Waste to Energy

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WASTE to ENERGY: Upgrade BioGas To Methane For Engine <10 Mw

Established to develop biogas/biomass project in Indonesia using liquid/solid waste from agro industry (palm oil mill, tapioca starch, farm etc.)

Competence staffs with years of experience in biogas/biomass project, project development, financing& management, and power generation.

Reliable technological partners from local and overseas to optimize the plant performance

RESEARCH AND DEVELOPLMENT

METHANE CAPTURE

COMBINED HEAT & POWER

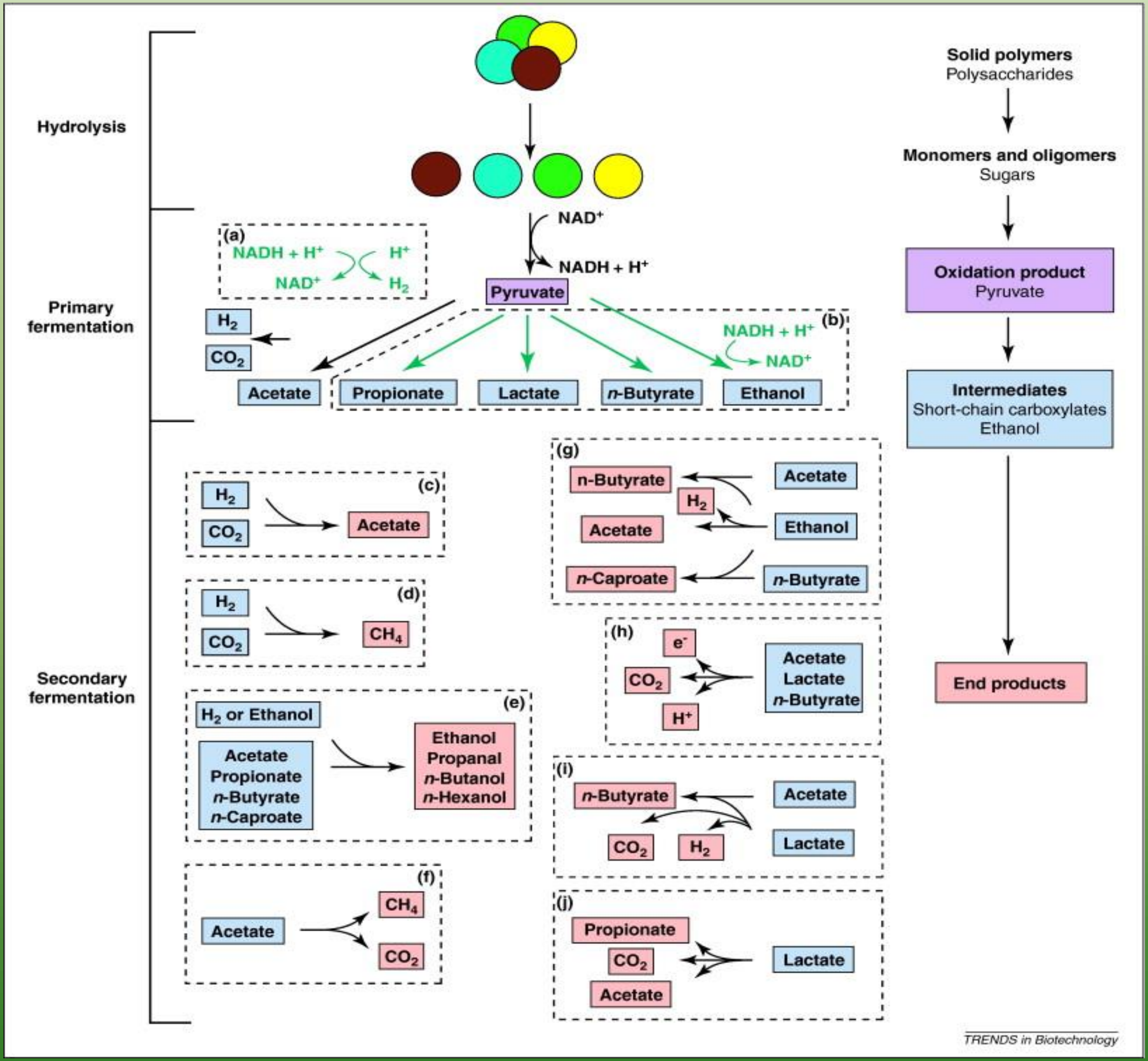
OPERATION ANDAINTENANCE

- **POME Biogas System;**
  - Bioflow Anaerobic Pond Capped
  - Process Control and Monitoring
  - Data recording
  - Biogas Distribution system
  - Biogas Treatment system
  - Biogas Utilization - Heat & Power

