Study of Combined Ceramic Membrane and Photocatalytic Treatment of Saline Wastewater

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Polymeric micro-/ultra membranes are widely used for current pre-treatment prior to reserve osmosis (RO) desalination but they have high fouling tendency. Ceramic membranes are promising as an alternative to polymeric membranes due to their superior physical integrity, chemical resistance and thermal stability and in turn have lower chemical demand, lower cleaning frequency and longer lifetime compared to their polymeric counterparts [1].

This study is to explore the knowledge of ceramic membrane combined with photocatalytic treatment as a novel treatment for the removal of refractory organic pollutant from saline wastewater and to establish the optimum conditions for the application of this process. A batch process system comprised of photocatalytic flow reactor and a crossflow ceramic membrane module was used in this study. Titanium dioxide (TiO$_2$, P25 Degussa, 80% anatase, 20% rutile) and ceramic membranes (different pore size of 5 nm and 100 nm with same active area 0.005 m$^2$, PALL) have been utilised in this study. The source water used for this study is saline Class A water from Western Treatment Plant, Werribee, Australia. The relative effect of different combination of each individual process featuring in the hybrid system (TiO$_2$/UV photocatalytic oxidation only and TiO$_2$/UV photocatalytic oxidation with ceramic membrane) was also assessed for the treatment of saline Class A water. Changes in totoal organic carbon (TOC) levels, UV$_{254}$ (organics absorption at the wavelength of 254 nm) absorbance and particle size distributions under different process conditions were examined over time. The adsorption of organic compounds onto the TiO$_2$ surface, transformations and removal efficiency during the reaction was examined by measuring changes in the particle size and zeta potential of TiO$_2$ over time. Further liquid chromatography (LC) and LC-organic carbon detective (LC-OCD) were used to study the degradation profile of organic matter in the saline wastewater.

The result shows that 0.5g/L dose of TiO$_2$/UV photocatalytic reaction only gained less than 5% of the overall TOC degradation. However with the addition of ceramic membrane filtration, more than 5% of overall TOC was removed based on LC and LC-OCD analysis. Further work will be investigated on the effect of addition of hydrogen peroxide (H$_2$O$_2$) to improve the efficiency of TiO$_2$/UV photocatalytic reaction.

Key Words: Saline Class A water, Organic compounds, Ceramic membrane, Photocatalytic oxidation.

Reference: