

**RESEARCH AND INNOVATION SYSTEMS
IN AFRICA (RISA) PROJECT:
BRIDGING THE RESEARCH INNOVATION-INDUSTRY
ASSIMILATION GAP THROUGH TECHNOLOGY CAPACITY
BUILDING IN RURAL GHANA PROJECT**



OVERVIEW OF THE TRAINING PROGRAM

This is the Research and Innovation Systems in Africa (RISA) funded project titled “**Bridging the Research Innovation-Industry Assimilation Gap through Technology Capacity Building in Rural Ghana Project**”. This training is being done by the University of Ghana Business School Innovation and Incubation Hub (UGBS Nest) in partnership with the Dairy Research Improvement and Innovation Consortium (DRIInC). The project seeks to build the capacities of rural small enterprises by training them on process enhancement innovations from the existing research and innovation knowledge available at DRIInC at the University of Ghana.

In building the capacities of local entrepreneurs, we seek to prioritize learnings towards empowering disability-owned businesses and under-represented groups of society. By delivering the project through our existing research and technology transfer infrastructure, the project widens the scope of the number of small enterprises that are likely to assimilate knowledge and innovations emanating from research communities in Africa.

The overall objective of the project is to improve the technology assimilation capacity of rural enterprises through capacity-building training across six (6) regions in Ghana. The project also aims at documenting learnings from these capacity-building approaches through building an ecosystem of hub partners and rural enterprises which continually creates the synergistic research-industry innovation assimilation loop that makes an impact beyond this project.

BACKGROUND

The innovations in food processing manuals are training manuals developed by the Research Innovation Systems in Africa (RISA) in simple terms for the average person to understand and practice. This manual was developed by faculty members from the Dairy Research, Improvement, and Innovation Consortium (DRIInC) in collaboration with the University of Ghana Business School Nest (UGBS Nest).

The training program is designed to bridge the knowledge and skills gap between traders, farmers, and small-scale food processors. Innovative processing training has been developed for dairy, egg, tomatoes, fruits, fish, and palm fruit. This training manual is designed to give step-by-step innovative ways to process these foods and scale up.

TARGET BENEFICIARIES

This training targets local entrepreneurs, disability-owned businesses, and under-represented groups of society. This will help educate them on proper food handling methods to prevent food contamination as well as processing equipment to increase productivity and save time.

COLLABORATING DEPARTMENTS

The University of Ghana Business School Innovation and Incubation Hub (UGBS-Nest)

The UGBS Innovation and Incubation Hub (UGBS-Nest) is an initiative of the University of Ghana Business School (UGBS). The goal of UGBS Nest is to promote student innovations and technology-based entrepreneurship, thereby facilitating the practical application of knowledge for public use. The main aim of the Innovation and Incubation Hub is to provide support and training for students and innovators who are interested in converting their social and innovative ideas into startups. The UGBS Nest provides necessary infrastructural support, prototype development support, research assistance, help in getting funding, business consulting assistance, mentoring, and guidance to grow student start-ups into successful ventures. The UGBS Nest, in its quest to project the entrepreneurship and innovation development capacity of the University of Ghana and the Business School, has adopted an operational direction that fits the agenda of the University and its strategic direction.

The Dairy Research Improvement and Innovation Consortium (DRIInC)

The Dairy Research Improvement and Innovation Consortium is made up of researchers and experts from various departments and centers within the College of Basic and Applied Sciences (CBAS) of the University of Ghana. DRIInC primarily conducts research into holistic dairy production and processing in Ghana. Due to demand in the food industry, DRIInC has extended its training and research activities to cover other food and agro-processing sectors. With an increasing demand for quality food products in the country, DRIInC aims to improve the nutritional value, quality, and safety of foods through research and training of farmers and handlers of food products.

Oil Palm: Best Management Practices from Farm to Frying Pan

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What Do Farmers/Processors want?

- High yield
- Extended shelf life
- Superior taste
- Happy customers
- More money

What do consumers (Domestic and Industrial) want?

- Great taste
- Great Price
- Extended Shelf life
- Low Free Fatty Acid (FFA) < 5%
- Low Moisture Content < 0.1%
- Low dirt or grit level

How Do we satisfy farmers, Processors and Consumers?



