Integrated Production of Energy, Fertilizer and Microalgae from Biowastes

İlda DEĞİRMENTAŞ, Ph.D.

06.10.2022

Contents

Anaerobic digestion (AD) is an important pillar of the circular economy:

- ✓ mitigates GHG emissions

- ✓ recycles nutrients in the form of organic fertilizers

- ✓ prevents nitrogen leakage into groundwater

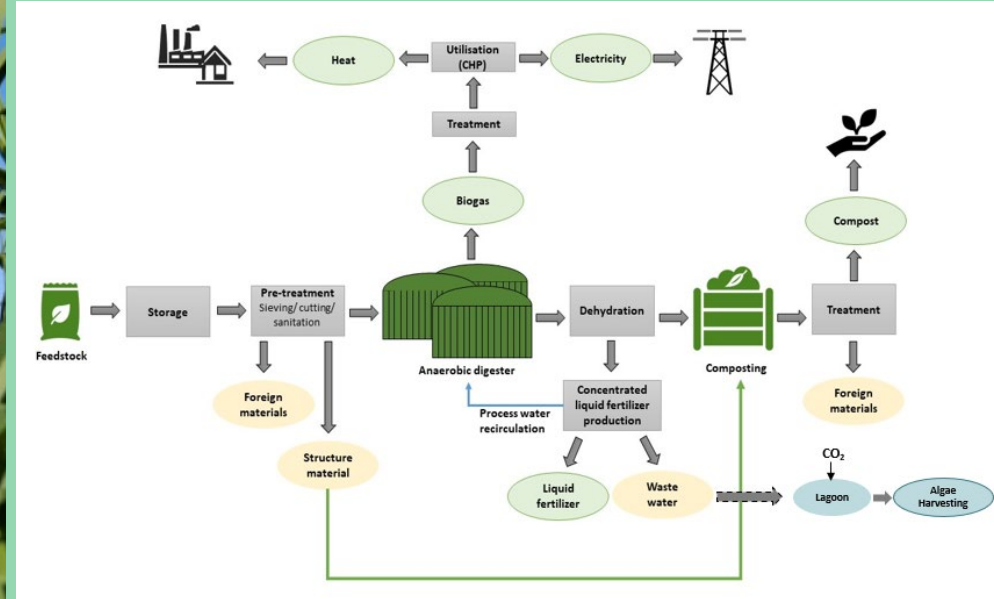- ✓ avoids the spread of harmful diseases through landfilling.

Restoration
Decomposers restore the biological nutrients back and natural cycles restore the resources.

Waste Management
Reduction, recycling of waste and reusing resources for production.

Consumers
Animals depend of plants for food.

NATURE

Resources
Nutrients for biological cycles and raw materials for manufacturing.

Circular Economy

Consumption
Responsible consumption and reuse of products and services.

Natural Producers
Plants produce food using the biological nutrients from soil, water and sunlight.

Production
Redesigning processes, products, services to reduce the usage of resources and using harmless materials & clean energy.

AD is a vital part of bio-economy tapping into leftovers of other industries and thereby improving resource-efficiency.
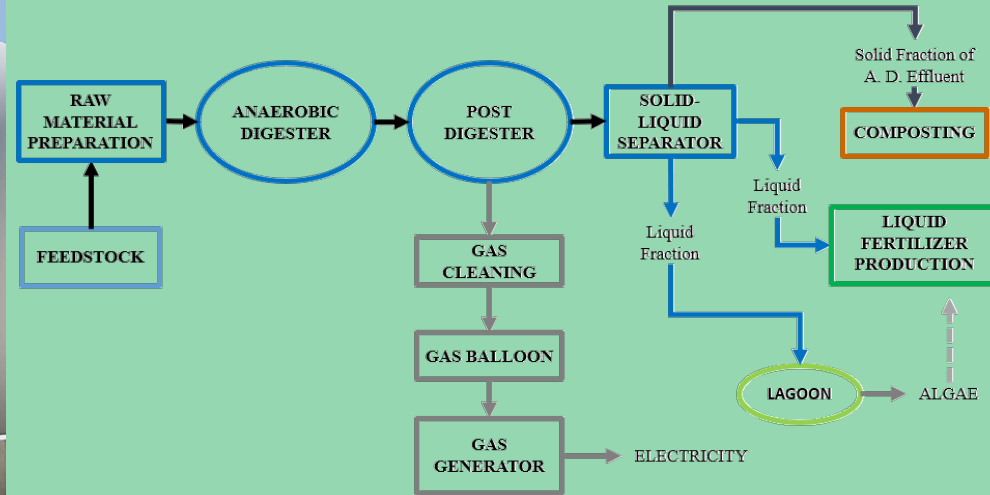
3

