demEAUmed Technologies

Solar Photoelectro-Fenton process

Eight categories of innovative technologies together with a monitoring, control and decision support system are integrated and demonstrated in real life situation within the European project demEAUmed "demonstrating integrated innovative technologies for an optimal and safe closed water cycle in Mediterranean tourist facilities." This factsheet presents one of these eight technologies; the **Solar photoelectro-Fenton process (SPEF)** technology.

Description

Solar photoelectro-Fenton (SPEF) process is an advanced electrochemical oxidation process (AEOP) that has been developed for the remediation of acidic wastewaters containing hazardous organics. These process is based on the H_2O_2 generation from the two electron reduction of O_2 at a carbonaceous cathode:

$$O_2(g) + 2H^+_{(aq)} + 2e- \rightarrow H_2O_{2(aq)} \quad (1)$$

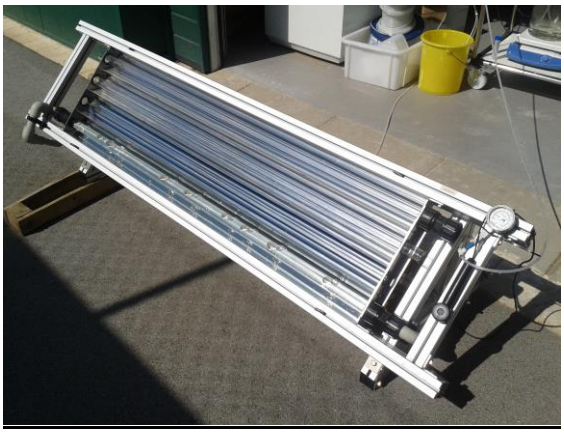
and the addition of a small amount of Fe^{2+} to the treated solution to produce $^{\bullet}OH$ and Fe^{3+} from the classical Fenton's reaction:

$$Fe^{2+}_{(aq)} + H_2O_{2(aq)} \rightarrow Fe^{3+}_{(aq)} + \bullet OH_{(aq)} + + OH^-_{(aq)} \quad (2)$$

Since Fe^{2+} can be regenerated from Fe^{3+} reduction at the cathode and due to solar radiation (solar photo-Fenton process), Eq. 2, it can be propagated due to the catalytic behaviour of the Fe^{3+}/Fe^{2+} system.

The most frequently used anodes in the indirect electro-oxidation EF systems are Pt and boron-doped diamond (BDD). The latter is preferable due to its higher oxidation power on organic pollutants. If the electrochemical process is carried out in an undivided cell, apart from the electro-Fenton mechanism, organics can also be destroyed by $^{\bullet}OH$ produced at the anode surface from water oxidation (3) in the case of a BDD anode[i]:

$$BDD + H_2O_{(l)} \rightarrow BDD\ (^{\bullet}OH) + H^+_{(aq)} + e^- \quad (3)$$



Applicability

The technology is applied as tertiary treatment for removing emergent/prior pollutants and disinfecting (swimming pool effluents, greywaters, wastewaters…) as well as primary treatment for recalcitrant and/or toxic industrial effluents (such as pharmaceutical, landfill leachate, etc.).

Design Criteria for demEAUmed

Size

The dimensions of the pilot plant expected to be around 2m x 5m x 2m.

Location

Outside where solar light could irradiate the CPC system. It has to be located close to secondary treatments.

Flows

From approximately 0.05m^3/h to 0.5m^3/h.

Operation and Maintenance

- To remove the dust of CPC.

The research leading to these results has received funding from the European Union's Seventh Framework Programme (FP7/2007-20) under grant agreement nº 619116

- To ensure continuous air flow through the cathode. Otherwise, the system could fail.
- Acidic cleaning systems in order to remove the fouling on electrodes and in the inner part of the CPC borosilicate.

Advantages of SPEF technology

- Use of solar light as driving-force of the process as well as for feeding the power supply.
- Minimization of the use of chemicals externally.
- Water disinfection and reuse.
- Removal of toxic/recalcitrant emergent pollutants.

Costs issues (or additional value)

- Generation of in-situ oxidants with high oxidant power to mineralize non-selectively organic matter.
- Solar light could be used as an energy resource.

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Please find further information and updates on demEAUmed project, its technologies and DSS at: www.demeaumed.eu

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