



Company, Technology and Products Overview

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Renovare International, Inc.

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Company Overview

Renovare¹ International, Inc. is a California corporation, headquartered in Northern California in the city of Alameda. The Company is privately owned.

Renovare is dedicated to providing superior low-cost, high-performance solutions to the metal plating, microelectronics and related industries' need to remove metals from its process and waste waters. Its RenoCell^{®2} product line is based on a world-class electrochemical technology utilizing a patented three-dimensional cathode that reduces metal concentrations to the sub-ppm³ range with the lowest cost of ownership. Today, RenoCell products are sourced from a world-class supply chain and available through Renovare selected resellers and OEM suppliers. RenoCell designs are compact, modular, industrial grade and adaptable to all industrial environments, and are supported through the combination of Renovare staff and supplier resources. This allows Renovare to provide superior products and services that exceed customer expectations, and position RenoCell as the technology of choice in identified strategic markets for industrial applications of metal removal and recovery.

Background

The Company was incorporated in October 1996 primarily to exploit the advantages of a unique patented electrochemical technology.⁴ Renovare, through its RenoCell product line, offers its users improved operations and reduced cost for metal removal and recovery. Renovare obtained an exclusive worldwide license in mid-1997 and began shipment of its first commercial RenoCell products in 1999.

Early Stage Accomplishments

- The successful engineering and manufacturing of three RenoCell product models (see RenoCell specifications).
- Proven application success in more than 30 different applications within the printed wire board, metal finishing, and precious metals market segments.

¹ Renovare — Latin *renovare*, to make new; the root of the English word renovate.

² RenoCell[®] is Renovare's registered trademark for the commercial implementation of the Porocell technology.

³ ppm - parts per million, or milligram/liter (mg/L).

⁴ Patents have been issued in Europe, the United States and other foreign countries.

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- Proven performance with RenoCell product installations approaching 200 with no warranty issues or customer complaints.

Technology and Products

RenoCell brings an advanced electrochemical cell technology to the metal ion removal and metal reclamation industrial market. Unlike RenoCell, current electrochemical cell technologies, as well as precipitation, ion exchange, reverse osmosis, and adsorption technologies, were not developed nor designed to meet the increasingly stringent process and effluent treatment standards imposed today without incurring excessively high costs and complexity.

The technique of metal recovery through electrochemical deposition on a charged surface, also called electrodeposition or electrowinning, is a well-established technology and widely used in many forms throughout industry. Renovare considers its RenoCell electrodeposition technology to be “revolutionary” because it increases the effective metal ion removal range by a factor of 100 to 1000 into the parts per billion (ppb) range. In addition, this new three-dimensional porous cathode technology offers an improvement in cost effectiveness that is three to five times greater than current electrodeposition cells which have remained essentially unchanged during the past decade. Market response to RenoCell during the past year confirms this perspective and strong industrial interest.

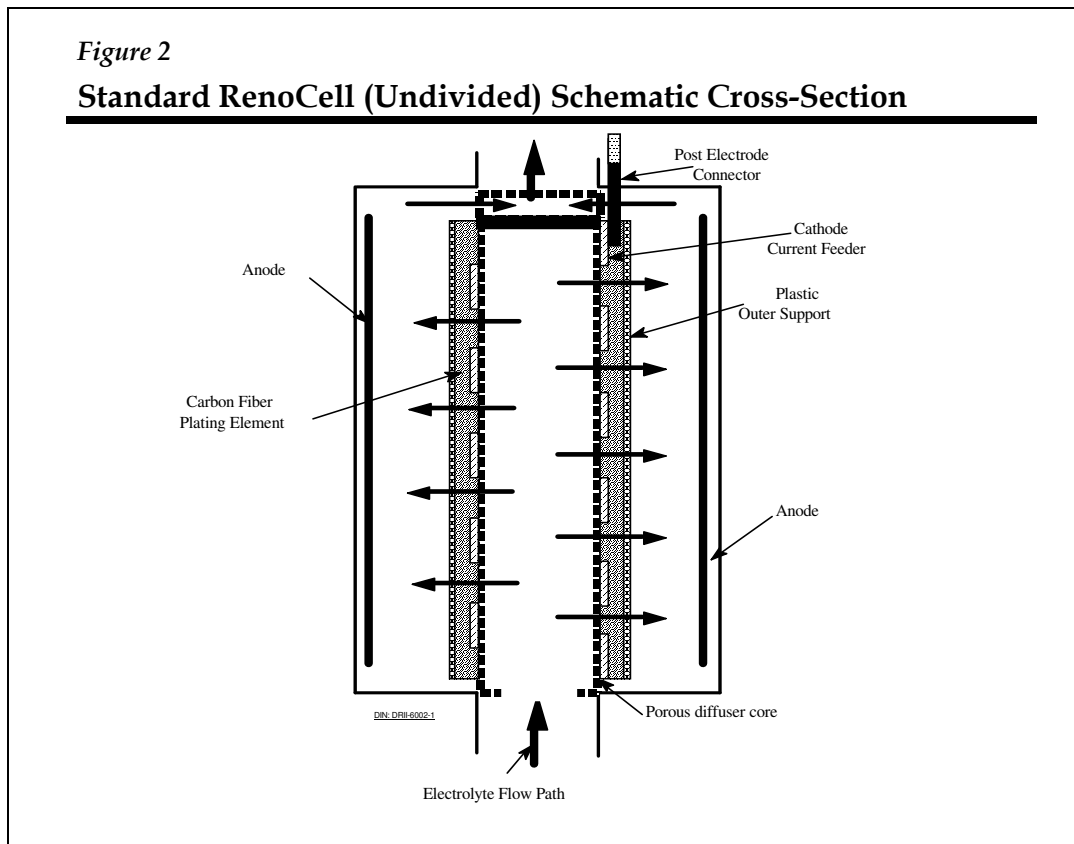
Electrodeposition of a metal occurs at the cathode of an electrochemical cell. In many cases, such as high-value heavy metals (e.g., copper and nickel) and precious metals (e.g., gold and palladium), electrodeposition allows the plated metal to be directly recycled. When the intrinsic toxicity of the metal ion is the problem (e.g., lead and cadmium), removal of the metal from a waste solution by a single stage process, as is provided by RenoCell, is extremely cost effective.

