



CETAQUA
CENTRO TECNOLÓGICO DEL AGUA

**EPC-EqTech- An innovative turnkey solution to
process spent caustic in the Oil&Gas industry**

Clàudia Pastor

PROJECT : EPC-EqTech

TITLE: EPC-EqTech – an innovative turnkey solution to process spent caustic created in the Oil&Gas industry at low-cost and that meets wastewater regulations

PROJECT LOCATION: Kirikkale (Turkey)

FINANCING: H2020 – FTI- 2018 (79 % subsidized)

BUDGET: 3,296,650 € (2,604,317.5 € subsidized)

DURATION: 2 years (July 2021 – June 2023)



COORDINATING BENEFICIARY

CETAQUA
WATER TECHNOLOGY CENTRE

ASSOCIATED BENEFICIARY(IES)

 **AQUATEC**  **Tüpraş**
INFORMATION:

 **DEKRA**



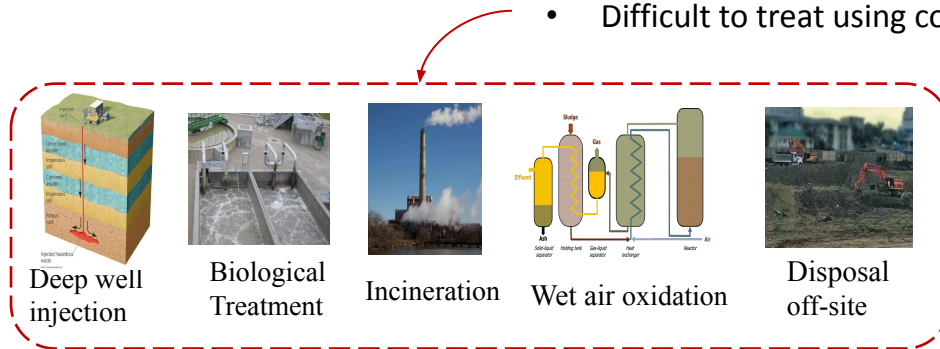
In the petrochemical industry, alkaline washing processes for oil product desulphurisation purposes result in spent alkaline solutions, known as **spent caustic**.

Characteristics

- High chemical oxygen demand (COD) → range of 20 g/L–300 g/L
- High hydrogen sulphide concentration → 3-5 g/L
- pH >11
- Hazardous odours
- Corrosive components
- Toxic volatile organic compounds

Challenges

- High environmental impact
- High processing cost
- Few approved local spent caustic disposal facilities
- Difficult to treat using conventional processes



- i) Difficult operation
- ii) Significantly cost prohibitive
- iii) Damaging to the environment
- iv) Inability to treat extremely hazardous materials



RESEARCH. COLLABORATION.
THINKING FORWARD

EPC-EqTech
CETAQUA WATER TECHNOLOGY CENTRE

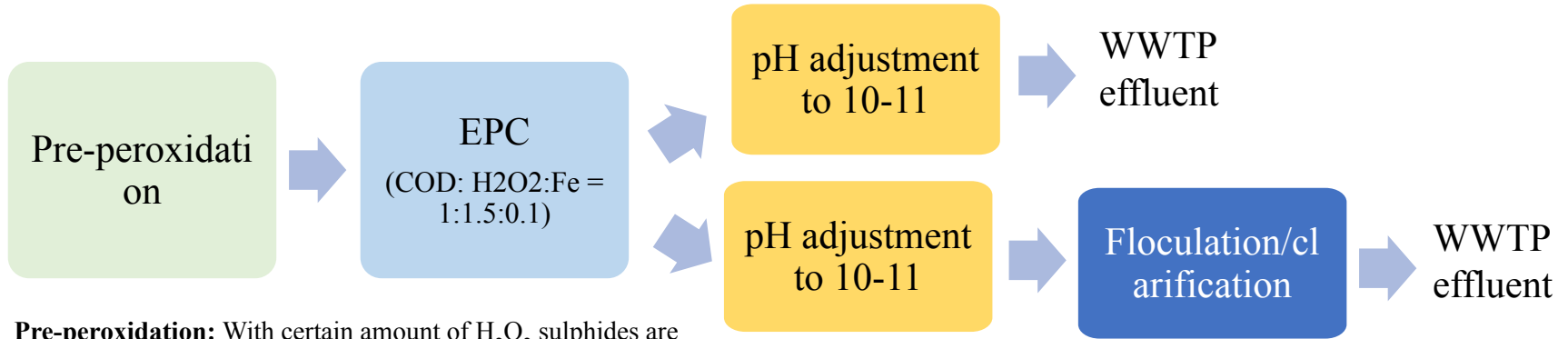
EPC-EqTech is an innovative electrochemical solution based on electro-peroxicoagulation (EPC) technique.

