

Revolution in Green Coffee Storage

by Rolando Chacon Araya¹ and Philippe Villers²

(Submitted for publication to "Tea & Coffee Trade Journal")

Introduction

A recent evaluation of hermetic storage for green coffee beans was completed in Costa Rica by Icafe (Coffee Institute of Costa Rica) in December 2009, which produced similar results to the trial performed in 2008 at the Neumann Kaffee Gruppe in Costa Rica. As described in this article, these trials provided further validation as to the reasons why long-term hermetic storage of coffee, first used in 2001 at Monte de Oro Co-Op in Costa Rica, has become a widely accepted trend in the industry.

Safe storage of up to 1-year using flexible hermetic containers, for green or parchment coffee is currently used in some 13 countries. Hermetic storage is currently used by growers, processors, traders, importers and roasters in Brazil, Colombia, Costa Rica, Dominican Republic, Guatemala, El Salvador, Ethiopia, Holland, Indonesia, Jamaica, Kenya, Peru, and the US (including Hawaii and Puerto Rico).

What is the role of hermetic storage in storage of coffee?

There are three important challenges that must be overcome in storing high quality coffee whether in green or parchment state:

1. First, since coffee harvests, unlike coffee demand, do not occur throughout the year, how to provide safe storage on the farm or at the processor for periods of up to a year prior to shipment/sale without loss of quality?
2. Second, how to maintain the "quality" in quality coffee when transporting coffee from the country of origin to the country of consumption? How to avoid the all-too-frequent deterioration in color, flavor, aroma and body of the brew during transport due to either cross contamination on shipboard, in the warehouse, or exposure to high relative humidity in transit?
3. Third, how can the importer or roaster who buys coffee in batches and therefore needs to store it for months, preserve quality before selling or roasting? The objective of a proper storage is to maintain the characteristics of quality and weight of the grain after harvest and later milling. This means protecting the grain from the weather, fungi and other microorganisms, from moisture, high and destructive temperature variations, insects, rodents and birds, foul odors and other contaminating agents. This also means how to inhibit increases in the growth of Ochratoxins produced in the presence of high humidity and normal oxygen levels. It is also getting away from the need to use pesticides and fumigants in storage with their many problems.

Findings of Icafe

Icafe conducted a 5-month study of green coffee stored between June and December 2009. Icafe is Costa Rica's government-chartered, non-profit organization tasked with servicing and policing the coffee industry in that country and was founded in 1933.

In Costa Rica there is great diversity of coffee storage installations, ranging from piles of completely unprotected green or parchment coffee in jute or polypropylene bags, to bulk storage in non-hermetic wood or metal silos of many shapes, sizes and types of construction. However, an increasing number of growers and processors are using hermetic storage either in airtight PVC Cocoons™ made from a special grade of 0.83mm PVC, (Figure 1b) or coextruded SuperGrainbags™ liners (Figure 1c) of 60kg capacity inside a conventional bag, or SuperGrainbags-HC™ of 1 tonne capacity (Figure 1a).



SGB - HC™
 Figure 1a
 1-Tonne SGB-HC

COCOONS™
 Figure 1b
 150-Tonne Cocoons

SGB™
 Figure 1c
 60kg SuperGrainbag (SGB)

In the Icafe trial, the green coffee beans (Caturra Arabica) were stored in a 10-tonne GrainPro Cocoon, to determine what the effect of 5-month trial had on the appearance, cupping quality and moisture content of the coffee beans. As emphasized in the Icafe report, storage can preserve but not improve the quality of a product. Improper handling of coffee during the harvest and milling, especially during drying, will result on low-quality product, and will remain so no matter how well it is handled during and after storage.

