


Biodigestion Processes in Palm Oil Mills

Environmental Fabrics Inc

Methane to Markets. Monterrey, México

January 2009

Who we are

- Environmental Fabrics de México S. de R.L. de C.V. (EFM) is a subsidiary of Environmental Fabrics Inc. The EFI/EFM team works with different companies developing CDM projects for the Ag sector in countries such as Malaysia, China, Thailand, Australia, Spain, Latin America, the Caribbean, the United States, and Canada.
- Environmental Fabrics Inc, was founded in 1993 by Zeb Fuchsluger, Dennis Shanklin and Ray Pickel.
- The firm has achieved international recognition for its work on geosynthetic applications in biodigesters and wastewater projects.
- The principals combine an experience of more than 50 years in the manufacturing, construction and environmental industry.

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What we do

- *Consorcio Ingenieria Ambiental Mexicana (CIAM)* is in charge of the design, construction, supervision and project management of our CDM projects. *CIAM* is responsible for this division in our international ventures.
- CIAM is composed of highly qualified and skillful professionals with great experience in methane capture CDM projects, and have a combined experience of over 10 years in the industry.
- Our engineering team has performed work in the Ag market and has developed projects for various applications such as pork, dairy, slaughter facilities, palm oil, and industrial organic waste.

Biodigestion in Palm Oil Mills

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Palm Oil

- The palm oil industry generates the largest amount of biomass in the oil industry, worldwide. Its operations obtain 4 main byproducts:
    - **Mesocarp Fiber**
    - **Shell**
    - **Empty Fruit Bunches (EFB)**
    - **Palm Oil Mill Effluent (POME)**
- From these byproducts the mesocarp fiber and the shells are burnt to generate steam and electricity and the EFB is utilized as a fertilizer. The POME is the only byproduct that did not have a viable application until now.[1]

[1]Hassan et al., 2004

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Palm Oil

- It is estimated that in 2005, 50 millon tonnes of biomass were generated. This biomass tendency will increase if the demand for this edible oil increases. [1]
- 50 millon tons of biomass has the potential of 1.4 trillion cubic meters of biogas or 337 MW of electrical power generation.
- The POME is generated mainly from the extraction of the Palm Oil, the washing process and the cleaning of the mill.[2]

[1]Hassan et al., 2004
[2]Agamuthu, 1995

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Palm Oil Process

- ***Flow***

Production varies during the year. In Malaysia, for example, January to April is the period of maximum production and August to November is the other high-production period. Production in the other months can be less than half the peak production rate but varies depending upon what raw material can be brought in (from other plantations etc).

So say a “60 tonnes FFB/hr” Mill may operate at 80 tonnes/hr and work 24 hrs /day in the peak season and drop to 20 tonnes/hr and 16 hrs/day in off-peak season.

Items to check are past 12 months records and plans for future volume when assessing for a POME digester.[1]

[1]Trott, 2009

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Palm Oil Process

COD Destruction Assumptions

To calculate COD destruction we assume the following (based on Malaysian standards)

- 1 ton of FFB (Full Fruit Bunch) = 1 m^3 POME ;
- Conversion factor – Digested POME to Biogas = 25m^3; due to variations in the digestion process the Biogas generated maybe less than 25m^3
- COD range for mills = 55,000 ppm to 80,000 ppm, according to Malaysian Palm Oil Board (MPOB).

[1]Trott, 2009

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Palm Oil: Economic Incentives

- The Anerobic Digestion systems provide the following benefits:
  - **Reuse of the POME byproduct:** Yesterday's trash has become today's source of energy.
  - **Creation of Electricity:** Savings for self consumption or joint production of electricity (with the utility company, in a net metering system).
  - **Production of Carbon Credits** by the mitigation of Greenhouse Gases.
  - **Odor Reduction** and utilization of the digestrate as **fertilizer.**

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POM Regions: Malaysia and Central America

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Malaysia: Research on POME Digesters

- A research paper done in Malaysia in 2005 by Shahrakbah Yacob et al. was published in the Science of the Total Environment Journal on August of 2005. The study was based, in part, on the following:

