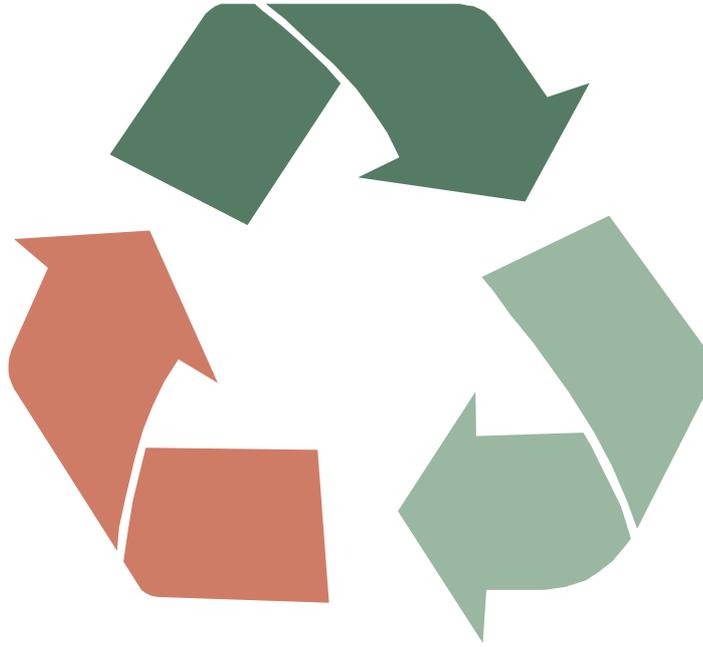


# MECER



## CLOSED LOOP RECYCLING OF ACIDIC CUPRIC CHLORIDE ETCHANT

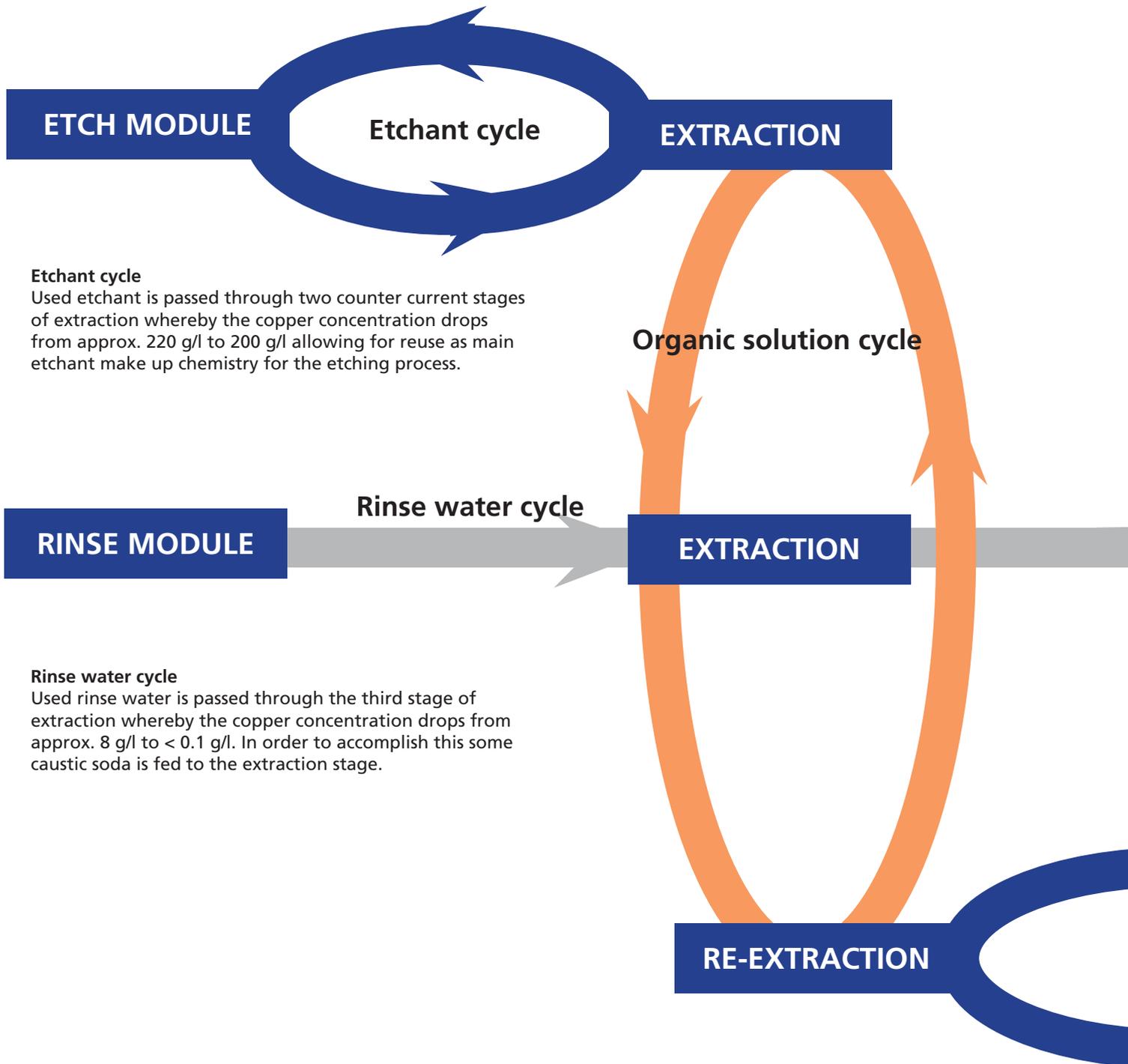


# HOW THE SYSTEM WORKS

## The MECER process for acidic cupric chloride etching

During the etching process of printed circuit boards, the etchant becomes increasingly loaded with copper. Optimum etching performance is achieved when the copper concentration of the etchant is between 200-220 g/l with an equivalent amount of chloride ion and a low free hydrochloric acidity of < 0.05 molarity. Relevant oxidation potential of the working etchant solution is maintained by means of dosing an oxygen gas mixture to the etching zone. The given chemical environment is controlled by adequate sensors which intermittently activate the dosing of

regenerated etchant from the recovery system, and small amounts of hydrochloric acid. Overflowing excess etchant is recycled in the MECER extraction system for recovery of all etched copper and etching chemistry. The production of big volumes of environmentally hazardous spent etchant is eliminated. The rinse water falling from the rinse section is also treated in the recovery process to recover its copper content. The water effluent with minor copper concentration is taken to waste water treatment.



**Etchant cycle**  
Used etchant is passed through two counter current stages of extraction whereby the copper concentration drops from approx. 220 g/l to 200 g/l allowing for reuse as main etchant make up chemistry for the etching process.