Materials and Methods

The trial started on June 22nd, 2009 by storing the green Caturra coffee beans, which had previously been stored conventionally in unprotected polypropylene bags since March when the parchment had been removed. The trial was performed in the concrete structure of the Coffee Mill of the Coffee Research Center at CICAFFE, the research arm of Icafe, located in San Pedro de Barva de Heredia, Costa Rica. The CICAFFE Research Center is at an altitude of 1180 meters, with average annual temperature of 22.7°C, and an average annual humidity of 78%. A hermetic silo called the GrainPro Cocoon of 10-tonne capacity was used to store 2000kg of green coffee with the balance of the space occupied by air. The coffee used came from the coffee grown at Icafe’s own facility. Data was collected on a monthly basis ending on December 1st, 2009.

Temperature and relative humidity (r.h.) inside and outside the Cocoon™ were measured with a data logger. Grain moisture content was then analyzed in the CICAFFE laboratory using the oven method under the ISO 6673 standard. Cupping was conducted by certified personnel. Inside the Cocoon, relative humidity remained within the range of 54.0% to 56.9%, or an average of 55.5%, while the external relative humidity ranged from 57% to 92% with an average of 80%. Temperature inside the Cocoon varied from 20°C to 24°C. While outside, it varied from 19°C to 23°C.

During the 5 months, the moisture content of the green coffee increased gradually but very slightly from 10.42% to 10.54%, as seen in Table 1, while coffee stored outside the Cocoon went from 10.42% to 13.30%. As shown in the cupping data (Table 1), there was already a slight moldy flavor in the then 3-month old green coffee beans at the beginning of the five-month trial period and this observation remained unchanged throughout except for a slight deterioration, taking place in the final two weeks.

Date	Cupping	Roasting	Aroma	Body	Acidity
06/24/2009	Slightly moldy flavor	Good. Light.	Very good.	Good.	Very good.
07/06/2009	Slightly moldy flavor	Good. Light.	Very good.	Good.	Very good.
07/20/2009	Slightly moldy flavor	Good. Light.	Very good.	Good.	Very good.
08/18/2009	Slightly moldy flavor	Good. Light.	Very good.	Good.	Very good.
09/23/2009	Slightly moldy flavor	Good. Light.	Very good.	Good.	Very good.
10/24/2009	Slightly moldy flavor	Good. Light.	Good.	Good.	Very good.
11/13/2009	Slightly moldy flavor	Good. Light.	Good.	Good.	Good.
11/24/2009	Slightly moldy flavor	Good. Light.	Good.	Good.	Good.
11/30/2009	Slightly old flavor	Good. Light.	Good.	Good.	Good.

Hermetic Storage Trials at The Neumann Kaffee Gruppe

Neumann’s report (translated) describes the trial as follows: “A 10MT Cocoon was installed outdoors in the coffee storage company CAFEX (located in Cartago, Costa Rica) in January, 2008. 50 bags of green coffee and 93 bags of parchment coffee in kenaff sacks were stored in the Cocoon positioned outdoors and between two regular warehouses. The coffee beans were kept inside the Cocoon until February, 2009 and during these 13 months it withstood the characteristic severe tropical weather condition that was accompanied by two 7-day tropical storms with long periods of heavy rain and prolonged rainfall for up to 8 consecutive days.

Evaluations were made every 4 months (opening the Cocoon’s hermetic zipper for sampling) to test the following parameters of the beans: a. Grain moisture content b. Physical appearance (color, tainted grains) c. Flavor d. Body e. Acidity f. Aftertaste. The results are shown in Tables 2 & 3.

TABLE 2 – Trial Results, Parchment Coffee, Neumann Kaffee Gruppe data




Results of the cupping I REPORT FROM EXPERIMENT COCOON™ (CAPULLO™) 								
PTDI COFFEE IN PARCHMENT								
# ID Batch	Date of Sampling	# Sacks	Kilos Parch	H ₂ O Parch	H ₂ O Green	Mesh # 15	Yield Parch-Green	Comments
0472 A	02/10/08	93	3,728.90	10.50%	11.00%	88.00%	82.00%	4 cups OK.
0472 A	07/17/08	93	3,728.90	10.70%	11.40%	87.70%	81.80%	4 cups OK.
0472 A	09/30/08	93	3,728.90	11.30%	12.30%	90.90%	82.60%	4 cups OK. Oldish flavor, very light if we consider the time of storage.
0472 A	01/30/09	93	3,728.90	11.70%	12.10%	88.50%	82.70%	4 cups OK. Oldish flavor, a little discrete but still very light if we consider the coffee has been stored in the Cocoon™ for more than one year; qualities of the cup has been very well preserved, good acidity and flavor.

