ZIMBABWE GRAIN MARKETING BOARD

MAIZE STACKBURN IN ZIMBABWE: REVIEW AND CURRENT STATUS

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Introduction

1. In 1931, the Maize Board of Rhodesia was formed to provide a market for maize produced mainly by white commercial farmers who were registered with it. The name was subsequently changed to the Grain Marketing Board of Rhodesia and it then operated a few depots along the line of rail serving white commercial farm land. Initially, these permanent depots were provided with bag storage facilities only. The range of commodities handled widened to encompass other commodities such as wheat, soyabeans, sunflower, sorghum, coffee and others. Bulk storage started in 1954 when the Aspindale silo complex became operational. With the advent of independence, the depot network expanded into communal and resettlement areas which are served mainly by road (many of which are not in a good state of repair). Government policy also raised production of grains and oilseeds by all types of farmers such that more storage depots were built, some with bulk storage facilities. The Grain Marketing Board now runs a total of 72 permanent depots of which 12 have bulk handling facilities. In addition to these, grain collection and distribution points are also operated to meet prevailing needs. To date, the Board has the potential to store a total of 5 million tonnes comprising:

Bulk	-	0.7 million tonnes
Bag-outdoor stacks	-	3,9 " "
Bag-indoor stacks	-	0,2 " "

Stackburn definition and where it occurs

2. The term stackburn was coined to denote a change in colour from the original normal cream/white (in white maize) colour to other shades, ranging from yellowish to dark brown. The discolouration starts at the embryo area (hyphae are often seen) and it progresses all over the kernel's surface. In lightly affected maize, only surface layers of the kernel are affected; the inside remains pure white. Under more prolonged and severe conditions the whole grain becomes discoloured. As the name suggests, stackburn was first observed on stacks of white maize and it is suggested that in Zimbabwe, stackburn is as old as the Grain Marketing Board itself! Stackburn was at first prevalent only in the top layer of bags lying immediately under the tarpaulins covering the stack. Even in these bags the discolouration was confined to the top layers of grain within individual bags.

3. In the 1989/90 storage year, maize discolouration was observed in maize from within the stacks at the time of despatch. The term internal stackburn was used to differentiate it from the more familiar top stackburn. The incidence of internal stackburn coincided with the Boards decision to switch to using woven polypropylene (wpp) bags in place of jute. However, records indicate that internal stackburn had also occurred in jute bags stacked outside.

When it occurs

4. Many depot and operations managers concede that stackburn, particularly the top type, occurs between the months of September and March. This is the period during which it rains, temperatures and humidity are high, and stacks are under permanent cover due to fear of rain. In contrast, internal stackburn starts earlier on in the life of a stack when temperatures are invariably high inside a stack.

Causes of Stackburn

5. The primary causes of the top type of stackburn appear to be high temperature and high moisture content of the stored commodity. The length of the storage period also plays a part. Packaging is also implicated in causing stackburn and so are varietal characteristics. The black tarpaulins used to cover outdoor stacks absorb radiant heat during the day and raise the temperature under them to as high as 60 degrees Celsius. The expanded heated air has a capacity to take up more moisture and as such moisture moves up the stack by capillary action to be absorbed by this expanded air. The moisture can migrate from pockets of moist maize in the stack, from areas of localised insect infestations and even from the "wet" ground under the stack. During receipt it is possible to take in maize wetter than 12.5% moisture content due to sampling error or due to calibration error of the moisture meter being used. When the hot air under the tarpaulins is cooled at night, the moisture condenses out and water droplets are formed under the tarpaulins. This water flows onto the bags immediately under the tarps and wets them, raising the moisture content. With time, the process is repeated and the maize is discoloured. Woven polypropylene bags are not as porous as jute and therefore tend to retain heat and moisture compared to jute bags. In this regard, poly bags tend to accelerate the discolouration process.

6. Since 1931, the Board has taken in increased amounts of produce which has been stored for longer periods. Stacks can therefore remain at a depot for anything up to 4 years. If the maize was at a high m.c. and high temperature acted on it for 4 years, then severe discolouration is a probability. Unintentional water ingress into stacks has the same consequences.

7. Insect pests meet their water requirements from their food. If the maize is moist, insect pests thrive and raise

the temperature through their metabolic activities. Attempts to control infestations under such circumstances are not always successful because part of the fumigant is absorbed by the wet maize, thus rendering it unavailable to kill the infestations. Prolonged heavy infestations make conditions suitable for invasion by fungi which sustain the deterioration process.

8. In the history of the Board, there has been deliberate concealment of stackburn because it was always feared to be associated with mismanagement of stocks, particularly acceptance of high moisture rain and failure to air stacks ie removal of stack covers when weather permits. Information available at present indicates that other factors apart from mismanagement are at play.

