

LIGHTNIN EXTRACTION news

A Newsletter for Solvent Extraction Engineers

September 1998, Vol. 3, No. 1

An SX/EW Operational Success Story!

Interview with a Plant Manager

Interview with
Mr. James Stefanic,
Plant Manager of
Cia. Minera "Dos
Amigos," Chile.

By Brenno Ganahl
Tecpromin LTDA, Chile



Operators and supervisors at
Dos Amigos installation

The following dialogue is a summary of our recent due diligence survey with James Stefanic, Plant Manager of Dos Amigos. The survey was conducted by Brenno Ganahl of TECPROMIN, LIGHTNIN's Chilean representative. We can all learn from successful case histories.

B.G.: Will you please start off by giving me a brief description of your operations?

J.S.: The Dos Amigos Project is located in the Domeyko area, Region III, in the northern part of Chile. We are owned by CEMIN, SCM. Our plant is a LX/SX/EW operation producing 99.999% copper cathode.

B.G.: What is your production rate?

J.S.: The original design was for 5,000 tons per year. We then expanded to 10,000 tons per year.

B.G.: What flow rate are you running through the pumper mixers?

J.S.: Total organic and aqueous flow through each mixer settler is 2,000 gallons per minute.

B.G.: Please describe the timing of the project, specifically regarding the mixers.

J.S.: We placed the original mixer order for (8) Series 10 mixers with LIGHTNIN SX/EW impellers in March 1996. The pumper mixer impeller is an R323 impeller and the auxiliary mixer impeller is an A305. The mixers are designed to work with variable frequency drives and remote operator stations.

B.G.: What about start-up?

J.S.: The plant went on line in January 1997. TECPROMIN assisted with the mixer installation, mounting, and conducted a pre-test evaluation of each setup. There were no major surprises and I am proud to say, our operation started-up smoothly. Pumper flow rates were easily achieved.

B.G.: Tell us more about your plant expansion.

J.S.: In October, we expanded by adding one additional mixer settler unit in an E1P configuration. This allowed us to double production by only investing in one quarter of

Continued on page 6.

Spend a Little, Save a Lot

How to Increase SX Plant Performance on a Shoestring Budget

Problem:

Management is calling for more production with less cost. In order to meet production targets, all equipment must be available 110% of the time. Does this sound familiar? If only operations and maintenance could invent a 30-hour day without telling management, everything would be fine.

There is an alternative. Change your conventional SX mixers with the SX Overachievers by LIGHTNIN. The following example illustrates the benefits that can be achieved.

I. Existing Plant:

- Two 2:1 trains of SX mixers
- Each train has two extractors and one stripper, which run in series at 22 hours per day, 365 days per year
- Plant flows of PLS from the heap are 6000 gpm/train at avg. head grade of 2gr./l (gpl) copper
 - A) Each train achieves 95% extraction of the PLS
 - B) 50% of the lost organic is recovered for regeneration
- Organic losses 140 ppm per train
- Cathode selling price = \$0.85
- Plant costs avg. \$0.52/lb. of copper produced
- 144" sq. mix boxes
- 84" liquid level
- 2.15 minutes retention (total)/stage
- Pump-mixer is 50 horsepower, 44 rpm, 90"+ diameter conventional impeller

ISO 9000 Compliant Copper Cathodes for Plant A

lbs./yr. shipped = 90 million (MM)+

Total Revenue	\$77.8 MM
Production Cost	\$47.6 MM
Gross Profit	\$30.2 MM

Current Losses	70ppm @ 12,000 gpm
Total Current Losses	405,000 gal./yr.
- at a cash cost of	\$4.25/gal.
- at a total of	1.72 MM
- % of total system operating costs	4%

As a result of this study, the local LIGHTNIN rep was invited to the site for a discussion about how to improve operations. The primary goal was to significantly decrease organic losses. Achieving this must be done without negatively affecting production capacity.