MAIN ADVANTATGES

- Environmentally compatible
- Hard COD removal (>80 %)
- Low CAPEX and OPEX
- Known regularity standards
- In- situ production of coagulant and flocculant
- Scalable capability
- No secondary pollutants are generated

MAIN DISADVANTATGE

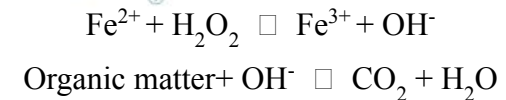
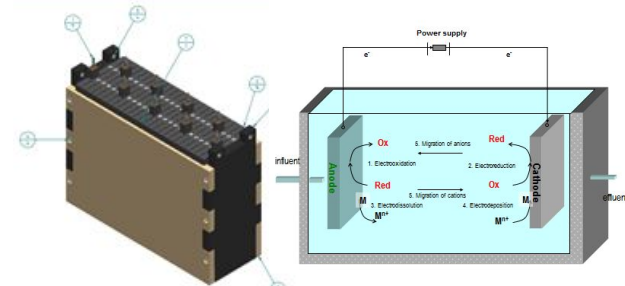
- Periodic replacement of (low-cost) sacrificial anodes



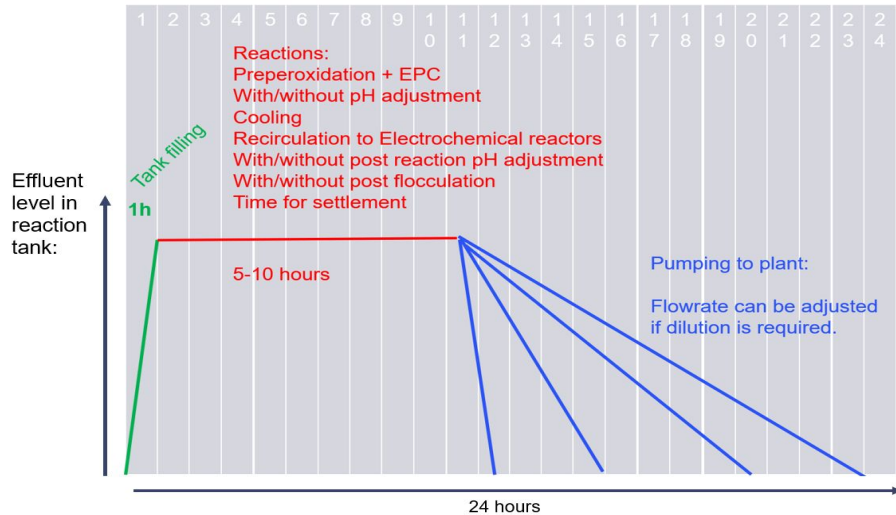
- **Pre-peroxidation:** With certain amount of H_2O_2 sulphides are oxidized to sulphates, and COD easily biodegradable is greatly reduced (50 %)
- **EPC:** In presence iron soluble species and hydroxyls radicals the hard COD and toxic pollutants are removed.
- **pH adjustment :** Reduce >85 % of toxicity
- **Flocculation/clarification :** Optional stage to remove iron as settleable matter and precipitable organic matter

KPIs:

