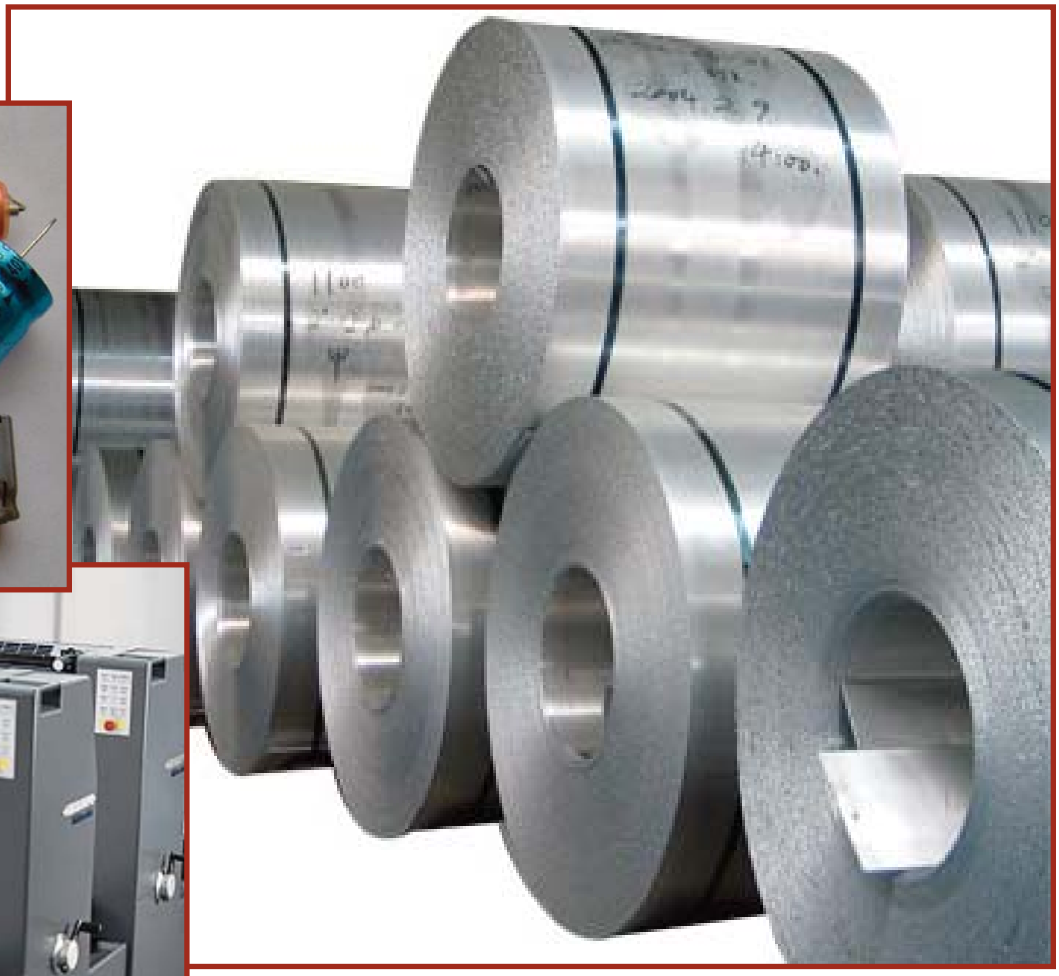
Chemical Recovery and Purification Systems for Aluminum Processing

in the manufacture of

Electronic Capacitor Foil and Lithographic Printing Plates



Acid Purification and Recovery

Chemical Treatment Processes

Modern methods for the production of electronic capacitors and lithographic printing plates involve the modification of the surface structure of aluminum foils by electro-chemical processes.

These processes often involved the use of one or more of the following acids:

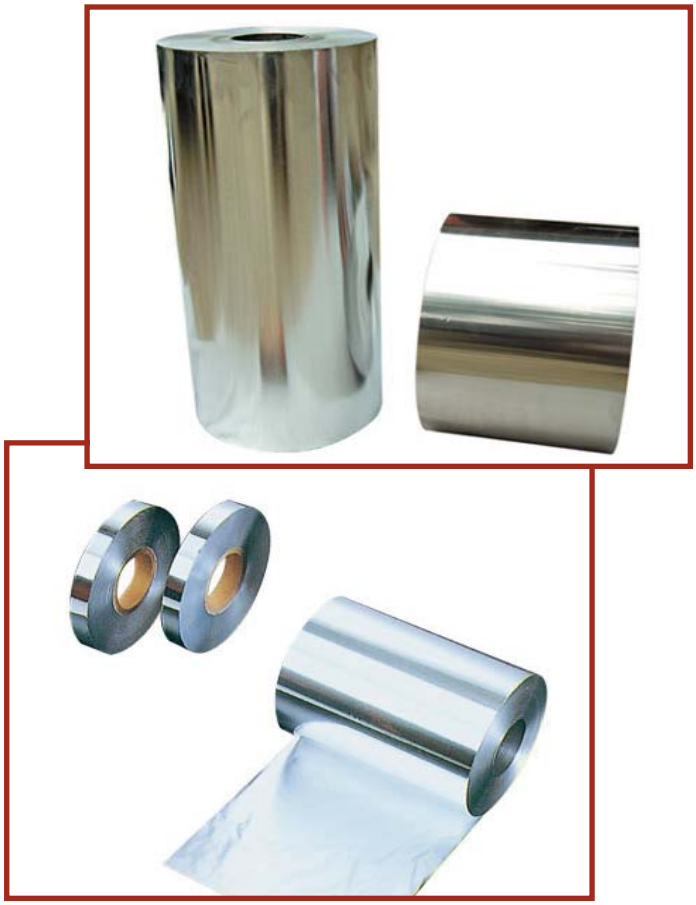
- ***Phosphoric Acid***
- ***Nitric Acid***
- ***Hydrochloric Acid***
- ***Sulfuric Acid***
- ***Various Weak and Organic Acids***

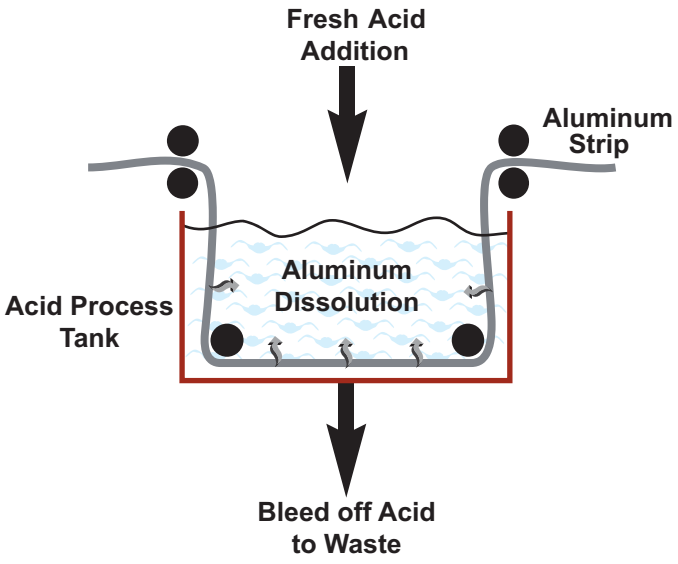
These processes go by various names depending on the process objectives such as:

- ***Etching***
- ***Graining***
- ***Forming***
- ***Anodizing***

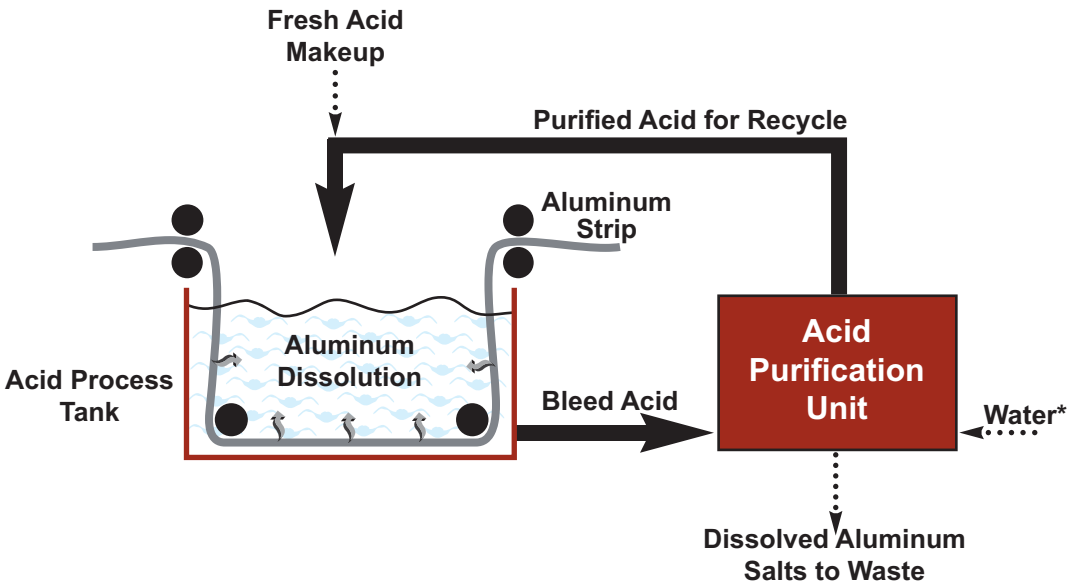
Typically, the process results in some dissolution of aluminum metal into the acid that forms aluminum salts. An increase in dissolved aluminum is undesirable in the acid as it can effect the surface characteristics of the aluminum foil either directly or by affecting the electrical current flow in the acid solution. The most common method to control the concentration of dissolved aluminum is to periodically or continuously bleed off acid from the process and replace it with fresh acid. This acid bleed process presents a number of problems for the manufacturer:

- ***High cost of replacement fresh acid***
- ***High cost of waste acid neutralization***
- ***High cost of handling sludges generated in waste treatment***
- ***Meeting allowable waste discharge concentrations of salts***





Acid Purification and Recovery



* *some applications require only water, other applications require water and alternate acid for regeneration (typically sulfuric or hydrochloric acid).*

By separating the dissolved aluminum from the acid, the acid can be recycled and reused in the process. This has the following benefits:

- ***Reduction in acid purchases***
- ***Reduced costs for waste acid neutralization***
- ***Reduction in waste sludges - in some cases, the waste aluminum can be converted to a by-product having commercial value***
- ***Reduction in waste salt concentration (e.g. lower nitrate, phosphate)***

Eco-Tec systems use ion exchange resins to separate the dissolved aluminum from the acid. Compared with traditional ion exchange equipment, Eco-Tec uses its proprietary, high efficiency Recoflo® process in one of two equipment configurations:

1. **Acid Purification Unit (APU®)**
2. **Decationization and Purification Unit (DPU™)**

Acid Purification and Recovery

Acid Purification Unit (APU®)

Applications

- High acid concentrations (>100 g/l)
- Low value acids (e.g. sulfuric)

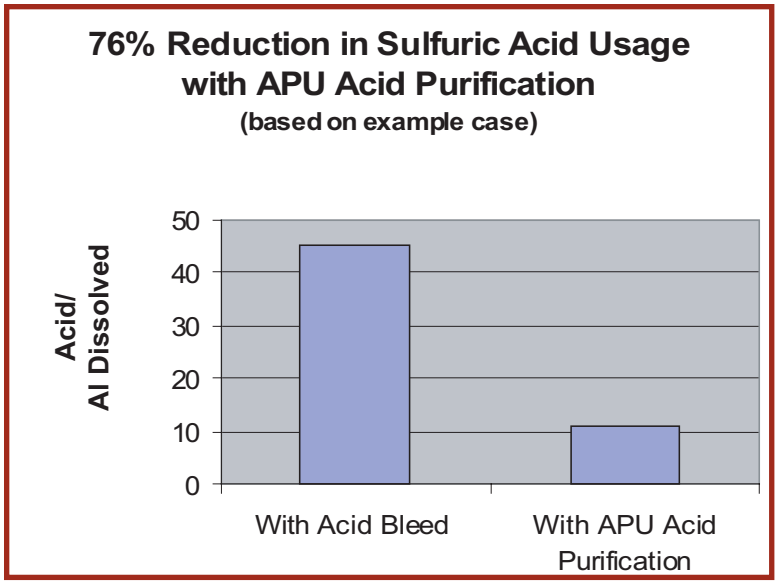
Features

- Uses resin sorption separation process
- No chemicals used in process - only water
- Low operating cost
- No risk of cross-contamination
- Removed dissolved aluminum as salt of process acid (i.e. for sulfuric acid process, waste is aluminum sulfate)

Acid Purification Unit installed on Capacitor Foil Process in Korea

Example of Performance

Stream/Component	Free - H_2SO_4 (g/l)	Al (g/l)	Total - H_2SO_4 (g/l)	Relative Volume
Process Acid	200.0	5.0	227.2	1
Purified Acid	193.5	3.8	214.6	1
By-product/Waste	20.5	3.8	41.6	0.32
Water	-	-	-	0.32