  • *Malaysia has several resources generated by the Agricultural sector, the largest of which is the Palm Oil.*

  •*The testing results on this paper utilize a document published in 1999 by Ma et al. which indicated that POME digestion produced 65% of methane in the total biogas mix.*

  • *The findings were based on a study in 2 ponds on the Felda Serting Palm Oil Mill for a time period of 52 weeks.*

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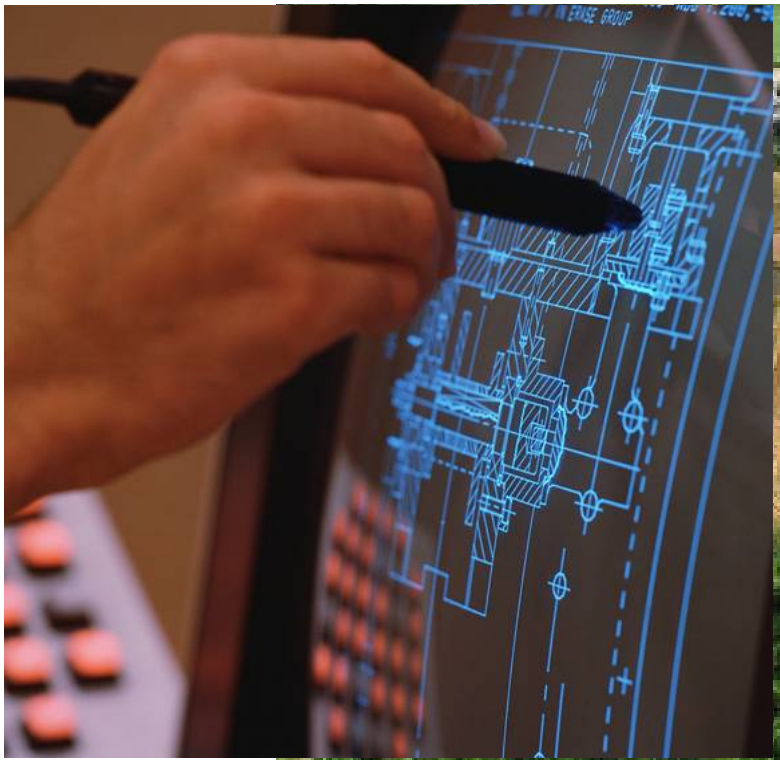
Malaysia: Research on POME Digesters

- The findings were as follows:
  - *The anaerobic lagoons registered a percentage of 54.4% methane. Lower methane composition was believed to be attributed by the large variation in the chemical properties of POME and the volume discharged to the ponds, resulting in the daily variation of organic loading rate and hydraulic retention time.*
  - *POME contains cellulosic material, fat oil and grease.*
  - *The lagoon digesters emitted higher and more consistent methane composition in the biogas mixture while severe daily fluctuations of the methane emission pattern were observed in the open digesting tank. (54-65% against 35% in a tank)*[1]
  - *Higher organic conversion efficiency rates were obtained in a lagoon digester which for every kg of COD removed, 237 g of methane was emitted or 12.36 kg of methane/t of POME*



Examples of POME Digester Projects

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Low Cost Existing Cell POME Digester Project

- Location: Malaysia
- Project: 2 Mesophilic Lagoon Anaerobic Digesters
- Plant Production: 60 ton/hr
- Wastewater Production: 24 m^3/hr
- Biogas estimated production: 7000 m^3/day
- Electricity Generation Expected: 616 kW.
- Status: In Operation.
- Services Provided: **Construction and Installation of Geomembrane.**

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Low Cost Existing Cell POME Digester Project

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Low Cost Existing Cell POME Digester Project

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New Lagoon POME Mesophilic Digester Project.