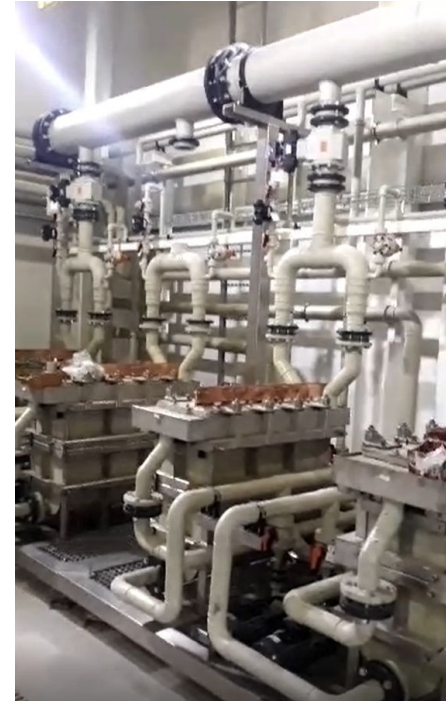
- >80 % of COD Removal
- >85 % of sulphides Removal
- Plant life time >12- 15 years
- End-user waste reduction 20 %



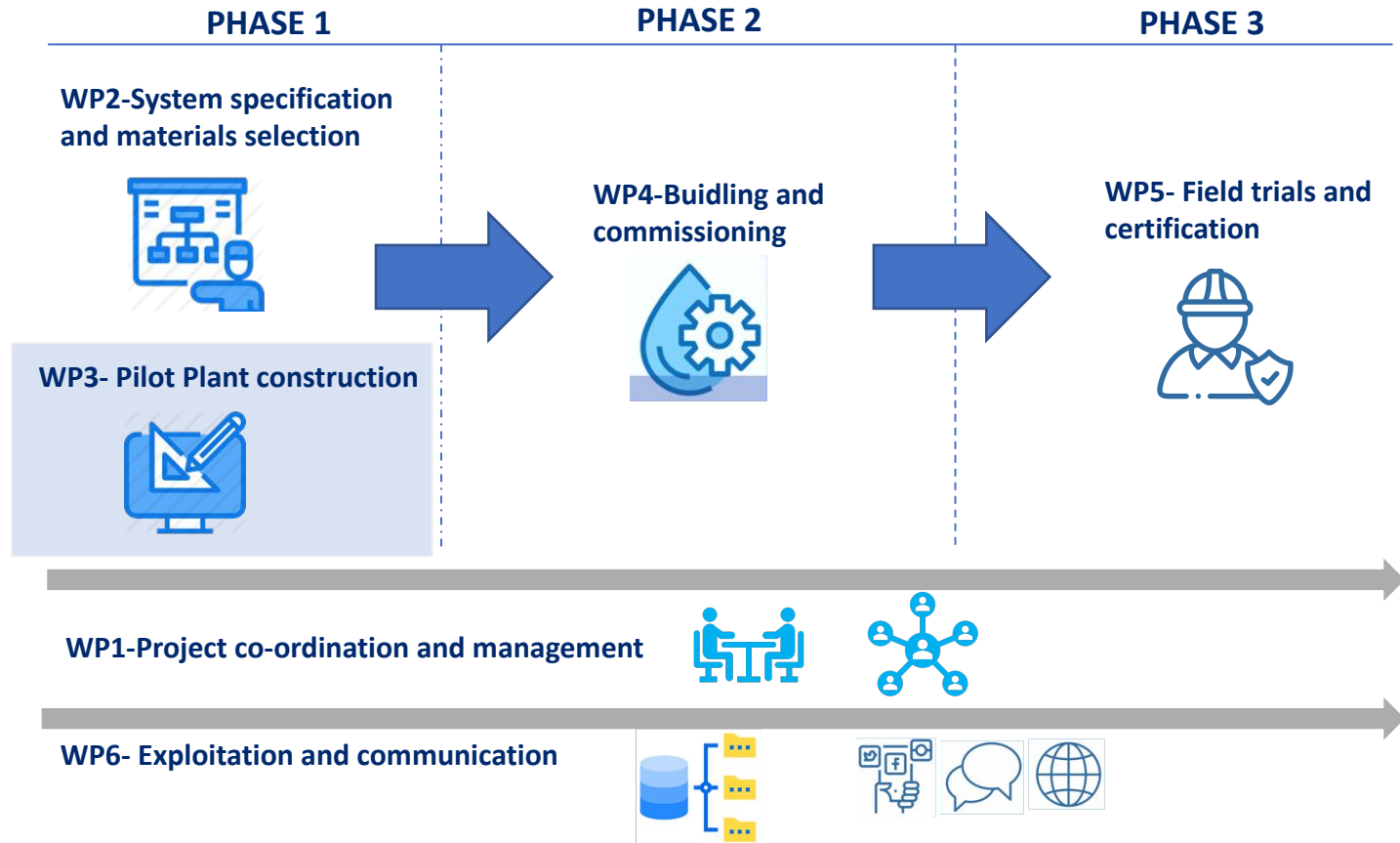
