PROJECT FOR THE ELECTRICAL COGENERATION IN A DISTILLARY INDUSTRY: CAPEL CASE

Viña de Mar, November 2004

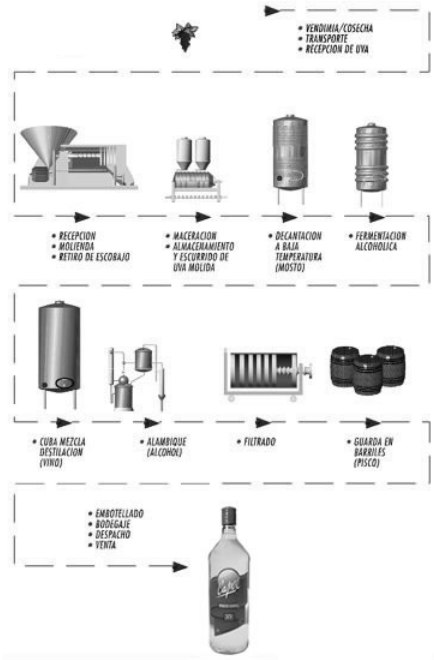
Presentation's Content

- **Chilean Pisco industry.**
- **Laboratory experiments.**
  - **Wastewater anaerobic treatability**
  - **Irrigation experiments**
- **Full scale UASB implementation.**
- **La Chimba cogeneration Project**

Chilean Pisco

Popular alcoholic drink prepared by distillation of wine which is produced out of especial aromatic grapes (mainly Muscatel).

Chilean Pisco



Its production involves several operations:

- ⇒ **Maceration**
- ⇒ **Filtration**
- ⇒ **Flotation**
- ⇒ **Fermentation**
- ⇒ **Distillation**

Chilean Pisco

Wastewater generation

- **Washing operations (the most important in a volume basis).**
- **Punctual discharges.**
- **High content of organic matter (5-35 gCOD/L).**
- **High content of suspended solids.**
- **Generation of high concentration vinasses (40 gCOD/L).**

ANAEROBIC WASTEWATER TREATMENTS

Biogas production / kg CODr

↓

300 L of methane
≈ 400-500 L of biogás

↓

2600 kcal
3 kWh

ANAEROBIC WASTEWATER TREATMENTS

Vinasse: 38 gCOD/L

17 m^3 biogas /m^3 vinasse
100 kWh / m^3 vinasse

25 kgDQO / ton grape

11250 m^3 biogas / ton grape
70 kWh / ton grape

ANAEROBIC WASTEWATER TREATMENTS

Vinasse: 38 gCOD/L

14 kg charcoal / m^3 vinasse, or
21 kg wood / m^3 vinasse, or
9.7 L oil / m^3 vinasse

25 kgCOD / ton grape

9.5 kg charcoal / ton grape, or
14 kg wood / ton grape, or
6.4 L oil / ton grape

Laboratory Experiments

Anaerobic reactors operation

- **Two types of reactors were used: UASB and EGSB**
- **EGSB and UASB reactors were operated at superficial liquid velocities of 7 and 0.8 m/h respectively.**
- **The reactors were fed by wine vinasses.**

Laboratory Experiments

Anaerobic reactors operation

Laboratory reactors dimensions.

	UASB	EGSB
Volume (L)	4.5	4.7
Diameter (cm)	10	6
Height (cm)	60	160
Height/diameter relation	6	27

Laboratory Experiments

Anaerobic reactors operation

Vinasses characterization.

Parameter	*Units*	*Value*
Total COD	mg/L	37800
Soluble COD	mg/L	34400
BOD	mg/L	13500
Total solids	mg/L	25226
Volatile solids	mg/L	20588
Total suspended solids	mg/L	1526
Volatile suspended solids	mg/L	1495
Acidity	mg $CaCO_3$/L	1719
pH		3.0

Laboratory Experiments

Anaerobic reactors operation

	UASB	EGSB
Organic loading rate (gCOD/Ld)	20	20
COD removal rate (%)	93	89
Hydraulic retention time (d)	1.8	1.8
pH	6.7-7.0	6.7-7.0
Biogas production (ml/g removed COD)	490	490
Methane concentration in biogas (%)	65	65

Laboratory Experiments

Anaerobic reactors operation

- **EGSB operation was unstable due to growth of excessive acidogenic microorganisms.**
- **Granules from UASB reactor showed better physical properties, offering a much stable operation.**
- **UASB technology was selected over EGSB reactor (less investment and operational costs).**

Laboratory Experiments

Agricultural utilization of treated water

- **Irrigation experiments were performed using lemon nursery plants**
- **Different levels of irrigation and fertilization were used.**
- **Height and diameter of stem were followed during a period of 4 months.**
- **Supplementary experiments were carried out using different levels of dilution of treated wastewater in order to evaluate the effect of its salt content.**

Laboratory Experiments

Agricultural utilization of treated water

Laboratory Experiments

Characterization of the anaerobic granular sludge

Parameter	Units	Results
Nitrogen	%	5.29
Phosphorus	%	1.45
Potassium	%	0.32
Calcium	%	4.5
Magnesium	%	0.42
Zinc	ppm	293.8
Manganese	ppm	182.5
Iron	ppm	13031
Copper	ppm	365
Boron	ppm	8.16

