A REVIEW OF THE APPLICATION OF MOLECULAR RECOGNITION TECHNOLOGY (MRT) FOR NI/CU/CO HYDROMETALLURGICAL PROCESS SEPARATIONS AND FOR THE PURIFICATION OF COBALT STREAMS

S R Izatt, R L Bruening, N E Izatt, and J B Dale
IBC Advanced Technologies, Inc.

Abstract

Molecular Recognition Technology (MRT) has been shown to be advantageous in a number of applications for the purification of cobalt streams. This paper is a review of previously reported results for the extraction of contaminants from cobalt electrolytes, including Fe, Cd, Cu and Ni as well as the refining of Ni and Co from a Ni laterite ore leach stream. Operating conditions are given as well as key results and conclusions.

INTRODUCTION

IBC Advanced Technologies, Inc. (IBC) has developed a range of SuperLig® products that are highly effective and economic in the selective separation and extraction of cobalt, nickel, copper and iron from leach, process and waste streams. These products are effective in both sulfuric and nitric acid matrix solutions. The value metals are recovered as salts of high purity. Various flow sheet separation alternatives based on MRT are provided. The flow sheet chosen depends on the relative concentrations of each metal ion and the primary target of the separation. This paper also provides a review of some examples of applications for MRT related to purification of cobalt bearing streams containing contaminants such as copper, nickel, iron, cadmium, and others. In some cases cobalt is also extracted and purified, producing a high value, high purity salt.

MRT column systems operate on a 4-step cycle basis. A complete system cycle sequence consists of the following (see Figure 1):

1) **Loading Phase** – The target ion is loaded onto the appropriate selective SuperLig® product which has been charged into the column(s).
2) **Pre - Elution Wash Phase** – Any remaining feed solution is washed out of the column.
3) **Elution Phase** – The target ion is eluted from the SuperLig® product in the column, forming a high purity product solution.
4) **Post – Elution Wash Phase** – Any remaining eluant is washed out the column.
   The cycle then begins again as above.

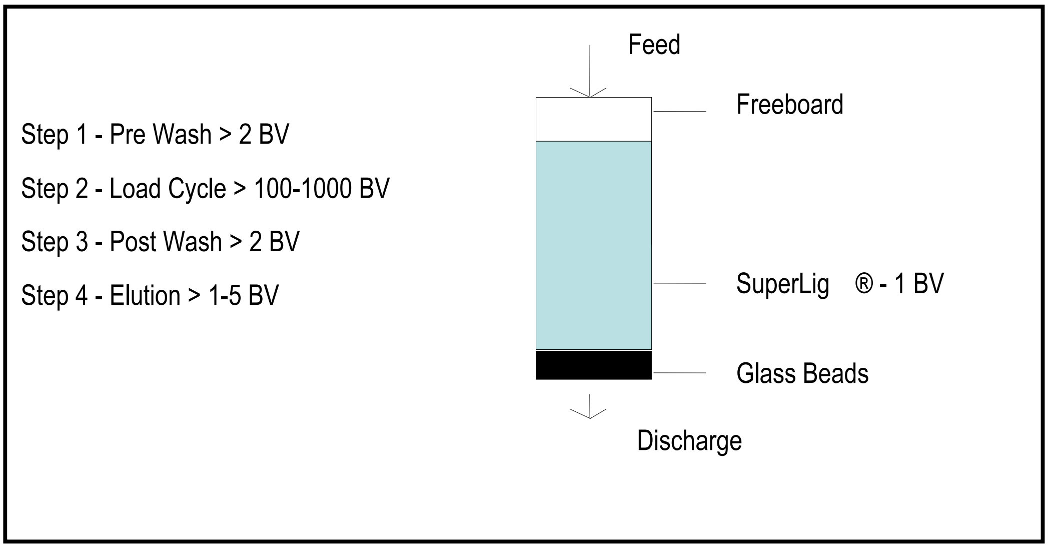

Figure 1: Typical MRT Process Cycle

In the examples that follow, the four step process will be described as it applies to specific SuperLig® products and feed streams.

COBALT SPECIFICATIONS FOR USE IN BATTERIES

Cobalt specifications are constantly tightening, particularly for end use applications such as rechargeable batteries, electronics, catalysts, and pigments. The increasing need for impurity control is highlighted by the general specifications for cobalt used in battery applications, (e.g., $LiCoO_2$), as provided in Table 1 below (1).

Table 1: General Specifications for Cobalt Used in Battery Applications

Element	Target Specification (ppm)	Nominal Specification (ppm)
Fe	<5	<10
Cu	<5	<10
Zn	<5	<10
Cr	<5	<10
Pb	<10	<100
Ca	<100	<200
Si	<10	<50
Na	<100	<300
K	<10	<50
Cd	<10	<50

MRT APPLICATIONS FOR PURIFICATION OF COBALT STREAMS AND COBALT SEPARATIONS

IBC has developed and commercialized a wide range of MRT systems for purification of various cobalt stream matrices and for cobalt/nickel/copper separations. Table 2 below provides a review and summary of examples of a number of MRT capabilities for cobalt purification as well as for cobalt/nickel/copper separations. Additional details regarding each separation are provided in this paper.

