BIO-CEL® MBR in Petrochemical Industry Waste Water Treatment

INTRODUCTION

The global petrochemical industry is a mature and still growing industry despite the environmental and socio-political pressure it faces. With global population ever growing there is still a high demand for petrochemical products such as fuels, plastics and other chemical derivatives. With this industry's predicted expansion over the next 20-30 years and the ever growing need for water resources with global population growth, there is a need for addressing the contaminated water that the petrochemical industry produces.

Petrochemical producers have been predominantly located in the USA (15%), Europe (15%) and the Middle East (55%) according to a 2019 global market share study. However there is a growing market and production increases in the developing regions in Asia, Africa and Russia while the use of renewable energy and electric vehicles grows in the developed countries. The petrochemical industry is not only responsible for fossil fuel production but also for plastics, fertilizers and textiles. There are enumerable other specialty by-products that are used in pharmaceutical, mining and even in the food and beverage industries.

There are multiple waste water streams that are created from the extensively complicated petrochemical industry. There are feedstock related industries such as oil rigs, shale oil processing (fracking water) and coal mines. These produce wastewaters that are contaminated by the fossil fuel during extraction or initial processing. Then there are process related industries; refineries, cracking facilities, or catalytic facilities. These consume fresh water as reactants, process fluids, cooling water as well as produce a by-product from some of the reactions. Lastly contaminated water is produced in the processes associated with the industries which use petrochemical products mentioned above. Often these petrochemical waste waters are blended with traditional sewage water before being treated.

As mentioned above the waste waters are extremely varied in terms of contaminants. Typical contaminants are Chemical Oxygen demand (COD) in the range of 1,100 mg/L, Biological oxygen demand of 550 mg/L, but also have various toxic organic and inorganic compounds present in the waste water depending on the process involved. Generally in oilfield production there are benzenes, PAHs phenols, heavy metals and mineral salts. When looking at refinery wastewaters the are often phenol, ketones, ethers, ammonia, hydrogen sulphides, mercaptans and heavy metals present. Lastly in synthetic petrochemical waste waters halogenated hydrocarbons, phenols, pyrazines, hydrogen sulphides, mercaptans and cyanides are often present. These complicated contaminants make treating this waste water biologically a challenge.

PRE-TREATMENT

In order to have an effective biological treatment process to occur there needs to be an advanced/complex pre-treatment step in place. This often includes an oil/water separator which will remove fats, free oil and grease. This is a critical step in protecting the biological and membrane filtration stages. Hydrogen sulphide (as is often present in typical petrochemical waste waters) can be removed using a wet air oxidation unit operation. Most commonly the last step before the biological treatment step is a dissolved air floatation (DAF) operation which can be flowed by coagulation and flocculation clarifiers.

MANN+HUMMEL

MEMBRANE BIOREACTOR

BIO-CEL® modules are specifically designed with a Polyethersulphone (PES) surface chemistry which delivers a filtration on the ultrafiltration level. This allows for the filtration of biologically treated water while retaining the activated sludge in the bio-reactor. The membrane is configured in a flat-sheet, submerged-style (vacuum-operated), module with air-scouring, for cross-flow filtration, and backwashing capabilities. The use of and MBR removes the need for large traditional clarifiers. This is especially beneficial for the petrochemical industries where space is often a limitation. This technology is also modular and can be containerized which allows flexibility. The permeate from the membrane modules is of excellent quality which is free from solids and bacteria.

POST-TREATMENT

The permeate that is extracted from the BIO-CEL® modules can be further treated based on the dissolved components that are present in the specific waste water. Sometimes valuable recourses can be recovered by using further tertiary treatment operations. These include the use of reverse osmosis membranes, ion-exchange resin, electric dialysis reversal or polishing with activated carbon. Depending on the level of treatment, the permeate can be reused back in the process, for cooling water, for sanitation reuse or for irrigation/discharge into surface water.

BENEFITS OF BIO-CEL ® MBR TECHNOLOGY.

BIO-CEL® has a self-healing effect which will block up damaged membrane surface due to the use of laminate technology. This prevents solids from entering into the permeate stream even if the membrane is scratched, teared or cut. The effluent that is produced from the MBR is a cleaner and of higher quality then compared to conventional waste water treatment plants. It has a high packing density and therefore has a 2 times smaller footprint. The BIO-CEL® makes use of fine bubble air diffusor which create the cross-flow filtration as well as clean the sludge off of the active membrane surface. The use of fine bubbles is more efficient then coarse bubbles because of the higher oxygen transfer efficiency and therefore reduces energy consumption.

As the petrochemical industry is perceived in a negative light from an air and water pollution perspective, employing the use of bio-technology in an MBR system for water re-use is seen as a green approach. It is a good approach to take to tackle water pollution and ease the environmental and political pressure that the industry faces.

For more information, please contact MANN+HUMMEL Water & Fluid Solutions.

Contact

Europe
Germany: +49 611 962 6001
Italy: +39 0721 1796201
info@microdyn-nadir.com

Americas
USA: +1 805 964 8003
sales.mnus@microdyn-nadir.com

Asia
Singapore: +65 6457 7533
China: +86 10 8413 9860
waterchina@mann-hummel.com

FORM NO.: TA-WW004
REVISION DATE: 16/07/2021