- **Palm Biomass System**
  - Fuel preparation system
  - Heat recovery system
  - EFB Pelletizing plant

- Agro industries produced significant amount of waste in liquid or solid form. This waste mainly consist of organic matter which can be converted into source of energy.
- A palm oil mill produces on average 0.6 m^3 wastewater per ton FFB processed with organic content ranging from 30,000 – 60,000 mg COD/l.
- Commonly treated in open lagoons as it is still considered as the most cost-effective system.

Fig.1 Typical Open Lagoon



Road Map: Potensi BioMasa untuk Energi Alternative

Palm Oil Mill Effluent (POME) Characteristics

Parameters	Value	
pH	4.2 ±0	mgCOD1
COD total	89,933 ± 32,621	mgCOD1
COD soluble	38,850 ± 11,950	mg/l
Suspended Solids	30,054 ± 10,742	mg/l
Volatile Suspended Solids	27,226 ± 9,156	mg/l
Carbohydrate total	29,384 ± 17,983	mg/l
Proteins total	25,340 ± 7,580	mg/l
Lipids total	19,427 ± 3,781	mg/l
Minerals	Ca: 860, Mg: 800, Fe:126, Zn:1.1, K: 2,470, Na: 130, B: 5.18, Mn: 9.22 mg/l	

Palm Oil Mill Effluent (POME)

Optimal growth temperature and optimal pH of some methane-producing bacteria

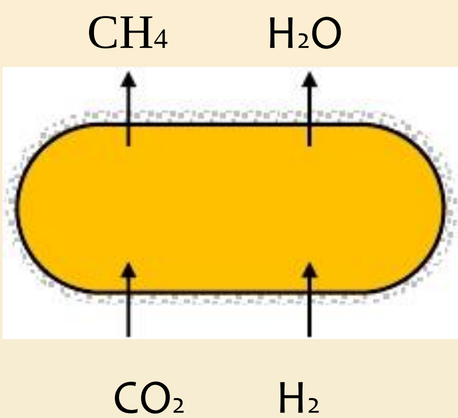
Genus	Temperature range °C	pH
Methanobacterium	37 – 45	
Methanobrivibacter	37 – 40	
Methanosphaera	35 – 40	6.8
Methanothermus	83 – 88	6.5
Methanococcus	35 – 40	
Methanocorpusculum	30 – 40	
Methanoculleus	35 – 40	
Methanogenium	20 – 40	7.0
Methanoplanus	30 – 40	
Methanospirillum	35 – 40	7.0 – 7.5
Methanococcoides	30 – 35	7.0 – 7.5
Methanohalobium	50 – 55	6.5 – 7.5
Methanolobus	35 – 40	6.5 – 6.8
Methanosarcina	30 – 40	
Methanothrix	35 – 50	7.1 – 7.8

Michael H. Gerardi: The Microbiology of Anaerobic Digesters, 2003

Specific biogas yields

Substance	Gas yield m^3/kg	CH_4 Content % by volume
Carbohydrates	0.830	50
Proteins	0.610	65
Lipids	1.430	71