Table 2: Summary of MRT Separations for Purification of Cobalt and Cobalt Separations Reviewed in this Paper

Application	SuperLig® Number
Extraction and Polishing of Iron from a Cobalt Stream in a Sulfuric Acid Matrix	SuperLig® 48
Cadmium Removal from Cobalt Electrolyte	SuperLig® 177
Extraction and Purification of Copper from a Cobalt Process Stream	SuperLig® 77
Extraction and Polishing of Nickel from a Cobalt Stream in a Sulfuric Acid Matrix	SuperLig® 241
Extraction and Polishing of Nickel from a Cobalt Stream in a Nitric Acid Matrix	SuperLig® 199
Co- Extraction of Copper, Iron, and Nickel from a Cobalt Stream in a Sulfuric Acid Matrix	SuperLig® 176
Co- Extraction of Cobalt and Nickel together from a Nickel Laterite Ore Process Stream With Separate Elutions for the Nickel and the Cobalt	SuperLig® 138
Separate Extractions of Nickel, Copper, and Iron from Concentrated Acidic Cobalt/Base Metal Solution With Separate Elutions Producing Pure Salt Products	Solution pH 1 Cu: SuperLig® 86 Fe:: SuperLig® 14 Ni: SuperLig® 199 Co: SuperLig® 86
Separate Extractions of Copper/Iron, Nickel and Cobalt from Concentrated Acidic Cobalt/Base Metal Solution With Separate Elutions Producing Pure Salt Products	Solution pH 2 Cu/Fe: SuperLig® 145 Ni: SuperLig® 199 Co: SuperLig® 138

FE (III) REMOVAL USING SUPERLIG® 48 FROM CO/MN/NI IN SULFURIC ACID MATRIX FEED SOLUTIONS

The tolerance for iron content in battery grade cobalt is particularly stringent (2). Fe (III) can be removed from Co electrolyte using SuperLig® 48. Figure 2 below provides a general process flow sheet schematic. The process involves a four step operation:

- **Step 1 – Loading Phase:** An oxidized and acidified feed solution at ~ pH 2 is passed through the column containing SuperLig® 48. The Fe (III) ion is loaded onto the SuperLig® 48. The Co and other ions pass through the column into the raffinate stream.
- **Step 2 – Pre-elution Wash Phase:** The column is washed with dilute 0.1 M H_2SO_4. The wash solution is then cycled into the raffinate stream.
- **Step 3 – Elution Phase:** The Fe (III) ions are eluted from the SuperLig® 48 product in the column with 37% HCl at room temperature, forming an Fe concentrate product solution of approximately 10 grams per liter Fe. The second half of each elution is recycled. The elution can be essentially completely recycled by boil off of the Fe concentrate solution.
- **Post-elution Wash Phase:** The column is washed with dilute 0.1 M H_2SO_4. This wash solution cannot be recycled because it will contain some HCl. Consequently, the wash is neutralized and discharged. This is different from many of the MRT systems where the post- elution wash can be recycled as the pre-elution wash for the next cycle. The cycle then begins above at Step 1 above.

The Fe (III) is readily removed from an adjusted Co/Mn/Ni feed solution to virtually non-detectable levels. The Fe elution is extremely rapid and produces a concentrated Fe solution. A single column, 50% loaded with the Fe, is recommended as the most efficient, economical way to treat such streams with dilute Fe feed concentrations. This process has been reviewed in detail previously (2).

