sample	Gluten content, %	
	Before drying	After drying
Dryer that was using natural gas	29	28
Dryer that was using diesel	29	27

Table 3. Results regarding Mineral content before and after drying

Sample	Mineral content, %	
	Before drying	After drying
Dryer that was using natural gas	1,714	1,766
Dryer that was using diesel	1,714	1,821

Table 4. Results regarding Water content before and after drying

Sample	Water content, %	
	Before drying	After drying
Dryer that was using natural gas	13,25	12,50
Dryer that was using diesel	13,25	12,80

Table 5. Results regarding Zeleny index before and after drying

Sample	Zeleny index	
	Before drying	After drying
Dryer that was using natural gas	58	55
Dryer that was using diesel	58	54

For experience 2 the results for six months of storage were the folowing:

Table 6. Results regarding Protein content during storage

Month	Protein content, %			
	Metallic bin		Warehouse	
	Gas dryer	Diesel dryer	Gas dryer	Diesel dryer
1	11,98	12,22	11,98	12,22
2	11,93	12,14	11,87	12,00
3	11,90	12,07	11,85	11,88
4	11,90	12,00	11,83	11,83
5	11,98	12,01	11,80	11,86
6	12,04	12,09	11,82	11,93

Table 7. Results regarding Gluten content during storage

Month	Gluten content, %			
	Metallic bin		Warehouse	
	Gas dryer	Diesel dryer	Gas dryer	Diesel dryer
1	28	27	28	27
2	28	27	28	27
3	28	27	28	28
4	27	28	28	28
5	29	28	28	28
6	29	28	27	28

Table 8. Results regarding Mineral content during storage

Month	Mineral content, %			
	Metallic bin		Warehouse	
	Gas dryer	Diesel dryer	Gas dryer	Diesel dryer
1	1,766	1,821	1,766	1,821
2	1,768	1,816	1,766	1,823
3	1,763	1,820	1,768	1,824
4	1,766	1,821	1,772	1,826
5	1,771	1,824	1,775	1,826
6	1,775	1,824	1,779	1,826

Table 9. Results regarding Water content during storage

Month	Water content, %			
	Metallic bin		Warehouse	
	Gas dryer	Diesel dryer	Gas dryer	Diesel dryer
1	12,50	12,80	12,50	12,80
2	12,45	12,77	12,40	12,73

3	12,42	12,70	12,38	12,70
4	12,48	12,68	12,41	12,67
5	12,51	12,68	12,43	12,66
6	12,48	12,61	12,40	12,50

Table 10. Results regarding Zeleny index during storage

Month	Zeleny index			
	Metallic bin		Warehouse	
	Gas dryer	Diesel dryer	Gas dryer	Diesel dryer
1	55	54	55	54
2	56	55	56	56
3	56	54	56	56
4	56	54	56	56
5	55	53	56	56
6	54	53	55	56

The results shown that there are small differences between experiences.

The biggest differences were recorded regarding chemical parameters, due to different storage environment.

From drying system point of view the main differences were in favor of gas dryers and this had impact in changes of storage parameters as well especially at the end of the storage duration.

CONCLUSION

Current study shown that storage system is important and lead to preservation of quality parameters and storage yield as well.

In this way the silos provide storage conditions that ensure high yields and more constant evolution of quality parameters during storage.

The warehouse on the other way provide better quality parameters values during storage from technological point of view.

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