II. Option 1 - Retrofit Existing Mixers

The existing mixers could be modified to produce approximately the same results. The only costs would be for motors, couplings, and impellers (plus installation and organic modifications). Due to the use of existing equipment, LIGHTNIN thinks the organic entrainment will be higher than optimum. Losses with use of the organic recovery system were estimated at 20 ppm. The complete cost to modify both trains was just over \$600k.

The estimated cost savings are:

Organic makeup	
70-20 = 50 ppm savings	\$1.229 MM
Energy (motor horsepower savings)	
60HP = 45kW @ \$0.06 per kWh →	\$0.022 MM
Annual Plant Savings	\$1.25 MM
Estimated Payback Period	5 3/4 months
Estimated cost per pound (all else the same)	\$0.506

III. Option 2 - New SX Mixers

LIGHTNIN's optimized SX mixer solution is a 25 horsepower pump-mixer with 5 horsepower auxiliaries. Based on existing plant data and the hydraulic efficiency of the new offering, LIGHTNIN estimates the new entrainment level to be 15 ppm prior to the organic recovery system. With this system operating, the total organic loss is figured (by plant personnel) to be about 10 ppm. Cost for this unit changeout of both trains including mixers, installation, and pumpbox modifications is just under \$1 MM.

The estimated cost savings are:

Organic makeup	
70-10 = 60 ppm savings	\$1.474 MM
Energy (motor horsepower savings)	
270HP = 200 kW @ \$0.06 per kWh →	\$0.096 MM
Annual Plant Savings	\$1.57 MM
Estimated Payback Period	7 1/2 months
Estimated cost per pound (all else the same)	\$0.503

Continued on page 3.

Droplet Size Distribution Study

LIGHTNIN SX/EW mixer settler systems are so successful because one, of the understanding of how droplets are formed and two, the knowledge of the principles and requirements for mixing two immiscible liquids in a flow through mix tank. Video imaging was one tool that we utilized to understand the mechanisms of droplet breakup and to quantify the different impellers' specific characteristics. Remember larger droplets equate to lower entrainment and chemical losses.

Our video-imaging software in LABVIEW was able to accurately interpret and count single droplet distributions. This, in-turn, developed histograms using number fractions ($f_{n,i}$), area fractions ($f_{a,i}$), and volume fractions ($f_{v,i}$). Following is an example of the three types of droplet distributions generated when studying the effect of pumper design.

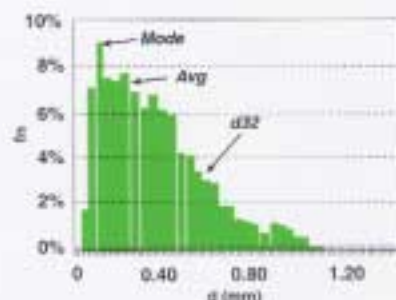
This study quantifies LIGHTNIN's R320 pumper impeller and A310 high efficiency auxiliary impeller designs. They assure the proper droplet size and the distribution required for maximized mass transfer/extraction and minimized entrainment.

LIGHTNIN's capability of video imaging and laser doppler velocimetry gives us the knowledge and experience to design a low shear pumper impeller system that is the driving force of our optimized mixer settler unit.

Mike Giralico, T.A. Post, M.C. Graves, 1998. New Mixer Designs for the Next Generation of SX/EA Mixer Settler Systems
M.A. Giralico, T.A. Post, M.J. Prados, 1995. Improve the Performance of Your Copper Solvent Extraction Process by Optimizing the Design and Operation of Your Pumper and Auxiliary Impeller

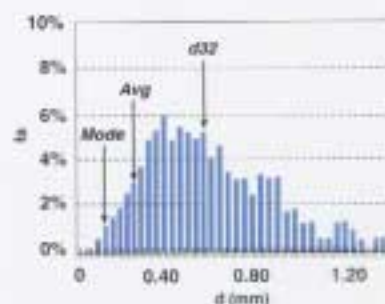
Number Fraction at Equation: is useful in predicting the average droplet size that can be used to characterize pumper design.