TIME SEQUENCE



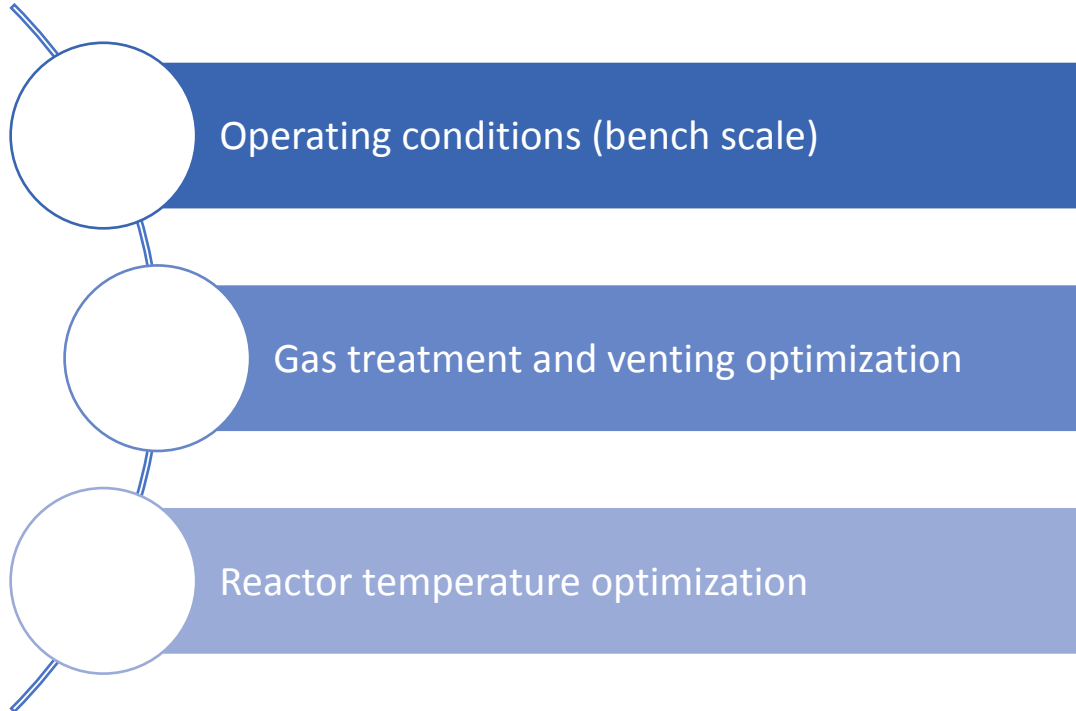
Treated volume: 12 m³/h (batch mode)



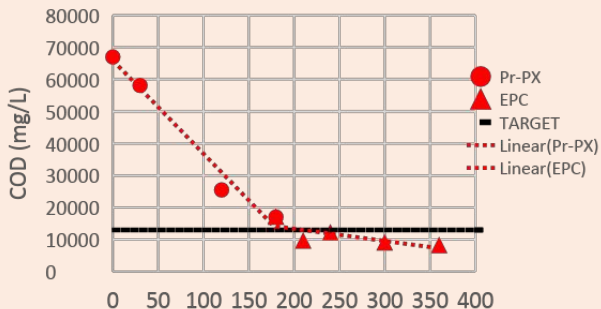
In each reactor there are 20 steel plates of 25x250x500 mm.