- Location: Honduras
- Project: Palm Oil Mill Waste to Energy Project (2 digesters at 7500m³)
- Plant Production: 20 ton/hour
- Wastewater Production: 340 m3/day
- Biogas Production: 10,000 m3/day
- Electricity Generation: Two 633 kw generator sets = (1.27 MW/hr) = (6 GW/ year)
- Savings to the owner: $ 1,000,000 USD per year.
- Status: Operating
- Services Provided: **Construction and Installation of Geomembrane per design by Biotec.**

biotec
The Biogas Experts

EFI
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New Lagoon POME Mesophilic Digester Project.

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New Lagoon POME Mesophilic Digester Project.

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Upward Flow Solids Reactor POME Thermophilic Digester Project.

- Location: Malaysia
- Project: Palm Oil Mill Waste to Energy Project (2 Digesters)
- Plant Production: 45 ton/hour
- Wastewater Production: 497 m3/day
- Biogas Production: 12,425 m3/17 hr day
- Electricity Generation: 1.1 MW
- Status: Operating
  - 9-days HRT in Biodigester/reactor. Temperature = 50°C with a variation of 2 degrees;[1]

[1]Trott, 2009

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Upward Flow Solids Reactor POME Thermophilic Digester Project.

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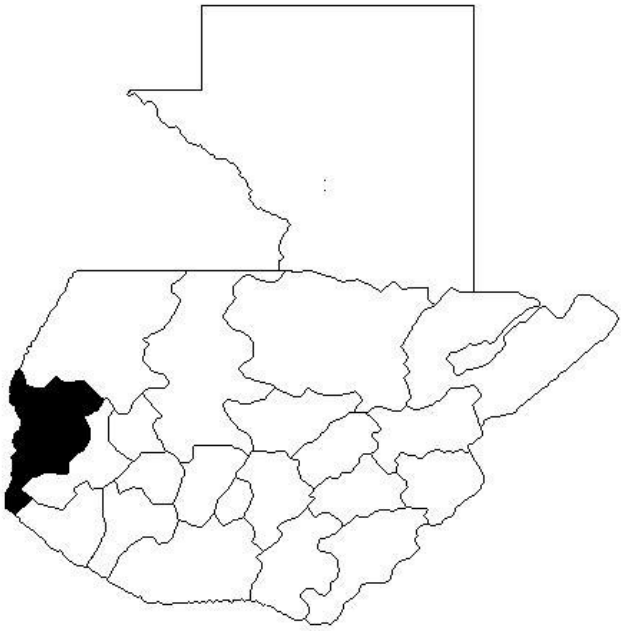

The BUNGE Guatemala POME Project

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The BUNGE Guatemala POME Project

•Location: Guatemala

•Expected Biogas Production: 22,500 m3/day

•Expected Electricity Generation: 2 MW

•Status: Under Construction

•Estimated Completion Date: May 200

•Services Provided: **Turn Key**

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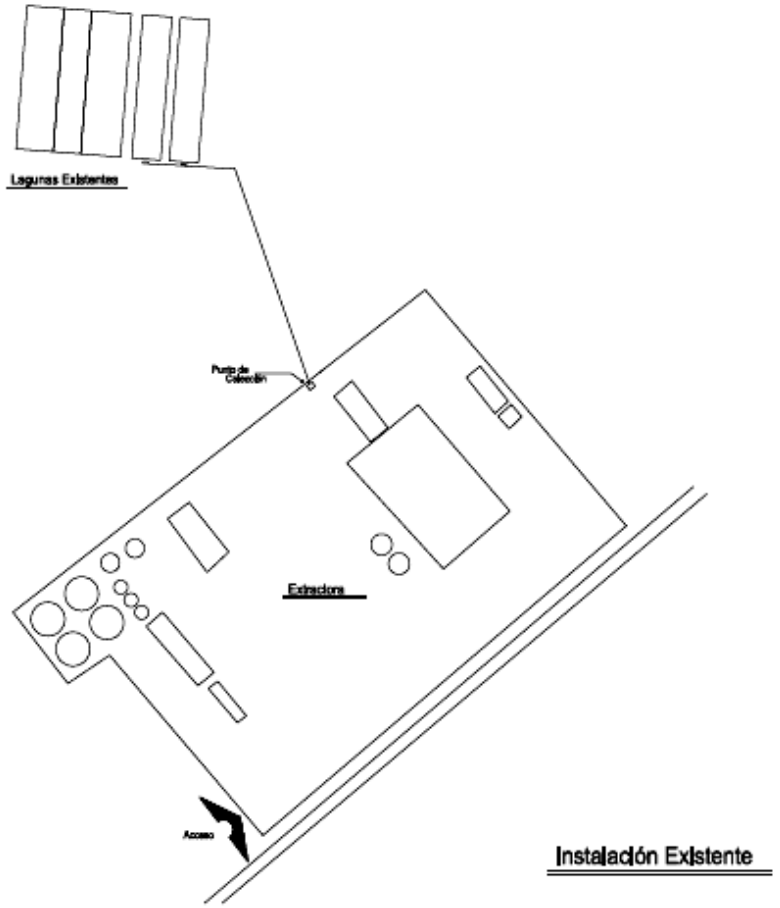
The BUNGE Guatemala POME Project

