ABSTRACT

Mixed matrix membrane (MMM) is a special class of membrane where one or more inorganic additives are dispersed in the polymer matrix. The main advantage of this class of membrane is combined action of sieving mechanism by the porous membrane and specific beneficial properties of the additive. MMMs can be customized uniquely for targeted application. The purpose of this work is to fabricate and characterize different types of MMMs for application in different high throughput filtration processes.

Alumina nanoparticle embedded MMM offers high throughput and charged surface with adsorptive properties, showed good rejection performance of different types of phenolic compounds. Simultaneous removal of phenol and suspended solids was achieved using powdered activated carbon MMM. In order to improve separation efficiency, hollow fiber MMM with carbon nanoparticle was spun for the first time and has been employed for removal of various organic components. However, limitation of fouling leads to deterioration in membrane performance in prolonged usage. Titanium-d-oxide embedded hollow fiber MMM was developed leading to photocatalysis assisted ultrafiltration of phenolic compounds with no loss in term of flux decline.

Graphene oxide impregnated flat sheet membrane showed good performance in adsorptive removal of heavy metals, like chromium, copper, cadmium and lead. Interestingly, throughput was enhanced substantially with marginal loss in rejection efficiency in hollow fiber configuration. Positively charged MMM with zinc oxide nanoparticle was proved to be another good alternative in this same purpose. The system was demonstrated by treating chrome tanning effluent.

Polyaniline, a well known conducting polymer with good surface functionality was used to improve membrane throughput substantially to shift the membrane for nanofiltration to ultrafiltration grade while retaining its salt rejection property. Graphene oxide was used to gain high permeate flux and good rejection of salt with higher throughput in hollow fiber configuration.

Removal of anion, like nitrate was carried out using alumina nanoparticle embedded hollow fiber MMM. Whereas, zinc-chloride impregnated MMM was very effective in simultaneous removal of multiple anions from real life steel industry effluent.

Overall this work can pose an alternate route for energy efficient process for selective separation techniques with an array of MMMs with novel composition.

Keywords: *Mixed matrix membrane; adsorption; surface charge; removal of organic; desalination; heavy metal removal; photocatalytic ultrafiltration; real life effluent treatment.*