Configuration of the Process

- ✓ Biogas Production

- ✓ Compost Production

- ✓ Organomineral Fertilizer Production

- ✓ Liquid Fertilizer Production

- ✓ Algae Cultivation

BIOGAS PRODUCTION

RAW MATERIAL PREPARATION → **ANAEROBIC DIGESTER** → **POST DIGESTER** → **SOLID-LIQUID SEPARATOR**

FEEDSTOCK → RAW MATERIAL PREPARATION

SOLID-LIQUID SEPARATOR → Solid Fraction of A. D. Effluent → **COMPOSTING**

SOLID-LIQUID SEPARATOR → Liquid Fraction → **LIQUID FERTILIZER PRODUCTION**

SOLID-LIQUID SEPARATOR → Liquid Fraction → **LAGOON** → ALGAE

POST DIGESTER → **GAS CLEANING** → **GAS BALLOON** → **GAS GENERATOR** → ELECTRICITY

FEATURES of PROCESS

Detailed Raw Material Preparation

- ✓ Special solids and sand removal technology
- ✓ Size reduction of agricultural waste
- ✓ Pre-treatment of lignocellulosic material
- ✓ Early-stage ammonia removal from poutry waste
- ✓ External recipe preparation
- ✓ External heating
- ✓ Precise temperature control
- ✓ Effective mixing technology
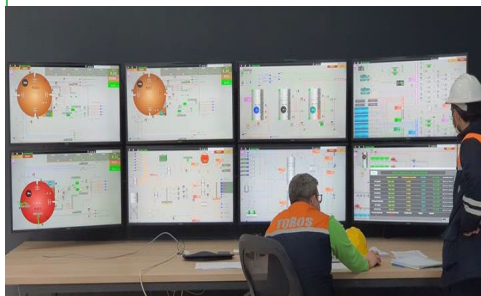
Special Mixing Design

- ✓ Capability to mix up to 12% dry solids content
- ✓ 99% mixing efficiency
- ✓ Low speed mixing not to disturb bacteria
- ✓ Elimination of sedimentation
- ✓ All equipment that may require maintenance located outside of the reactor
- ✓ State of art lubrication technology
- ✓ Special bearing design
- ✓ Energy efficient VFC control

6

FEATURES of PROCESS

Precise Temperature Control

- ✓ Utilization of low temperature cooling water
- ✓ Constant temperature (max temp variation: ±0.5 ^{o}C winter/summer)
- ✓ External heat blanket at the reactors
- ✓ No heating elements in reactor
- ✓ Total concrete construction
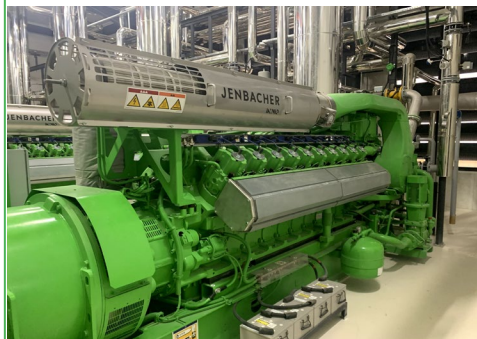
High AD Efficiency

- ✓ More than 60 % of degradation of organic material
- ✓ **Biogas :** composed of 60-65% CH_4
- ✓ The concrete roof design of reactor provides the opportunity to operate high gas pressure
- ✓ Maintenance and leak free concrete roof

FEATURES of PROCESS

Special Technology for avoiding scum formation in ADs

✓ Custom design scum removal technology guarantees formation of scum at the top of the reactors

No Fossil Fuel

✓ No external energy requirement!
✓ The facility generates enough energy to operate and transfers excess energy to network
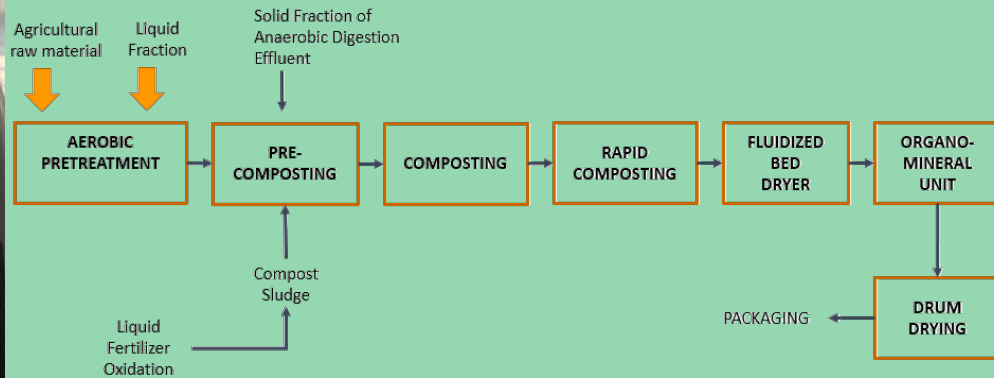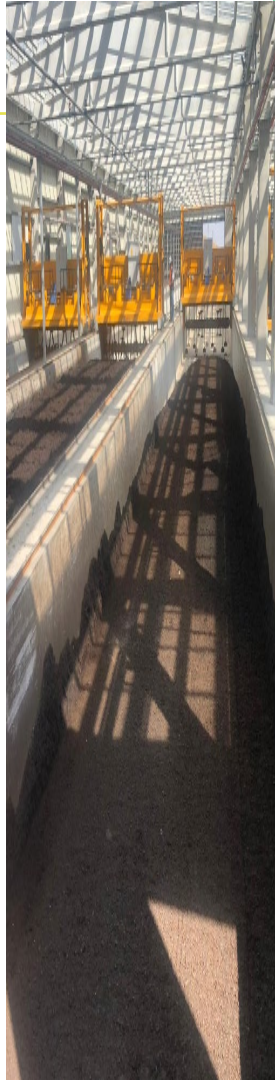✓ Waste heat is used for heating requirements of facility