Understanding some basic science behind the farming and processing



By looking at critical unit operations from farm to processing that affect various quality parameters.



Developing simple techniques to measure some quality parameters.



Continuously updating farming and processing technologies and techniques

Day 1 learning Activities

Brief history of oil Palm
development

Explanation of key terms

Best Management
Practices (BMP) of farms

Day 2 Learning Activities: BMP Processing

- Bunch Reception
- Bunch threshing
- Fruit Cleaning
- Fruit Sterilization/ Cooking
- Digestion
- Pressing
- Clarification
- Oil Drying
- Oil Packaging

Day 3: Practical session on moisture content determination

- Divide class into groups
- Each groups determines the moisture content of Crude Palm oil and other commercial refined edible oils
- Discussion on how to apply it at scale

Day 4: Contemporary technologies and techniques

- Improved stoves
- Bio-digesters
- Cement from waste
- Animal feed from effluent

Oil Palm: Best Management Practices



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FRESH FRUIT BUNCH HARVESTING

OBJECTIVES

- To harvest all available fruit at optimum ripeness, when fresh fruit bunches (FFB) contain the maximum quantity of oil and kernels.
- To harvest only ripe fruit and collect all loose fruit (LF).
- To deliver the FFB to the mill within 24 hours of harvest and in good condition, which will reduce the amount of free fatty acid (FFA) in the crude palm oil (CPO).
- To maintain optimum frequency of harvesting rounds.

STANDARDS

- Mature bunches must have at least one detached loose fruitlet on the ground at the base of the palm before the bunch is harvested.
- Pruned fronds must be cut and stacked neatly in the interrow. All ripe bunches and all LF must be harvested, collected and delivered to the mill.
- Harvesting rounds should be maintained at 7–10 day intervals. FFB and LF must be stacked neatly on the roadside for collection.
- Stalks must be removed from harvested bunches and any debris removed from the FFB stacks prior to loading.



Harvesting
using sickle
and Chisel



FRESH FRUIT BUNCH (FFB) DELIVERY

OBJECTIVES

- To deliver fresh fruit bunches (FFB) and loose fruit (LF) to the mill in undamaged condition through minimal and careful fruit bunch handling.
- To maintain delivery schedules and quantities so that the palm oil mill is run at maximum capacity and efficiency.

STANDARDS

- **All FFB and LF should be delivered on the day of harvesting.**
- Minimal handling and bruising of fruit.
- No contamination from stalks, dirt, stones and other material (e.g. fronds). Efficient FFB truck loading and turnaround times with minimum delays.

CIRCLE AND PATH WEEDING – CHEMICAL



OBJECTIVES

- To maintain unimpeded access to the oil palms for manuring, pruning, harvesting, fruit collection, and general supervision.
- To reduce competition from weeds for nutrients, moisture and sunlight.

STANDARDS

- Eradication of all weeds in the palm circle and along harvesting paths. Circles and paths are always sprayed during the same round.

SELECTIVE WEEDING – MANUAL

OBJECTIVES

To encourage optimum oil palm growth by reducing competition from weeds for nutrients, moisture and light.

To preserve and maintain soil fertility, by maintaining legume cover plants which reduce erosion, fix atmospheric N_2 , and supply litter to replenish soil organic matter.

To establish a suitable environment for beneficial insects (i.e. predators of insect pests). To prevent the establishment of large trees or bushes in the plantation.

STANDARDS

Uprooting and removal of all woody plants, young trees, deep rooting ferns and plants with fleshy and persistent rooting systems (e.g. taro).

Manuring

Objectives

- To supply palms with sufficient nutrients for healthy vegetative growth, maximum economic fruit bunch yield, and resistance to pests and diseases.
- To
- integrate the use of mineral fertilizers and palm residues.

