

# **Progress of Membrane Technology in the Treatment of Oily Wastewater**

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**Abstract:-** As a whole, this membrane integration desalination technology without acid and alkali is benefit to the environment. As a new technology, membranes are used into separate and concentrate the pollutants in oily wastewater through its permselectivity. In this paper, organic film, inorganic film and biofilm are described in the progress of oily wastewater, including the film of polyvinylidene fluoride (PVDF), polytetrafluoroethylene membrane (PTFE), polysulfone film (PS), carbon film , ceramic membrane and biofilm. Then these treatment methods were compared and evaluated in order to propose the research direction in the future.

**Keywords:-** organic film; inorganic film; biofilm; research progress; oily wastewater.

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## **I. INTRODUCTION**

Membrane technology is the most promising technology for water treatment in twenty-first Century. The development of science and technology of the 12th Five-Year Plan were pointed that Chinese membrane market is growing rapidly. The membrane industry output value in China has exceeded 30 billion RMB and it has accounted for about 10% in the global membrane industry market in 2010. The country engaged in membrane products enterprises amounted to more than 300, separation membrane research institutes nearly 100, has initially formed a relatively complete industrial chain and innovation chain membrane materials. Scholars at home and abroad, in the preparation of membrane for membrane materials in recent years, the modified membrane backwash and conducted a lot of research. Membrane technology can effectively deal with particle size less than 100 microns of oil membrane separation. Membrane technology has broad application prospects in oily wastewater treatment<sup>[1]</sup>. According to the material classification, film can be divided into the organic membrane and inorganic membrane. In these paper two types of membrane in the treatment of oil wastewater is introduced. A reference for related research is provided.

## **II. STUDY ON OIL WASTEWATER ORGANIC MEMBRANE TREATMENT**

Organic film is a kind of membrane treatment of oily wastewater by the most widely used. It is the use of some preparation of organic polymer materials of a film which has a simple preparation process, variety, easy modification, low-cost characteristic. The organic film of PVDF, polyvinylidene fluoride composite membrane, PTFE and PS have the most commonly used

### *A. PVDF*

With the good dielectric, alkali resistance and heat resistance of PVDF, have reports in used of oil wastewater. Taixing oilfield is a typical oilfield with low permeability. The original design can not meet the needs of oilfield injection-production. Therefore, ultrafiltration membrane treatment process of PVDF pipe was designed by Fengdong Zhang<sup>[2]</sup> and others. The field experiment results show that the water reached the standard of SY/T5329-1994. No need of corrosion inhibitor, flocculant and bactericide, water quality can meet the requirements of low permeability reservoir. Polyvinylidene fluoride ultrafiltration treatment of Daqing oil field wastewater used by Jun Xu<sup>[3]</sup> and others. Used in the experiments for the domestic inside-out membrane molecular weight cutoff of  $5 \times 10^4$  Dalton polyvinylidene fluoride ultrafiltration membrane. The results show that the oil content of membrane filtration effluent decreased from 10mg/L to 1mg/L, suspended matter content reduced from 15mg/L to 1 mg/L, turbidity decreased to 1 NTU and removal rate reached more than 90%.

### *B. Polyvinylidene fluoride composite membrane*

Composite polyvinylidene fluoride membrane is add hydrophilic inorganic materials and some hydrophilic organic materials in the membrane material for the preparation process. It is better than PVDF in membrane hydrophilicity. Treatment of oil wastewater by this method has been reported. Yan Lu<sup>[4]</sup> and others harness the oilfield outflow water with polyvinylidene fluoride ultrafiltration membrane modified by nano Al<sub>2</sub>O<sub>3</sub>. Results show that UF effluent COD<sub>Cr</sub> removal rate is greater than 90% and oil concentration removal

rate is greater than 98%. UF effluent reached the low permeability oilfield reinjection water "recommended clastic rock reservoirs water quality index and analysis method of water quality standard" (SY/T5329-94). Jianguo Zhang<sup>[5]</sup> and others harnessed the oil refinery effluent with the polyvinylidene fluoride membrane modified by polysulfone. Research shows that, PVDF membrane flux increased by 23.1% ~ 48.2% than before, the interception rate increased by 1.7% ~ 8.5% and easily through the back washing regeneration. Chunhua Wu<sup>[6]</sup> and others using the modified PVDF ultrafiltration membrane harnessed the emulsified oil wastewater. The results show that the modified polyvinylidene fluoride membrane flux increased from 16.8 L / ( m<sup>2</sup>·h ) to 21.0 L / ( m<sup>2</sup>·h). Oil removal rate can reach more than 95% in different feed concentration.