$$f_{n,i} = \frac{n_i}{\sum n_i}$$



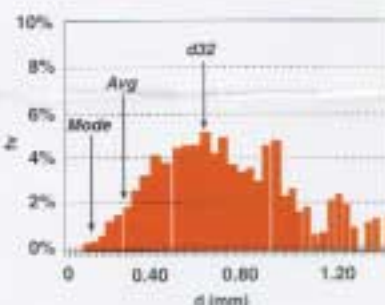
Area Fraction at Equation: is useful in predicting mass transfer performance.

$$f_{a,i} = \frac{f_{n,i} \cdot d_{n,i}^2}{\sum f_{n,i} \cdot d_{n,i}^2}$$



Volume Fraction at Equation: can signify the entrainment performance of a specific impeller system.

$$f_{v,i} = \frac{f_{n,i} \cdot d_{n,i}^3}{\sum f_{n,i} \cdot d_{n,i}^3}$$



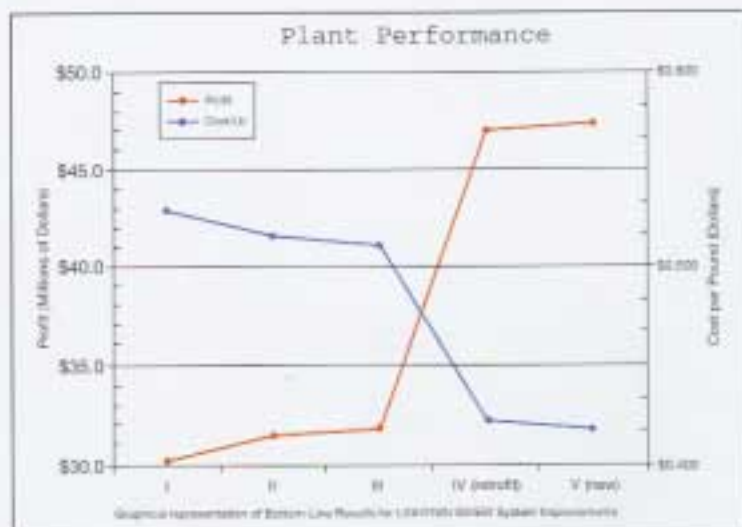
Save a Little, Save A Lot – continued from page 2.

IV. Additional Benefit and Greater Production Capacity

Both of these options are excellent solutions to production problems. In addition to the stated benefits of organic entrainment reduction, both units are capable of significantly more throughput than the original equipment. A 20% increase in PLS and Organic flow to 7200 gpm will yield an additional 18 MM pounds of copper cathode per year.

This is accomplished at little to no increased entrainment. Provided the electrowinning plant can handle the increased capacity, plant profitability benefits greatly from the added production.

New plant designs for grass roots facilities through big engineering houses are not the only application for this technology. As you can see, the benefits of either retrofitting or replacing your conventional SX mixers makes sense (and dollars too)! Please be sure to contact Mike Giralico at (716) 436-5550 or your local LIGHTNIN representative for a specific plant solution at YOUR plant.



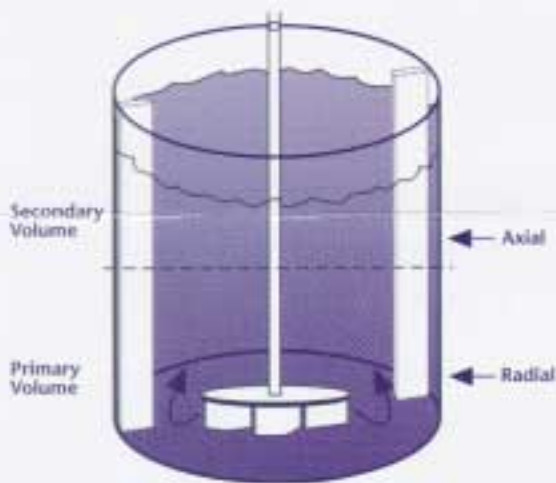
Mixing in the Pumper Tank

An important stage in ore processing is the introduction of the aqueous and organic phases. During this stage, dynamic and thorough mixing is necessary to obtain the conversion levels. If there is insufficient mixing, then the two phases will separate. This results in a failure to obtain the yields. If there is too much mixing, then the two phases do not separate in the Separator Stage, and valuable organic chemicals are wasted. This will drive up operating costs.