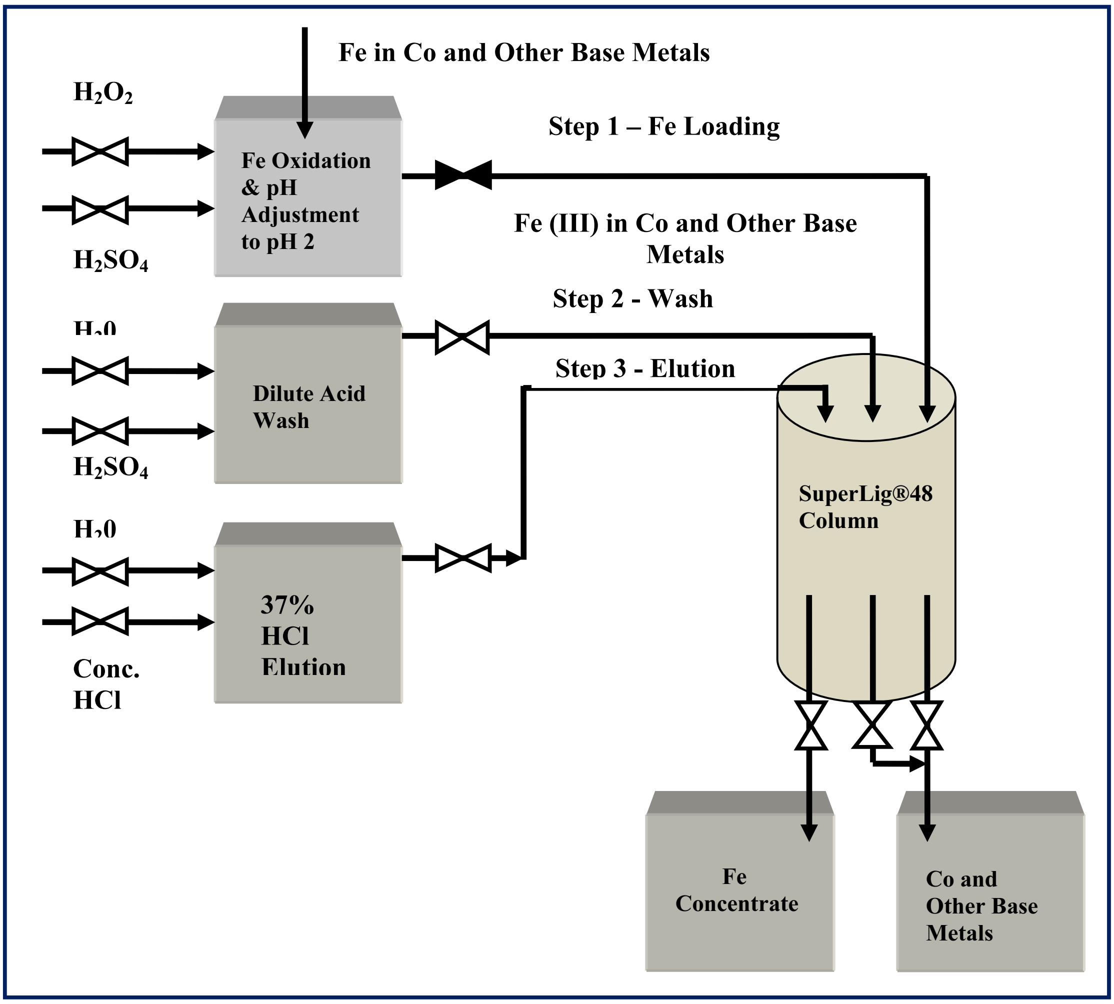

Figure 2: Schematic Flow Sheet of Design for a Plant Scale MRT Iron Removal System

CADMIUM REMOVAL FROM COBALT ELECTROLYTE

In work at Mintek (3), several techniques were compared for the removal of Cd (~6 mg/L Cd) from high-Co electrolyte solution (55 – 60 g/L). Solvent extraction (di-2-ethylhexylphosphoric acid (D_2EHPA)), adsorption (amino-methyl phosphonic acid resin (Purolite S950)), and MRT (SuperLig® 177) were evaluated in the pH range between 2 and 4.

The typical MRT cycle sequence for SuperLig® 177 involves a four step process:

- **Step 1 – Loading Phase:** A Co feed solution at pH 2~4 is passed through the column containing SuperLig® 177. The Cd (II) ion is loaded onto the SuperLig® 177. The Co and other ions pass through the column and into the raffinate stream.
- **Step 2 – Pre-elution Wash Phase:** The column is washed with water. The wash solution is then cycled into the raffinate stream.

- **Step 3 – Elution Phase:** The Cd (II) ions are eluted from the SuperLig® 177 column with weak sulfuric acid (1 g/l), followed by strong sulfuric acid (100 g/l.), forming a cobalt sulfate product solution. The second half of each elution is recycled.
- **Step 4 – Post-elution Wash Phase:** The column is washed with water. The water wash is then cycled into the pre-elution wash. The cycle then begins at Step 1 above.

The SuperLig® 177 was shown to offer a number of important advantages over the competing products, including the following (3):

1) **High Cd Loadings.** The SuperLig® 177 loaded 2.9 g/L Cd from a feed solution containing ~6 mg/L Cd (upgrading ratio of 480), in contrast to Purolite S950 (0.1 g/L) and D_2EHPA (0.01 g/L).
2) **High Selectivity.** The SuperLig®177 co-loaded <0.05% of the cobalt in the feed solution and had excellent selectivity for cadmium over not only cobalt but also magnesium and manganese. In contrast, D_2EHPA cobalt co-loading was 4%. The cobalt loading in the organic phase needs to be minimized in order to limit NaOH consumption. The low selectivity of the D_2EHPA circuit for cadmium over cobalt thus puts a high demand on the circuit. Purolite S950 co-loaded 11% of the cobalt in the feed solution, thus making it unsuitable for this application. Both D_2EHPA and Purolite S950 had very poor selectivities for cadmium over not only cobalt but magnesium and manganese as well.
3) **No Pretreatment.** SuperLig® 177 requires no pre-treatment prior to Cd extraction. D_2EHPA requires neutralization and prior extraction of Mn.
4) **Small System Footprint.** Due to the higher loadings and short elution period achievable with SuperLig® 177, the amount of resin required is substantially lower than that required for Purolite S950.

Based on the results of this study (3), *"...the SuperLig® 177 product was proven to be the most attractive for the removal of cadmium from cobalt electrolyte."*

COPPER REMOVAL FROM COBALT ELECTROLYTE

Copper is another common impurity in cobalt electrolytes that must be reduced prior to further cobalt processing. The MRT process is an effective method for removing the copper away from a pregnant cobalt solution prior to solvent extraction.