- Project: Palm Oil Mill Waste to Energy Project (2 Digesters)
- Plant Production: 30 ton/hr
- Wastewater Production: 1,000 m3/day



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The BUNGE Guatemala POME Project

Engineering Data

•POME Temperature: 65°C

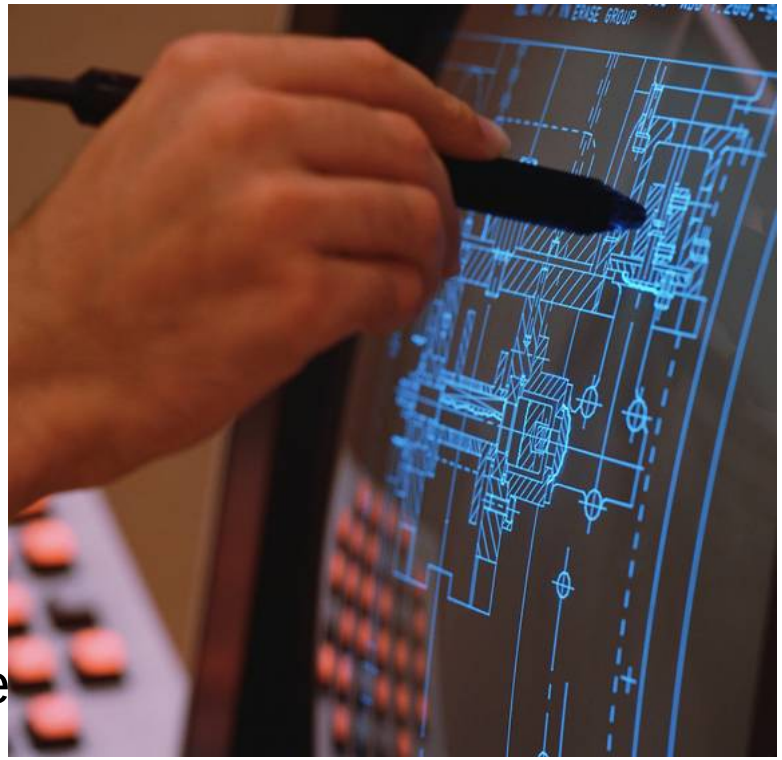
•Water Table: 1.8 m depth

•Restriction on Water discharge level.

•Backup system Required by owner.

•Parallel systems on POM discharge and treatment.

•Electrical Generation system in Parallel.