High Energy Recovery Rates

✓ 85 % of the total energy content of raw material is recovered !

8

COMPOSTING & ORGANOMINERAL FERTILIZER PRODUCTION

WIRE

Agricultural raw material

Liquid Fraction

Solid Fraction of Anaerobic Digestion Effluent

AEROBIC PRETREATMENT → PRE-COMPOSTING → COMPOSTING → RAPID COMPOSTING → FLUIDIZED BED DRYER → ORGANO-MINERAL UNIT

Compost Sludge

Liquid Fertilizer Oxidation

ORGANO-MINERAL UNIT → DRUM DRYING → PACKAGING

9

FEATURES of PROCESS

Odor-free Operation

- ✓ Ammonia recovery
- ✓ Acidic and alkali two stage scrubbing system
- ✓ All process units under negative pressure
- ✓ Enclosed raw material reception area

Increased Composting Efficiency

- ✓ 3 stage composting technology guarantees very efficient composting and DEWAR5 quality product
- ✓ Odor free compost product
- ✓ Custom design compost mixers provide excellent air circulation and controlled aeration

10

Organomineral Granulation Technology

Mineral Fertilizer → Compost → Granulation → Drying → Packaging
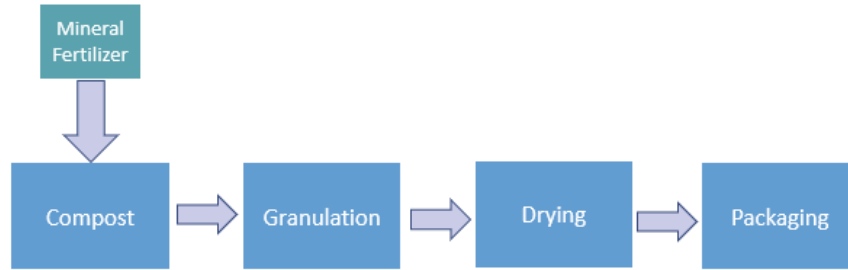
Flexibility to produce different N,P,K formulas

Customized granulation technology

SOLID ORGANOMINERAL FERTILIZERS

TOROS Agri has 4 different OM formulations in the marketTITLE

Farmers prefer 9.21.0+OM and 15.20.0+OM formulations instead of DAP, 12.12.12+OM formulation to 15.15.15, and choose OM added 20.20.0 to regular 20.20.0 as a premium fertilizer

Organic material added mineral fertilizers, mainly compound fertilizers, could replace regular mineral fertilizers as they produce better results

Solid Organic and Liquid Organomineral Fertilizers

Solid Organic Fertilizer	Contents
Organic Material	50%
Total N	2%
Total P_2O_5	3%
Water Soluble K_2O	1%
Total Acid (Humic+Fulvic)	20%
EC (Max, dS/m)	8
Moisture (Max)	35%
pH	7.5-8.5

Liquid Organomineral Fertilizer	Contents
Organic Material	15%
Total N	2%
Total P_2O_5	1%
Water Soluble K_2O	2%
Water Soluble Zinc (Zn)	0.1%
Water Soluble Boron (B)	0.2%
Water Soluble Iron (Fe)	0.2%
EC (Max, dS/m)	30
Chlorine (Max)	2%
pH	5-7