**Rinse water cycle**  
Used rinse water is passed through the third stage of extraction whereby the copper concentration drops from approx. 8 g/l to < 0.1 g/l. In order to accomplish this some caustic soda is fed to the extraction stage.

An integrated MECER system has three main functions:

- Solvent Extraction (SX) for removal and transfer of copper from used etchant and rinse water to an acid electrolyte. Two types of solvent extraction units exist, the Mixer Settler unit and the Mixer Extractor unit.
- Electrowinning (EW) for transfer of the copper from said electrolyte for production of high quality copper metal.
- Auxiliary equipment such as process control system, transport tanks and buffer tanks etc.

#### Organic solution cycle

The organic solution is loaded with copper from etchant and rinse water in the respective stages. In the two reextraction stages the copper leaves the organic solution and transfers to the acid electrolyte. Having passed the reextraction stages the organic solution is ready for a new extraction cycle.

#### Acid electrolyte cycle

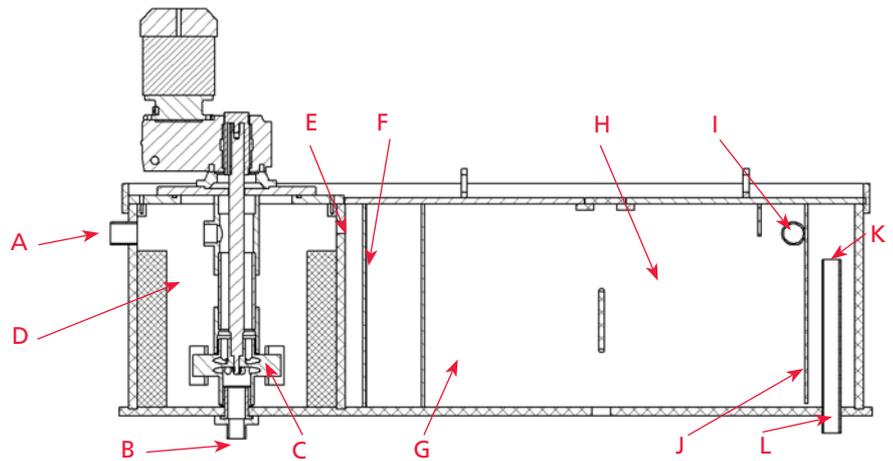
Acid electrolyte from the electrowinning cell is passed through the fourth and fifth stages for reextraction increasing its copper concentration before being returned for continuous copper plating in the electrowinning cell.

