A viable, robust and low cost CPU System to achieve ZLD in the Ethanol Industry

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In collaboration with
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Global leadership in biological wastewater & gas treatment

A FAMILY own business founded in 1960;
Significant shareholding owned by Ms. S. Klatten

a worldwide presence through a network of regional offices and partners

think global, act local
Paques India - Sri City Factory, close to Chennai, since October 2016

Paques India - factory was opened in 2016 to serve India and Asia Pacific

Side View

Main Entrance
“Paques Environmental Technology India (PETI) Pvt. Ltd., a wholly-owned subsidiary of the Netherlands-based industrial waste water management company Paques, opened its manufacturing base in Sri City. Marking the start of commercial production, Ambassador of the Netherlands in India A.H.M. Stoelinga, accompanied by Paques Holding CEO Stephan Bocken, founder and major shareholder of Paques Dr. Jos Paques, PETI managing director Sudeep Sangameswaran, and Sri City founder and managing director Ravindra Sannareddy, inaugurated the plant here on Tuesday.

Mr. Stoelinga said: “In recent years, the value of mutual trade has risen enormously and there are nearly 115 Dutch companies that have their presence in India. Besides, Netherlands too attracts most of the out-bound foreign direct investments from India.”

The plant, with a 2,500 sq metres area, was commissioned with an initial investment of Rs.30 crore, across a plot of two acres. It will manufacture core components for reactors that treat waste water and gas, and will supply its products to customers across South East Asia, Japan, Vietnam, besides India and the SAARC countries.

The plant will manufacture core components for reactors that treat waste water and gas.”
World-class Production Facility
Paques’ uses natural biotechnology to treat waste

- 1000+ References in anaerobic digestion
- 50+ References in ammonium removal
- 250+ References in gas desulfurization
- New Bioplastic production
Evolution of technology

- **18th century**: Steam Vehicle
- **19th century**: Combustion Vehicle
- **20th century**: Gasoline/Diesel Vehicle
- **21st century**: Electrical Vehicle

Advanced, High-Rate, Anaerobic Reactors Powered by GRANULAR BIOTECHNOLOGY are today the Gold Standard in Wastewater Treatment. PAQUES has been the world leader in evolving faster, better and more efficient ANAEROBIC REACTORS for treating various Industrial Effluents—from the first BIOPAQ®UASB Reactors to the latest generation of BIOPAQ®ICX.

Today’s PAQUES BIOPAQ®ICX technology offers multifold improvements like:
- High Efficiency Wastewater to Energy Conversion
- Enhanced Volumetric Loading Rates
- Smallest Footprint
- Lowest Energy Consumption
- Maximum Reuse Potential
- Lowest Maintenance Due To Low Fouling & Calcification
Paques has repeatedly introduced technological innovations and converted them into high quality industrial applications.

we have invented practically everything that we sell
Paques expertise with ethanol effluents
Paques has 100 anaerobic references and more than 30 years experience in the Ethanol Industry.
9 BIOPAQ® reactors were sold to the Ethanol & Sugar Industry in 2018 alone.

- **DCM SHRIRAM**: 1 ethanol (CPU) 3 sugar references
- **Radico** 1 ethanol (CPU)
- **RED RIVER BIOREFINERY**: Grand Forks, North Dakota, USA 1 ethanol reference
- **La Martiniquaise**: 2 ethanol references (vinasse)
- **Dwarikesh Sugar Industries Limited**: 1 ethanol (CPU)
Paques’ first ethanol experiences were with UASB’s treating cane vinasse in Brazil
Paques’ first condensate references (CPU) in the Ethanol Industry

1992
BIOPAQ®UASB, Netherlands

1996
BIOPAQ®IC, Japan
The experience of Paques in the Ethanol Industry ranges from small liquor distilleries to the big bio-refineries.

Beverage alcohol from fruits
Production: 0.2~0.3 mln l/year
COD load: 2.5 ton/day

1993

Cellulosic fuel ethanol
Production: ~80 mln l/year
COD load: 250 ton/day

2012
Paques has experience with different vinasse from sugar cane.
Paques has experience with treatment of Tequila vinasse from agave
Paques has experience with stillage/condensates from grain distilleries.
Paques has experience with stillage from cassava

2013
207 ton/day SCOD

2007
146 ton/day SCOD
Paques has experience with stillage/ condensate from second generation ethanol
Paques installed a BIOPAQ® reactor at the first plant where ethanol is made from syngas from steel production.

