

At a Glance

Copper etchant is a hazardous chemical used to remove copper from plastic boards during the manufacture of printed circuit boards (PCBs). The traditional copper etching process creates large quantities of waste etchant for disposal.

This project sought to prevent the generation of this waste etchant at Micam by utilising the Elo-Chem closed loop copper etchant regeneration system which allows continuous regeneration of etchant and the subsequent recovery of high purity copper for sale.



Copper Etchant Phase 1 Regeneration Chamber

CGPP2004/10

Closed loop regeneration and recycling of copper etchant used in printed circuit board manufacture



MICAM Ltd.,
Sean Moylan Park, Mallow, Co. Cork

Micam Ltd is a leading European manufacturer of specialist reinforced plastic laminates, pre-impregnated materials, machined components and printed circuit boards. Micam is based in Mallow, Co. Cork.

Aim of this Project

The aim of the project was to replace Micam's copper etching system for printed circuit boards, which was responsible for over 80% of the hazardous waste generated on-site, with the Elo-Chem closed loop recycling system for the etchant integrated with a system for the recovery of high purity copper.

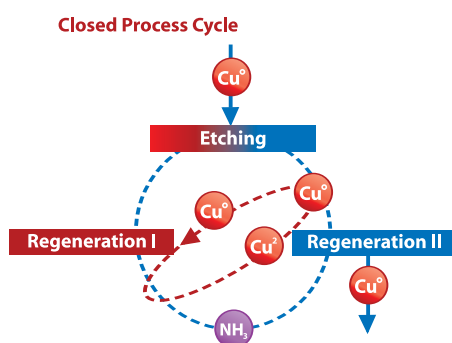


Figure 1 Schematic of the closed loop copper etchant regeneration system

After initial installation of the system, the main focus was the testing and commissioning of the system in Micam's production environment, introducing this system as a production process and the development of operating and maintenance procedures. This involved plant commissioning, testing and employee training. In addition the project focused on reducing ammonia emissions to air and waste water and reducing copper emissions to sewer.

Project Description

The closed loop recycling system has a two stage regeneration process:

Regeneration I

The copper etchant in the etching machine is continuously reactivated by the injection of oxygen and ammonia from the electroplating process and by ammonia gas cylinder controlled by solution pH.

Regeneration II

Copper is electroplated out of the etchant solution onto stainless steel plates. The copper is then removed from the plates in the form of a foil plate, which is then sold.

The key features of the project were as follows:

- Testing, fine-tuning and commissioning of the etchant regeneration installation to ensure the installation met the required production throughput and etchant recovery rates.
- Testing of the post-etch and final rinse water to ensure licence requirements were met and to determine if post-etch rinse water flow rates could be reduced.
- Determination of copper discharges to sewer before and after installation and completion of investigation on reducing copper emissions to sewer.
- Determination of ammonia emissions from the new process and completion of investigation on reducing ammonia loss.
- Development of operational and maintenance procedures.
- Training members of Micam staff on operation, trouble-shooting, maintenance and safety/environmental aspects of the system.

Achievements

The successful implementation of the project has resulted in the following environmental and cost savings.

During 2005 the following outcomes were realised:

- The production of 23 tonnes of hazardous etchant waste was prevented.
- 2.8 tonnes of copper plate was recovered and sold at a price in excess of 50% of the London Metal Exchange value for grade A copper.
- Eliminated on-site bulk storage of hazardous fresh and spent etchant and eliminated the need to transport hazardous etchant to and from the site thus reducing safety and environmental risks.

Lessons

This project involved a large financial investment in plant and equipment with significant management resource investment on the technical side during the commissioning process along with subsequent employee development and training on the system operation and maintenance.

The environmental improvements achieved have exceeded initial expectations but the resultant process cost savings were less than expected and the company experienced a 25% loss in production rate as a result of the new etchant regeneration system.

Based on Micam's 2004 PCB production the company expected the project investment to pay for itself within 3 years. In 2005 due to the collapse of the European PCB market from

Forecast competition, the PCB production level at Micam fell to 33% of the 2004 level. During 2006 production fell again. From a financial point of view the large investment on plant and equipment should have been made 5 years earlier when the European market for PCBs was strong and still sourcing within Europe.

More Information

For more information on this project please contact:

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Cleaner Greener Production Programme

The Cleaner Greener Production Programme (CGPP) of the EPA was funded under the National Development Plan 2000 – 2006. The CGPP was launched in 2001 as a grant scheme to Irish organisations to implement cleaner greener practices while achieving significant cost savings.

Cleaner Greener Production is the application of integrated preventive environmental strategies to processes, products and services to increase overall efficiency and reduce risks to humans and the environment.

- Production processes: conserving raw materials and energy, eliminating toxic raw materials, and reducing the quantity and toxicity of all emissions and wastes
- Products: reducing negative impacts along the life cycle of a product, from raw materials extraction to its ultimate disposal.
- Services: incorporating environmental concerns into designing and delivering services.

The programme aims are focussed on avoiding and preventing adverse environmental impact rather than treating or cleaning up afterwards. This approach brings better economic and environmental efficiency.

Under Phase 2 of CGPP, 22 organisations were funded from a variety of sectors (e.g. chemicals, food, metals, electronics, service). The total achievements from the projects for the participating organisations included annual reductions of 250,000 tonnes in input/output streams (water/waste water), 660 MWh energy reduction and €1.6m cost savings.

The programme will continue to be funded by the EPA in the NDP 2007-2013.

This case study report is one of the reports available from the companies that participated in the second phase of the Cleaner Greener Production Programme. A summary of all the projects and CD containing all the reports are also available.

More information on the programme is available from the EPA:

Ms. Lisa Sheils or Dr Brian Donlon,
Environmental Protection Agency,
Richview, Clonskeagh Rd., Dublin 14, Ireland.
www.epa.ie/researchandeducation/research/

Programme Managers...

The Clean Technology Centre (CTC) at Cork Institute of Technology was appointed to manage the programme. Established in 1991, the CTC is now nationally and internationally regarded as a centre of excellence in cleaner production, environmental management and eco-innovation across a range of industrial sectors.

KPIs (Key Performance Indicators)	Before (July-Sept 2004)	After (Jan-Dec 2005)	Programme Outcomes
M2 of PCB production	9815	10809	
Waste Etchant produced Kgs/m ² pcb prod.	2.24	0.008	99.6 % reduction in hazardous waste etchant produced.
Ammonia to sewer g / m ² pcb prod.	1.16	0.21	82 % reduction in Ammonia discharge to Sewer.
Ammonia to Air g / m ² pcb prod.	96	65.7	31.5 % reduction in ammonia emission to air.
Copper to sewer g / m ² pcb prod.	0.18	0.134	25.5 % reduction in Copper discharge to Sewer.
Etching Process Cost Comparison €/kg of copper etched	5.18	3.62	30% reduction in etching operation process costs after sale of recovered copper.
Rate of Production in panels / hr	400	300	25% loss of production capacity / hour