Acid electrolyte cycle

**ELECTROWINNING**

## The Mixer Settler

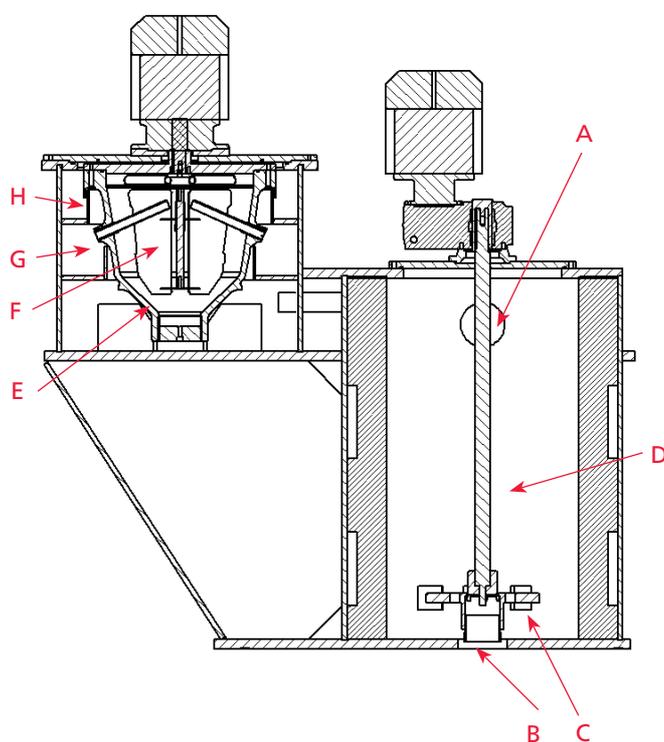
The Mixer Settler is an apparatus used for solvent extraction which includes the following functions. In the mixing chamber (Mixer) two in each other insoluble solutions, (one is organic and the other aqueous) are mixed whereby transfer of copper ions between the two solutions takes place. The liquid dispersion overflows into a large separation chamber (Settler) where it settles into two liquid layers under the influence of gravity. The upper layer is the low density organic solution and the lower is the high density aqueous solution. In the far end of the mixer settler the two solutions leave the unit overflowing to separate exits as pure aqueous and organic liquids.



- A. Inlet of organic solution
- B. Inlet of aqueous solution
- C. Mixing impeller
- D. Mixing Chamber (Mixer)
- E. Dispersion overflow
- F. Dispersion distribution wall
- G. Separation chamber (Settler)
- H. Separated solutions, where organic solution (low density) forms the upper, and the aqueous solution (high density) the lower layer
- I. Organic solution overflow exit
- J. Separation wall between the organic and aqueous solutions
- K. Aqueous solution overflow
- L. Aqueous solution exit

## The Mixer Extractor

The Mixer Extractor is an apparatus used for solvent extraction which includes the following functions. In the mixing chamber (Mixer) two in each other insoluble solutions, (one is organic and the other aqueous) are mixed whereby transfer of copper ions between the two solutions takes place. The liquid dispersion overflows into a centrifuge where it is allowed to separate into two layers. The inner layer is the low density organic reagent solution and the outer layer is the high density aqueous solution. In the outlets of the extractor, the two solutions are taken out as pure aqueous and organic reagent liquids.



- A. Inlet of organic reagent.
- B. Inlet of aqueous solution
- C. Mixing impeller
- D. Mixing Chamber (Mixer)
- E. Separation chamber (Extractor)
- F. Separated solutions, where reagent (low density) forms the inner and the aqueous solution (high density) forms the outer layer
- G. Organic reagent outlet
- H. Aqueous solution outlet

## Hydrochloric acid consumption is reduced by about 95%

The etching chemistry is recycled and the hydrochloric acid consumption is drastically reduced. The only acid consumed corresponds to the amount of etchant drag out from the etching chamber.

## Use of environmentally hazardous hydrogen peroxide is eliminated

Oxygen gas enriched to a certain degree with ozone substitutes environmentally hazardous liquid oxidation chemicals.