Temperature



reduction of carbon dioxide

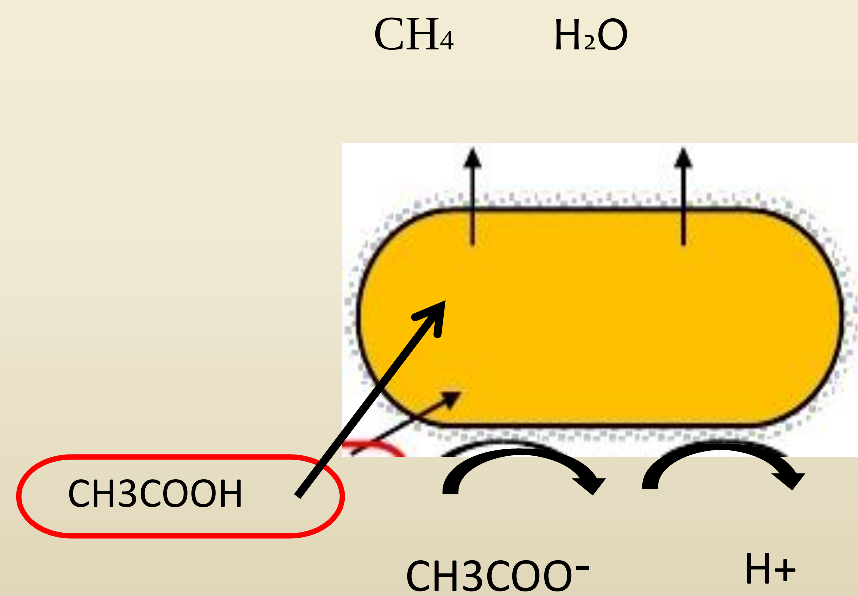
$CO_2 + 4 H_2 \longrightarrow CH_4 + 2 H_2O \; \Delta G_0 = - 135{,}6$ kJ

Feature	Mesophilic Digester	Thermophilic Digester
Loading rates	Lower	Higher
Destruction of pathogens	Lower	Higher
Sensitivity of toxicants	Lower	Higher
Operational costs	Lower	Higher
Temperature control	Less difficult	More difficult

Michael H. Gerardi: The Microbiology of Anaerobic Digesters, 2003

Temperature Range for Methane Production

Temperature [°C]	Methane Production
35	Optimum
32 - 34	Minimum
21 – 31	Little, digester going „sour"
< 21	Nil, digester is „sour"



decarboxylation of acetic acid

CH3COOHà CH4 + CO2 Δ G0 = - 31 kJ

Anaerobic Digester Systems

Digester Tank System

Relatively expensive to construct. (require high quality concrete foundation – in some cases piling is needed – to support the tank)
Suitable to construct any type of soil and the footprint of the biogas plant is relatively smallerCorrosion risks with steel tanks increased the concern about maintenance and safety risks.
Leaking gas because of rusted tanks has been reported at some CSTR sites.
Short POME retention time raised a risk of performance problem if management of the sensitive digester was not perfect. During peak season the production of POME could increase drastically which could reduce the retention time inside the tank.
Easily affected by temperature changes, required a good insulation to maintain the temperature inside the tank.
Little or no gas storage. This can be a disadvantage at a palm oil mill where there are seasonal fluctuations in POME production and electricity requirement throughout the day/week.

Pond Capped System

Relatively cheaper to construct
Not suitable to construct at pit soil area and required larger space area.
Very large capacity reactors with a POME retention time between 40 to 60 days compared to 7 – 20 days with digester tank. The large capacity would reduce the risk that the anaerobic process could be killed or impaired by sudden changes in waste composition, volume, temperature or pH, such as can occur within a smaller and more sensitive tank reactor.
Covered lagoon have more ability to maintain temperature inside the reactor which help promotes bacterial growth
Have a large volume of gas storage. The covered lagoon can easily store gas to later generate electricity during the off period or night times

Bioflow Anaerobic Pond Capped System

- Mill throughput and operational hours (past, present and future)
- POME characteristics and quantity
- Project direction – thermal application, power application or combine heat and power
- Site location and space availability
- Required power or heat and future extension
- Sludge and wastewater processing facility
- Current heat and power situation (fuel consumption etc)

