USE OF METHANE IN WASTEWATER TREATMENT PLANTS

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AQUALOGY it’s the solutions brand of AGBAR related with the world of water.

AQUALOGY offers solutions and technology in 4 areas:

- **ENVIRONMENT.** Solutions for companies of water and environment area.
- **INFRASTRUCTURES.** Projects of construction and hydraulic engineering.
- **SOLUTIONS.** Services and solutions oriented to improve water companies.
- **KNOWLEDGE.** Services based on knowledge and people management.
International data:
Municipalities served: 545
Equivalent pollution load (inhabitants): 21,009,950
Treatment plants in service and assistances: 579
Volume treated treatment plants (m$^3$/year): 1,196,716,489
Technologies

Agbar Group manages over 500 treatment plants, in Spain and internationally, from small sizes (less than 2,000 inhab.) to more important sizes (Santiago de Chile, La Farfana WWTP: 8.8 m$^3$/s).

Practically all the water treatment in Spain is **biological**.

The following stand out in **sludge technologies**:

- **Biological stabilization through anaerobic sludge digestion** (32 treatment plants).

- **Thermal drying of sludge** (solar or high/low temperature)

- **Composting of sludge.**
1- Operation of big plants in Santiago de Chile
2- WWTP La Farfana
   - Treatment of biogas for use in city gas
   - GHG reduction – Carbon credits
   - Biogas methanisation
   - Carbon footprint calculation
3 – WWTP Trebal-Mapocho
   - Use of biogas in cogeneration
EDAS operates La Farfana since 2007, after an international tender. 
5 year contract (2012) renewable for 5 years (2017)

EDAM operates Trebal-Mapocho since april 2010, after an international tender. 
7 year contract (2017) renewable for 5 years (2022)
1 - Operation of big plants in Santiago de Chile
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Construction: 2003, Ondeo Degrémont
Exploitation: Degrémont (2004-2007) and EDAS (2007- present)
Start up of biogas treatment plant: 2008
Design flow: $8,8 \text{ m}^3/\text{s}$ (average), $15,0 \text{ m}^3/\text{s}$ (maximum)
Treatment of 57% of Santiago wastewater: 3.294.000 people
Investment : 315 millions US$
La Farfana biogas production

38 MMm³/year (300 ppm H₂S)

12.5%

Treatment of biogas (<25 ppm H₂S)

87.5%

Metrogas

Biogas is used in boilers to heat digesters

Biogas available for its valorisation in city gas network

City gas supply to homes

Unused biogas is burned in torch
BIOGAS TREATMENT FOR CITY GAS USE
LA FARFANA

Project benchmarks

1) Contract signature with Metrogas
   2) Start of the engineering project
   3) Conclusion of the engineering project
   4) Start of the plant building
   5) Start of operation
Wash tower: scrubber + biological reactor

Cooling + Compressing

95% H₂S from biogas removal

Exceeding water elimination by condensation

Biogas compression to inject it in gas pipeline

Metrogas

Maximum flow: 4.175 m³/h
Dew point: 4°C
Delivery pressures: 0.6 - 1.0 bar
Biogas production: 38 MMm³

Biogas destination:
- 12.5% self-consumption in boiler
- 87.5% to supply or torch burning

Biogas availability: 33.3 MMm³

Supplied to Metrogas: 14.1 MMm³

Burned in torch: 19.4 MMm³

Composition: CH₄ = 63% / CO₂ = 36% / Others
Carbon footprint calculation of installations using self-developed tool CAFCA. This tool keeps in touch with all processes emissions.