For the plant design optimisation, the following aspects are evaluated:



Operating conditions

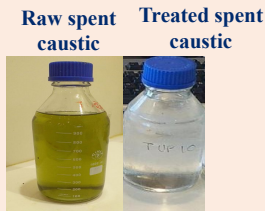


BENCH SCALE CONDITIONS
Pr-PX- 180 min
 0,8 L, COD 67,000 ppm

EPC- 180 min (ratio COD:
 H₂O₂: Fe = 1:1.5:0.15)
 0,8 L, COD 30,000 ppm

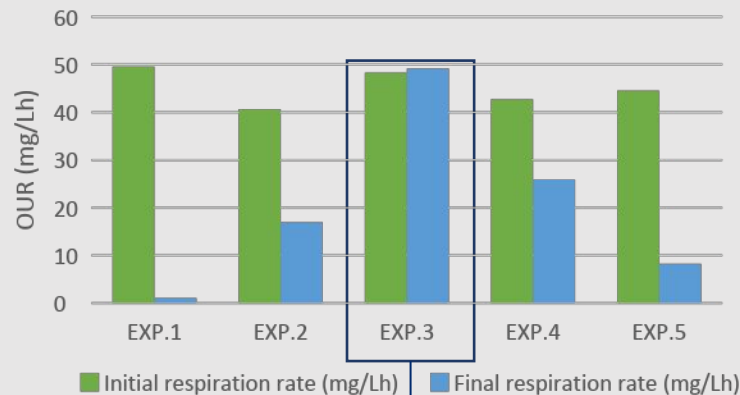
Parameters	Raw spent caustic	Treated spent caustic
pH	11.5	12
Conductivity (mS/cm)	223	230
COD (mg/L)	67,000 ± 960	8,180 ± 750
Sulphides (mg/L)	3,340 ± 440	< 0,1
TSS (mg/L)	382 ± 35	23 ± 7

- ✓ >85 % of COD removal
- ✓ >99 % of sulphides removal



Impact of biomass in WWTPi

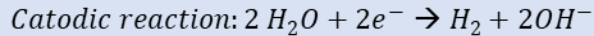
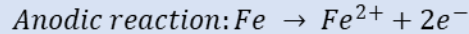
The treated spent caustic will be discharged upstream of the biological treatment. For this purpose, the impact on the biomass of the Biological Reactor was assessed by carrying out **Respirometry Tests**.



By adjusting the pH to 10.5-11.0 of the treated spent caustic and discharging the flow to 1 m³/h (FD 1:200) the biomass is not affected and does not lose activity.

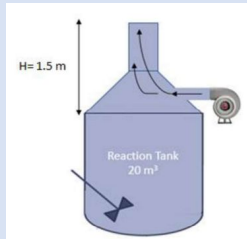
Gas Treatment and Ventilation system

- H_2 is generated during the operation and is directly proportional to the amount of dissolved iron
- H_2S only could be generated in the worst-case scenario where there is a pH mismatch and decrease below 7.



During operation, H_2 and H_2S shall be operated below the flammable limit (< 25 % LEL).

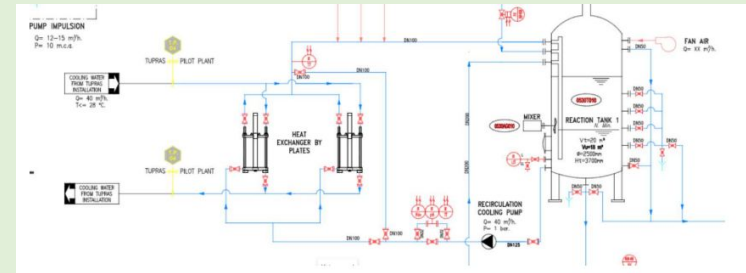
Therefore, the main **reaction tank will be equipped with a chimney and a fan for the introduction of forced air to ventilate the pilot area.** In addition, the **pilot will be equipped with explosion sensors** that if they detect gas, will trigger an alarm and shut down the system.