TABLE 3 – Trial Results, Green Coffee, Neumann Kaffee Gruppe data

Results of the cupping II
REPORT EXPERIMENT COCOON™ (CAPULLO™)

PACO CAFÉ ORO						
# ID Batch	Date of Sampling	# Sacks	Kilos Green	H ₂ O Green	Mesh # 16	Comments
CE-3206A	02/11/08	50	3,450.00	11.00%	87.10%	4 tazas OK.
CE-3206A	07/10/08	50	3,450.00	10.70%	88.00%	4 cups OK. Well preserved.
CE-3206A	09/30/08	50	3,450.00	11.00%	93.90%	4 cups OK. Well preserved.
CE-3206A	01/30/09	50	3,450.00	11.70%	89.00%	4 cups OK. Well preserved, old flavor. Appearance in green is very good and the cup is good if we account for the long time it has been stored in the Cocoon™. More deterioration is perceived in green than in parchment grains, the qualities of the coffee decrease a little; acidity and flavor mainly.

The Neumann report states that: “Cup and physical characteristics of the coffee beans, both in parchment and green, were preserved intact until the 9th month of hermetic storage. At the 13th month green coffee yielded an insignificant oldish flavor during its last cupping test. In the case of the parchment coffee, its characteristics were improved with this forced long rest, which is a result proper for this type of coffee storage. The difference was that this improvement was stable throughout the whole 13-month period of hermetic storage. It should be noted that the weather conditions prevailing in this zone of Cartago allows green coffee to maintain its good qualities for up to one month if stored in the industry standard non-hermetic conditions and the parchment coffee up to 2 to 3 months.”

Commenting on the trial and his cupping tests, CECA’s Master Cupper, Abraham Castro said “Storing coffee in Cocoons is an excellent option for outdoor or indoor coffee storage even under very adverse weather conditions. It allows long term storage of green and parchment coffee without degradation of its qualities, in particular to preserve specialty high quality lots and to prevent contamination of the product from possible external and out of control factors”.

Other Trials - Costa Rica, Hawaii, Indonesia

These findings are also consistent with the first detailed field study of hermetic storage of green coffee performed at Café Britt in Costa Rica (See November 20, 2005 issue of “Tea & Coffee Trade Journal” entitled “Breakthrough in Storing High Quality Coffee”). In this trial which took place from May to November, 2004 they compared storage in standard 43kg jute bags, with bulk storage in multi ton bins and with jute bags stored in a GrainPro Cocoon. The article concludes that “after two months, there was already a significant difference between the three groups, while “cup average” of 4.0 remained for coffee beans in the Cocoon, coffee in unprotected sacks was already down to 3.8 and in large bins 3.5. The overall cup quality continued to diverge, and after storage of five months the “cup average” remained at 4.0 for those in the Cocoon and dropped to 3.0 for both unprotected coffee beans in bags and coffee beans in bulk. It went on to say that “the superiority of coffee stored in hermetic Cocoons became very noticeable”.

“Café Britt is now in a position to maintain freshness and high quality, allowing for storage of production until coffee from the previous harvest is consumed and new supplies become available.”

In Hawaii C. Bido, owner of Keauhou Kona Coffee Organization, and a grower who uses SuperGrainbags for farm storage of his Kona Coffee, commented “GrainPro SuperGrainbags have made it possible for me to keep my coffee parchment & green coffee at the same moisture level as when the parchment or green was originally bagged.”