## Maintenance advantages for the etch machine

Thanks to the low acidity of the etchant the strong and hazardous odor of hydrochloric acid vapor is eliminated. This provides significant benefits to the working environment in connection with maintenance actions in the etching line.

## Recovery of pure metallic copper

The final product from the recycling is 99,995 % pure copper, which can be sold to the metal market. Each copper sheet weights around 130 kg.

## Optimally controlled etching condition

By the integration of a MECER system all parameters for consistent and high performance etching will be controlled. The low etchant acidity provides much better conditions for optimum etching control with improved undercut performance. The oxygen/ozone environment creates better conditions for control of oxidation potential and monovalent copper content.

## Reduced possibilities for liability

With a 95% reduction in hydrochloric acid consumption and elimination of spent etchant transports the possibilities for liability are dramatically reduced. Great benefits in terms of logistics are achieved.

## Secured etching operation

The MECER system is configured in such a way that if the system should ever fail, for whatever reason, it is possible to continue the etching operation according to the original (once through) nonrecovery etching procedure.

## Buffering capacity

The integrated MECER installation includes a buffer tank capacity for independent etching operation. It also optimizes the available operation hours for the regeneration system as well as for the etching operation.

## Short pay-back time

By the cost reduction for hydrochloric acid, oxidation chemicals and the revenue from the recovered high quality copper, the pay back time on investment is usually between 12-24 months.

## Low maintenance cost

A high grade of automation and optimized design, provides for low maintenance cost.

## No hazardous gases

The electrowinning technology used in the system is well known by the PCB industry and has no formation of highly hazardous gases.

## Location of installation

The MECER system can be installed anywhere within the plant independent on the distance to the etching line.

## Many years of operation experience

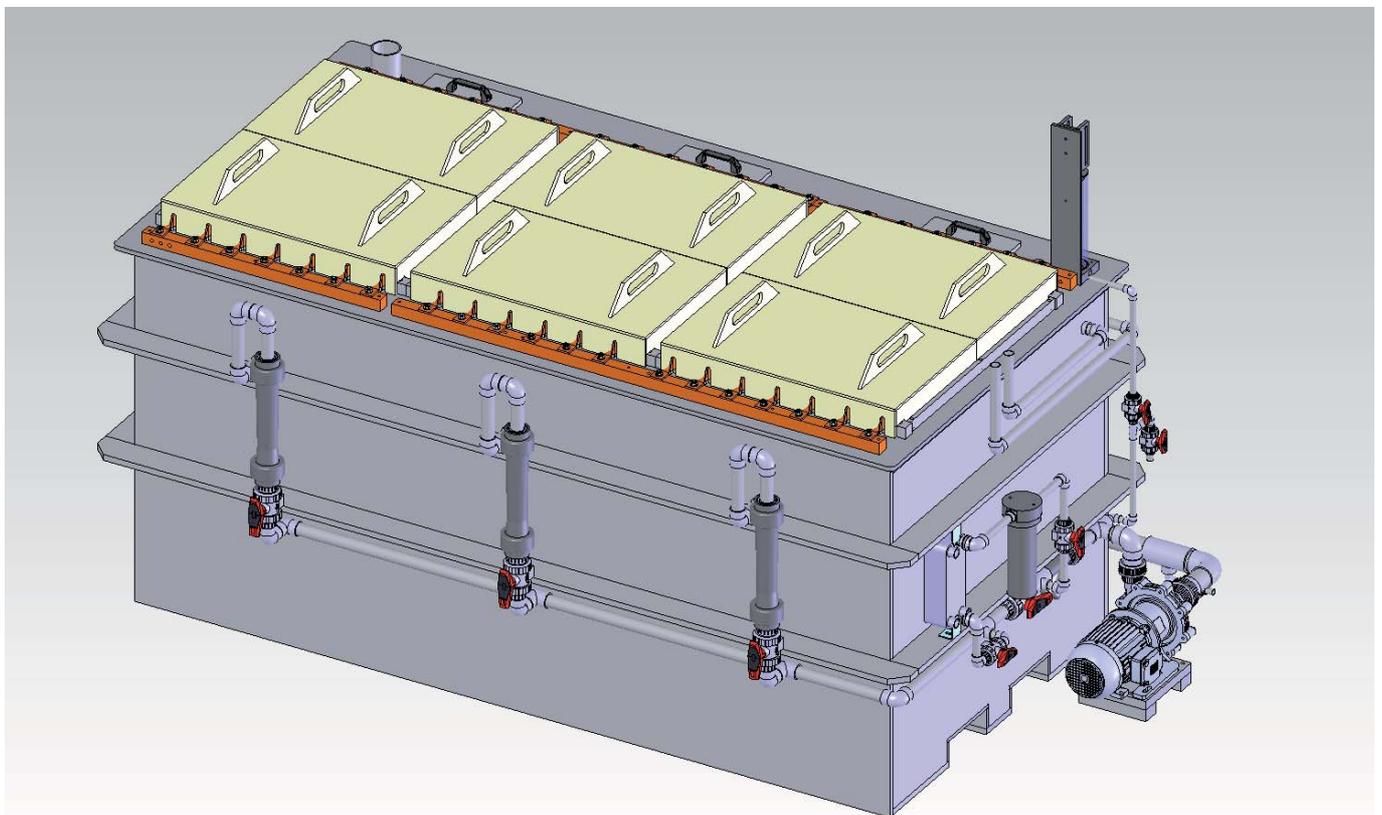
MECER systems have been on the market for nearly 30 years giving an unbeatable know-how and operation experience for recycling of alkaline etchant. All the basic closed circuit concepts are essentially the same for the acidic MECER.