CUSTOM TECHNOLOGY FOR CONCENTRATED LIQUID FERTILIZER PRODUCTION

➤ The process converts liquid fraction of AD into a concentrated and marketable liquid fertilizer form. No liquid fraction discharge to fields
➤ Part of the liquid fraction recycled
➤ Remaining liquid fraction
* de-odorized
* enriched with trace elements
*concentrated
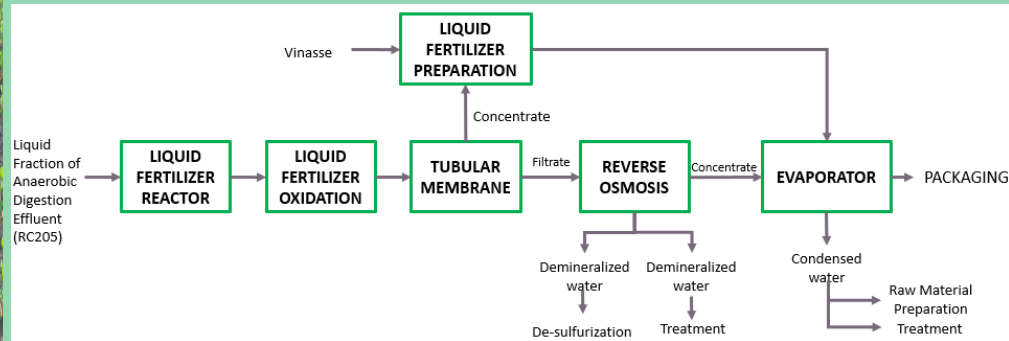
2 different quality of products
✓ Drip irrigation fertilizer (High humic acid content)
✓ Leaf fertilizer (High fulvic acid content)

MERAM Integrated Biogas & Organomineral Fertilizer Production Plant

Feedstock Capacity:
685 ton/day

Electrical Production Capacity:
6 MWe

Annual Energy Production:
42 M kWh

Solid Organic Fertilizer Production Capacity:
75.000 ton/year

Liquid Organic Fertilizer Production Capacity
15.000 ton/year

Feedstocks & Locations

Turkey

Konya

- **Meram Biogas & Organic Fertilizere Production Plant**

MERAM Integrated Biogas & Organomineral Fertilizer Production Plant

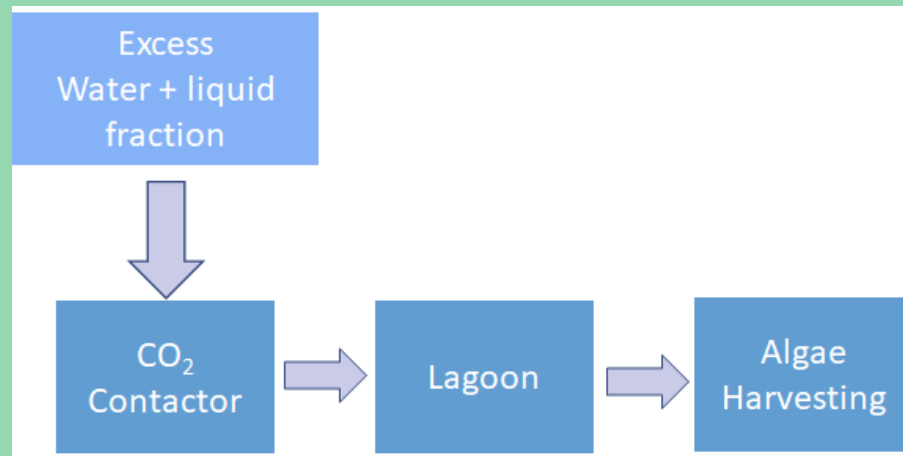# MERAM Integrated Biogas & Organomineral Fertilizer Production Plant

MICROALGAE PRODUCTION

- ✓ Mitigation of CO2 emissions
- ✓ Biological CO2 capture
- ✓ Zero liquid discharge


```
Excess
Water + liquid
fraction
      ↓
CO₂ Contactor → Lagoon → Algae Harvesting
```

TEKFEN goes a step further and made additional investments for microalgae production in Meram Plant.

19

OPPORTUNITIES

Circular economy and environmental sustainability
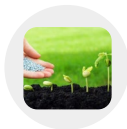
3rd generation feedstock usage for production

High efficiency and rate of return

Waste minimization & Economic benefit maximization

Reduction of Carbon footprint via biogas, algae, compost production
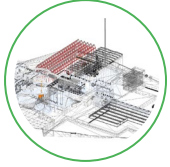
Fertilizer

Low OPEX & Maintenance cost

Ecofriendly – Green Energy

Smart Facility Applications

The Technology and Experience of TEKFEN Leading to Green Investments

TEKFEN ENGINEERING

Design and Engineering

TEKFEN CONSTRUCTION

Construction

TOROS

MERAM YENİLENEBİLİR ENERJİ

Start-up & Operation

✓ Design of facility based on special requirements, Survey, Contracts, Permits...

✓ Turnkey Construction, Quality Check, Functional Testing...

✓ Start-up support of facility until target performance level is achieved and Operation supervision by experienced operators...

Waste biorefinery technologies for accelerating sustainable energy processes

Thank you…

ilda.degirmentas@tekfen.com.tr