

Cocoon storage keeps cocoa in condition in the Tropics

Cocoa beans are usually harvested twice yearly in a main harvest and a secondary harvest, the timing and length of the harvest being closely related to climate. Like coffee, cocoa beans go through a process of fermentation in which the pulp is removed from the bean. Depending on the region, fermentation of cocoa beans is either 'dry' or 'wet.'

In the dry fermentation process cocoa beans are sun dried for several weeks until the pulp decays, whereas in the wet process, the pulp is washed away and subsequently the cocoa beans are sun dried till the moisture content (wet basis) reaches 7 per cent.

Wet fermentation demands a better post harvest infrastructure than dry fermentation and produces better quality beans. Most cocoa beans in West Africa are handled by wet fermentation, whereas, for instance, most Indonesian beans are dry fermented.

The beans are collected by traders and sold to exporters or local processors who decide either to sell right away or keep the commodity in storage for several months, in order to secure steady supply or speculate for better world market prices.

In West Africa, some companies are trying to introduce bulk handling in containers, but most of the trade still goes in jute bags of 150lb.

Climatic conditions in the tropics, high humidity levels of 70 to 90 per cent relative humidity and above are common, and temperatures fluctuate greatly, and are often far from ideal for storage of agricultural products.

Problems faced during storage

Once in storage, cocoa beans face a number of problems, including infestation by a variety of pests, the most common particular pest being the cocoa moth (*Ephestia cautella*, which is dominant in Indonesia and South America), the rice



moth (*Corcyra cephalonica*, which is dominant in cocoa beans from West Africa, and the tobacco beetle (*Lasioderma serricorne*) and the flour beetle (*Tribolium castaneum*).

Moreover, in warehouses in the tropics prevailing temperatures are ideal for optimal and rapid insect development, with temperatures in the range of 35-40° C. Infestation is a major problem and is usually taken care of by fumigation using aluminium phosphide or methyl bromide.

Moisture and humidity are also potential problems. Ideally, cocoa beans should have a moisture content of not more than 6 per cent, in equilibrium with relative humidity of 65 per cent at 30° C, but for practical reasons the trade standard is 7-8 per cent because the hygroscopic characteristics of cocoa beans mean that they easily absorb moisture because of the humid conditions prevailing in the tropics.

The correlation between mould growth and moisture content is obvious, and it is clear that cocoa beans stored for several months under tropical conditions will develop mould. Mould in cocoa beans causes a rise in free fatty acids, and

Storing cocoa in the Tropics, where temperatures and relative humidity are high, can be problematic, but a new kind of storage technique being promoted by GrainPro, a US company with a subsidiary in the Philippines, seems to offer a cost-effective alternative to conventional solutions

reduces the quality of the product and its acceptability to processors.

In contrast, exporters in Indonesia experience weight losses when the beans are stored for six months, a phenomenon that seems to be a result of improper drying following the fermentation process.

Cocoa beans with high moisture content have a significant respiration rate that is promoted by the microflora developing on the beans. The rate at which the respiration process occurs is associated with the consumption of the constituents of the beans that are converted to carbon dioxide, water, and energy resulting in weight loss. This was corroborated on samples of cocoa beans taken at random from the warehouses of exporters in Makassar, Indonesia, that showed an equilibrium relative humidity of 82 per cent, in equilibrium with more than 8 per cent MC wet basis.

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Yet another potential problem is the chemical changes affecting quality. A high moisture content in cocoa beans will trigger an enzymatic process in the beans which will lead to increased free fatty acid (FFA) levels. The standard set for FFA in processed cocoa butter of good quality is 1 per cent. Levels higher than that have a negative impact on the taste of the butter.

The web site of ICCO mentions as main causes for increased FFA levels a number of factors, including: the use of beans from diseased pods; slow drying after fer-



ProDelta starts work on construction of Commodity Park Rotterdam

ProDelta in The Netherlands has stated construction of the new Commodity Park Rotterdam on the former Krabbe site, near Maasvlakte, a facility which it describes as being "ahead of its time" by virtue of the fact that it is being built to the most up-to-date fire safety regulations; is sustainable and energy-efficient; provides a high security storage facility; and one that is flexible, scalable and highly efficient.

The new development comprises a total of 70,618m² of high-quality business space and has been specially developed for the storage of commodities such as cocoa, coffee, non-ferrous metals and plastics.

The development is ProDelta's response to new, more stringent environmental and fire safety requirements, which particularly apply to the storage of commodities such as cocoa. Partly for this reason, the project is being developed in close co-operation with the various government agencies.

"Commodity Park Rotterdam offers businesses a location where they will be able to develop their activities in the long term without having to worry about retaining or obtaining the necessary environmental permits, as these have already been applied for by ProDelta," a spokesperson for the company explained.

Said ProDelta: "During the last decade, many facilities for the storage of commodities has relocated to cities such as Antwerp and Amsterdam. However, this new development means that Rotterdam will soon possess the most modern buildings suitable for the storage of commodities such as cocoa and, thanks to the large scale, multi-functional nature of the project, businesses active in these markets will be able to form 'clusters' here, and remain in the region, or move to the region if they are not already present."

The Commodity Park Rotterdam will consist of three buildings, one of approximately 18,956m² and two of approximately 25,831m². All of the warehouses will offer a high degree of security, being built out of concrete, and to allow cocoa to be stored securely for extended periods, the three buildings are divided into units of approximately 2,148m² each.

