

EFFECTIVE GRAIN STORAGE IN HOUSEHOLDS: A MAJOR MEANS OF ENSURING FOOD SECURITY IN NIGERIA

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Abstract

Two shallow silos were constructed using mould clay and concrete respectively, each with a capacity of four tonnes to investigate their effectiveness during grain storage in rural societies. Four tonnes of maize grains was purchased and dried with a solar drier to a moisture content of 14% dry basis. The dried maize was divided into two and each portion was stored in each silo for a period of six months. The temperature and relative humidity in each silo was measured and recorded every hour using Elitech data logger RC-5 and RC-4 while the moisture content was measured using grain moisture meter. The measured parameters in the two silos were compared to each other and to the safe storage conditions for maize to ensure the stability of maize grains in each of the silos. Mould clay silo recorded a better stability condition: lower temperature (27.1 – 31.2°C), moderate moisture content (12.3 – 13.5%) and considerably higher relative humidity (70 – 81%) with the tendency of releasing moisture to the environment easily. Both silos maintained lower stability conditions than the safe storage conditions for maize.

Keywords: Grain storage; Food security; Post-harvest losses; Silos; Moisture content.

Introduction

Grains contribute largely to components of daily food need in most countries in Africa. Maize, for instance, is a very important component of the diet in many African countries. In Nigeria, maize contributes about 30–35 percent of the daily caloric intake (Economic and Work Sector Report, 2011). Food security is one of the important requirements for social and economic development of any nation (Maxwell and Frankenberg, 1992). In Nigeria, post-harvest losses have been recognized as the greatest threats to food security amongst other factors. In Africa, around 13 million tons per year of cereals, i.e. more than 15 percent of the total, are lost in post-harvest operations only (APHLIS, 2016). Storage is the art of keeping the quality of agricultural materials and preventing them from deterioration for specific period of time, beyond their normal shelf life. Storage is understood to be an important activity in the sequence of post-harvest operations. It is an interim and repeated phase in the transit of agricultural products from the producer till it gets to the final consumer (Adejumo and Raji, 2007). Typical storage facilities in the tropics mostly provide short term storage. This is because of the subsistent farming pattern and the quantity produced by individual farmer is small. The bimodal rainfall pattern also contributes to the storage problem. The relative humidity is high at the period of harvest. In

Ibarapa area of Oyo State, for example, early maize is harvested between June and July while late maize is harvested between November and December. The relative humidity during these periods is between 72 – 84% while the environmental temperature is between 26–30°C. These climate conditions could not be guaranteed while using the traditional method of storage practiced by most households, hence, the need for each household to build a more effective modern storage system.

In 1998, Boxall reported that the common practice in many African countries is to sell maize grains immediately after harvest, to avoid losses to insect pests. National Stored Product Research Institute also stated in 1988 that storage of maize grains using fumigated maize, stored in gourds for a period of ten months was more effective than non-fumigated maize, stored in similar containers because the latter got damaged within three months of storage. Birkinshaw and Hodges (2000) further reported a high level of protection in mud silo and traditional cob-storage structures when pesticides application is reduced by 50 and 80% respectively. Silos are so far, the most appropriate modern structures for storage of grains; their performances are largely influenced by the materials of construction and the climatic conditions of the environment where they are used. Under the

warm and humid environment common in South-western Nigeria, metal silos, which is of temperate region origin, although purchased and stocked at very high costs, experience moisture condensation, hot spot development, high temperature fluctuation and caking which results into grain deterioration (Mijinyawa *et al.*, 2007). Effective storage of maize grains in households is therefore a major research thrust for enhanced maize productivity in order to reduce food scarcity during pandemic.

Methodology

Two shallow Silos were designed and constructed at the Department of Agricultural and Bio-Environmental Engineering of Oyo State College of Agriculture and Technology, Igboora, Nigeria. Silo A was made of mould-

clay while Silo B was made of concrete and each has a capacity of four tonnes when fully loaded.

Four tonnes of maize grains was purchased and dried with a solar dryer to a moisture content of 14% dry basis. The dried maize was divided into two and each portion was stored in each silo for a period of six months. The temperature and relative humidity in each silo was measured and recorded every hour using Elitech data logger RC-5 and RC-4. The temperature and relative humidity in each silo had a direct effect on the moisture content of the stored grains in the silos, the moisture content also have a direct effect on the rate of deterioration of the grains. The moisture content was measured using grain moisture meter.



Plate 1: Pictorial view of the two silos

Results and Discussion

i. Average Temperature

The average temperature recorded in silo A ranges between 27.1°C and 31.2°C while that of silo B ranges between 30.2°C and 38.1°C. Generally, it was observed that there

was heat retention in silo B which could be due to the material of construction (concrete). The average temperature in silo A was lower than that of silo B throughout the 180 days period as shown in figure 1. Sawant *et al.*, 2012 states that the safe storage temperature for maize should be at least 39°C, which both silos maintained.

