



## Simultaneous Photocatalytic Reduction of Ni(II) and Oxidation of Naphthalene in Aqueous Solutions: A Kinetic Study and Energy Consumption

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### ABSTRACT

*The individual and simultaneous photocatalytic reduction of poisonous Ni(II) ion, coupled with photooxidation of the pollutant naphthalene (NA), were examined with trace amounts of commercial titania nanoparticles. A direct imposed irradiation photo-reactor was employed. The effect of major operational parameters, solution pH and temperature was investigated. The co-presence of naphthalene and Ni(II) ion gives a better separation of charge carriers, resulting enhancement in the both naphthalene oxidation and nickel ion reduction. Pseudo first order reactions are proceeding. As a relevant criterion, the electrical energy consumption and other criteria were evaluated and were compared with other previously reported processes.*

**Keywords:** photocatalytic reduction, naphthalene oxidation, Kinetic study, energy consumption,

### 1. INTRODUCTION

The pollution of water sources has been an increasing global concern with respect to the disposal of heavy metals and organic compounds in wastewaters. Nickel is one heavy metal with many applications in the important industrial fields such as stainless steel, nickel alloy, storage battery and electroplating [1]. On the other hand, Wastewaters from electroplating units, for instance, contain some organic materials in addition to metal ions, which are used in different stages of the manufacturing process, as lubricant, surfactant, polisher and so on [2]. Aromatic organic compounds, such as naphthalene, are widely used in industries as brighteners [3]. The approved limits for naphthalene existence in the surface water is changed from 8 µg/L to 10 µg/L.

In recent years, some new approach has been photocatalytic reduction of metal ions with simultaneous photocatalytic oxidation of organic pollutants. For example in a respective works simultaneous photocatalytic reduction of Cr(VI) and Ni(II) ions, coupled with oxidation of SDBS, is investigated using only 40 mg/L of titania nanoparticles. For this aim, naphthalene can be one suitable organic substance (brighteners) that conventionally exists in relevant wastewaters [4] despite their strong resistance nature in biodegradation treatment.

In this work, an investigation on the simultaneous photocatalytic reduction of Ni(II) and oxidation of naphthalene from aqueous solutions using UV/TiO<sub>2</sub> process was done. The effect of parameters such as initial pH, nickel and naphthalene concentration and temperature was investigated on the reduction efficiency (RE). The kinetic of reactions in the mixed solution is also investigated. Another important parameter is the energy consumption. In this regard, the process cost-effectiveness is estimated with respect to energy consumption.

### 2. MATERIALS AND METHOD