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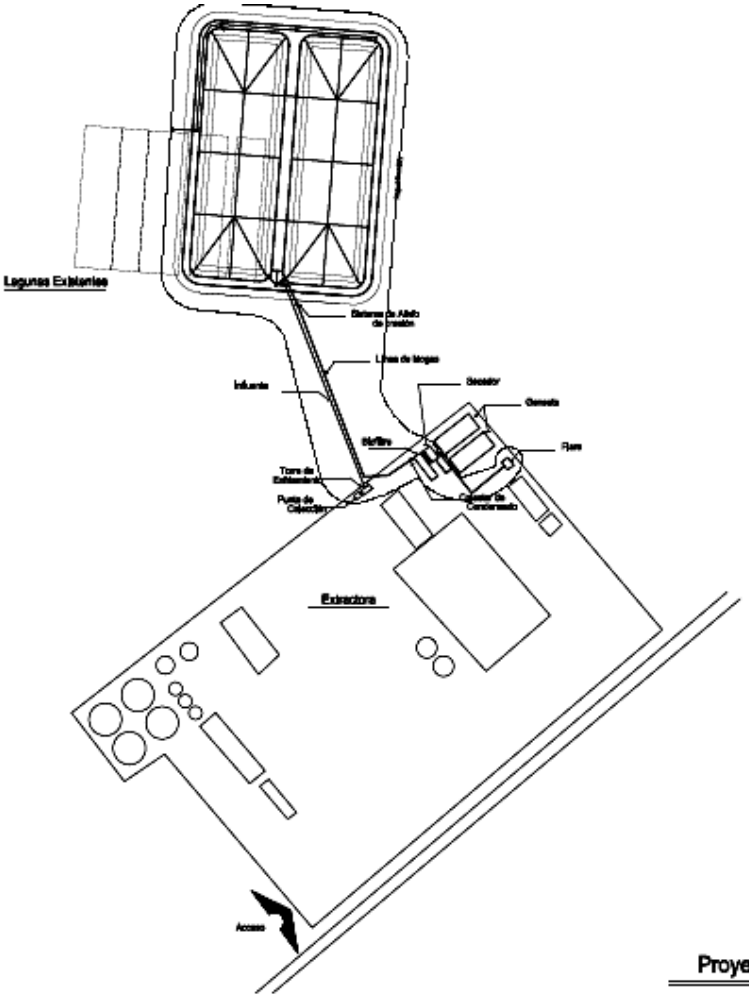
The BUNGE Guatemala POME Project

- Project implementation without impacting Mill Production.

- Parallel System; 35 HRT

- 1 New Digester

- 1 Digester 50% using two existing lagoons



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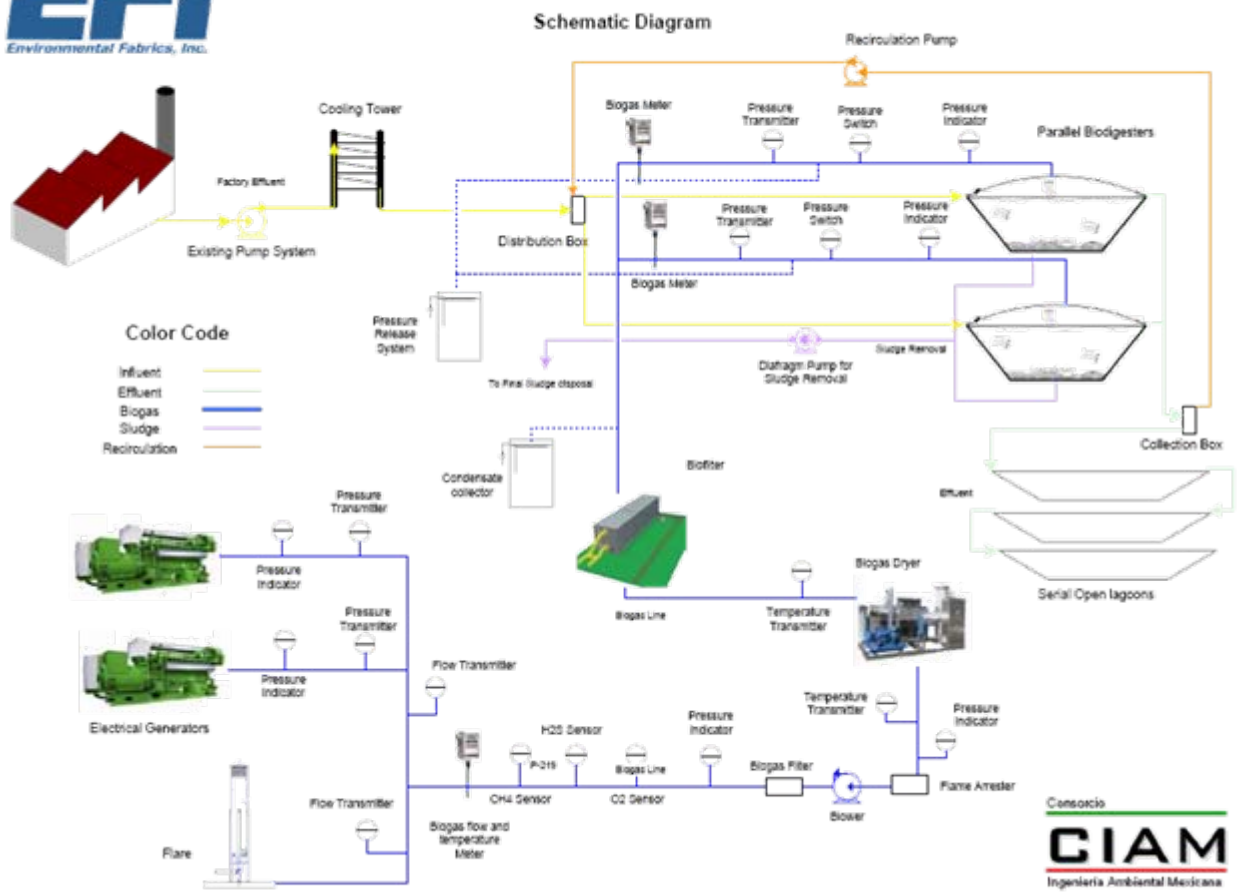
New Facilities Required

