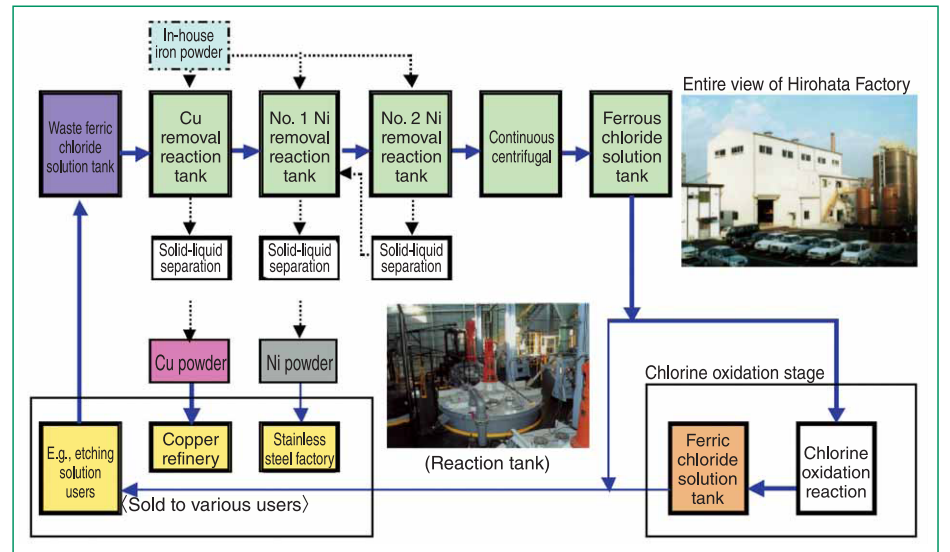


Recycling of waste ferric chloride solution along with collection of copper and other valuable metals

# Recycling Technology for Waste Ferric Chloride

## Features

- Recycles waste ferric chloride solution and other waste acid solutions to reproduce metals.
- Collects dissolved valuable metals (e.g., copper, nickel, and chrome), respectively, from ferric chloride solution and other waste acid solutions.
- Provides a merit of waste reduction as a consequence of the recycling of dissolved valuable metals collected from waste acid solutions.



Recycling System (Flow) of Ferric Chloride Solution

## Overview

(Technical principles, actions, etc.)

Etching stages of electronic parts typified by semiconductors and IC lead frames on production sites discharge waste ferric chloride solution that contains valuable metals, such as copper (Cu) and nickel (Ni). These metals are dissolved into the solution from products, such as copper foils, lead frame plates, and stainless steel plates in production process.

- Astec Irie utilizes highly reactive oxygen gas powder (OGP) of high quality manufactured in-house at low cost and controls the oxygen reduction potential (ORP) of ferric chloride solution, thus making it possible to collect valuable metals, i.e., Cu and Ni (in the state of metals) and Cr (in the state of chromium hydroxide) separately.
- The technology is a continuous treatment process that makes it possible to use compact facilities.
- Japan's first waste acid recycling process.

(Reference: Patents)

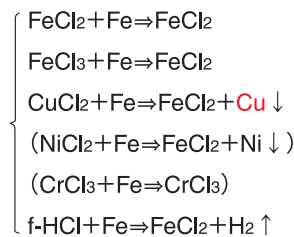
- H2.05.01 App. No. 2-116388: Method for Removing Heavy Metal of Iron Chloride-Base Waste Liquid  
 H3.11.14 App. No. 3-323856: Method for Purifying Iron Chloride-Base Waste Liquid Containing Chromium or the Like  
 H4.10.16 App. No. 4-304816: Method for Purifying Iron Chloride-Base Waste Liquid Having Low Content of Chromium Ion  
 H8.06.28 App. No. 8-188506: Treatment of Aqueous Iron Chloride Solution Containing Ferric Ion  
 H8.06.28 App. No. 8-188508: Method for Removing Impurity Metal of Aqueous Iron Chloride Solution Using Iron Powder Fluidizing and Agitating Vessel

### System Characteristics

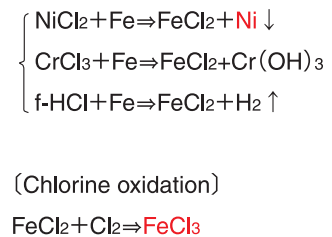
In the past, waste ferric chloride solution was neutralized and disposed as industrial waste. Astec Irie's new technology enables the collection of individual metals. This technology processes waste ferric chloride solution added with in-house iron powder as a reducing agent, controls the oxidation reduction potential (ORP) and pH of the solution by utilizing the difference in ionization tendency between the iron powder and dissolved metal ions, separates the Cu and Ni ions in the solution, and recovers them. The collected Cu powder and Ni powder are sold as materials to stainless steel factories while ferrous chloride after the elimination of the valuable metals is converted into ferric chloride and sold to etching solution manufacturers.

As explained above, this technology recycles waste solutions, which were discarded as waste in the past, and reproduces the commercial products, thus contributing to the reduction of global environmental burdens and the effective reuse of scarce metals.

### (Cu removal reaction tank)



### (Ni removal reaction tank)



Reaction mechanism

## Introductory Track Record

### Operation records of accomplishment

- Japan: Yahata Factory (Kitakyushu) and Hirohata Factory of Astec Irie Co., Ltd.

## Effects

- This technology enables the recycling of waste ferric chloride and other acid solutions, which were discarded as industrial wastes in the past. The technology enables the collection and reuse of Cu and Ni, in particular, which are in high demand worldwide these days and the depletion of them is apprehended. The recycled solution is converted into ferric chloride and provided to users who will utilize it for etching solution and coagulant for sewage disposal. Therefore, this technology enables the reduction of industrial wastes to realize zero emissions, thus contributing to the reduction of global environmental burdens.

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