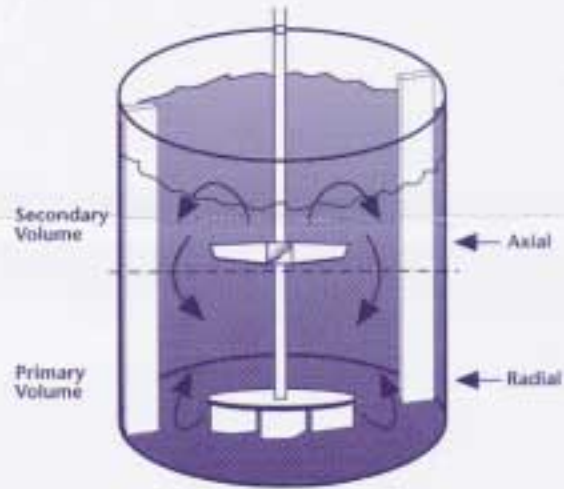
In LIGHTNIN's solvent extraction research, the optimum mixing levels have been defined. Computational Fluid Mixing (CFM) has been applied in order to guide mixer selections. CFM is a software package that solves equations for the conservation of mass, momentum, energy, and chemical species using a finite volume technique. The CFM software is flexible so that it can be customized to specific needs. In the finite volume technique, the governing equations are integrated over each control

volume. The mixer models shown here contain 10,000 control volumes. This formulation ensures that all solutions satisfy the conservation equations, provide solution stability and accuracy.

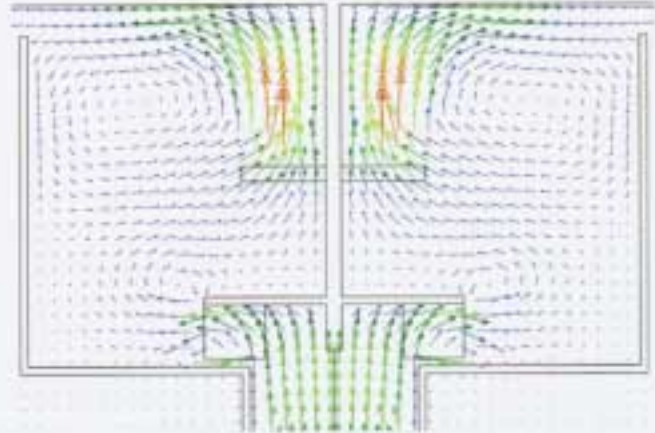
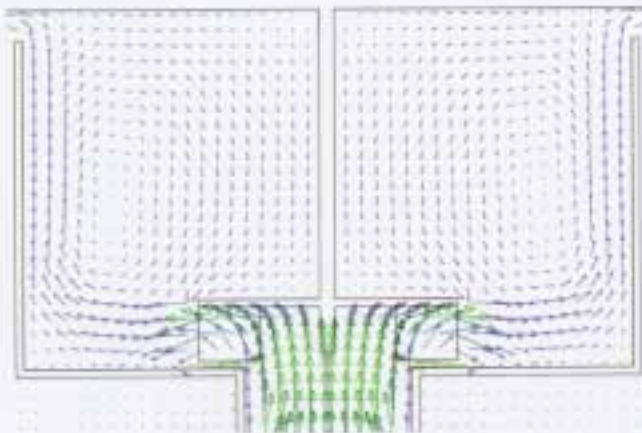
The resulting mixer selection maximizes ore conversions and lowers operating costs. LIGHTNIN's patented R300 series impellers provide the initial micro-mixing levels necessary to transfer the organic phase into the aqueous phase. The CFM results, CASE A, shows the typical flow patterns within the Pumper Stage. Ensuring that the two phases stay in contact, a second impeller is added to the stage to provide macro mixing. The CFM output in CASE B shows the additional mixing provided to the stage. The benefits of this second impeller allow the mixing to be fine tuned within the system. Conversion levels and entrainment values can be maximized and minimized, respectively.