STANDARDS

- Sufficient fertilizers are applied to produce the maximum economic yield.
- Nutrients removed in fruit bunches are replaced by the addition of mineral fertilizer nutrients and the recycling of organic residues.



a) Pruned fronds

- The fronds removed annually during harvesting and pruning contain about 125 kg N, 23 kg P_2O_5 , 176 kg K_2O , and 25 kg MgO/ha, derived from both native soil nutrient reserves and applied mineral fertilizer.
- To prevent the development of large differences in soil fertility between the frond stack and the interrow path, alternate the position of the frond stack at 3–5 year intervals. The old frond stack will completely decompose in 6–12 months. Apply empty bunches over the harvesting path before changing the location of the frond stack.



b) EFB

- A yield of 25 t FFB/ha will produce about 5 t EFB/ha after milling. Since EFB is usually applied at 30 t/ha, each field may be mulched once in six years. It may be more useful to apply EFB each year to soils where the efficiency of mineral fertilizer use is reduced by low organic matter status (refer to Section 214.0).



Palm Oil Mill Effluent (POME)

- The field application of POME is costly and requires complex infrastructure. The application of POME as a source of nutrients and water is particularly valuable during periods of low rainfall or in areas prone to seasonal drought.



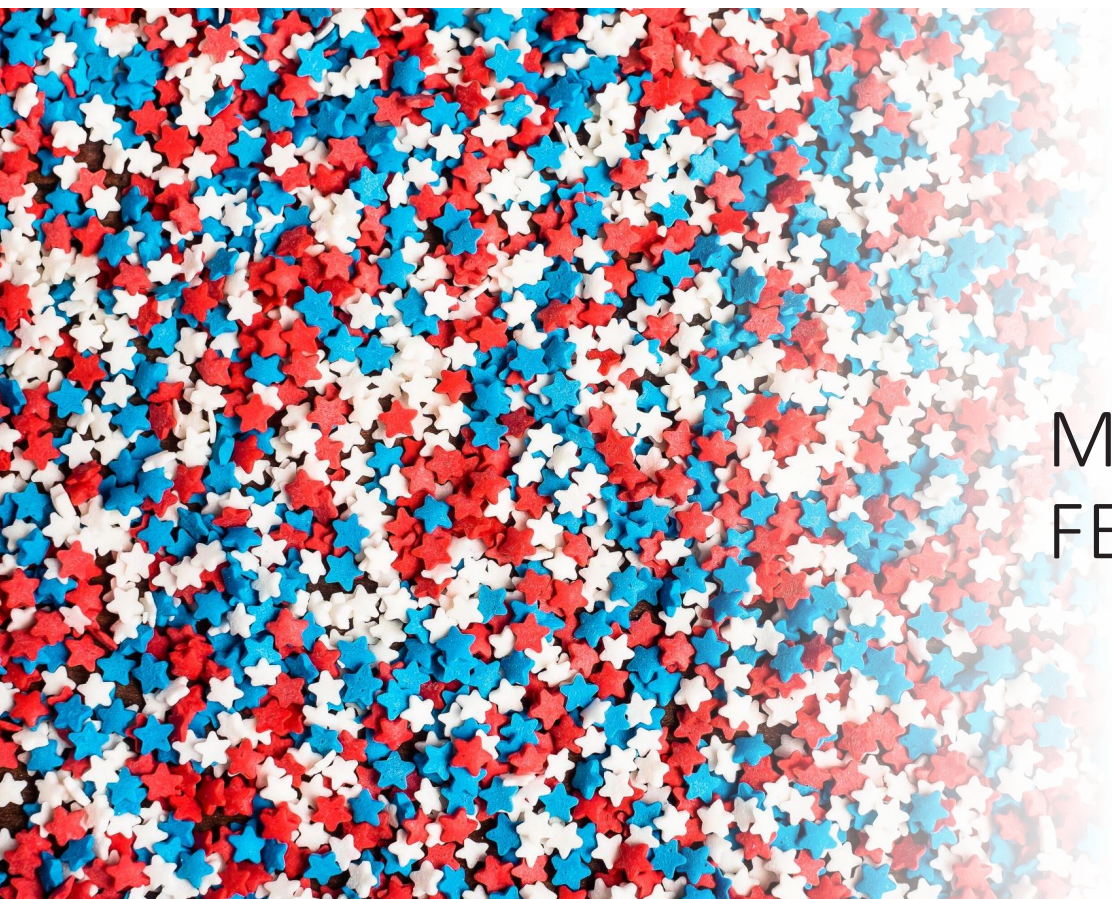
Bunch Ash

- A yield of 25 t FFB/ha will produce about 150 kg of BA after milling and bunch incineration. Since BA is usually applied at about 5 kg/palm, sufficient BA is produced to substitute for muriate of potash (MOP) once every 4–5 years. BA is particularly useful for raising the soil pH of peat soils if applied in the planting hole