### C. PTFE film

PTFE with good chemical corrosion resistance, chemical stability have been used in treatment of oil field wastewater at present. For strong acid sulfonation modification, hot rolling and special surface treatment by cobalt radiation of PTFE membrane by China University of Petroleum<sup>[7]</sup> harnessed oil wastewater. It makes oil removal rate above 98%. The treated water quality has basically reached the requirements of SY/T5329 - 1994. Fujun Xia<sup>[8]</sup> preparing membrane filtration equipment by using the membrane modification method of China University of Petroleum carries on industrial scale-up experiment. Modified PTFE membrane filters used for fine treatment of oilfield wastewater can be used as two stage filtration equipment to replace the oil present in the two stage of dual-media filter tank. Requirements for water quality control index of membrane filtration effluent quality can reach the reinjection water of low permeability reservoir. Aiguo Lin<sup>[9]</sup> and others prepared PTFE charged microporous membrane with the PTFE film surface treatment. Experiments show that the oil removal rate was above 91% and suspended solids removal rate in more than 95%. To the analysis of fluorescence spectra, PTFE charged microporous membrane in the treatment of oil wastewater has good stability and resistance to chemical corrosion.

## III. STUDY ON OILFIELD WASTEWATER TREATMENT OF INORGANIC MEMBRANE

Inorganic membrane has good corrosion resistance, high-temperature resistance and chemical stability. Inorganic membrane is easy to clean and hard to corroded by microorganism. The inorganic membrane has complex production process and high cost, though the oil removal rate is much higher than that of organic membrane. Carbon membrane and ceramic membrane are commonly used in inorganic membranes.

### A. Carbon Film

Carbon membrane is a new type of porous inorganic membrane with high thermal stability and long service life. Wandong Zhang<sup>[10]</sup> harnessed oil wastewater using coal-based tubular carbon membrane prepared with coal as raw material. The results show the oil rate can reach more than 97% and the oil content of penetrant is less than 10mg/L. Hongbo Tu<sup>[11]</sup> and others harnessed Jiang Han Oilfield Wastewater with moderate compression method of expanded graphite prepared membranes. The results show that the expanded graphite filter of 0.025 g /cm<sup>3</sup> can balance oil removal effect and wastewater treatment efficiency. One-time processing ability of Jiang Han oilfield produced wastewater is about 16.1L/g. Oil removal efficiencies of different aperture carbon membrane was investigated by Yanqiu Pan<sup>[12]</sup> and others. Using the self-made diameter of 0.6~2.5μm single and seven tubular carbon membrane, the oil removal efficiency and the permeate oil content was determined. The experimental results show, the oil removal efficiency is more than 97% and permeate oil content less than 10mg/L, effluent can reach the first class discharge standard of SY/T5329-94.

### B. Ceramic Film

Inorganic ceramic membrane has good corrosion resistance, heat resistance and easy to clean. Yongqing Wang<sup>[13]</sup> et al. studied the effects of operating parameters of ceramic membrane modification conditions and membrane filtration flux of membrane. The results show that when the velocity is 7m/s, oil-water separation can effectively realize the stability of oily wastewater, oil retention rate of 96.4%. Shuanshi Fan<sup>[14]</sup> and others studied the separation characteristics of emulsified oil by using self-made aluminium sesquioxide ceramic membrane. The results show that ceramic membrane has good separation efficiency. The result meets the national emission standard. The interception rate reaches above 95% and the concentration of liquid oil is lower than 0.005 kg /m<sup>3</sup>.

## IV. CONCLUSION

Although membrane technology for the treatment of oil wastewater effect is good, there are still some shortcomings. Inorganic membrane has good chemical stability, long service life, easy cleaning and the oil removal rate is higher than that of the organic film, but the cost is higher. Organic membrane has the virtue of simple preparation process, high filtration precision and low price, but the service life is short. Future need to be further studied in the following aspects if the membrane technology is more widely used in oil wastewater

treatment engineering. Develop new low-cost sewage treatment for oily inorganic membrane materials and modified the organic membrane to improve its hydrophilicity.

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