CASE A



CASE B



1998 Major Mining Tradeshow Roundup

SME March 1998, Orange County Convention Center, Orlando Florida, USA

The change of venue to Orlando and the Latin American Perspectives: Exploration, Mining, and Processing Symposium made this year's SME quite unique.

Final registration totaled 4,555 attendees with an international attendance which included 14%, from some 52 countries other than the U.S. The exhibit area was large and well designed. The technical conferences had a variety of subject matter and attendance was as expected.

Our booth at SME was conceived and coordinated to convey the *LIGHTNIN* image of quality as a World Leader in Mixing Technology and Mineral Recovery Systems. We unveiled our new mining trademark; a large globe driven by a Series 10 that showed our A6000 impeller. It was suspended over our island booth. The new autoclave exhibit with up-pumping A340's generated the greatest interest, with the solvent extraction exhibit a close second.

Expomin May 1998, Feria Internacional de Santiago, Chile

Expomin keeps getting bigger and better. *LIGHTNIN* has participated in all of the past 5 exhibits. It has now grown to the second largest mining conference in our industry. The event involved over 2,200 exhibiting companies with more than 33,000 professional visitors.

The high quality exhibits were attractive and informative. More large-scale construction equipment was shown in the outside pavilions. The U.S. delegation occupied ten exhibit halls on the 81 acre exposition grounds.

A first at EXPOMIN this year, was the International Conference on Clean Technologies for the Mining Industry. Carlos Sanchez, chairperson, presented his paper on *Advanced Mixer Impeller Designs for Water and Waste Treatment*. In addition, Mike Giralico presented his paper on *New Mixer Designs for the next Generation of SX/EW Mixer Settler Systems and Their Affect on Chemical Losses*.

The theme of *LIGHTNIN* as the World Leader in Mixing Technology was emphasized with the new globe display. The solvent extraction pond exhibit stimulated many inquiries and questions. Sales representatives from *LIGHTNIN*'s South American locations were at the *LIGHTNIN* booth in full force: TecProMin: Juan Carlos Michels; Brenno Ganhal, Vicente Esparza; Benavides & CIA; Alejandro Benavides, Alfonso Miranda; Tecnointer: Marcelo Salvat. Thanks to all for your participation and hard work.



Interview with a Plant Manager – continued from page 1.

the capital equipment in SX, with no additional changes in EW. In addition to increased production, we are also benefiting daily because we lowered our production costs per pound.

B.G.: How is your copper quality?

J.S.: That question really puts a smile on my face. I am happy to report that the copper quality is excellent. We received a laboratory analysis by SGS and the quality of the cathode was 99.9999% copper. Dos Amigos recently received an award for having low impurities.

B.G.: What type of entrainment levels do you presently have?

J.S.: The organic and aqueous entrainment levels are very low. The high quality of our copper can be attributed to maintaining almost zero levels of aqueous entrainment in the rich electrolyte. Our organic consumption is presently running at a level below 1 Kg/ton of copper cathode. Both levels are extremely low when compared to industry standards.

B.G.: Any closing thoughts?

J.S.: To date, our operations have been successful and profitable. The anticipated life of our plant is predicted to be 5 years. The amount of mineral will dictate plant life.

I am happy with the LIGHTNIN design, equipment quality, and support. Our next challenge will be to further optimize our plant with a goal of lowering production costs even further. Productivity improvements which fine tune our plant will maximize profits. This is especially important in today's market conditions of depressed copper prices.

B.G.: John, thank you for being so kind and for answering all of our questions, muchas gracias!

J.S.: My pleasure, de nada!

Would you like to see LIGHTNIN Extraction News on the Internet? If you would like to read Extraction News on our website, e-mail Mike Giralico at mike.giralico@LIGHTNIN.gensig.com.

Visit LIGHTNIN on the Internet: www.LIGHTNIN-MIXERS.com

Please contact Mike Giralico with any questions at (716) 436-5550 or e-mail comments to mike.giralico@LIGHTNIN.gensig.com

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LIGHTNIN

135 Mt. Read Blvd.

Rochester, New York 14603