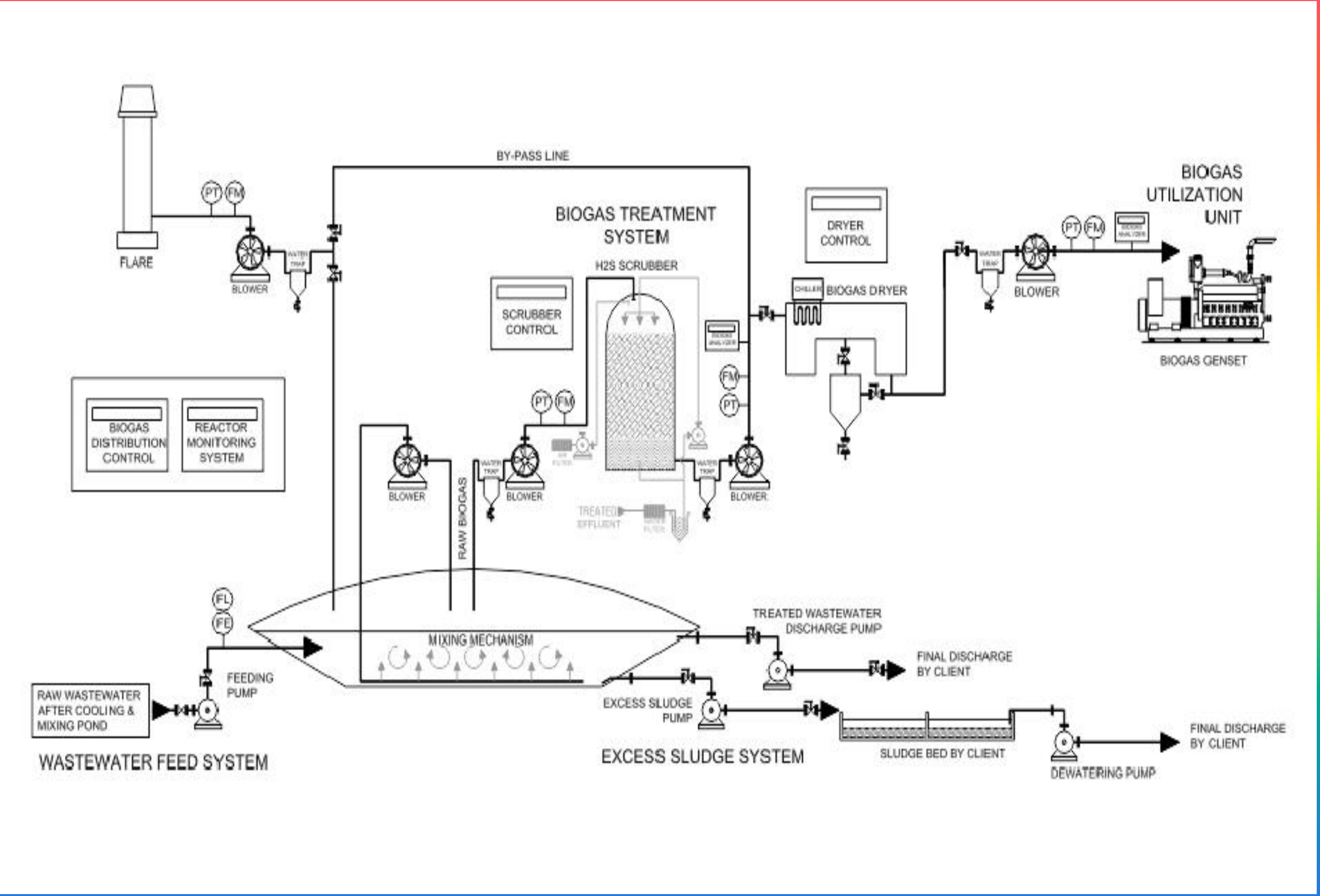
Bioflow Anaerobic Pond Capped System

Parameters	30 ton/h mill	45 ton/h mill	60 ton/h mill
Design biogas plant rate	20 m3/hour	30 m3/hour	40 m3/hour
COD/BOD reduction	90%	90%	90%
Est. biogas production	500 – 815 Nm3/hour	815 – 1,000 Nm3/hour	
Methane %	55 – 65 %	55 – 65 %	55 – 65 %
Equivalent energy	4,204 – 6,852 MJ/hour	6,852 – 8,400 MJ/hour	8,400 – 11,088 MJ/hour
Equivalent shell	0.8 – 1.3 ton/hour	1.3 – 1.6 ton/hour	1.3 – 1.6 ton/hour
Electricity potency	±1000 kWe	±1,500 kWe	±2,000 kWe

