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Review

State of the art of produced water treatment

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HIGHLIGHTS

- Oil and gas sector is one of the eight most water intensive industries.
- PW is generated when water from reservoirs is brought to surface in oil extraction.
- Composition and final use of PW determines its treatment train.
- Combination of treatments are necessary when there is a wide variety of components.
- Minimization, disposal and reuse are options for PW.

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ABSTRACT

Produced water (PW) is the wastewater generated when water from underground reservoirs is brought to the surface during oil or gas extraction. PW is generated in large amounts and has a complex composition, containing various toxic organic and inorganic compounds. PW is currently treated in conventional trains that include phase separators, decanters, cyclones and coarse filters in order to comply with existing regulation for discharge. These treatment trains do not achieve more restrictive limitations related to the reuse of the effluent (reinjection into extraction wells) or other beneficial uses (e.g., irrigation). Therefore, and to prevent environmental pollution, further polishing processes need to be carried out. Characterization of the PW to determine major constituents is the first step to select the optimum treatment for PW, coupled with environmental factors, economic considerations, and local regulatory framework. This review tries to provide an overview of different treatments that are being applied to polish this type of effluents. These technologies include membranes, physical, biological, thermal or chemical treatments, where special emphasis has been made on advanced oxidation processes due to the advantages offered by these processes. Commercial treatments, based on the combination, modification and improvement of simpler treatments, were also discussed.

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1. Introduction

The Oil & Gas industry is characterized by the high-volume water consumption and wastewater generation associated with extraction activities (the so-called produced water) -upstream sector- and by the generation of complex wastewater associated with refining activities -downstream sector-, as it is shown in Fig. 1. In both cases, wastewater has a high pollution potential and is complex, both regarding the chemical composition and the technologies required for proper treatment. As a result, efficient treatment and reuse of treated water is one of the main technological challenges with regard to the management of the effluent.

A certain amount of natural water is always found together with petroleum and gas in reservoirs. It is also known as formation