Decationization and Purification Unit (DPU™)

Applications

- Low acid concentrations (<100 g/l) or weak acids (e.g. phosphoric)
- Low aluminum concentrations (<3 g/l)
- High value acids (e.g. phosphoric, nitric, orgnic acids)
- Requirement for minimal acid salt (e.g. nitrates, phosphates) to waste

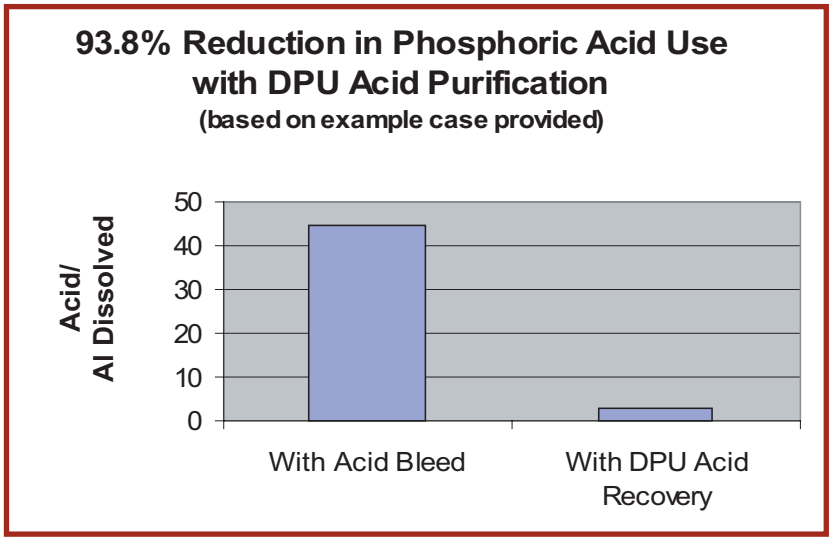
Decationization and Purification Unit (DPU) installed on Capacitor Foil Process in Japan

Features

- Uses high efficiency cation exchange with acid sorption for minimizing regenerant acid consumption
- Excellent economics
- Greatest reduction in acid salt (e.g. nitrates, phosphates) to waste
- Removes dissolved aluminum as salt of regenerant acid (i.e. for phosphoric or nitric acid process, using sulfuric acid for regeneration, waste is aluminum sulfate)

Example of Performance

Stream/Component	H_3PO_4 (g/l)	Al (g/l)	H_2SO_4 (g/l)	Relative Volume
Process Acid	90.0	2.0	0	1
Purified Acid	85.0	0.2	< 0.1	1
By-product/Waste	7.2	2.6	22.4	0.7
Water	-	-	-	0.7
Regenerant	-	-	1742.0	0.009



Systems to Meet Your Requirements and Process Objectives

Eco-Tec has a range of standard Acid Purification models. As a result of our extensive experience, we can help select the model best suited to meet your particular needs. In most cases, we have process data to support the performance capabilities of any system that is offered. In some cases, we develop optimized performance conditions in our automated pilot testing and laboratory facility.

In some cases, additional or alternate equipment may be required to offer a complete solution. Eco-Tec has experience with:

- ***Water Demineralization or rinse water recycling using ion exchange or Reverse Osmosis***
- ***Evaporation***
- ***Filtration***
- ***Chemical Treatment***

Simply complete an Engineering Survey Form and submit it for a detailed technical and commercial proposal to meet your needs.

Systems are designed, manufactured, and tested in our factory as fully assembled, skid-mounted equipment, ready for shipment anywhere in the world. Eco-Tec provides full, on-site services for commissioning, performance demonstration, operator training, and technical support.

Eco-Tec is the global leader in the purification and recovery of acids and other chemicals used in aluminum surface finishing. Since its first installation in 1977 for sulfuric acid purification in an aluminum anodizing process, Eco-Tec has installed hundreds of systems in more than 55 countries on a variety of acid mixtures and processes.

Below is a list of some of Eco-Tec's clients. Based on successful experience with their systems, many clients have returned to Eco-Tec to puchase numerous systems for their operations.

