



## Manufacture characteristics of metal oxide–hydroxides for the catalytic decomposition of a sodium hypochlorite solution

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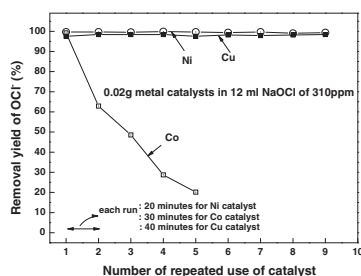
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### HIGHLIGHTS

- Decomposition of hypochlorite in a discharged stream after treatment of ballast water.
- Comparison of manufacture characteristics of various metal catalysts for decomposition of hypochlorite.
- Ni oxide–hydroxide catalyst superior to hydroxide and oxide type catalysts in decomposition of hypochlorite.
- Effective and stable packed column with the Ni oxide–hydroxide beads for decomposition of hypochlorite in seawater.

### GRAPHICAL ABSTRACT



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### ABSTRACT

In this work, we studied several manufacture characteristics of various metal catalysts of Ni, Co, Cu, and Fe for the catalytic decomposition of a sodium hypochlorite solution. The metal oxide, metal hydroxide, and metal oxide–hydroxide forms were prepared and compared. Ultimately, a bead-type catalyst impregnated with a metal oxide–hydroxide mixture was manufactured and evaluated. The metal ions were oxidized and precipitated in the form of metal oxide–hydroxide or metal oxide in a hypochlorite solution, and the precipitates could decompose the hypochlorite in solution. The Ni oxide–hydroxide catalyst showed the best hypochlorite decomposition performance and was the most stable among the other metal catalysts as well as the Ni hydroxide and Ni oxide catalysts. When the Ni oxide–hydroxide catalyst was manufactured in a hypochlorite solution, an optimal mixing volume ratio of hypochlorite solution to the metal ion solution was achieved. A column packed with Ni oxide–hydroxide beads was confirmed to continuously and effectively decompose hypochlorite in seawater.

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### 1. Introduction

Sodium hypochlorite (NaOCl) is a compound that can be used for water purification. In addition, it is widely used in industry for surface purification, bleaching, odor removal, and water purifi-

cation. Recently, interest has increased regarding the treatment of the ballast water of ships using sodium hypochlorite that is electrochemically generated onboard [1–3]. This increased interest has been generated because the International Maritime Organization has developed international legislation, the International Convention for the Control and Management of Ships' Ballast Water and Sediment, to regulate discharges of ballast water and reduce the risk of introduction of non-native species from ships' ballast

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