Full Scale Application

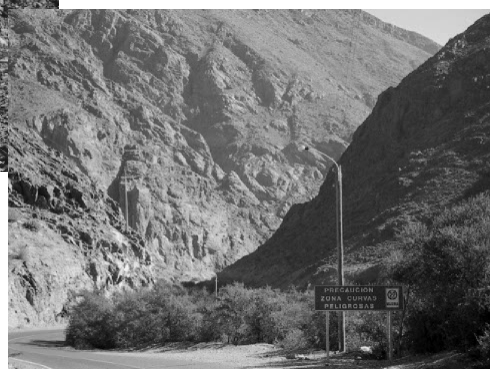
UASB Reactor

- **A 60 m^3 UASB was built in Alto El Carmen (the smallest production plant).**
- **The start up was performed between January and March 2001.**
- **Treated water is being used to irrigate an eucalyptus and corn plantation.**

Full Scale Application

UASB Reactor

Alto del Carmen, Chile

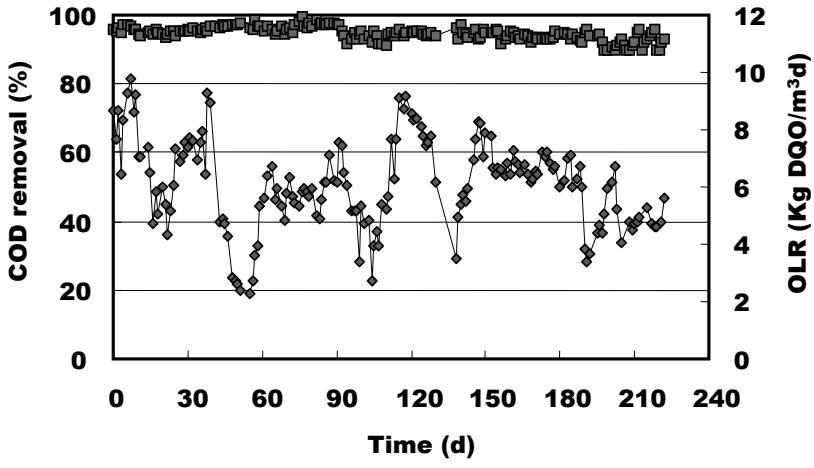


Full Scale Application

UASB Reactor

Full Scale Application

UASB Reactor



(♦) Organic loading rate, (■) COD removal.

Full Scale Application

UASB Reactor

Eucalyptus plantation

Full Scale Application

UASB Reactor

- **During the first weeks a high amount of sodium hydroxide was use for pH control (close to 2 g/L).**
- **During this period some problems were detected on tree leaves, due to high content of sodium of treated water**
- **At organic loading rates over 6 kgCOD/m^{3}d, the use of NaOH was considerably reduced (biogas production provides an important level of alkalinity)**

Full Scale Application

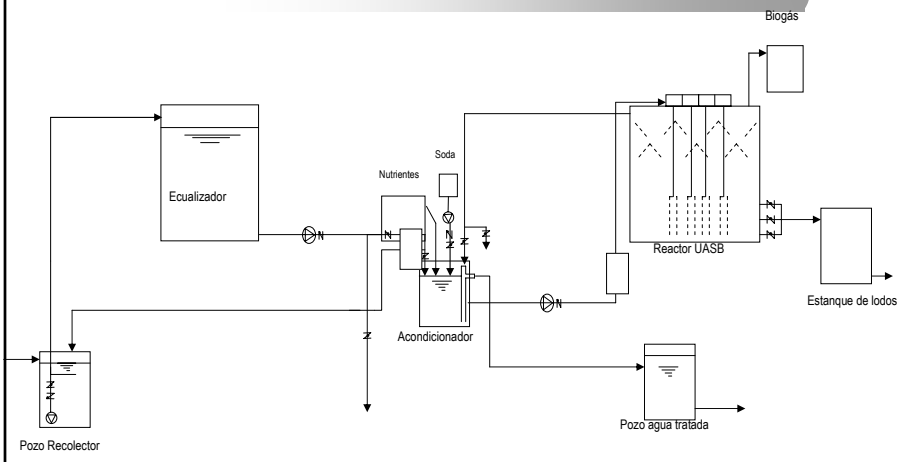
LA CHIMBA PROJECT

- **A 330 m^3 UASB was built in La Chimba (Ovalle) with the Alto El Carmen developed technology.**

- **The start up was performed since October 2004.**

- **Generated Biogas will be used as energy source for the industry.**

UASB Reactor



			Consumo combustible		Energía requerida	Biogas requerido	Biogas disponible m^3/d	
	Combustible	Unidad	mes*	día	Kcal/d	m^3/d	Vendimia	Post vendimia
Vicuña	petróleo	L	46.597	1.553	14.289.599	2.485	820	509
Valle del Limarí	petróleo	L	95.208	3.174	29.197.158	5.078	631	2.669
La Chimba	carbón bituminoso	Kg	206.375	6.879	43.338.750	7.537	3.000	767
Punitaqui	petróleo	L	107.916	3.597	33.094.125	5.756	662	2.669
						20.856	11.708	56%

* considerando 8 meses para plantas Capel Vicuña, Valle del Limarí y Punitaqui y 12 meses para La Chimba

** considerando proceso continuo, es decir, requerimientos de vapor 30 días/mes

** considerando proceso continuo, es decir, requerimientos de vapor 24 horas/día

UASB Reactor

- **Biogas for steam utilization**
- **Biogas for energy cogeneration**

UASB Reactor

Planta La Chimba

Conclusions

- **Anaerobic digestion is a suitable technology for treatment of wastewater generated during Chilean Pisco production.**
- **This industry offers an opportunity to exploit all advantages of anaerobic digestion by wastewater treatment.**

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