Work conducted with Kasese Cobalt Company Limited (KCCL), a major processor and refiner of cobalt, based in Uganda and IBC has been previously reported (4). MRT was evaluated for its ability to reduce the Cu concentration to less than 0.05 mg/l in the feed solution to the cobalt solvent extraction process. The solution provided contained under 5 g/l Co at slightly acidic pH and the Cu concentration was 0.5 mg/l. SuperLig® 77 was used to demonstrate the successful polishing of the copper.

The Cu is removed from the Co electrolyte using SuperLig® 77 in the following four step process:

- **Step 1 – Loading Phase:** A Co feed solution at slightly acidic pH is passed through the column containing SuperLig® 77. The Cu (II) ion is loaded onto the SuperLig® 77. The Co and other ions pass through the column and into the raffinate stream.
- **Step 2 – Pre-elution Wash Phase:** The column is washed with 0.01 M sulfuric acid. A portion of this wash is recycled.
- **Step 3 – Elution Phase:** The Cu (II) ions are eluted from the SuperLig® 77 column with 2 M sulfuric acid forming a cobalt sulfate product solution. The second half of each elution is recycled.
- **Step 4 – Post-elution Wash Phase:** The column is washed with 0.01 M sulfuric acid. The wash is then cycled into the pre-elution wash. The cycle then begins at Step 1 above.

Figure 3 below indicates the placement of the proposed MRT system for Cu removal in the KCCL flowsheet. For optimum results, the proposed MRT system is placed after the copper precipitation in order to treat the feed solution to the cobalt solvent extraction process.

The main advantages of the MRT system for Cu removal from the post copper precipitation Co electrolyte have been summarized as follows (4):

- *"MRT is the only technology capable of Cu removal at such low input/output concentrations on a commercial basis.*
- *There is no pH change requirement.*
- *The process has a very low chemical consumption due to the short, sharp elution curve, and minimal wash requirements.*
- *SuperLig® 77 has a multi-year life.*
- *Long loading/polishing curve for Cu maximizes the capacity of the SuperLig® 77, thus allowing for a compact and efficient MRT plant design.*
- *There is no cobalt loss during the MRT process.*
- *Very simple MRT flow sheet fits efficiently into Co plant flow sheet.*
- *The MRT process is flexible to treat a wide range of Cu concentrations in the feed.*
- *The elution product from the MRT process is a high-purity copper sulfate.*

- *MRT plants are easy to add in modular fashion to increase the impurity removal capacity*
- *The above factors result in a very low Opex/Capex for the commercial plant."*