Forms of Hermetic Storage

Many innovative new ideas have been developed to meet the needs of the coffee industry. Hermetic storage, in particular, now takes a number of forms: ranging from Cocoons available from 5-tonnes to 1000-tonnes, but generally used in 10- to 50-tonne range, to individual hermetic liners for standard jute or polypropylene bags, typically holding 50- to 60-kg, called SuperGrainbags (SGBs). For transport across intercontinental distances, the TranSafeliner™ (TSL) (Figure 2) was introduced in 2007 and is being used for shipments originating from producers in Central America to Indonesia in order to insure that shipments remain of good quality during long and unpredictable transits.



FIGURE 2 – Loading TranSafeliner in standard 20ft. shipping container

For those who use mechanized handling, the SuperGrainbag-HC (SGB-HC) (Figure 1a) (holding 1- to 2-tonnes) is increasingly popular. A large user is Royal Coffee in its New York, Wisconsin, and California warehouses.

Overview of Other Major Applications of Hermetic Storage

Hermetic storage of cocoa beans is now used on a significant scale both in the country of origin (Indonesia, Ghana and Brazil), and for intercontinental transport using TranSafeliners™ shown in Figure 2. In cocoa, oxygen levels decrease to less than 1% after a few days, protecting the beans against molds and resulting mycotoxins as well as growth of Free Fatty Acids (FFAs), which affect taste.

Starting in 2003, the International Rice Research Institute (IRRI) proved that hermetic storage of paddy and rice seed using 5-tonne Cocoons produced results equivalent to storing under air conditioning or refrigeration for periods of up to a year. Later IRRI showed equally safe storage in the smaller, 60kg-capacity SuperGrainbags (Figure 1c). Other studies on hermetic storage of rice and corn seed in Mexico, Thailand, Bangladesh, and Cambodia showed similar results for periods of 90-280 days with germination rates at the end of the period from 95% to 98.3%. Among large seed companies using Cocoons or SuperGrainbags on a large scale is Bayer CropSciences who use SGBs for rice seed storage in the Philippines, India, Indonesia and Brazil.

Hermetic corn storage using large Cocoons, such as at Cargill in the Philippines (Figure 1b), is used on a large scale in the Philippines, Rwanda and Thailand. In Ghana, several hundred thousand SuperGrainbags are sold at retail to small farmers and others for storing corn, sorghum and beans as well as seeds. Field trials in Costa Rica have shown that beans stored hermetically in Cocoons for 3-months not only are well-preserved and insect-free but avoids the otherwise doubling of required cooking time after 3-months of conventional storage. In 2009, initial trials in Kerala, India have shown promising results in storing tea by maintaining essential constant moisture content as well as taste, color and texture for 4-months.

In January 2010 GrainPro announced the availability of an improved SuperGrainbag with even lower permeability and an improved seal called the SuperGrainbag II Z™. This new model uses a “zip lock” type of closure to ensure a more perfect seal, in order to allow even longer-term storage without degradation.

Conclusion:

To quote Oscar Rohmoser, (Title: General Manager of the Industrial Advisory Unit) of Neumann Kaffee Gruppe in Costa Rica, “Storing coffee in Cocoons is an excellent option for outdoor or indoor coffee storage even under very adverse weather conditions.” He added, “It allows long term storage of green and parchment coffee without degradation of its qualities, in particular to preserve specialty high quality lots and to prevent contamination of the product from possible external and out-of-control factors.” Increasingly, coffee importers and roasters in the US are requiring their suppliers to provide hermetic storage so that deterioration is prevented before it arrives to them. This takes the form of SuperGrainbags inside a jute or polypropylene envelope or non-hermetic bags inside a reusable

TranSafeliner™ (TSL™) lining standard shipping containers. These importers, in turn, are using hermetic storage at the destination. This is true of a number of high quality importers and roasters whether for specialty coffee and caffeinated or decaffeinated coffee. The specialty coffee industry is increasingly benefitting from pesticide-free hermetic storage to meet the demand of sophisticated customers on a year-round basis.

¹-Chief of Technical Services, Icafe, San Jose, Costa Rica (rchacon@icafe.go.cr)

²-President, GrainPro, Inc., Concord, MA 01742 USA (pvillers@grainpro.com)

For further information contact Philippe Villers (pvillers@grainpro.com)