Study of Dopping Effect on The Structure of Metal Titanate

Hajira Tahir
Department of Chemistry, University of Karachi-Pakistan

ABSTRACT

Introduction: Nanotechnology, is the engineering and art of manipulating matter at the nanoscale (1-100 nm), offers the potential of novel nanomaterials for the treatment of surface water, groundwater and wastewater contaminated by toxic metal ions, organic and inorganic solutes and microorganisms. Due to their unique activity toward contaminants many nanomaterials are under active research and development for use in the treatment of water. Environmental pollution is one of the burning issues of the today's world. Pollution not only causes environmental changes but also causes different diseases. Textile effluent is a major contributor of water pollution. The disposal of dyes into receiving water causes damages to the environment and effect ecosystem.

Dyes are colored, ionizing and aromatic organic compounds which show an affinity towards the substrate to which it is being applied. Their structures have aryl rings which delocalized electron system. These structures are said to be responsible for the absorption of electromagnetic radiation that has varying wavelengths, based upon the energy of the electron clouds.

Objective: Treatment of waste water specially textile waste water by using nanomaterials as an efficient adsorbent.

Methodology: The removals of dyes have been carried out by different methods: coagulation, chemical oxidation, membrane separation, electrochemical, biological and adsorption processes. In the present studies adsorption was adopted by using nano particles which are acting as effective adsorbent.

In the present study Ag (Silver) doped ilmenite type Co (Cobalt) nanoparticles were synthesized by calcinations of precursor mixture of Ag (OH), Co (OH) $_2$ in aqueous cetyltrimethylammonium bromide (CTAB) solution by co precipitation method. They were applied in various ratios like $CoTiO_3$, $Ag_{0.8}Co_{0.2}TiO_3$, $Ag_{0.5}Co_{0.5}TiO_3$, $Ag_{0.2}Co_{0.8}TiO_3$ and$AgTiO_3$.

The characterizations of synthesized nanoparticles were done by using Scanning electron microscope (SEM) techniques, Fourier infrared spectroscopy (FTIR) and Energy dispersive spectroscopy (EDS).

The variable ratios of $Co_xAg_{1-x}TiO_3$ (x=1.0, 0.8, 0.5, 0.2, 0.0) nanoparticles were used for the removal of Congo Red (CR) dye from aqueous solutions.

Result: Adsorption method was adopted for the removal of dyes under variable parameters effect such as adsorbate concentration, adsorbent amount, agnition time, and pH. The pH at point zero charge was also estimated to determine the neutrality of the system.

The swelling measurement, gel content and temperature were studied to explore the potential feasibility for the removal of (CR).

Thevalidityofadsorptionprocesswasestimatedbyproceedingadsorptionmodelslike Freundlich, Langmuir, D-R (Dubinin-Radushkevich) and Temkin Isothermmodels.

The electrolytic effect for the removal of respective dyes was also investigated in the presence of KCl electrolyte. It was observed that ionic strength was one of the key factors affecting the thickness of electrical double layer (EDL).

Thethermodynamicstudywasconductedtodeterminethefreeenergy(ΔG°),enthalpy(ΔH°)and entropy (ΔS°) of thesystem.

AdsorptionKineticwasalsostudiedbyIntraparticlediffusionandBoyd'smodel.Itfollowsintra- particle diffusionmodel.

Conclusion: It was observed that the adsorption efficiency was found to be 81%$CoTiO_3$, 87%$Ag_{0.8}Co_{0.2}TiO_3$, 80%$Ag_{0.5}Co_{0.5}TiO_3$, 69% $Ag_{0.2}Co_{0.8}TiO_3$ and 83% $AgTiO_3$ for the dye-nanocomposites system.

The present model system can be employed on industrial scale for the waste minimization from point source.