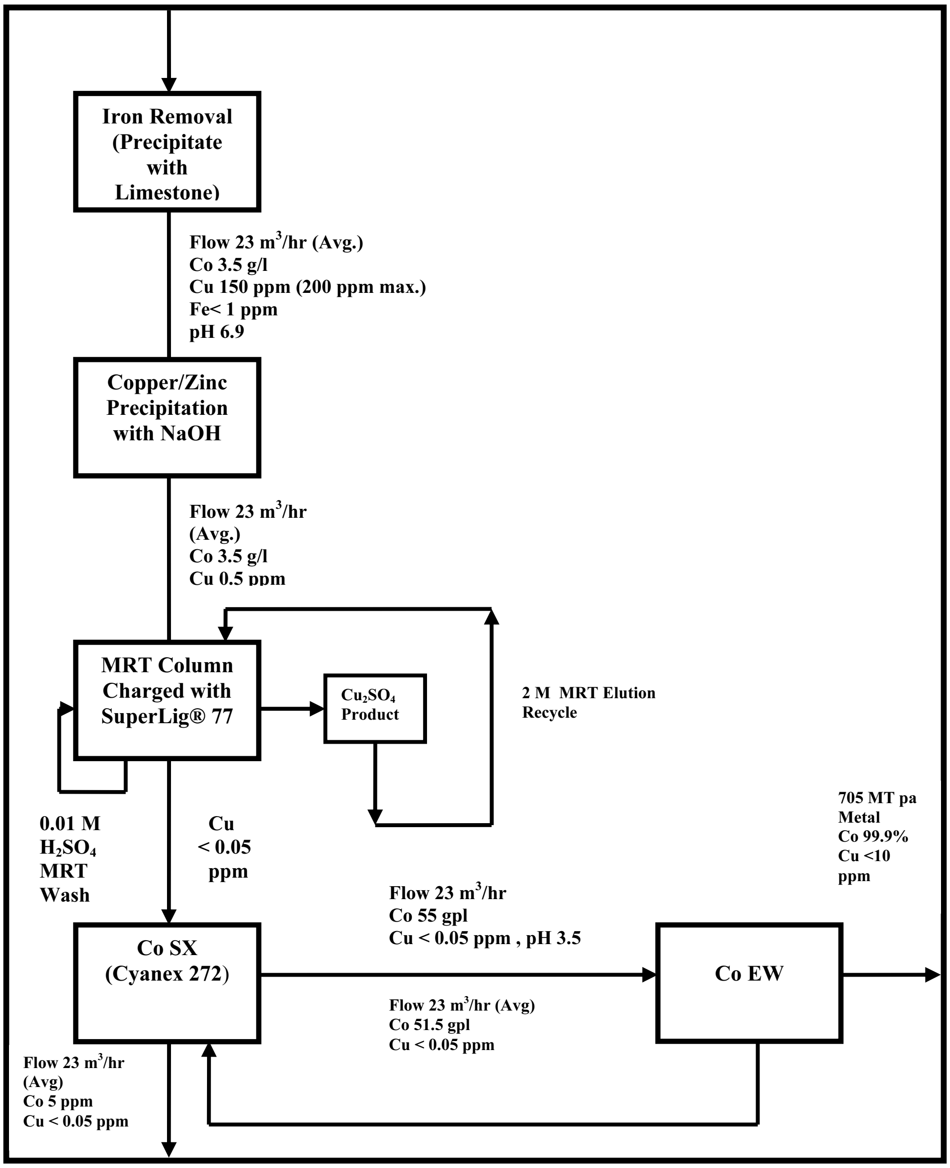

Figure 3: Overview of KCCL Co Circuit with Proposed MRT System for Cu Recovery (4)

EXTRACTION AND POLISHING OF NICKEL FROM A COBALT BEARING FEED STREAM IN A SULFURIC ACID MATRIX

For nickel removal from a sulfuric acid matrix, the MRT process has proven its capability and usefulness (5):

> *"Th[e] MRT process has been installed by a secondary cobalt refiner and manufacturer of cobalt and nickel chemicals. In this application, SuperLig® 241, in a three column polishing system, is used to extract and polish nickel from a cobalt feedstock containing approximately 63 g/l Co in a sulfuric acid matrix. The nickel concentration in the feed stream is approximately 150 ppm. No Cu is present. Ni concentration at the exit of the columns is 4 mg/l. The solution pH is approximately 1. This SuperLig® resin has a high selectivity for Ni^{2+} over Co, and is very effective for nickel from cobalt separations when the Co/Ni ratio ranges up to 500 – 1,000/1."*

The four step process for using SuperLig® 241 is described below:

- **Step 1 – Loading Phase:** A Co feed solution at pH ~ 1 is passed through the column containing SuperLig® 241. The Ni (II) ion is loaded onto the SuperLig® 241. The Co and other ions pass through the column and into the raffinate stream.
- **Step 2 – Pre-elution Wash Phase:** The column is washed with 0.1 M sulfuric acid. A portion of this wash is recycled.
- **Step 3 – Elution Phase:** The Ni (II) ions are eluted from the SuperLig® 241 column with 3 M sulfuric acid at room temperature, forming a high purity nickel sulfate product solution. The second half of each elution is recycled.
- **Step 4 – Post-elution Wash Phase:** The column is washed with 0.1 M sulfuric acid. The wash is then cycled into the pre-elution wash. The cycle then begins at Step 1 above.

A flow sheet of the process is given in Figure 4 below.

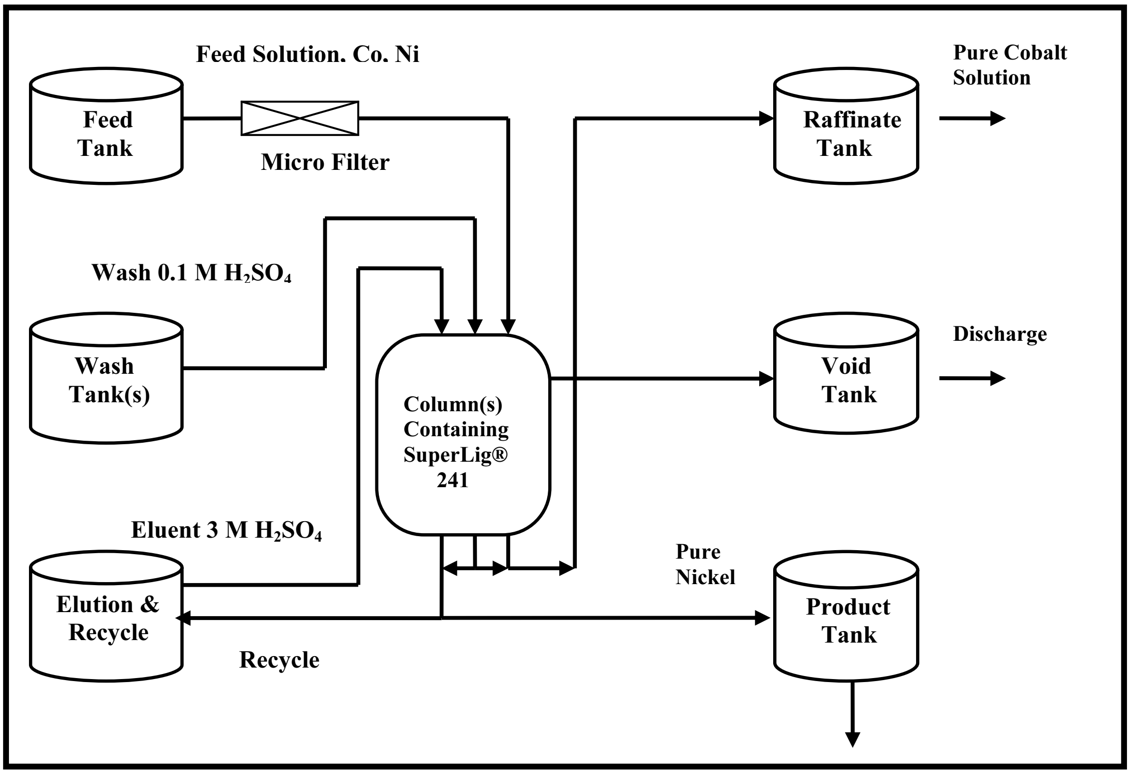

Figure 4: Extraction and Polishing of Nickel from a Cobalt Bearing Feed Stream in a Sulfuric Acid Matrix (5)