Bioflow Anaerobic Pond Capped System

- ❑ Anaerobic Pond Capped With HDPE Membrane
- ❑ Bioflow Mixing Mechanism
- ❑ POME Feed System
- ❑ Treated POME Discharge
- ❑ Biogas Feeding Stations
- ❑ Sludge Pumping System
- ❑ Plant Utility System
- ❑ Reactor Monitoring System
- ❑ Calibrated equipment, sensors, monitoring and recording system in
- ❑ compliance to CDM requirement
- ❑ Biogas Treatment System (H_2S biological scrubber & Biogas dehumidifier)
- ❑ Biogas Flare System
- ❑ Biogas Generator Set

Bioflow Anaerobic Pond Capped System



Anaerobic Pond Retrofitting

Bioflow Diffuser Mixing Mechanism

HDPE Skirting & Biogas Collection Pipe

HDPE Capping Process

HDPE Capping Process

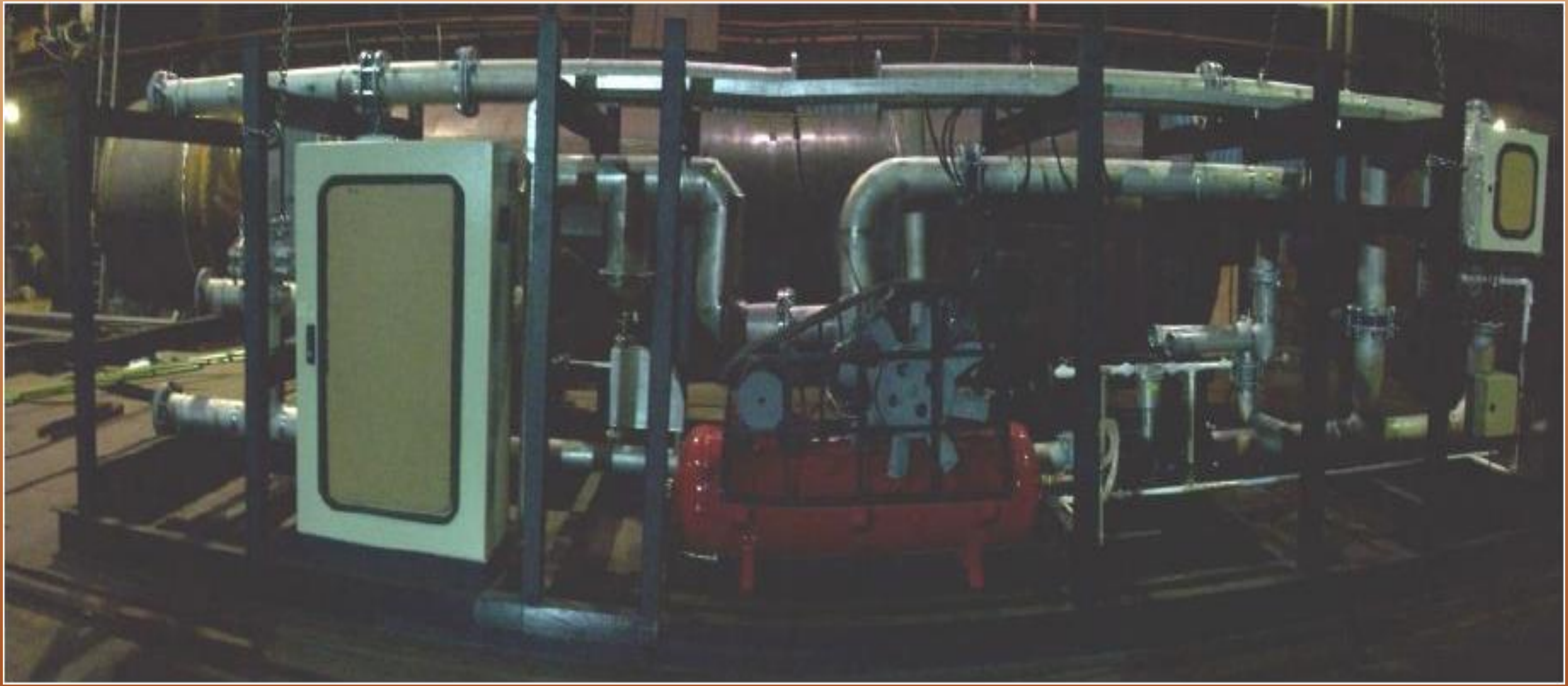
HDPE Cap Welding Process

Anaerobic pond started to generate biogas

Skid Mounted – Biogas Plant System

Skid Mounted – Biogas Scrubber Feeder System

Skid Mounted – Biogas Genset Feeder System