The technical specification for the facility includes: column-free units from 2,148m²; concrete column structure of 36m wide and 12m deep; concrete walls and steel roof; monolithic concrete floor with a floor load of between 6,000kg/m² and 9,000kg/m²; two electric overhead doors in each unit; clear height of 11.6m; smoke and heat exhaust system; fire separations between the various units with a fire resistance rating of 240 minutes; automatic fire detection, including automatic alarm to the fire brigade; fire hose reels in the business spaces; paving suitable for traffic category 5.

The new facility will also be completely enclosed by a fence, with access via a central entrance provided with an access control system and electric sliding gates. Incoming and outgoing traffic will be separated and will have their own dedicated marshalling areas.

The facility is favourably located along the A15/N15 (Europaort-Nijmegen) motorway (after crossing the Suurhoff bridge, leave the motorway at the Oostvoorne exit and then take Krabbeweg and Beerweg).

Commodity Park Rotterdam is being built in three stages, and will be constructed entirely of concrete. The first stage is due to be complete in June 2008, and the entire development will be finished by February 2009.

mentation; prolonged storage under humid conditions or with a moisture content above 8 per cent; prolonged storage of well prepared beans at tropical temperatures in the country of origin; activity of bacteria or moulds; and increased levels of broken beans and fragments in a consignment, which can significantly increase the average FFA content of the fat extracted as they normally have a higher FFA content. Thus a clear link exists between storage in the tropics and increased FFA levels.

Innovative approach to storage

It is a well known fact that cocoa beans 'respire' in the sense that they produce large amounts of CO₂, in fact the web site of German transport of insurers even issues warnings against entering closed spaces where cocoa beans are stored because of this production of CO₂.

This respiration activity is also described as 'post fermentation' activity and is linked to the high fat content (50 per cent) of cocoa. There is a clear correlation between the intensity of this respiration and moisture content.

Trials in the laboratory of the Department of Food Science, Agricultural Research Organization in Israel with cocoa beans of different moisture content kept in gas tight glass jars, showed that beans with an ERH of 81.9 per cent (8.2 per cent MC) reached a level of 1 per cent O₂ and 30 per cent CO₂ in less than 10 days, whereas at 59.1 per cent (5 per cent MC) the O₂ reached a level only of 8 per cent and CO₂ level 10 per cent in 21 days.

Thus, the cocoa beans created a 'modified atmosphere' in which the combination of O₂ depletion and CO₂ enrichment of the atmosphere controlled the natural infestation by killing all developmental stages of insects. These modified atmospheric conditions also prevented further development of aerobic moulds, since these are dependent on O₂.

Based on this laboratory information, 7 tonnes of bagged cocoa beans with an MC of 7 per cent was placed in a gas tight container made of flexible PVC with a good gas permeability and equipped with a gas tight zipper, called a GrainPro Cocoon.

Oxygen levels were monitored daily with a GrainPro oxygen analyzer that showed a drop to almost 0 per cent in

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just over a week of storage. As a result all insects in the beans were killed and oxidative processes were arrested.

Using the same techniques, beans belonging to a major processor in Ghana were stored outdoors and indoors, and their quality preserved for a period of more than six months, in fact the results showed a stable FFA level, control over infestation and a stable moisture content. No difference was observed between in and outdoor storage.

Advantages of the new technology

GrainPro, the manufacturer of the Cocoons, says that using its technology, cocoa beans can now be stored outdoors, the Cocoon being designed for outdoor storage, without any need for fumigation with toxic gases.

Beans stored for two weeks or more in a GrainPro Cocoon provide a cost-effective,

sustainable, and environmentally benign control method that eliminates the need for use of toxic fumigants, due to the gas tight properties of the Cocoon, notes GrainPro.

Storage in modified atmosphere prevents any change in moisture content, since the plastic liner has an extremely low permeability rate for water vapour, and the normal absorption of the beans of moisture from the humid ambient air will not take place.

The modified atmosphere controls chemical changes which are O₂ dependent and preserves taste, aroma, flavour and fat composition over extended periods. More importantly, says GrainPro, mould development that is associated with mycotoxin contamination can be prevented.

In addition to Cocoons, GrainPro has also developed 'SuperGrainbag' in which large gas tight plastic bags serve as liners to any type of bag, thus enabling long term storage under modified atmosphere conditions. Thus, cocoa beans can be stored for prolonged periods without the use of toxic fumigants and without the risk of re-infestation and mould damage, using the conventional bagging method in jute bags.

"This technology has been in use for

more than two years by one of the largest cocoa processors in Indonesia and gives excellent results, both in terms of insect control as well as preservation of FFA levels. Undamaged bags can easily be reused for another cycle of storage," notes the company.

GrainPro Cocoons are available in different sizes up to more than 400m³ and can contain more than 200 tonnes of cocoa beans. If the cost of fumigation, warehousing and reduction of quality and quantity are considered, the return of investment for the purchase of such equipment could be less than two years says the company.

The life span of a Cocoon is more than 10 years, and Cocoons can be set up - without any infrastructure - near to existing warehouses or in fenced and guarded areas.

SuperGrainbags purchased in commercial quantities easily pay for their extra cost through control of insects, prevention of moisture ingress and stable FFA level, and will ensure that cocoa stored in them makes a better price on the market. Moreover, as GrainPro also notes, the technology used also meets the standards of the organic market. ■ C&CI