Short communication

Fast catalytic oxidation of phenol over iron modified zeolite L nanocrystals

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Highlights

► Iron modified nanozeolite L was synthesized and tested in the oxidation of phenol.
► The oxidation was significantly enhanced by the addition of acetic acid.
► 93.40% of phenol conversion was achieved in 30 min.
► Acetic acid was oxidized by H₂O₂ to form peracetic acid.

Graphical Abstract

Oxidation of phenol in the presence of acetic acid was carried out over iron-modified nanozeolite L. The oxidation activity of phenol was significantly enhanced by the addition of acetic acid. It was found that the acetic acid was oxidized by H₂O₂ to form peracetic acid which served as a better oxidant.

Abstract

Iron modified zeolite L nanocrystals (Fe/KL) were synthesized hydrothermally by the incorporation of Fe³⁺ in zeolite L lattice. XRD results showed an increase in the inter-planar spacing and lattice parameters. Transition characteristic of the tetrahedral Fe³⁺ species were observed in the UV–Vis spectrum. The oxidation of phenol in the presence of acetic acid over Fe/KL gave 93.40% conversion in 30 min with selective formation of 77.47% catechol and 22.53% hydroquinone. The catalytic activity was significantly enhanced by the addition of acetic acid. It was found that the acetic acid was oxidized by hydrogen peroxide to form peracetic acid, which served as a better oxidizing agent.

1. Introduction

Oxidation of phenol has been given much attention in industries over the past few decades as mild oxidation of phenol produces benzenediols. Benzenediols, viz., catechol (CAT) and hydroquinone (HQ) are important precursors in the production of many valuable chemical products [1,2]. For example, catechol is used in the production of pesticides, perfumes and pharmaceutical products; hydroquinone is used as a major ingredient in rubber antioxidants, herbicides, and dyestuffs.

In recent years, many studies have been conducted for the oxidation of phenol using various heterogeneous catalysts such as titanosilicates [2–4], copper alginate [5], iron silica [6], zeolite-Y encapsulated metal complexes [7,8], and polymer-supported transition metal complexes [9]. Among the oxidants, hydrogen peroxide is often used for the oxidation of phenol, due to its clean and eco-friendly nature [10,11]. These catalysts showed good catalytic activity with good recyclability. However, most of the catalysts available for the production of CAT and HQ take ~6 h for the