A PILOT STUDY ON PHOTOCATALYTIC HYDROGEN PRODUCTION FROM SULPHIDE WASTEWATER USING CERIUM DOPED TITANIUM OXIDE SPHERICAL NANOCATALYST

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ABSTRACT: Hydrogen sulfide (H_2S) is one of the colourless, flammable, highly toxic pollutants being produced from oil refineries, sewage treatment plant, and paper and pulp industry. In this present situation, the rapid depletion of fossil fuels intensive research has focused into other alternatives to replace them with technically feasible and economically viable technology. Fossil fuels usage leads to adverse change in the environment and fossil fuel reserves are diminishing. Hence, it is necessary to generate alternative energy which will meet our enormous requirements and demand. Hydrogen has been identified as an attractive candidate for the energy the energy carrier of the future.

There is much interest in finding ways to produce hydrogen gas from renewable energy source such as solar to avoid the emission of greenhouse gases. It has always been clean, efficient, and a versatile energy carrier. Many sulfide ion removal techniques have been employed to remove the presence of H_2S such as aeration, membrane filtration, wet absorption method, biological removal and chemical oxidation methods. Various hydrogen producing methods such as thermochemical, photoelectrochemical, biological method are very slow and costlier than photocatalytic process. Among all these methods, photocatalytic decomposition of hydrogen sulfide in an alkaline solution is not only for treatment of sulfide ion and also the recover useful fuel hydrogen.

In this research, the photocatalytic degradation of sulfide wastewater from sewage treatment plant was studied using Cerium doped TiO_2 nanocatalyst. The cerium doped titanium dioxide was prepared by using precursors Titanium Isopropoxide and Cerium Nitrate through Sol-Gel method. The catalyst characterized by XRD for particle size of 62.62 nm and with the spherical, body centered cubic lattice configuration. The amount of dopent was found 0.5 mol% contained 3.54 wt% analyzed by EDAX. The band gap was found to be 2.55 eV from 3.2ev and 485 nm which were confirmed through UV-DRS. The prepared Ce-TiO_2 photocatalytic behavior was tested through the pilot scale studies with the production of hydrogen. The performance of the photocatalytic trapezoidal pilot reactors (20L) was evaluated via studied by optimization of operating variables like catalyst dosage, concentration of sulphite ions, pH, liquid volume, light intensity and recycle flowrates.

The pilot scale study clearly revealed that the maximum hydrogen was recovered at Catalyst dosage of 4.5 g dispersed in the volume of the wastewater of 5L with the sulphite concentration of 0.2 M, pH of 10, flowrate of 0.083 Litre/Sec irradiated at 1 hour under the visible lamp of 800W produced 87mmol/h of hydrogen utilizing 0.46 % of sulfide was found to be the best results among the experimental study. The catalyst was effective photoactivite and recyclable up to 5 trials.

Keywords: hydrogen, photocatalytic, sulphide, Nano catalyst

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