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THE PHOTOCATALYTIC ACTIVITY OF PD-CR2O3/CDS ALONG WITH BATCH PROCESS WITH PASSIVE MIXING

(1)P.BALAMURUGAN ,(2)P.DAMODHARAN, (3)S.MASIMALAI,(4,)P.SAKTHIVEL,(*)MS THANGAM.N,
(1)(2)(3)(4)STUDENTS,(*)ASSISTANT PROFESSOR, DEPARTMENT OF CIVIL ENGINEERING,
PERI INSTITUTE OF TECHNOLOGY, CHENNAI-600048.

ABSTRACT

We report on the photocatalytic hydrogen production of Pd-Cr2O3/CdS photocatalyst using an unconventional batch process with passive mixing. The catalyst has been characterized using X-ray diffraction and Scanning electron microscope to reveal a colloidal solution of CdS aggregates with particle size 3.7 µm. The feasibility studies were carried out by varying the treatability parameters and it was found that maximum hydrogen production occurs at their respective optimum values. The highest volume of hydrogen produced after optimization is 40.1 mL at 220 W/m^2 light intensity, 0.2M sulphide concentration, 0.2M sulphite concentration, 10 pH, 300mL photolyte volume, 0.5g catalyst dosage and 30mL/hr recycle flow rate. Close investigation revealed that this high production is due to the optimization of parameters coupled with batch process with passive mixing. The catalyst also has proved to be photo stable for up to 5 trials.

Keywords: *Photocatalyst; Hydrogen production; photocatalytic activity; batch process*

1. Introduction

Hydrogen has gained importance as a clean fuel in the energy economy recently. The idea is to obtain a renewable solution to supply this fuel in sufficient quantities and photocatalytic splitting of hydrogen sulphide waste stream have been garnering attention in this area. H2, as an energy carrier with a high calorific value of 122 kJ g^{-1} (2.75 times greater than hydrocarbon fuels) is clean and renewable[1]. Photocatalysis was carried out using Pd-Cr2O3 nanocomposite cocatalyst which has been reported earlier in achieving high photocatalytic efficiencies greatly due to the doping of CdS with Pd and Cr [2]. The rate of hydrogen production depends on the type of reactor used as its main purpose is to facilitate photocatalysis using a catalyst. Batch process with passive mixing was found out to have good photocatalytic hydrogen production [3]. This method of batch process with passive mixing omits the need for a magnetic stirrer to circulate the catalyst that have settled at the bottom in conventional batch processes. There is no formation of dead zones where some amount of the catalyst settles down and remains stagnant.

2. Materials and methods

Preparation of photocatalyst

For the synthesis of the photocatalyst Palladium chloride (PdCl2, 99.99% purity), Chromium nitrate (Cr (NO3)3.9H2O, 98% purity), Sodium borohydride