INTRODUCTION

The study carried out on a petrochemical site industry aims the demonstration of reduction of withdrawal intake while improving the quality of the wastewater for compliance with future regulations particularly on micropollutants discharge. The objective is to develop combination of treatment technologies for complex industrial wastewater streams for recycling and reuse within cooling water make up and/or in other operation/production processes, by ensuring an innovative and cost effective water scheme. The current wastewater treatment plant consists in dealing with.Causing the limits of background technologies (1) [9] [10] [11] and the improvements offered by the latest developments (2) [3] [4] [5] [6] [7] [8], the extended treatment line proposed includes complementary and synergistic stages arranged in a treatment train able to combine pollution concentration and degradation into cycles. The whole results in an innovative Low Liquid Discharge system: Ozonation to increase biodegradability of the effluent, Biofiltration to remove organic compounds and suspended solids, Ultrafiltration to protect reverse osmosis membrane, Reverse osmosis to demineralize water, Brine recycling to reduce volume of discharge.

METHODS

Preliminary water stream audit on the petrochemical site provides a detailed overview of the flows and their quality entering and leaving the plant (Table 1). The main stream regarding discharges rate is wastewater treatment plant outlet (Table 2). The main specific components to be controlled for final discharge are aromatic compounds including PAHs and BTX.

RESULTS

After biomass acclimatization upon water velocity increase up to 10 m/h, results obtained for the direct application of biofiltration to the deoiled wastewater confirm:

- Almost full biodegradable organic matter removal (BOD removal rate >98%)
- Good solids retention performances with outlet TSS concentration below 10 mg/L. It shows very good removal rates for most of the micropollutant detected in the influent BUTX (>97%) with contribution of non-biotic processes, i.e. adsorption onto the biofilm. As a result, only 4 PAHs occur outlet the treatment. Nonylphenoins are however still detected after the biofiltration (<1 µg/L).

Regarding ozonation treatment of deoiled wastewater, ozone appears highly reactive towards the organic matter in relation to the occurrence of unsaturated and aromatic compounds:

- The variation of the ozone dose in the range 15 to 70 mg/l makes possible COD reduction by more than 40%.
- The oxidation extent is consistent with a shift towards the accumulation of compounds of reticulated aromatic ring of lower molecular weight and thus more easily biodegradable.

In the first reaction stage, the impact of ozone dose predominates over the impact of contact time between 25.5 and 35 min suggesting that reaction rather proceeds under the diffusion regime.

Ozonation was then applied with the lowest ozone dosage prior to aerobic biological treatment for a synergetic oxidation:

- Accordingly, the combined oxidation system enhances COD removal from 50 to 70%.
- Furthermore, balances confirm that ozone mainly serves to make recalcitrant compounds more sensitive to further biodegradation and indicates the degradation of some PAHs and all BTX further completed by biofiltration.
- The control of biofiltration performances is simultaneously made easier as highlighted by the reduction of its washing frequency with decrease of water losses by 50%.

Considering background and technological limits in this application field, the implementation of the chemical/Biological oxidation developed successfully upgrades the water quality in terms of organic pollution to a sufficient extent to:

- Anticipate fouling issues in the operation of subsequent UF/RO membrane technologies dedicated to mitigate the salt control.
- Allow brine recycling

In the global water treatment chain, an additional physical-chemical treatment is required to manage wastewaters and biological sludge.

CONCLUSIONS

The related integrated water management systems are designed with a high level of reliability. They achieve the reduction of the water withdrawal by 40.2 to 42.6%. The capital and operational cost evaluations further performed favour the system involving extended wastewater treatment using deoiling, ozonation, biofiltration, ultrafiltration and partial reverse osmosis for reuse of the mixture UF/RO permeates as cooling make-up water.

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