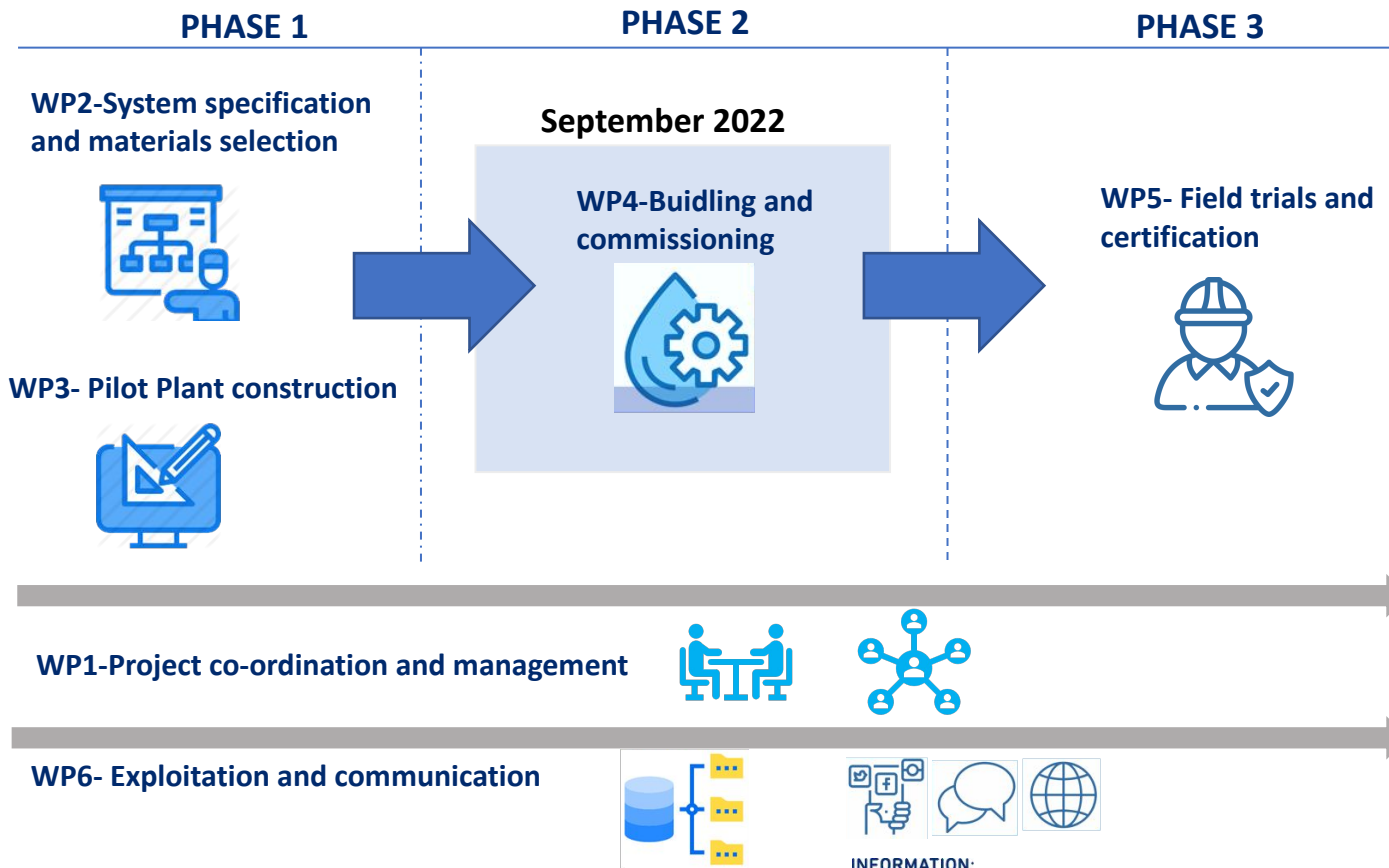
Reactor temperature optimisation

The reaction that occurs when oxidizing and breaking the organic matter chains is exothermic. To prevent the temperature from rising to dangerous limits and decreasing the efficiency of the process it is necessary to have a cooling system.

The cooling system must be able to dissipate all the heat generated during the process. Theoretical calculations and laboratory scale experiments determined **that 2 heat exchangers were necessary.**



The cooling system will allow to dissipate the energy generated during the reaction and maintain **the temperature of the spent caustic stream at about 30-35 °C.**



INFORMATION:

- EPC-EqTech solution has demonstrated technical viability to process spent caustic
- The solution is environmentally compatible application suitable for all Oil&Gas downstream spent caustic wastes.
- EPC-EqTech solution has a lower CAPEX and OPEX compared with the actual disposal management
- TRL 6 to TRL 8

Research. Thank you!
Collaboration.
Thinking forward.

Thanks to the organization for the opportunity to present the EPC-EqTech project in the 9th Conference on Sustainable Solid Waste Management

Clàudia Pastor Morell
claudia.pastor@cetaqua.com