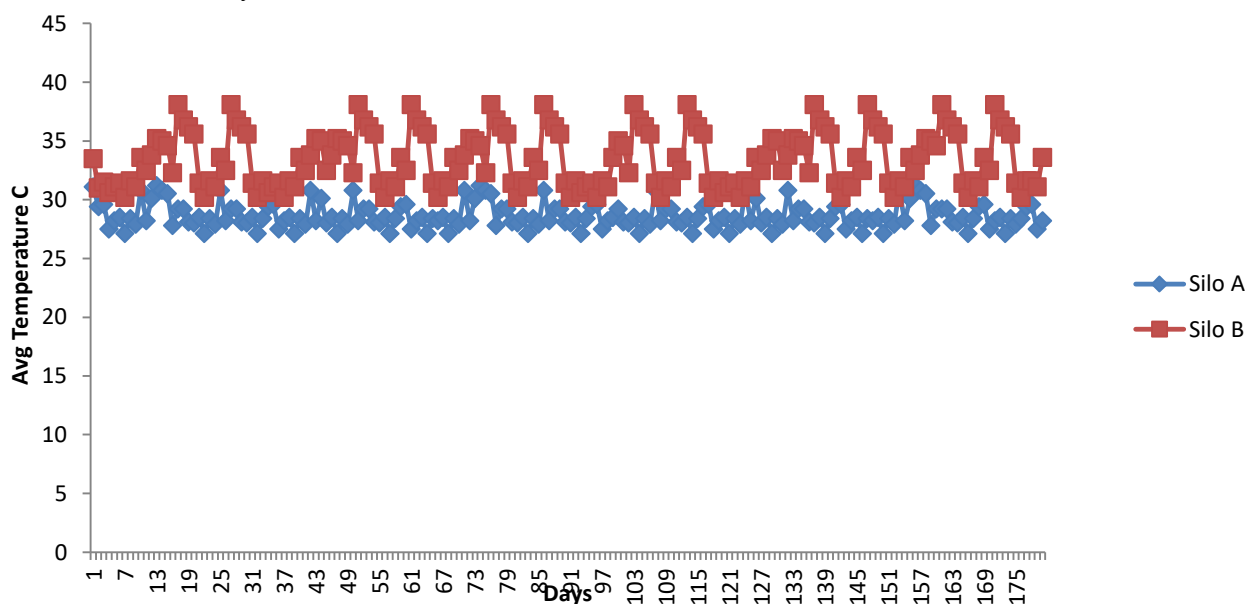


Figure 1: Comparison of daily average temperature in the two silos for 180 days

ii. Relative humidity within the silos

The average relative humidity recorded in silo A ranges between 70% and 81% while that of silo B ranges between 60% and 71%. Generally, the average relative humidity in silo A was higher than that of silo B throughout the 180 days period as shown in figure

2. This shows that moisture migration in concrete silo is higher than mould clay silo. Suma *et al.*, 2013 states that the safe storage relative humidity for maize should be at least 32%, which was maintained by the silos.