Renovare’s Technology

- Advanced, patented three-dimensional electrodeposition technology and cell design.
- RenoCell is the next generation of process and waste water metal ion removal and metal reclamation treatment equipment.
- The principle of electrodeposition is the same for all electrochemical cells. However, simply put, RenoCell technology works substantially better.

RenoCell Products

The technology illustrated in Figure 2 for the first time allows effective use of three-dimensional cathode materials – in this case a porous carbon element. The use of a three-dimensional cathode greatly enhances the performance of the cell because the porous carbon felt has at least 500 times greater effective surface area than a two-dimensional electrode of the same nominal geometric size.



The patented design of RenoCell makes this very high surface area available for metal deposition at higher current efficiencies, lower current densities and yields higher deposition rates than conventional cells all in a much smaller footprint. The next result is that RenoCell can achieve lower final metal ion concentrations while using less energy to remove a given amount of metal from a metal ion-bearing solution.

The standard RenoCell family of products for industrial applications consists of a polypropylene housing of varying heights with an outside diameter of 200 mm. The RenoCell Model M500 pictured in Figure 3 consists of a housing approximately 0.5 meter in height with a 200 mm outside diameter and has an effective three-dimensional cathode area of more than 55 m².

Figure 3
RenoCell Model 500



In addition, for certain applications, a variation of the 0.5m standard RenoCell is the “divided” RenoCell Model M500/D, in which a hydroscopic membrane (normally a cation exchange membrane) is positioned concentrically between the cell’s cathode and anode. The divided cell system can be applied to solutions containing species that can be oxidized at the anode and that would interfere with the cathodic deposition process (e.g., chlorine generation from aqueous chloride solutions). This capacity substantially expands the market opportunities for the RenoCell produce line and, for example, is central to color photoprocessing silver and precious metal recovery.

When the RenoCell cathode is completely plated with recovered metal, the cathode must be replaced. The spent cathode is recovered from the RenoCell and a new cathode cartridge assembly is then inserted and the cell is ready for operation, typically in less than 15 minutes. The metal-laden cathode can then be regenerated or smelted.

Figure 4 provides the specification for the current RenoCell family of products – Model 250, Model 500 and Model 1000. A divided cell configuration is available for each of these.

Figure 4

RenoCell Specifications

	Model 250	Model 500	Model 1000
Standard Material	Polypropylene	Polypropylene	Polypropylene
Dimension			
- Length	435 mm	645 mm	1065 mm
- Width	200 mm	200 mm	200 mm
Anode	DSA	DSA	DSA
Cathode	Carbon	Carbon	Carbon
Metal Loading	1-3 kg	3-5 kg	6-10 kg
Flow Rate	15 to 45 l/m	30 to 90 l/m	60 to 180 l/m

Renovare’s Products

- Porous, high surface area cathode.
- Replaceable cathode cartridge for easy metal removal.
- Industry standard components and compact, robust design.
- Optional divided cell configuration.
- Applicable to all electro-platable metal or electro-precipitable metal hydroxides and oxides.

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