3rd generation ethanol

Start up in 2018
Paques has many returning customers in the Ethanol Industry and has customer statements.

“Paques helped us in getting a customised solution to treat our distillery effluent. The Faques’ technology provides a stable operation and quick results, enabling us to reuse the water in our process at ease. The BIOPAQ® MC installation is one of the main developments to reduce the environmental impact and operational costs at the site.”

5 BIOPAQ® anaerobic reactors at 5 different production sites

Anoop Singh
3 Condensate treatment (CPU)
Recent condensate (CPU) references in operation

- **2014, China**
  - 600 m³/hour

- **2015, Finland**
  - 30 m³/hour

- **2017, Turkey**
  - 21 m³/hour

- **2017, India**
  - 89 m³/h
Typical composition evaporator condensate at molasses and grain distilleries

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Unit</th>
<th>Typical</th>
</tr>
</thead>
<tbody>
<tr>
<td>Avg TCOD</td>
<td>(g/l)</td>
<td>3 ~ 4</td>
</tr>
<tr>
<td>Avg SCOD</td>
<td>(g/l)</td>
<td>3 ~ 4</td>
</tr>
<tr>
<td>BOD / COD</td>
<td>(-)</td>
<td>0.5 ~ 0.7</td>
</tr>
<tr>
<td>TSS</td>
<td>(mg/l)</td>
<td>&lt; 10</td>
</tr>
<tr>
<td>Ca</td>
<td>(mg/l)</td>
<td>low</td>
</tr>
<tr>
<td>N, P, S</td>
<td>(mg/l)</td>
<td>low</td>
</tr>
<tr>
<td>pH</td>
<td>(-)</td>
<td>3.5 ~ 5.5</td>
</tr>
<tr>
<td>FOG</td>
<td>(mg/l)</td>
<td>absent</td>
</tr>
<tr>
<td>Temperature</td>
<td>(°C)</td>
<td>&gt; 40</td>
</tr>
</tbody>
</table>

There are also plants with an average COD of ~1.5 g/l or ~8 g/l
The **ICX technology is the most recent generation in the BIOPAQ® family**

BIOPAQ®ICX combines the best of all its predecessors!

- Excellent properties of the BIOPAQ®IC
- The modular flexibility of the BIOPAQ®UASB$_{\text{plus}}$
The anaerobic BIOPAQ® reactor is the beating heart of the condensate treatment (CPU)

Dosings:
- Nutrients (macro/micro)
- Caustic
- lime

Condensate: Spent Lees CIP

Pre-treatment: Buffering Cooling Screen/Sieve

BIOPAQ® IC/ICX Reactor

Activated Sludge

Aerobic treatment

Filtration UV Treatment Membrane Filtration

Tertiary treatment

Reuse Options:
- Cooling Water
- Process (Mashing/Fermentation)
- Boiler Water
- Make-up Water

Reuse/Discharge

Boiler/engine/flare

A similar flow scheme can be applied for Sugar Effluents (MillH, Sulphitation, Spray Pond, Blow-downs)
Using a BIOPAQ® HR Reactor (IC/ICX) for condensate treatment comes with benefits

A BIOPAQ® IC/ICX Reactor requires little maintenance, is easy to operate, can handle load fluctuations and starts up very fast (1~2 weeks)

A BIOPAQ® IC/ICX Reactor is characterized by excellent mixing properties which allows operation at a relative low pH

ALL Paques Biopaq® Internals are made from corrosion free materials and last for a long time

BIOPAQ® IC/ICX Reactors have a high biomass concentration and excellent biomass retention (2-stage separation)

Little Operator Attention
Low Caustic Requirement Minimum OPEX
Low Maintenance Costs
Small Reactor Small Footprint

revitalising resources
BIOPAQ® Ethanol references can well handle load fluctuations

Distillery Hungary (IC)

Distillery Slovakia (IC)

Distillery China (IC)

Distillery Switzerland (UASB)
The high biomass concentration (granules) in a BIOPAQ® Reactor creates a biological buffer, which can deal with sudden peaks/ fluctuations in COD loading.

