HERMETIC STORAGE OF BARLEY IN PVC - COVERED CONCRETE PLATFORMS UNDER ROMANIAN CONDITIONS FOR LONG - TERM

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Abstract

Providing grains for different use is a real chalange. The issues are regarding the seasonal production of the grains due to crops phisiology.
The crops are groving during agricultural year and harvested in short time, duration of harvesting is no longer than two - three weeks for each culture and the imputs are enourmous in this time. Those imputs are directed to storages and processing capacities and because of various climatic conditions are very etherogenious.
The storage and processing infrastructure in Romania was developed in the the years of 80s at high level because of concerns for exports and centralized socialist economy.
Barley was at that time one of the most important crop in Romania for brewery industry and animal breading. Also it was common in cropping because of low demands regarding agrotechnic, soil quality and climatic conditions.
Because the use of of barley grains was lasting for whole year the storageof them rise a lot of issues especialy because heterogenity of harvest and high water content.
Alternative storage solutions become necessary mainly because of the infrastructure distruction after 1989 when former state companies that were acting on the field dissapears.
The aim of the study was to assesing the barley grains quality in reinforced concrete platforms covered with PVC foils in comparison with the storage in silos, warehouses and plastic bigbags in order to provide a reduction of costs for small and medium farmers.

Key words: Barley; Storage; Hermetic storage; Plastics; Quality parameters

INTRODUCTION

The development of storage for agricultural harvests especially grains in Romania become state priority after the years of 60s. In this way there was created a state storage company that take over the harvests and allocate them according to needs of the sector.

Also there was created farm storage infrastructure for covering short and medium time storage of grains generally and in this respect barley grains as well.

At that time storage infrastructure was consisting mainly in warehouses and household small storage.

In the same period there was an significant increasing of the chemical industry that was become one of key sector of the economy due to large crude oil and natural gas production.

In this way producing the plastic materials was answering to the demands related with packing and wrapping of foodstuff and other industrial goods.

The agricultural sector become aware of the benefits of using plastic films and start to consume high levels of plastic products like plastic boxes, plastic drums, plastic films and others.

In the late of 80s because the agricultural outputs and harvests there were increasing significant and because of concentrating the storage in relatively low number of locations there were concerns of using plastic foil as alternative solution for temporary storage of grains.

First there was a stop gap solution for preventing the degradation of the grains during inappropriate storage conditions during climatic stressors and then as a complementary measurements in the use of classical storage infrastructure, especially in old storage spaces like ware houses.

At the beginning the first solutions were based on the 0,4 - 0,8 mm thick, white or black, non-reinforced, UV-protected foil made from polyethylene - PE. The color was chose according with the purpose of storage, white for protection against rainfalls and black as a complementary measure for increasing the passive drying of the grains.

This was providing windows of opportunity for temporary storage of grains until the infrastructure of conditioning - drying most of the time - and storage become available.

This was an efficient methods to keep control of grains bulk quality parameters from the issues regarding the possible changes that occurs in grains due to heterogenity, technological, pests, phisiology and chemical - pysically changes points of view.

The good results obtained were leading to the further developments ideeas in the way to replace the covers (plastic foils) with full and hermetical protection consisting in bags.

The aproach was simillar with other concerns like the solutions proposed in Australia (Navarro et al., 1984) and Israel (Navarro et al., 1993).

But the issues were regarding the mechanical and chemical limitation of the plastic foils that were produced at that time in Romania. The issues were quite important because was not answering to the o providing of proper conditions for safe storage for medium and long therm (Abramson, D., W. E. Muir, D. S. Jayas, 1999). The main issue was low resistance of plastic foils to the UV and handling.

Thus was leading to the severe degradations of the materials that increase the costs and pollution of the environmental.

This solution also was not alowed the aeration and handling of the stored grains.

Also the monitoring of the storage parameters was not possible and in this way there were just trials of plastic foils use.

After 1989 when the storage infrastructure has dissloved the solution came in to actuality and the concerns regarding it increase as a solution of the new farmers that received back the land from state and establish new households.