The benefits of the MRT process to the cobalt plant are summarized below (5):

1) "The by-product nickel revenues can substantially offset the annual operating expenses.

2) The MRT plant is able to significantly reduce the overall cobalt losses compared to a precipitation/IX plant. In the case of precipitation/IX, the cobalt losses could be around 5%, and this percentage is substantially reduced with the MRT plant, saving a considerable amount of money.

3) The final cobalt purity can be expected to be improved as a result of using the MRT impurity removal process. This is because the MRT plant is capable of consistently removing the nickel away from the pregnant cobalt concentrate down to very low solution levels.

4) The purification process is much faster with the MRT plant, compared to an IX and/or precipitation process. A higher throughput would result in increased cobalt refining capacity at the plant, which can be a significant economic advantage.

5) The SuperLig® 241 product consumption is less than for the IX resin."

EXTRACTION AND POLISHING OF NICKEL FROM A COBALT BEARING FEED STREAM IN A NITRIC ACID MATRIX

As previously reported, MRT has also been proven for Ni removal from a nitric acid matrix (5):

> *"Th[e] MRT process has been installed at a major international secondary cobalt refiner and manufacturer of cobalt and nickel chemicals. In this application, SuperLig® 199 is used to extract and polish nickel from a cobalt feedstock containing approximately 150 g/l Co in a nitric acid matrix. The nickel concentration in the feed stream is < 1 %. The solution pH is approximately 1. This SuperLig® product has a high selectivity for Ni^{2+} over Co and is most effective for nickel from cobalt separations when the Co/Ni ratio is less than 200/1. If significant amounts of copper are present in solution, the solution must first be pre - treated for removal of copper."*

The MRT process compares very favorably with the alternative technology, solvent extraction (SolvEx), in this application (5):

1) *"The SolvEx process has not been proven on a large scale basis.*
2) *SolvEx as a technology is very sensitive to scale up, operational control, and to fluctuations in feed concentrations, metal ratios and pH.*
3) *The SolvEx footprint is significantly larger than for MRT.*
4) *SolvEx has inherent safety and environmental issues due to use of organic solvent.*
5) *The MRT system is highly competitive with the SolvEx system on initial upfront costs, and the running costs substantially favor the MRT system over a longer period. Also, costs with the MRT system are much more predictable on a longer term basis because MRT is less sensitive to feed fluctuations.*
6) *The SolvEx system uses substantial quantities of caustic and acid which have seen rapid price escalation and can fluctuate widely in price.*
7) *The MRT system recovers a high value nickel nitrate product which has significant market value.*
8) *The MRT system is highly flexible and able to treat a wide range of cobalt and nickel concentrations in solution."*

COMBINED EXTRACTION OF COPPER, IRON, AND NICKEL FROM A COBALT FEED STREAM IN A SULFURIC ACID MATRIX

The MRT process has been successfully evaluated by a major cobalt electro - winning refinery for the combined extraction of Cu, Fe, and Ni (6):

> *"In this application, SuperLig® 176 is used for the combined removal of Cu (II) and Fe (III) together with Ni (II) from the electrolyte. Any Fe (II) present in the solution will not be removed by the SuperLig® material. The Cu, Fe (III), and Ni are eluted as a group with 3 M H_2SO_4 solution. The raffinate, containing pure cobalt, is returned to the electro - winning tank. Lead can also be removed from the electrolyte by adding a lead MRT removal system using SuperLig® 62. Various other impurities can also be removed, if desired, by using other selective SuperLig® materials."*

The MRT process for Cu, Fe (III) and Ni removal has been evaluated to have the following benefits (6):

> *1) "Efficient copper, iron and nickel removal, high capacities, and sharp elution curves.*
> *2) Very low cost of capital equipment for the MRT plant due to design simplicity and high capacity of the SuperLig®.*
> *3) Elution of the impurity metals is accomplished in several bed volumes, minimizing the amount of eluting chemicals and waste stream. No organic solvents are required. The plant can be easily expanded.*
> *4) Long loading curve maximizes the capacity of the SuperLig® products, thus allowing for a compact and efficient MRT plant design. No loss of cobalt occurs during the process.*
> *5) Small volume of chemicals used for the elution because the sharp elution curve (2-3 bed volumes compared with 10-12 for ion exchange). This represents a significant operating cost savings compared to alternate technologies such as ion exchange systems."*

EXTRACTION AND REFINING OF NICKEL AND COBALT FROM A NICKEL LATERITE ORE LEACH STREAM

The use of MRT for upfront extraction of Ni and Co provides a novel, simplified flow sheet to produce high purity nickel and cobalt (5):