These graphs of 2 BIOPAQ® CPU references demonstrate that high peaks in organic loading rate do not affect the COD conversion.
Condensate Case Study DSCL

Country, year: India, 2018
Feedstock: Sugar Cane Molasses
Production: 160 KLPD Alcohol
Streams treated: Condensates, Spent Lees
BIOPAQ® IC Reactor: 387 m³

Abbreviations
MEE: Multiple effect evaporation
Caustic (NaOH)
Lime (Ca(OH)₂)

Micro Nutrients
(BIOPAQ Micromix)

Nutrients (N&P)
(Urea + (NH₄)₂HPO₄)

Condensate
Spent Lees

Buffer Tank
355 m³

Gas Buffer
m³

Gas Buffer
m³

BIOPAQ®
IC
Ø5.0 x 20
392 m³

Effluent IC

UF/RO

Filtration Steps

Secondary Clarifier

Aerobic Reactor
2100 m³

Secondary Clarifier

Air

Flocculant
(PAM)

Decanter

Sludge
Tank

To Fermentation
(Future: Boiler)

To Cooling Tower

Dewatered Sludge to Disposal

UV

Filtration Steps

Secondary Clarifier

Aerobic Reactor
2100 m³

Sludge
Tank

Decanter

revitalising resources
On-site Start-up Team from Paques India and good cooperation with customer ensures smooth start up

Aerobic Treatment

Clarification & Filtration

UV Treatment

Membrane Filtration

BIOPAQ® IC Reactor

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Optimal & Stable performance in ~2 weeks!!

### Average TCOD

<table>
<thead>
<tr>
<th></th>
<th>INFLUENT</th>
<th>BIOPAQ® IC</th>
<th>Aerobic Outlet</th>
<th>RO Permeate</th>
</tr>
</thead>
<tbody>
<tr>
<td>February</td>
<td>2242</td>
<td>558</td>
<td>236</td>
<td>5</td>
</tr>
<tr>
<td>March</td>
<td>2141</td>
<td>147</td>
<td>42</td>
<td>0</td>
</tr>
<tr>
<td>April</td>
<td>1589</td>
<td>143</td>
<td>47</td>
<td>2</td>
</tr>
<tr>
<td>May</td>
<td>1741</td>
<td>149</td>
<td>50</td>
<td>0</td>
</tr>
</tbody>
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### Cumulated TCOD removal Efficiency

<table>
<thead>
<tr>
<th></th>
<th>BIOPAQ® IC</th>
<th>Aerobic Outlet</th>
<th>RO Permeate</th>
</tr>
</thead>
<tbody>
<tr>
<td>February</td>
<td>81%</td>
<td>90%</td>
<td>100%</td>
</tr>
<tr>
<td>March</td>
<td>93%</td>
<td>98%</td>
<td>100%</td>
</tr>
<tr>
<td>April</td>
<td>91%</td>
<td>97%</td>
<td>100%</td>
</tr>
<tr>
<td>May</td>
<td>91%</td>
<td>97%</td>
<td>100%</td>
</tr>
</tbody>
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**Condensate flow rate**

![Condensate flow rate graph](image)

**COD removal BIOPAQ® IC reactor**

![COD removal graph](image)
More than one year after start up, the final effluent quality has consistently met required demands.
Since start up, high quality granules are maintained with a very high methanogenic activity (no reseeding)

Due to excellent reactor design, superb biomass retention and optimized operation, healthy and robust granules are cultivated in BIOPAQ® reactors.

Specific methanogenic activity test
(Methane pressure vs time)

SMA is 0.8
(kg COD/kg VSS/day)
Benefits of the CPU for our customer

- **TREATMENT OF CONDENSATE STREAM**
- **CONTINUOUS AVAILABILITY WATER SOURCE**
- **ZERO LIQUID DISCHARGE (ZLD) AND ZERO SPENT WASH DISCHARGE (ZSD)**
- **REDUCE POWER AND CHEMICAL CONSUMPTIONS**
- **STRINGENT PCB/NGT NORMS**
- **VOLATILE COD REMOVAL**
On September 12th, 2018, Paques received a signed performance certificate from DSCL – this is one of our proudest moments in India when we feel we contributed to a huge technology shift in the Ethanol market – from conventional LR Reactors to HR Reactors.
Proud to Announce at AIDA 2019 ...

Paques Bagged two more Ethanol CPU Orders in on-going week - proud to announce it on the AIDA Platform – nearly 10 installations in past 12 months!!

Almel Village, Sindagi Taluk, Bijapur (DT), Karnataka.

Sir Shadi Lal Distillery, - A unit of SVP industries (Mansoorpur) Muzaffarnagar UP
RADICO Distillery Ongoing Installation

Ongoing Fast Track Project

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DSCL Sugar - Installations

DSCL Hariawan
DSCL Sugar Installations

DSCL Ajbapur

DSCL Loni

Fast Track Project
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QUESTIONS?

www.paques.nl

THANK YOU