Small farms become in the period of 1990 - 2000 the main form of agricultural exploatation and in this way the plastic big bags become a viable and economic alternative.

In this way the level of use of this kind of temporary storage increase significant.

Grains market also because of the low prices after harvesting and fair prices during winter lead to the use of this storage solution and there starts concerns for medium and long term storage aproach.

The new technologies in plastic material producing - reinforced of plastic foils, UV protection and recycling of the plastic materials - made available new PVC foils that has supperior properties that PE.

MATERIALS AND METHODS

The study was focused on following aspects:

- storage of barley grains in metallic bins for four months,
- storage of barley grains in warehouses for four months,
- storage of barley grains in plastic bigbags for four months,
- storage of barley grains in PVC covered reinforced concrete platforms for four months,
- assessing wheat grains quality by accepted methods for all storage systems at every two weeks.

The location of the experience was in the village of Bicaci from Bihor county, a pig and veil farm of farmer and University of Oradea, Faculty of Environmental Protection laboratory.

The experimental design of the study was the following:

The barley grains stored in bulk in 70 t metallic silo and 50 t warehouse for conventional storage systems and small batches 1000 kg for bigbags and 5 t for PVC covered reinforced concrete platform and sand sealed the edge of the foil from a private farmer, harvested in 2009 in the beginning of June.

There was taken in to study one barley cultivar - Ametist that was wide spread in cropping in Bihor county.

Experience 1. Assessing the barley grains quality from conventional storage systems.

At the reception of the batches the conditioning of grains was the same. The drying was done in a gas dryer up to 13,5 %.

There were conducted analysis for following parameters:

1. Protein content of the barley grains,

2. Starch content of the barley grains,
3. Water content of the barley grains,
4. One thousand mass of the barley grains.

Experience 2. Assessing the barley grains from plastic bigbags and PVC covered reinforced concrete platform.

At the reception of the batches the conditioning of grains was the same. The drying was done in a gas dryer up to 13,5 %.

There were conducted analysis for following parameters:

1. Protein content of the barley grains,
2. Starch content of the barley grains,
3. Water content of the barley grains,
4. One thousand mass of the barley grains - MMB.

The methods used were according with the Agriceck NIR from Bruins Instruments fabricant and Granomat from Pfeiffer fabricant for one thousand mass.

The calibration of the equipments was done by default by providers.

RESULTS AND DISCUSSION

After drying during storage there were recorded following parameters values in Experience 1.

Table 1. Protein content values in silo and warehouse

Month	Protein content, %			
	start		end	
	Silo	Warehouse	Silo	Warehouse
12.06 -26.06.2009	12,95	12,95	12,84	12,82
27 - 10.07.2009	12,84	12,82	12,81	12,79
11 - 25.07.2009	12,81	12,79	12,76	12,77
26.07 - 08.08.2009	12,76	12,77	12,77	12,77
09.08 - 23.09.2009	12,77	12,77	12,56	12,75
24.09 - 07.10.2009	12,56	12,75	12,22	12,71
08 - 22.10.2009	12,22	12,71	12,18	12,68
23.10 - 06.11.2009	12,18	12,68	12,11	12,20

Table 2. Starch content in silo and warehouse

Month	Starch content, %			
	start		end	
	Silo	Warehouse	Silo	Warehouse
12.06 -26.06.2009	60,64	60,64	60,60	60,60
27 - 10.07.2009	60,60	60,60	60,58	60,54
11 - 25.07.2009	60,58	60,54	60,55	60,47
26.07 - 08.08.2009	60,55	60,47	60,48	60,41
09.08 - 23.09.2009	60,48	60,41	60,32	60,28
24.09 - 07.10.2009	60,32	60,28	60,30	60,28
08 - 22.10.2009	60,30	60,28	60,16	60,22
23.10 - 06.11.2009	60,16	60,22	60,08	60,10