WWTP La Farfana carbon footprint 2010: 87,590 t CO₂, 0,325 kg CO₂/m³

Production (potable water plant)
Transport and distribution
Sewerage
Offices

Depuration (WWTP)

- Emissions from energy consume
- Emissions from transport
- Emissions from reactive consumption
- Emissions from water and sludge treatment processes

Action plan for annual emissions reduction
Fossil fuel substitution in city gas production

- Annual reduction of $\text{CO}_2\text{e} = 19.873\ \text{tCO}_2\text{e}$
- It's estimated to obtain 7 carbon credits per year. We are in verification-certification stage.
- CDM methodology was developed (Approved by United Nations in August 2008 – AM0069)

- Burning efficiency in torch: is 99%
- There are no methane emissions remaining, because almost every methane is burned (DICTUC)
BIOGAS TREATMENT FOR CITY GAS USE
LA FARFANA

RESIDENTIAL CUSTOMERS

Wastewater (organic waste)

CITY GAS FACTORY

City gas supply for 35,000 homes

City gas

WWTP LA FARFANA

Biogas production
38 MMm³/year

Treated biogas (<25 ppm H₂S)

“Energetic input for Santiago, La Farfana becomes environmental asset...”
After H\textsubscript{2}S elimination, biogas is compressed to 14 bar, to make CO\textsubscript{2} removal through Air Liquide membranes, rising CH\textsubscript{4} concentration from 63\% to 96\%, making biogas compatible with natural gas defined in NCH 2264.
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   Use of biogas in cogeneration
Operation start: 2001 (Trebal) y 2012 (Mapocho).

Exploitation: Aguas Andinas (2001-2010) y EDAM (2010- present)

Design flow: (4,4 + 2,2) 6,6 m³/s (average)

Treatment of 43% of wastewater from Santiago

Investment: 200 MMUS$ in Trebal and 140 MMUS$ in Mapocho
WWTP MAPOCHO-TREBAL

Pretreatment

Biologic tanks

Secondary settlers

Digestion

Chlorinators

Digested sludge tanks

Primary settlers

Primary sludge thickening

Digestion

Primary sludge thickening
• In WWTP Mapocho – Trebal, biogas is conditioned through H$_2$S removal, cooling, condensed water elimination and volatile organic compounds and siloxanes removal through activated carbon filters.

• Generated energy is transformed from 690V to 23,000V to be distributed in the electrical main grid in the plant, with the possibility to export to the general electrical grid. (Central interconnected system o SIC).

• Combustion gases are used to produce steam for the biologic sludge thermal hydrolysis, previous to digestion.

• Digesters temperature maintenance using motors heat. Refrigeration through liquid-liquid exchangers.
Biogas Use in Electric Cogeneration

Mapocho - Trebal

**Biogas**

- Biogas consumption = \( 1.075 \text{ Nm}^3/\text{h} \times \text{motor} \)
- Outlet energy = \( 2.742 \text{ kW} \times \text{motor} \)
- Self consume

**Cogeneration (3 motors)**

- 3 steam boilers
- Gas outlet = \( 2.439 \text{ kW} \times \text{motor} \)
- Steam = \( 11 \text{ BarG} \)

**Anaerobic digestion**

- Biochemical and chemical washing. H2S maximum outlet: 50 ppm
- Energy recovering to heat digesters

**Active carbon filters**

- Gas outlet

**Gas holders**

- Torches

**Boilers**

- Hot water = \( 1.268 \text{ kW} \times \text{motor} \)
- Hot water from boilers

**Self consume**
Batch Thermal Hydrolysis Plant (THP) for biological sludge. 10,000,000 €

Provider: CAMBI

2 parallel lines with 3 reactors of 7 m³ each

Maximum production: 25.75 m³/h a 110-120 gr/l

Extendable to 34.3 m³/h

Processes consequences:

• **Dryness increase** dried sludge to 30 % and sludge decrease.

• **Increase of production and improvement in quality.**

• **Pathogens removal**
References:

- Biogas volume produced: 68.064 Nm$^3$/d
- Consumed biogas volume: 68.064 Nm$^3$/d
- Motogenerator: JENBACHER, JMS 620 GS-B.L. (3)
- Electrical Power: ($2.742 \times 3$) 8.226 Kw
- Thermal Power: 3.806 Kw
- Generated energy: 40.000 Mwh/year
- Consumed energy: 64.000 Mwh/year
Thanks for your attention

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