Skid Mounted – Pome & Utilities System

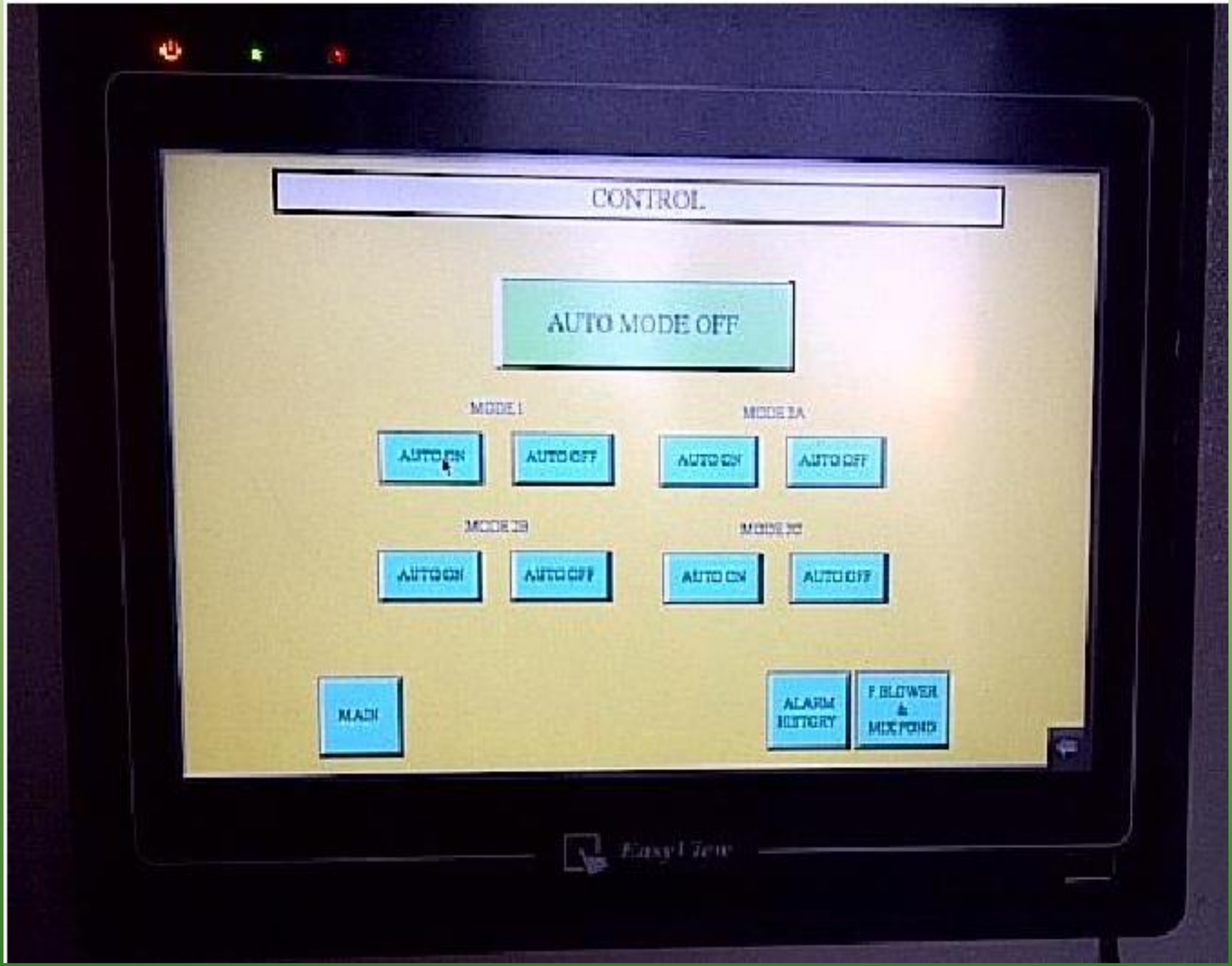
Skid Mounted – Treated POME Discharge

Biogas Flare

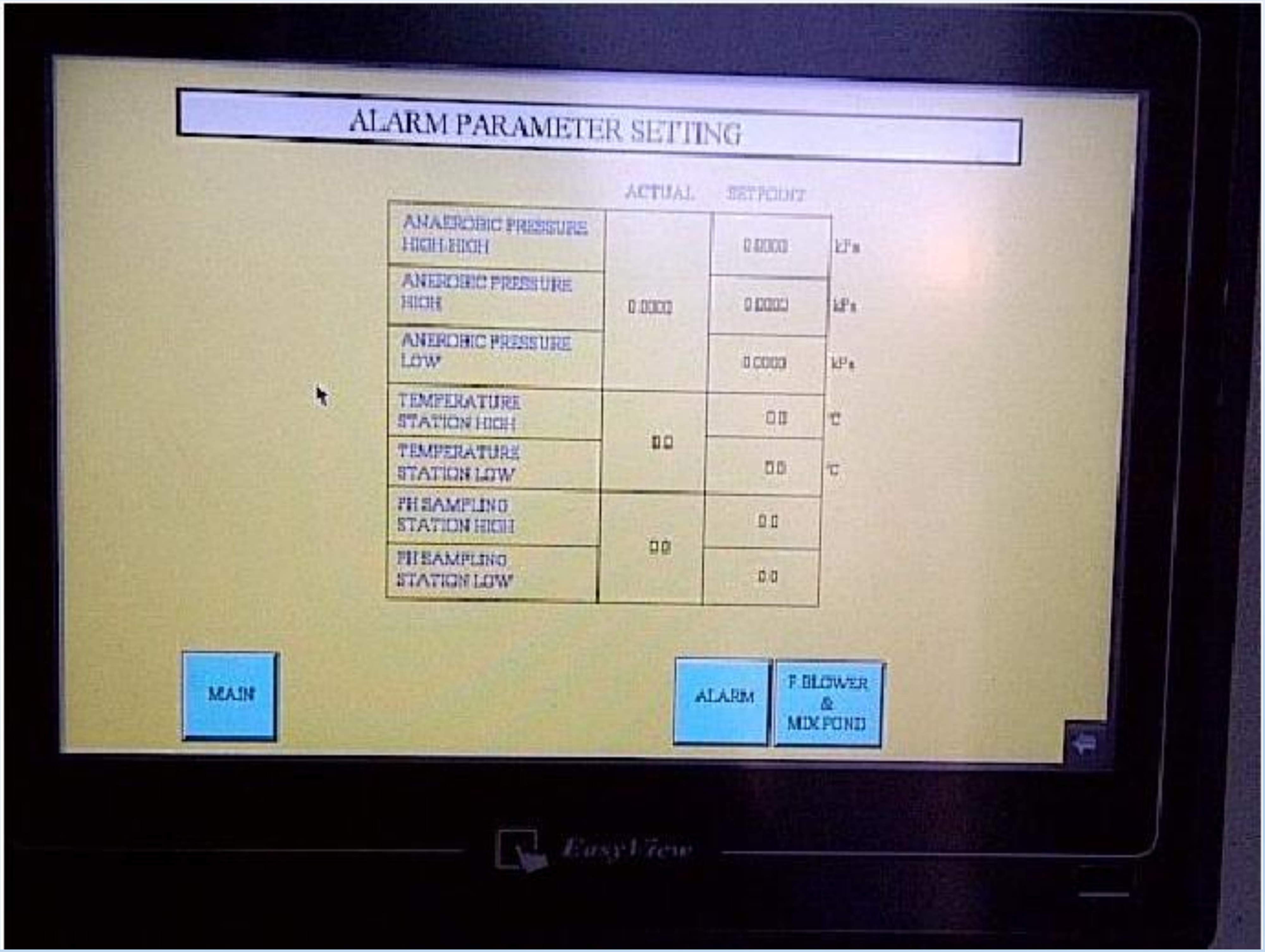
Biological H2S Scrubber System

Biogas Dehumidifier

Human Machine Interphase – Plant Automation



Human Machine Interphase – Plant Automation



Containerised - Biogas Generator Set

Containerised - Biogas Generator Set

Load Test Result

Bird Eye View of The Plant

TERIMA KASIH