Table 3. Water content of grains in silo and warehouse

Month	Water content, %			
	start		end	
	Silo	Warehouse	Silo	Warehouse
12.06 -26.06.2009	13,50	13,50	13,40	13,40
27 - 10.07.2009	13,40	13,40	13,28	13,22
11 - 25.07.2009	13,28	13,22	13,25	13,11
26.07 - 08.08.2009	13,25	13,11	13,15	13,05
09.08 - 23.09.2009	13,15	13,05	13,08	13,00
24.09 - 07.10.2009	13,08	13,00	13,00	12,98
08 - 22.10.2009	13,00	12,98	12,98	12,96
23.10 - 06.11.2009	12,98	12,96	12,89	12,94

Table 4. One thousand grains mass in silo and warehouse

Month	One thousand grains mass, g			
	start		end	
	Silo	Warehouse	Silo	Warehouse
12.06 -26.06.2009	52,95	52,95	52,95	52,95
27 - 10.07.2009	52,95	52,95	52,90	52,91
11 - 25.07.2009	52,90	52,91	52,87	52,88
26.07 - 08.08.2009	52,87	52,88	52,83	52,82
09.08 - 23.09.2009	52,83	52,82	52,80	52,81
24.09 - 07.10.2009	52,80	52,81	52,77	52,76
08 - 22.10.2009	52,77	52,76	52,70	52,71
23.10 - 06.11.2009	52,70	52,71	52,68	52,70

Table 5. Protein content values in bigbags and PVC covered platform

Month	Protein content, %			
	start		end	
	bigbags	PVC covered	bigbags	PVC covered
12.06 -26.06.2009	12,95	12,95	12,88	12,87
27 - 10.07.2009	12,88	12,87	12,85	12,86
11 - 25.07.2009	12,85	12,86	12,80	12,80
26.07 - 08.08.2009	12,80	12,80	12,78	12,76
09.08 - 23.09.2009	12,78	12,76	12,71	12,72
24.09 - 07.10.2009	12,71	12,72	12,68	12,66
08 - 22.10.2009	12,68	12,66	12,64	12,61
23.10 - 06.11.2009	12,64	12,61	12,60	12,61

Table 6. Starch content in bigbags and PVC covered platform

Month	Starch content, %			
	start		end	
	bigbags	PVC covered	bigbags	PVC covered
12.06 -26.06.2009	60,64	60,64	60,58	60,60
27 - 10.07.2009	60,58	60,60	60,54	60,58
11 - 25.07.2009	60,54	60,58	60,50	60,52
26.07 - 08.08.2009	60,50	60,52	60,41	60,41
09.08 - 23.09.2009	60,41	60,41	60,36	60,35
24.09 - 07.10.2009	60,36	60,35	60,30	60,30
08 - 22.10.2009	60,30	60,30	60,27	60,24
23.10 - 06.11.2009	60,27	60,24	60,20	60,21

Table 7. Water content of grains in bigbags and PVC covered platform

Month	Water content, %			
	start		end	
	bigbags	PVC covered	bigbags	PVC covered
12.06 -26.06.2009	13,50	13,50	13,48	13,47
27 - 10.07.2009	13,48	13,47	13,46	13,46
11 - 25.07.2009	13,46	13,46	13,45	13,46
26.07 - 08.08.2009	13,45	13,46	13,43	13,42
09.08 - 23.09.2009	13,43	13,42	13,42	13,42
24.09 - 07.10.2009	13,42	13,42	13,40	13,41
08 - 22.10.2009	13,40	13,41	13,37	13,36
23.10 - 06.11.2009	13,37	13,36	13,35	13,35

Table 8. One thousand grains mass in bigbags and PVC covered platform

Month	One thousand grains mass, g			
	start		end	
	bigbags	PVC covered	bigbags	PVC covered
12.06 -26.06.2009	52,95	52,95	52,95	52,95
27 - 10.07.2009	52,95	52,95	52,93	52,92
11 - 25.07.2009	52,93	52,92	52,92	52,92
26.07 - 08.08.2009	52,92	52,92	52,90	52,90
09.08 - 23.09.2009	52,90	52,90	52,88	52,87
24.09 - 07.10.2009	52,88	52,87	52,87	52,86
08 - 22.10.2009	52,87	52,86	52,84	52,82
23.10 - 06.11.2009	52,84	52,82	52,82	52,81