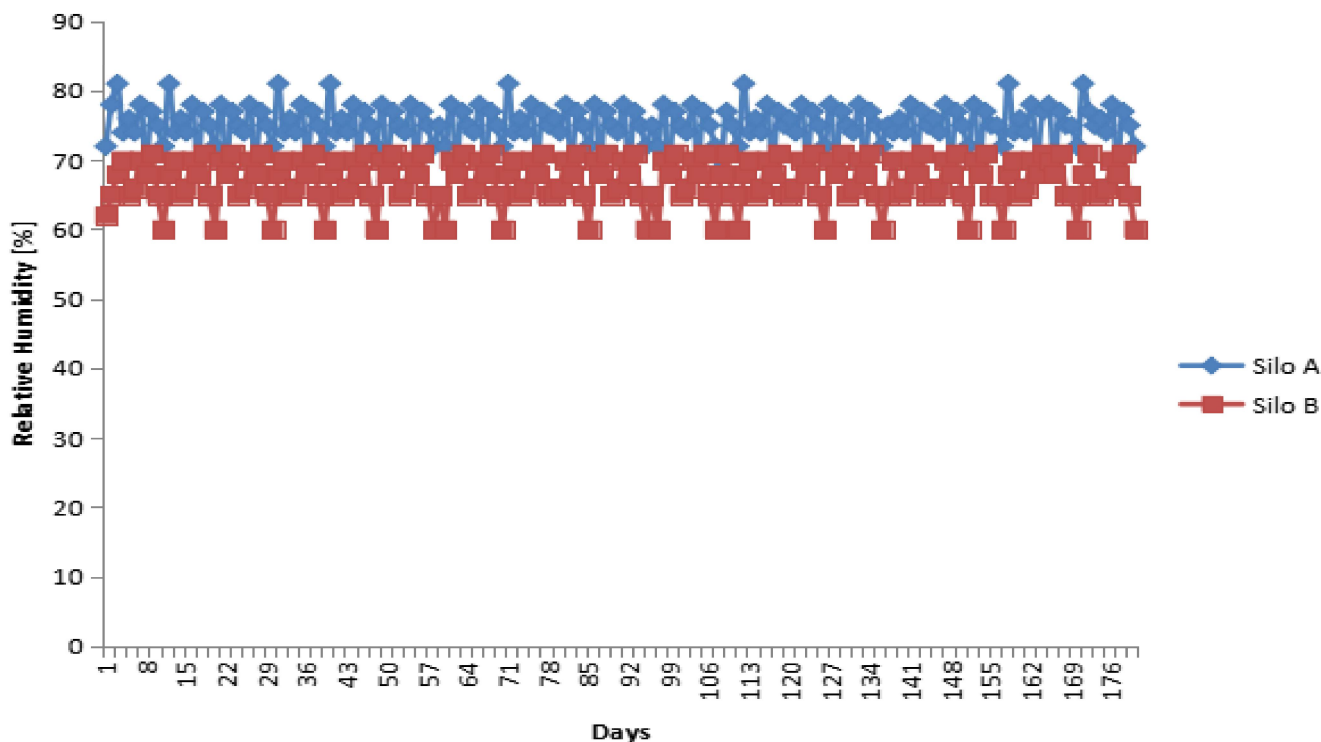


Figure 2: Comparison of daily average relative humidity in the two silos for 180 days

iii. Moisture content of maize grains within the silos

The moisture content recorded in silo A ranges between 12.3% and 13.5% dry basis while that of silo B ranges between 12.1% and 13.6% dry basis. Generally, it was observed that the grains in concrete

silo tend to retain more moisture than in silo A as shown in figure 3. This is due to condensation which occurs as a result of heat retention within the concrete silo. Both silos maintained the moisture content lower than the safe storage moisture content for maize 14% or less (Kelly, 1988) throughout the period of storage.

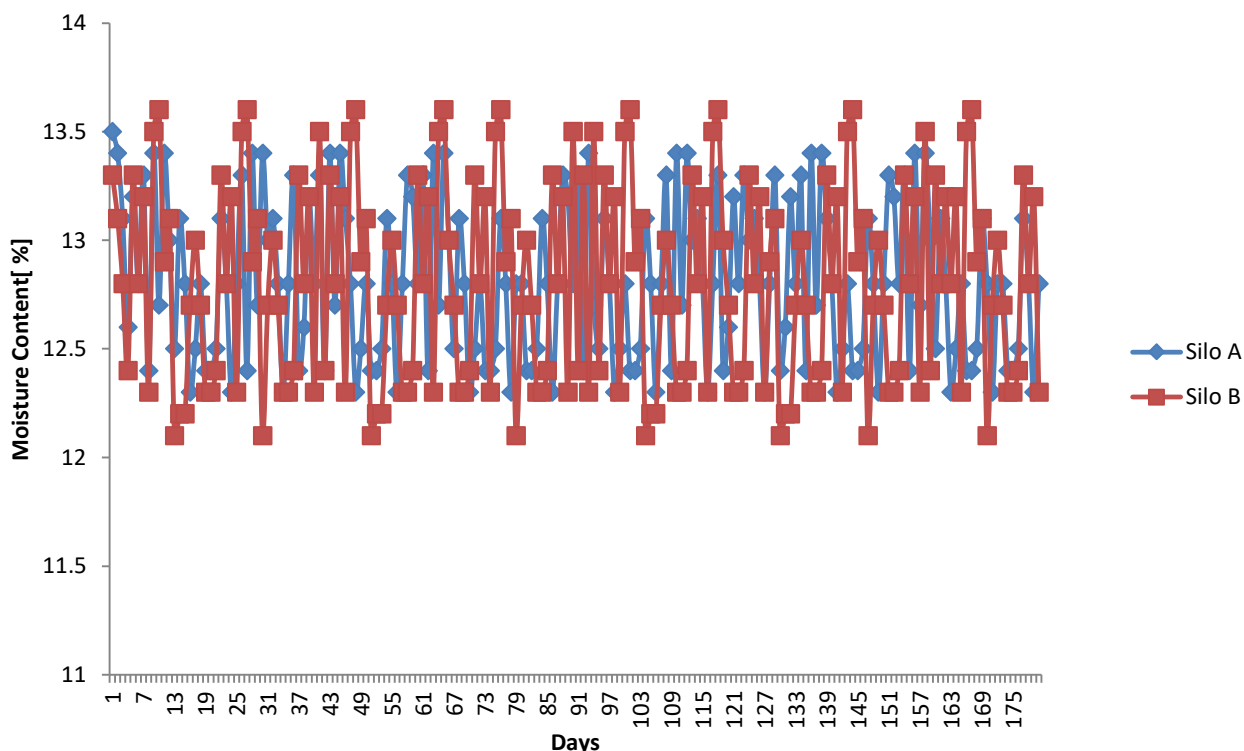


Figure 3: Comparison of the moisture content in the two silos for 180 days

Conclusions

It was concluded that mould clay silo recorded a better stability condition: lower temperature, moderate moisture content and considerably higher relative humidity with the tendency of releasing moisture to the environment easily. Both silos maintained lower stability conditions than the safe storage conditions for maize. This gives an assurance that storage of maize grains in Ibarapa central area of Oyo State in silos made of concrete and mould clay would maintain a stable condition for a period of at least, 180 days.

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