*Buffer tanks*

## Environmentally friendly

Since the need for transportation of voluminous hazardous chemicals is drastically reduced, the risk for environmental contamination is eliminated. Logistics situation is improved and natural resources are saved.



*Electrowinning cell*

## General

The capacity of a particular MECER installation depends primarily of the total throughput of copper in the etching line per 24 hour. There are basically two types of extraction equipment available, the Mixer Settler and the Mixer Extractor units. Choice of equipment type depends on the capacity required.

A complete integrated MECER system contains the following process units:

- Extraction unit (SX)
- Electrowinning unit (EW)
- Buffer tanks
- Etching control unit
- PLC based control system
- Auxiliary equipment

## Why Mixer Settler or Mixer Extractor?

Mixer Settler units only utilizes gravity force to separate the organic from the aqueous phase in the Settler part. This is the best solution for small and medium capacity demands. For equipment with high capacity, the Mixer Settler unit would be very large and it is for these units more favorable to use a Mixer Extractor unit. In a Mixer Extractor unit, the separation of the organic and the aqueous phase is taking place in a centrifuge where the separation speed is accelerated by centrifugal force.



*Mixer Extractor unit*

## Installation

Both Mixer Settler and Mixer Extractor alternative systems are designed with separate parts for solvent extraction, electrowinning, control equipment and buffer tanks which make it flexible to install at various locations. The solvent extraction part includes Mixer Settlers or Mixer Extractors and all necessary auxiliary, pumps, motors and instruments. Included in electrowinning part are the circulation tank, electrowinning baths, rectifier and other necessary equipment. The buffer tank part contains tanks, pumps and instruments.

## Etching control unit

This unit includes density monitoring device, acidity control instrument and ORP sensor for the operating etchant. It is used to control dosing of regenerated etchant, hydrochloric acid and ozone gas supply. It is complete with all functions necessary for maintaining constant etching conditions.

## PLC based control system

The function of the MECER system is controlled by PLC based system providing fully automatic operation and alarm management.

## Auxiliary equipment

The following is a list of equipment which optionally, depending on the situation at each individual installation, may be included in the delivery.

- Etching control unit
- Buffer tanks
- Cathode rinse station



*Mixer Settler unit*

With its 30 years of experience in liquid-liquid extraction Sigma Engineering AB has a leading position in this area. With the MECER process, a patented solvent extraction technique has been employed to accomplish the integrated recovery of etchants.

More than 100 MECER installations have been installed at printed circuit board facilities world-wide, some of them in operation for more than ten years. Increasing environmental concern during recent years has strongly influenced the efforts of the Printed Circuit Board industries in the areas of chemical waste treatment and recovery. Primary importance seems to be placed on those systems which are capable of providing point-of-source, closed-loop recycling, and thereby the possibility for material reuse. The patented MECER system provides for such recycling of acidic as well as alkaline etchant. Additionally, the process is totally integrated into the printed circuit board production scheme.

In response to requirements from the PCB industry during the latest years Sigma Engineering AB has developed the recovery system for acidic cupric chloride etchant called the acidic MECER. This process is quite similar to the alkaline MECER, on the market since 30 years, also using solvent extraction and electrowinning technology. All the basic closed circuit concepts are essentially the same. It goes without saying that Sigma in this new development relies on a long term experience and know how gathered from many deliveries of the alkaline MECER.



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