- Cooling Tower
- Biofilters and Biogas Dryers
- Electrical Generators Building



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Project Area

Earthworks

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Earthworks

Earthworks

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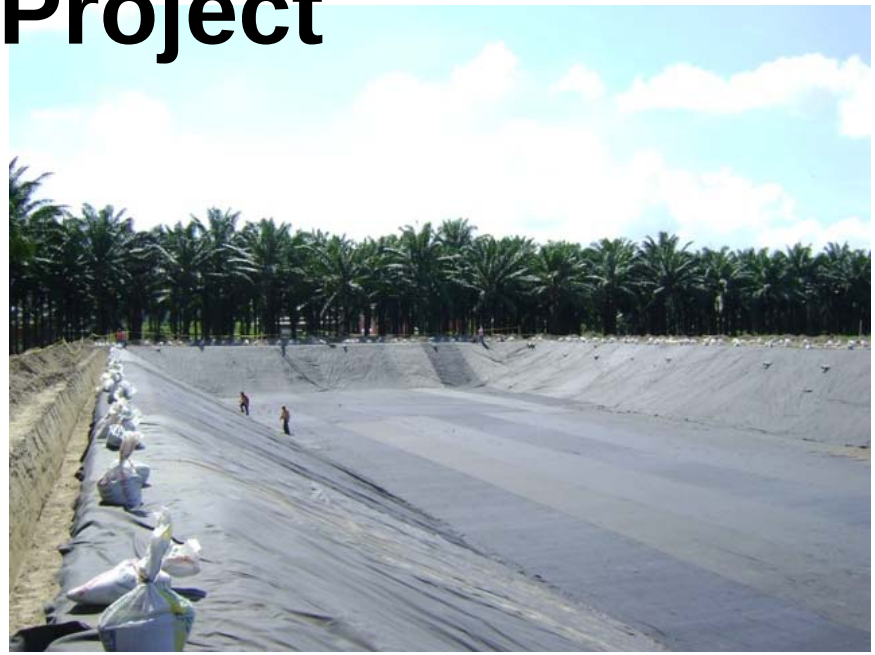
The BUNGE Guatemala POME Project



Geotextile Installation

Liner Installation

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Earthworks finishing

Erosion control system

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Erosion control

Sludge removal pipes

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Filling process

Filling process

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Cover installation

Cover Installed

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