> *"MRT is an attractive technology for the extraction, polishing, and refining of nickel and cobalt from a laterite ore leach feed solution containing high concentrations of other base metals and contaminants. In this application, the MRT plant would be the primary extraction and refining step up front in the process flow sheet for nickel and cobalt. The MRT process can produce a high purity nickel concentrate in sulfuric acid. This pure nickel solution can be treated to obtain high grade nickel metal by electro - winning or direct precipitation to nickel hydroxide after adjusting the pH. The MRT plant will also produce a high grade cobalt product. The cobalt is eluted from the SuperLig® 138 column with a sulfuric acid/sulfite elution to produce a pure cobalt concentrate liquor. High value cobalt metal can then be produced by electro - winning, or direct precipitation to cobalt hydroxide after pH adjustment. The raffinate stream will have a pH of approximately 1.0. The feed stream for one international metal/mining company contains approximately 2,100 mg/l nickel, 83 mg/l cobalt, 5 mg/l copper plus iron, base metals, and other metal contaminants. The MRT process is particularly attractive to treat feed streams such as this one that are relatively high in cobalt and low in copper."*

The four step process for using SuperLig® 138 is given below:

- **Step 1 – Loading Phase:** A Co/Ni leach stream feed solution at pH ~ 1 is passed through the column containing SuperLig® 138. The Co (II) and, Ni (II) ions in the feedstock solution are loaded onto the SuperLig® 138. The Fe and other ions pass through the column and into the raffinate stream.
- **Step 2 – Pre-elution Wash Phase:** The column is washed with 0.1 M sulfuric acid. A portion of this wash is recycled.
- **Step 3 – Elution Phase:** Nickel Elution Phase – The Ni (II) ion is eluted from the SuperLig® 138 product in the column with 5 M sulfuric acid, forming a high grade nickel product solution. A portion of the eluent solution is recycled.
  Cobalt Elution Phase – Periodically the Co (II) is eluted with 2 – 3 M H_2SO_4 plus SO_2. A possible alternative for a plant which can tolerate some HCl is to use Fe (II) in 1 – 3 M HCl for this additional elution. Remaining Fe (II) is then oxidized and the Fe (III) precipitated and filtered out prior to collecting the Co.
- **Step 4 – Post-elution Wash Phase:** The column is washed with 0.1 M sulfuric acid. The wash is then cycled into the pre-elution wash. The cycle then begins at Step 1 above.

The key benefits of the MRT process in this application are (5):

> *1) "The MRT plant can be placed upfront in the overall process flow sheet to ensure high recovery rates for nickel and cobalt before downstream processing for recovery of other metals.*
> *2) The estimated Capex including both the nickel and cobalt recovery plants has been determined to be very attractive on an installed annual nickel refining capacity basis.*
> *3) The estimated Opex (chemical and SuperLig® costs) including both nickel and cobalt recovery systems credit have been determined to be highly competitive per pound of nickel recovered. The cobalt credit provides a substantial net positive contribution to annual revenue. This ensures a positive, rapid, payback on the investment.*
> *4) One SuperLig® product can be used for recovery of both nickel and cobalt as high purity product solutions."*

A flow sheet of the process is given in Figure 5 below.