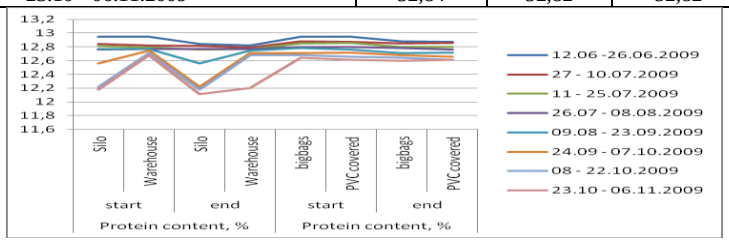

Figure 1. Protein content and starch content during storage in silo, warehouse, bigbags and PVC covered platform

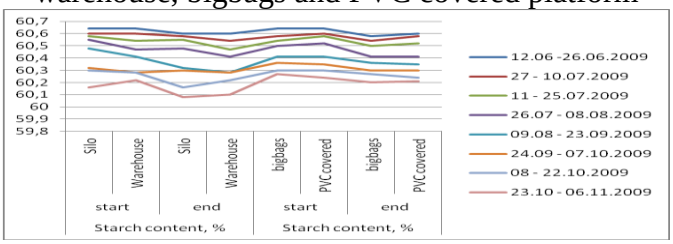

Figure 2. Starch content during storage in silo, warehouse, bigbags and PVC covered platform

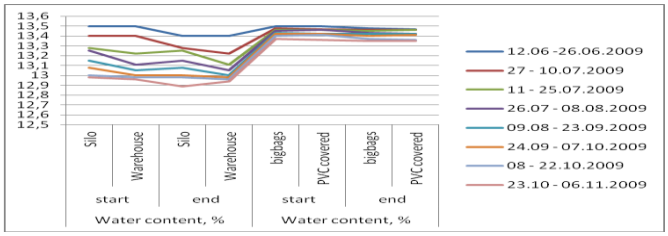

Figure 3. Water content content during storage in silo, warehouse, bigbags and PVC covered platform

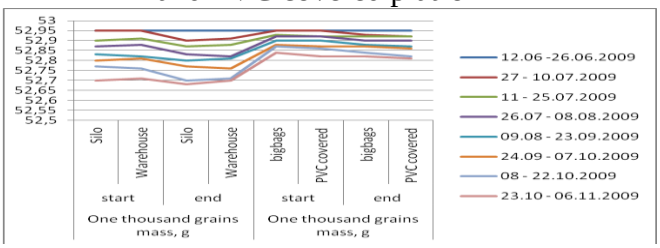

Figure 4. MMB during storage in silo, warehouse, bigbags and PVC covered platform

According with the results we recording strong correlations between Experience 1 and Experience 2.

The researches were shown that physically parameters were variable according with the moment of storage influenced by environmental conditions in all cases. The biggest variability was in silo and varehouse especially at the end of the experiences.

The starch content had different evolution because is the main source of energy for grains and microflora associated.

The protein content, MMB and water content was shown that in silo and warehouse at each stage of experience the variations were much bigger than in the bigbags and PVC covered platform.

The reasons are related with mass exchange between grains and external environment due to aeration systems and the free volume available for mass exchange.

CONCLUSIONS

The conclusion of this paper are relevant regarding chemical properties evolution during storage. In this way was shown that silo and warehouse storage lead to a quicker reduction of the water content.

In bigbags and PVC covered reinforced concrete platform the water content decrease very slowly and remain also at higher levels. This allow to the barley grains stored in this way in bulk conditions to maintain normal and slower protein and MMB reduction. The starch content dynamic was not concluding.

Although that was suggesting that the losses are lower in bigbags and PVC covered reinforced concrete platform that was not quite right

because the starch and partially protein content had similar behavior in all storage systems. The only advantage of bigbags and PVC covered reinforced concrete platform occurs in the short term storage when the protein content, the most important parameter was a lower reduction.

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