legume cover plants

- The advantages of LCP ground vegetation are realized 3–5 years after palm planting. A full canopy of LCP should be established during the first two years following palm planting. When the canopy closes and palms start production, the LCP dies out, releasing a large amount of N. N fertilizer application during this period can then be reduced as appropriate



MINERAL
FERTILIZERS

NITROGEN

- **FUNCTION**

- Nitrogen is an essential element for plant growth

- **SYMPTOMS OF N DEFICIENCY**

- Older fronds are pale green to yellow. Rate of frond production (frond/palm/yr) is reduced. Pinnae are narrow and rolled-in on the midrib (which may turn yellow if N is very deficient).
- Reduced growth rate, retarded palm development and flat top appearance

Nitrogen
deficiency



Treatment

Proper weed control and maintenance of legume cover plants (LCP) as long as sufficient light penetrates the canopy.

Prevent soil compaction – minimize vehicular traffic, fit infield fruit collection vehicles with wide flotation tyres, and maintain effective soil drainage.

A yield of 25 t FFB/ha contains about 74 kg N, equivalent to 160 kg urea/ha (or 1.0–1.3 kg urea/palm).

PHOSPHORUS

- Phosphorus is an essential element for plant growth and is particularly important for root growth during the establishment and early growth stages.

- **SYMPTOMS OF P DEFICIENCY**

- Unlike N, K and Mg, there are no easily recognizable P deficiency symptoms in oil palm leaves. However, the palms may be stunted and have short fronds, and the palm trunk may have a pronounced pyramid shape.
- Other species act as proxy indicators for P deficiency. For example,
 - a) *Imperata cylindrica* (alang-alang) with a purplish discoloration on leaf blades,
 - b) legume cover plants (*Pueraria phaseoloides*) produce small leaves, are difficult to establish, and root nodulation is sparse,
- b) *Melastoma malbathricum* and *Dicranopteris linearis* exclude other interrow species by their competitive advantage.

Purple leaf discoloration



POTASSIUM

- Potassium is an essential element for plant growth and important for proper stomata function in the leaf. K deficient palms are therefore more susceptible to drought conditions
- K deficiency appears in oil palm as orange spotting, confluent orange spotting, diffused midcrown yellowing and white stripe.

Potassium deficiency



A comparison of K and Mg deficiency symptoms. The centre pinnae is deficient in K, while the other two are deficient in Mg.



A frond on a mature palm showing severe K deficiency symptoms.

PREVENTION OF K DEFICIENCY

Apply sufficient K fertilizer.

Recycle K contained in empty fruit bunches (EFB) or bunch ash (BA) (if EFB is incinerated).

Apply EFB to sandy soils to build up soil nutrient retention capacity.

Palm Oil Production



Artisanal Palm Oil Mills



Introduction

- The artisanal palm oil production process is largely influenced by the type of oil being produced
- This section describes the various types of oil, the production processes and equipment used



Types of palm oil

- There are two main types of palm oil produced by artisanal processors in Ghana
- These are locally called Dzomi and Ngo Pa
- The Dzomi variety is made from relatively fresh palm fruit
- The Dzomi variety is mainly used for food products as it has an appealing aroma and flavor
- The Ngo Pa variety has a lower shelf life as it is constantly fermenting due to the excessive moisture content

Palm Oil Production Process

- Artisanal palm oil production is made of a maximum of 10 unit operations or stages
- The number of unit operations a processor uses, depends on the type and quality of oil being produced, as well as the technology being used
- Below is a process flow diagram showing the 10 unit operations prevalent in the artisanal palm oil processing industry