9. Proximity to areas of water such as dams/rivers has been attributed to the cause of stackburn at Mt Darwin and Guruve depots. During the day, wind carries moist air to the stacks and deposits the it there. During the night the air is cooled and water condenses out. Dry air also blows over the warm water bodies during the night, it picks up some more moisture and the process is repeated. Because of this, stacking areas near the water bodies at Mt Darwin and Guruve have been abandoned.

10. The method of drying maize employed also predisposes maize to discolouration. Drying maize on a dwala leads to discolouration. Artificial drying often leads to warm maize being accepted into storage. Susbsequently, the maize cools and releases moisture within the stack.

Characteristics of Stackburnt Maize

11. Apart from the obvious colour changes, stack burnt maize is also brittle and smells like roasted maize. It cannot germinate and may have an altered starch protein and a lower oil yield. It has an increased amount of reducing sugars and ash and has low test density and non-reducing sugars. All in all the nutritive value of stackburnt maize is lower.

What happens to Stackburnt Maize?

12. Approximately 90% of downgrading of maize is on account of stackburn. The other 10% is taken up by insect and mould damage. Because of the strong association between mismanagement and stackburn, the discoloured maize was silently blended with good maize and marketed at a higher grade. This was done at silo depots or even at bag depots where the discoloured bags would be opened at the top of the stack being despatched. When the stack is finished, the discoloured maize will have disappeared into the good one. At silos a definite proportion would be employed in blending. In the local sales rules, 14% defectives maximum are tolerated and as long as the discoloured maize did not raise the level of defectives beyond this figure, then blending would be resorted to and still market the maize for

human consumption. Clearly, blending was a function of the quantity of stackburnt maize. If large quantities are discoloured, these are put aside, downgraded to D and sold purely for stockfeed purposes. If the discolouration is so severe that the maize is no longer marketable, then the maize is written off and either buried or burnt. Authority to write-off is the prerogative of Regional Managers and the Chief Executive.

Prevention of Stackburn

13. In the history of the Board, the following steps were taken to prevent stackburn.

Channels
These were, and are still being incorporated to improve passive ventilation within the stack. They run along the length of the stack at the peak and if prevailing winds are parallel to the stack effective cooling of the top layers under the tarps occur. This slows down the development of top stackburn but is ineffective in cooling the block stack. Channels also facilitate methyl bromide fumigations.

Tarpaulin covers

These definitely raise grain temperature and so, weather permitting, they are pulled back into strips to cool the stack by ambient air. During the dry season (May-September) stacks are normally not covered and during the wet season, they are opened at least once a week. The tarps should not close the channel openings and should be strapped to the stack in such a way that billowing occurs. Billowing has the effect of pumping hot, moist air out of the top of the stack. The strapping of tarps to the stack was also such that the tarp does not contact the bags and as such condensate does not fall onto bags. The inclusion of hessian/saw dust/groundnut shells immediately under the tarps absorbed the condensate before it reached the bags with grain.

Dunnage
Dunnage encourages ventilation of bottom bags and the dunnage should be high enough to encourage air circulation.

Moisture Content
Strict control of moisture content at intake is a must if grain is to store well. To this end, moisture meters are calibrated and frequently checked for serviceability.

The Way Forward

14. At the moment, Zimbabwe has a stackburn problem which has increased and has adverse quality and financial implications. As pointed out earlier on, 90% of down

gradings are due to stackburn and in 1990 alone, Z$3m was lost through this. This figure is conservative and excludes expenditures on blending, rediverted delivery due to customer rejections and delays in meeting delivery deadlines particularly at ports of loading. It is a problem requiring urgent attention. In the writer's opinion, the following preventive measures must be adopted as standard practice.

(a) Strict control and inflexible adherence to moisture content standards at intake irrespective of political directives. Moisture meters have to be properly calibrated, maintained and operated by trained personnel.

(b) Fumigations have to be carried out immediately a stack has been built and they must be confirmed as effective.

(c) Tarps have to be strapped in a way which encourages ventilation through billowing wind action and channel openings must remain open for the same purpose.

(d) Regular airing of the stacks should be practiced.

(e) Hardstands of concrete should be used (in preference to compacted soil) as these exclude ground water and prevent sinking of stacks.

15. Additional measures which may reduce the problem should be investigated. These include:

(a) Use of reflective stack covers with a view to lowering stack temperatures. Previous work indicated the value of this.

(b) There may be scope in reducing the size of block stacks to increase contact with cool ambient air.

(c) Incorporation of tunnels within stacks (vertical and horizontal), has scope in improving stack ventilation.

(d) In the long-term more storage in sheds and silos will greatly reduce the incidence of stackburn.

(e) If all else fails, there may be need to go back to storage in jute bags since poly bags increase the incidence of discolouration.

Finally, the problem would be less if the Board reduced the overall size of stockholdings and the length of time that maize is held in store. However this does not appear to be an option for the present time.

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7. Personal Communication

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Myanga	Depot Manager - Guruve
Chokuda	Depot Manager - Mvurwi
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