CHAPTER 7 CONCLUSION

7.1. INTRODUCTION

This chapter reviews the research work carried out and its outcome. All the results obtained from various experiments are discussed. A brief scope of future work is also discussed.

7.2. RESULT & DISCUSSION

Bimetallic Fe-Ni nanoparticles in the size range of 36 – 41 nm are synthesized using simultaneous reduction method. These nanoparticles are crystalline in nature and exhibit well defined structure without any agglomeration compared to the nanoparticles synthesized by mechanical alloying method.

Crystalline FMO nanoparticles are synthesized in a controlled synthesis using ammonia and regulating the pH. The as synthesized nanoparticles are found to be in the size range of 25 – 45 nm. The nanoparticles are found to be crystalline and from the FTIR results it is observed that the nanoparticles have the vibrational frequencies of FeMnO [186].

CTO nanoparticles are successfully synthesized using solvo-thermal method. The as synthesized nanoparticles are crystalline and are in the size range of 40 – 50 nm. From the photoluminescence spectra it is observed that CTO has an absorption peak at 490 nm revealing that the band gap has been reduced to 2.51 eV.
Crystalline NTO nanoparticles are synthesized using solvo-thermal route. The as synthesized nanoparticles are found to be in the size range of 25 – 45 nm. An absorption peak at 450 nm is observed in the photoluminescence spectra of NTO implicating that the band gap is 2.8 eV.

Polysulfone based polymer membrane supports are fabricated using phase inversion technique. Among the four weight percentages i.e., 5 wt%, 10 wt %, 15 wt% and 20 wt% of PSf used to fabricate membranes, 15 wt% has been chosen for support because of its pore size and pore volume which is well suitable for immobilization of nanoparticles.

Fe-Ni nanoparticles are immobilized onto 15 wt% PSf membrane using various techniques such as dip-coating, adding nanoparticles to the PSf cast solution and in-situ immobilization. In-situ immobilization method gave the most desirable results. Leaching of Fe-Ni nanoparticles from the PSf membrane is also studied and from the ICPMS results it is evident that there is no leaching of nanoparticles. The PSf support membrane in-situ immobilized with Fe-Ni nanoparticles is found to have a specific surface area of 22.85 m²/g.

Alumina based ceramic supports have been fabricated to immobilize metal oxide nanoparticles (FMO, NTO & CTO). Nanoparticles exhibit very good binding with alumina and the surface area of these alumina supports is found to be in the range of 95 – 100 m²/g.

Reductive degradation efficiency of Fe-Ni nanoparticles immobilized PSf membranes has been studied using DCE and TCE as probe compounds. The results are compared with the results of traditional ZVI nanoparticles treated samples. Fe-Ni/PSf membranes have achieved 88 – 90% degradation of TCE where as ZVI nanoparticles achieved only 70 – 75% degradation in water. Fe-Ni/PSf membranes have achieved 90 - 92% degradation of DCE where as ZVI nanoparticles achieved only 70 – 75% degradation in
water. From these results it is evident that Fe-Ni nanoparticles supported by PSf mambraes have better efficiency in degradation of halogenated hydrocarbons compared the degradation by ZVI nanoparticles

Oxidative degradation efficiency of FMO nanoparticle immobilized alumina support has been studied using ethanol and isopropanol as probe compounds. FMO nanoparticles achieved 85 – 90% degradation of ethanol and 95 – 98% degradation of isorpropanol from air in ambient atmospheric conditions. This is an improvement in the oxidation activity of MnO₂ which needs temperatures above 60°C for degradation [87].

NTO nanoparticle immobilized alumina support and CTO nanoparticle immobilized alumina support have been studied for photocatalytic degradation efficiency. Benzene, toluene and chlorobenzene are used as probe compounds. NTO nanoparticles have achieved 95 – 97% degradation of benzene, 90 – 95% degradation of toluene and 94 – 98% degradation of chlorobenzene in water.

The efficiency of the NTO nanoparticle degradation is studied both in the presence of UV radiation and in the absence of UV radiation. From the results it is evident that there is no significant change in the degradation efficiency due to the presence or absence of UV radiation. CTO nanoparticles have achieved 97 – 99% degradation of benzene, 92 – 97% degradation of toluene and 95 – 98% degradation of chlorobenzene in water.

The efficiency of the CTO nanoparticle degradation is studied both in the presence of UV radiation and in the absence of UV radiation. From the results it is evident that there is no significant change in the degradation efficiency due to the presence or absence of UV radiation.

The degradation efficiency achieved by NTO and CTO nanoparticles is found to be better than that of traditional TiO₂ which has an efficiency of 83% [125].
7.3. FUTURE WORK

The future work involves long term testing of the nanocomposites for the study of prolonged activity and finding the durability and life time of the composites.

Testing with large volume of contaminated water and air over prolonged periods is to be performed to study the kinetics and dynamics of the composites.

Testing in varying ambiance like different temperature, flow rates, concentrations of contamination etc may be performed to identify optimum reaction conditions for the catalytic material.