Detailed Process Description



Bunch Reception

- The fresh fruit bunches are procured from oil palm farmers in the community or from the plantations managed by the mill
- The fruits are conveyed with either a tractor with a trailer, a small truck or a tricycle



Bunch threshing

- This stage involves the hacking of the fruit bunches into spikelet with a machete or an axe
- This stage is usually performed by men as it is energy intensive
- The main form of energy used at this stage is manual energy



Fruit Cleaning

- This process of separating the fruits from the spikelet and any form of leaves is the cleaning process and is usually undertaken by old women as it requires relatively small manual energy
- In many of the processing centers, this stage serves as an important source of income for many of the aged in the society as they get to earn some income from this activity
- This stage also allows the processor to determine how much fruit they have from the bunch procured
- This machine significantly reduces the processing time as processors would not have to wait for excessive softening of the fruit bunches



Fruit Sterilization/ Cooking

- The loading of the cookers is mainly done by women whiles the lighting of the stove is done by men
- The processors use a mixture of palm fiber, palm kernel shell, bamboo, fuel wood and scrap tyres
- However, if the processors do not have access to dry oil palm fiber and palm kernel shell, they purchase bamboo or fuel wood to cook the fruit



Scrap Car tires



Digestion

- The mechanical digester basically pounds the fruits and expels a mash of oil, fiber and nuts
- Hence, whiles the mash from the mechanical digester requires pressing to expel the palm oil, the press liquor from the screw press requires clarification in order to skim off the oil
- At the end of the digestion stage the cooked fruit is broken down into components depending on the equipment used



Screw press



Pressing

- Pressing is the next stage of processing after digestion, if the processor used the mechanical digester
- The mash from the digester could be pressed using the spindle and/or hydraulic press
- After digestion, the mash is moved to mostly the hydraulic press because of the relatively higher pressure it gives
- The hydraulic press is therefore used to squeeze out the first batch of oil from the mash



Hydraulic Press



Clarification

- The effluent is not treated in anyway as the processors do not generally understand the deleterious effect of the effluent on the soil
- The palm oil mill effluent negatively alters the enzymatic and bacterial structure of the soil
- The palm oil industry in general lack regulations on the treatment protocols for the effluent
- The lack of a coherent and enforceable national policy on the treatment of POME is a big incentive for the inaction on the part of palm oil processors in the country



Clarification



Palm Oil Mill Effluent (POME)



Oil Drying

- After clarification, the processors usually fry the oil with some spices to further enhance the flavor and aroma
- Excessive water will prohibitively increase the Free Fatty Acid content through autocatalytic hydrolysis
- The artisanal processors however estimate the acceptable moisture level by stopping the boiling process when effervescence ceases

Oil Packaging

- This is the last stage of the artisanal palm oil production process
- The nature of packaging varies depending on the quantum of oil or the intended market
- For large volumes of oil intended for export into the sub-region, the oil is stored in relatively bigger tanks as compared to the small gallons used for small volumes



