

Eco-Friendly Reduction of 2,5-Dichloronitrobenzene Using Electrochemical and Microbial Techniques

Abstract

Electrochemical reduction of 2,5-dichloronitrobenzene has been studied with the help of cyclic voltammetry at various scan rates and pH values in aqueous alcoholic medium. All cyclic voltammogram recorded exhibit one irreversible cathodic wave. The electrochemical reduction of 2,5-dichloronitrobenzene was carried out galvanostatically using economically viable stainless steel (SS-316) electrode at constant current.

The microbial reduction of 2,5-dichloronitrobenzene was carried out by use of free as well as immobilized baker's yeast (*Saccharomyces Cerevisiae*). The product was isolated purified and characterized by combined application of chromatographic and spectroscopic techniques.

Keywords: Electrochemical Reduction, Stainless Steel (SS-316) Electrode, Cyclic Voltammetry, Baker's Yeast (BY) and ImBY.

Introduction

Electro-organic synthesis is now a well established technique for synthesizing the desired compound by oxidation or reduction of substrate. Here electron obtained during electrochemical reaction plays an important role by acting as a reagent.

Biotransformation of organic compounds have been carried out using free as well as immobilized Baker's yeast (*Saccharomyces Cerevisiae*). BY has been the first and most popular whole cell biocatalyst for the transformation of various functional groups such as carbonyl and nitro groups etc. The Baker's yeast is a common microorganism that can be used for such purposes easily available then purified reductases have been disadvantageous to need expensive co-factor like NADH, NADPH.

In the present work the electrochemical reduction of 2,5-dichloronitrobenzene using stainless steel (SS-316) electrode in acidic media under galvanostatic (constant current) condition. Cyclic voltammetry was used to decide the reversibility of the process. Different nature of cyclic voltammetry was obtained in different media (Acidic, basic and neutral). This indicates that in different media different electrolysis products were obtained.

The biotransformation of the 2-nitroacetanilide was also carried out using free Baker's yeast in alcoholic aqueous media

Experimental

All the used reagents NaOH, CH_3COONa , KCl, 2,5-dichloronitrobenzene etc. were of AR grade. The solutions were prepared in double distilled water.

Cyclic voltammograms were obtained on a fully computer controlled Basic Electrochemistry System ECDA 001, using 3 electrode cell assembly with 1 mm diameter glassy carbon as working electrode, Ag/AgCl as reference electrode Pt wire as counter electrode. Cyclic voltammetric studies were carried out in alcoholic media using 4-nitroacetanilide (1. mM) KCl (1.0 M) as supporting electrolyte and BR buffer to maintain the desired pH viz. 5.0, 7.0 and 9.0 were taken in 10 ml cell. Galvonostat designed and made by CDPE was used for carrying out controlled current electrolysis.

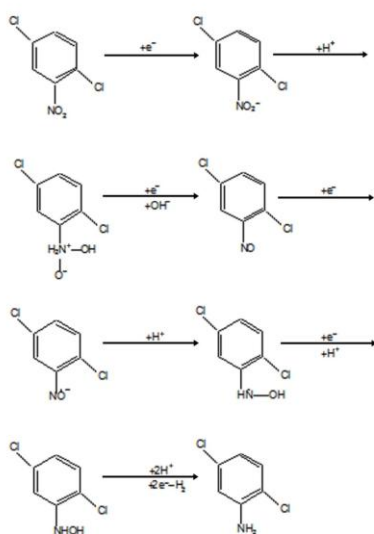
For constant current electrolysis the conventional H-cell was used, stainless steel electrodes were used both as anode and cathode. The electrolysis process was carried out in the pH of the solution was maintained at 5.0 for obtaining corresponding amine.

In a biotransformation process a suspension of Baker's yeast 30 g in water 80 ml was heated for 5 min at 70°C with vigorous stirring, and a mixture of 4-nitroacetanilide 0.5 g in methanol 40 ml and NaOH 4 g in H_2O



Ishwar Chand Balae

Lecturer
Deptt. of Chemistry,
Govt College,
Neem Ka Thana
Sikar, Rajasthan



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