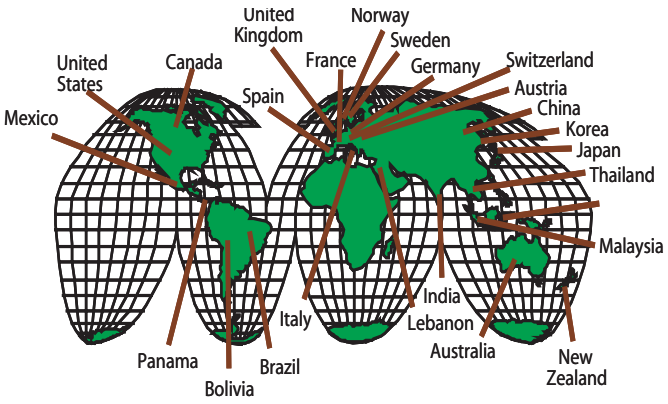
Acid Purification Partial User's List

Customer	Location
Agfa Graphics Limited **Multiple Systems**	Leeds, UNITED KINGDOM
American Litho Inc.	Michigan, USA
CMC	Washington, USA
Kodak	Colorado, USA
IBF	Rio de Janeiro, BRAZIL
Nippon Chemicon Corporation **Multiple Systems**	JAPAN
Samyoung **Multiple Systems**	Kyundki-Do, KOREA
SPA Process Technology	Alsama, SAUDI ARABIA
Technova	Taloja, INDIA

Eco-Tec

For over 35 years, Eco-Tec has specialized in industrial equipment designed to improve operational efficiencies, while at the same time addressing environmental needs.

Working with regional, national and international corporations including General Motors Canada, Airbus Industries, Nippon Chemicon, PEMEX, Ontario Power Generation, John Deere, Sinopec Anqing, and Sterlite Industries, Eco-Tec is providing solutions world wide.



Customer Service

A key to the success of Eco-Tec is our focus on Customer Service. Skilled members of our Customer Service Team will supervise system installations and train the operating and maintenance personnel. To ensure a system operates at peak efficiency, our Performance Evaluation Program monitors the operating sequence, measures key process parameters and adjusts when necessary. Our Customer Service is available around the clock for emergency technical service.

The Eco-SERV™ Program

Factory and On-Site Training

Commissioning Supervision

Performance Evaluation Program

24/7 Service

Lifetime Monitoring

Extensive Parts Inventory

Laboratory Backup

Process Development Capabilities

Chemical Laboratory

Automated, Computer Controlled Pilot Plants

Extensive Technical Database and Library

Knowledge Network and Strategic Partners

Fabrication Capabilities

Engineering Design

Stainless and Carbon Steel CertifiedWelding

Plastic Fabrications

Chemical Treatments and Formulations

Paint & Coatings

Electrical Design Programming

Mechanical Assembly

Full Process Test

Awards

2007 Canadian Innovation Award for Environmental Technology

2007 Ontario Global Traders Award for Innovation for Excellence in Exporting

2005 Ontario Global Traders Award for Innovation for Excellence in Exporting

2005 Ontario Global Traders Award for Market Expansion

2005 Falconbridge Innovation Award

2004 Canadian Innovation Award for Environmental Technology

Eco-Tec Inc. designs, develops and manufactures water purification, gas processing and chemical recovery systems for industrial operations and facilities around the world. Eco-Tec systems incorporate proprietary technology including the Recoflo® ion exchange process, which uses a short, compressed resin bed to reduce overall equipment size and improve system operating effiiency.

Applications for Eco-Tec systems include:

- Industrial Water Treatment
- Aluminum Anodizing
- Stainless Steel Finishing
- Amine Purification
- CO_2 Recovery
- Produced Water
- Electroplating
- Hydrometallurgy
- Pulp & Paper
- Biogas Purification

Eco-Tec offers continuous product and process development, engineering design, equipment manufacture and assembly, sales and technical support for clients. Equipment is manufactured at the Canadian headquarters and is ISO 9001:2000 registered.

Complete systems often incorporate additional process technologies such as filtration, membrane processes, crystallization and evaporation. Efficient processes provide high throughput and performance and address environmental issues, while keeping lifecycle costs low. The equipment is skid-mounted and manufactured with a compact design. This allows for ease of installation and minimizes equipment costs. Essentially, Eco-Tec systems enable our clients to economically, effectively and efficiently manage Earth's resources.

Over 1,500 systems have been commissioned and installed in over 55 countries around the world. Eco-Tec is represented in all major and emerging markets through a network of agents and distributors. Eco-Tec is proud to have been recognized as one of Canada's 50 Best Managed Private Companies and has received the Canada Award for Business Excellence.

For a Quote - Email: ecotec@eco-tec.com

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