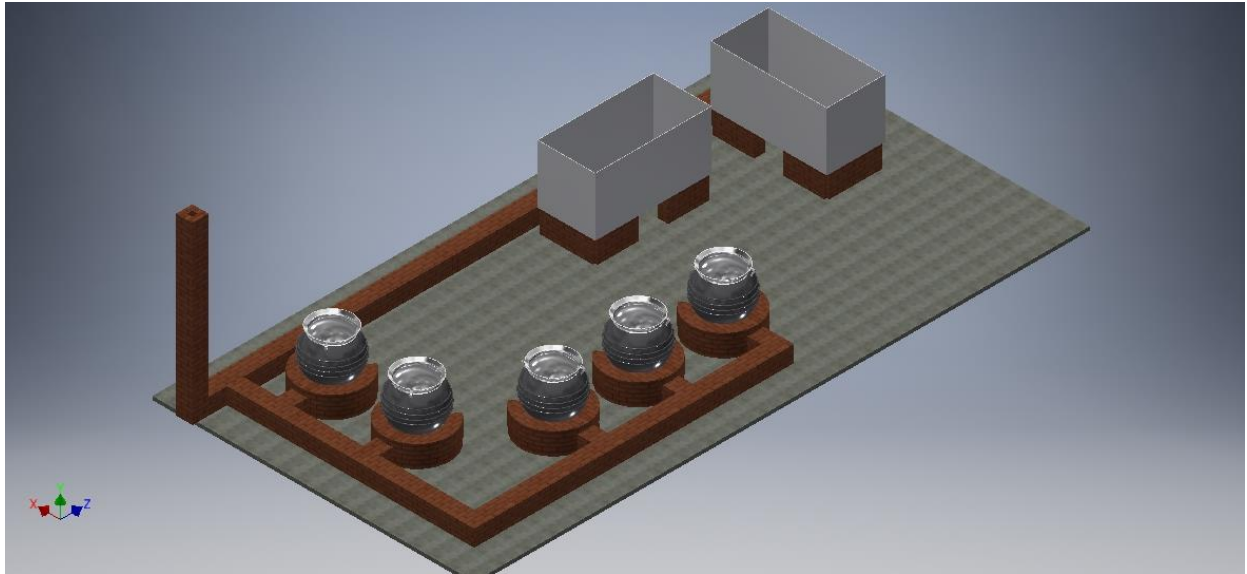
Emerging Issues

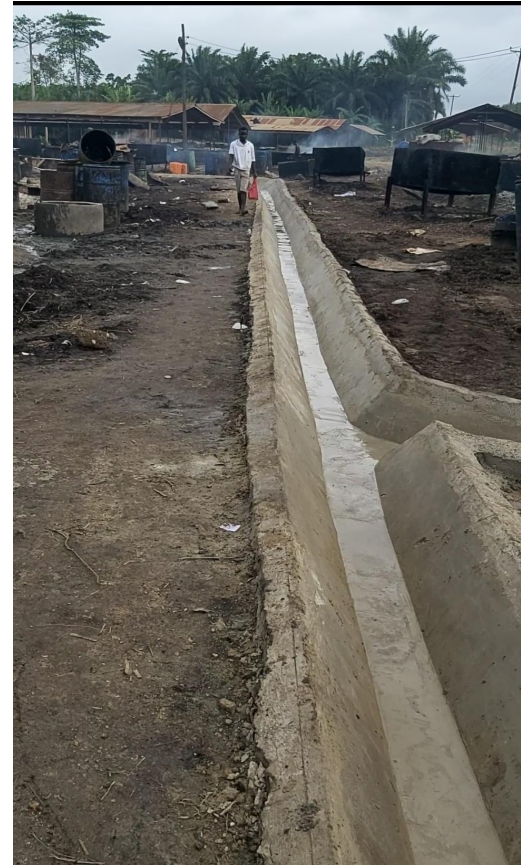




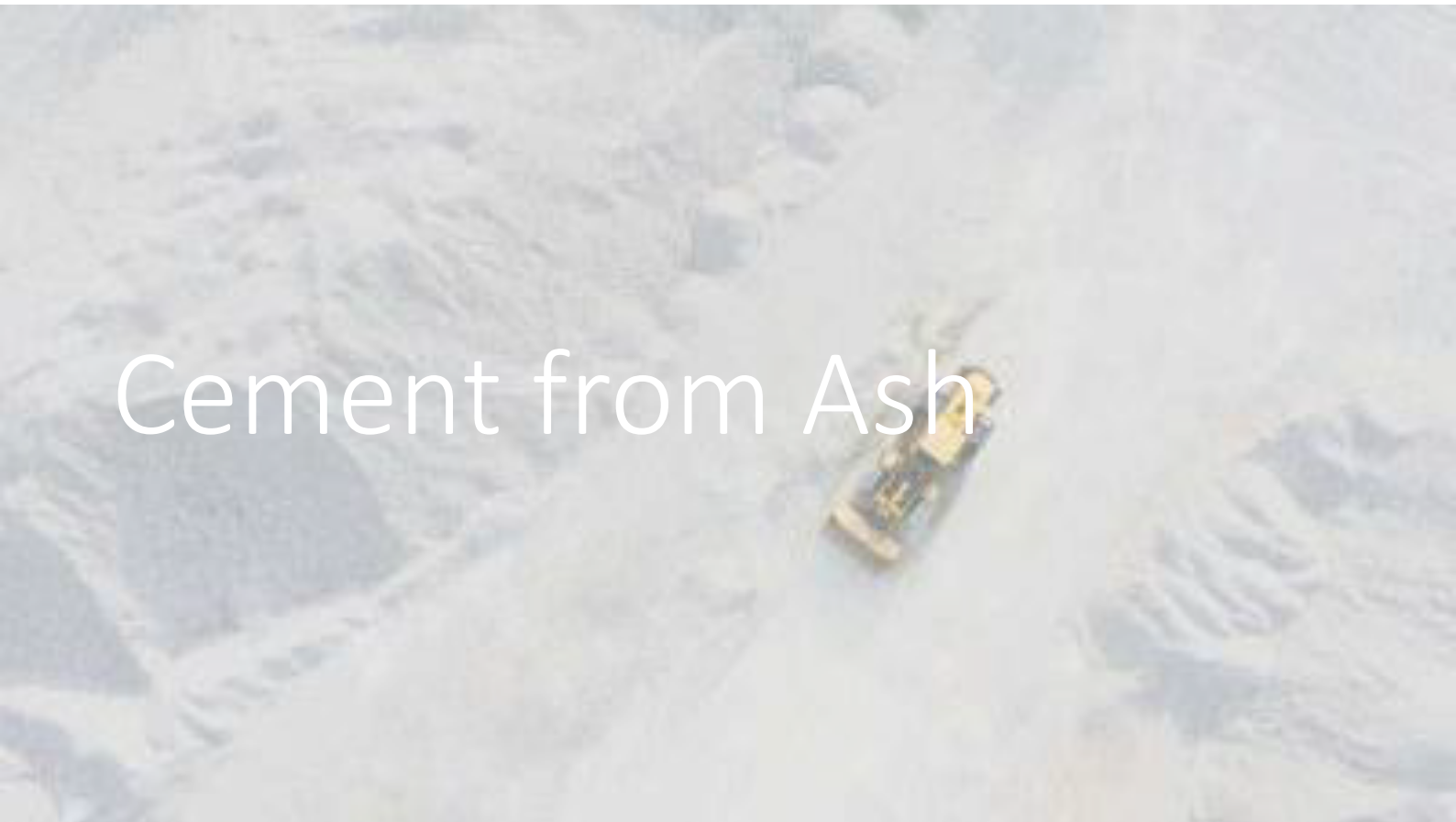
Moisture Content Test

WELLER





Cement from Ash





Biogas digester



THANK YOU



FOOD AND DRUGS AUTHORITY

DOC. TYPE: FORM

DOC NO.: FDA/FER/RQT- 04

Page 1 of 1

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GENERAL LABELLING REQUIREMENTS FOR PRE-PACKAGED FOOD

- Name of Product (Brand and Generic names)
- Net weight, Net volume or Drained Weight for solid in liquid medium e.g. Tuna in Brine
- List of ingredients (specific names of ingredients and/or E-numbers)
- Date of manufacture
- Best Before Date or Use by Date (*Where applicable*)
- Batch or lot number
- Country of Origin
- Name and complete address of manufacturer/agent
 - *Labels of locally manufactured food shall have in addition, the specific premises location address of the manufacturer (ie. House Number/Plot Number/ Ghana Post Digital Address)*
- Directions for use, if any.
- Any instructions for storage/handling
- Labelling shall be in English
- Labelling shall be legible and shall be of indelible ink.

These are stipulated in the FDA Guidelines for the Labelling of Pre-packaged Foods (FDA/FERD/GL-LAB/2013/02).

NB:

- ***Where a product has both Primary and Secondary Packaging, the labelling of both the Primary and Secondary packages shall conform to the FDA's requirement on labelling of food products***
- ***Documentary evidence must be provided to substantiate nutrition information and claims on labels (if any).***
- ***All vegetable oils, both imported and locally produced, are to bear the plant source of the oil and labelled as such e.g., corn oil, groundnut oil, rapeseed oil, sunflower oil, etc.***

FDA/FID/FERD/GLR-001/2013