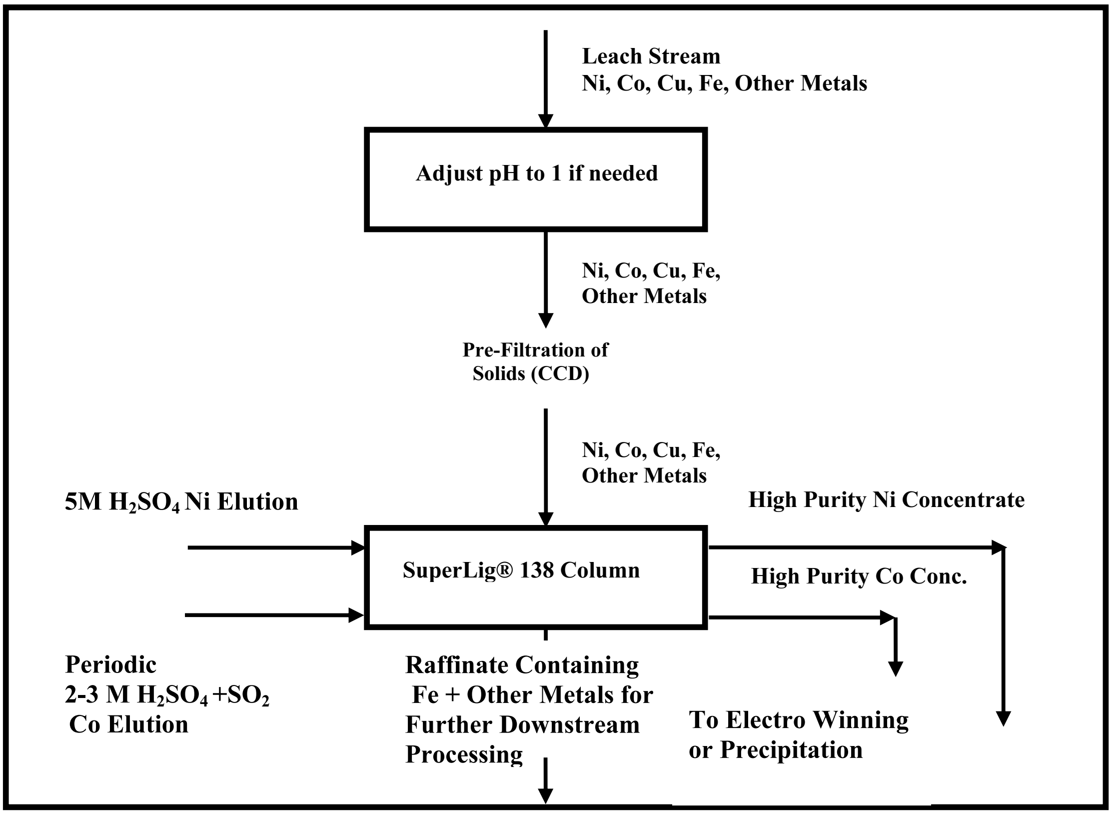

Figure 5: Extraction and Refining of Nickel and Cobalt from a Nickel Laterite Ore Leach Stream (5)

SEPARATE EXTRACTIONS OF NICKEL, COPPER, AND IRON, FROM CONCENTRATED ACIDIC COBALT/BASE METAL SOLUTION WITH SEPARATE ELUTIONS PRODUCING PURE SALT PRODUCTS

Table 2 above provides the individual SuperLig® products that can be used for separate extractions of Ni (II), Cu (II), and Fe (III) from concentrated acidic cobalt/base metal solution at a pH in the range of approximately 1 to 2. Separate corresponding pure salt elution products are produced.

SUMMARY AND DISCUSSION

MRT is broadly applicable to purification of Co electrolyte streams as well as to the extraction and refining of Co and Ni from primary mine streams. The technology is easy to operate consisting of four steps: loading, pre-elution wash, elution and post-elution wash. Besides the applications for cobalt purifications discussed above, MRT can also be applied to other separations within the cobalt and copper industries. These applications include:

- Extraction and recovery of bismuth and antimony from copper sulfate electrolytes (7, 8, 9, 10).
- Extraction and recovery of bismuth from selenium reduction solution in a chloride matrix. This is produced in the anode slimes treatment process (9). The bismuth can also be recovered from the slimes leach.
- Extraction and recovery of platinum group metals from copper refinery slimes (10).
- Extraction and recovery of mercury from concentrated sulfuric acid streams (11).
- Extraction and recovery of copper from acid mine drainage streams and waste streams (12,13)
- Extraction and recovery of chloride from copper sulfate electrolytes (14).

Due to the relative ease of operation associated with MRT plants, there are a number of powerful economic advantages that derive from their usage, as discussed above and summarized in Table 3 below. For each application, one must determine the overall economic benefit that is contributed to the process by the MRT system. MRT is currently used in numerous commercial applications worldwide. These include precious metal as well as various base metal processing and refining applications. All of these commercial systems underwent an extremely rigorous evaluation procedure to prove them to be economic before project implementation.

Table 3: Key Economic Advantages Offered by MRT Separation Plants

Advantage	**Resulting Economic Benefits Provided by MRT System**
Extremely high selectivity for target ion	High purity, concentrated eluent products can be produced. Minimum additional downstream processing is required to produce marketable product.
Effective at any target ion concentration	The MRT process can be used to remove target ions present at very low concentration levels.
Quantitative 100% metal recovery in single solution pass through	Minimizes cost of metal recycle.
Minimal metal losses in process	Additional metal sales revenue and reduced cost can be achieved.
High feed solution flow rates	Increases unit throughput capacity.
Extremely rapid processing time	Dramatic reduction in work in process inventory, resulting in a substantial increase in annual metal throughput and consequent revenue and cash flow.
Greatly simplified process	Lower capital cost, reduced space requirement, and minimal maintenance.
Full automation possible	Minimal manpower requirement.
Long life, multi-cycle use for the SuperLig® product	Ensures economic benefits for the MRT process.
Wide range of solution pH capability	Wide variety of feed solutions can be treated.
No transfer of impurities to the solution being treated	Simplifies process flow sheet and maximizes product purity.

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The Author

Steven R. Izatt, *President and CEO*, IBC Advanced Technologies, Inc.

Mr. Izatt has over 20 years of experience in the separations and metallurgical industries. He is the President and CEO of IBC Advanced Technologies, Inc., which specializes in Molecular Recognition Technology. Mr. Izatt is the author or co-author of over 60 publications and presentations. He serves on the Board of Directors of the International Precious Metals Institute (IPMI) and was honored with the 2008 IPMI Jun-ichiro Tanaka Distinguished Achievement Award, the Institute's highest award, in recognition of entrepreneurial contributions to the precious metals industry. Prior to IBC, Mr. Izatt worked as a management consultant for PA Consulting Services and Touche Ross & Co. He was also employed as a new ventures engineer and project manager at Bethlehem Steel Corporation.