

# LIGHTNIN EXTRACTION *news*

A Newsletter for Solvent Extraction Engineers

May 1996, Vol. 2, No. 2

## LIGHTNIN Receives SX Design Patents

LIGHTNIN has been awarded two patents for its revolutionary Solvent Extraction system design.

The first patent was awarded for the R320 family of pumper impellers. The R320 impellers have the highest head and flow designated per power input yet developed and maintain the required mass transfer and copper recovery of traditional impeller designs. The R320 impellers are designed to:

- maximize head and flow while reducing entrainment through lower power consumption,
- lower shear generation and turbulence,
- eliminate air incorporation,
- produce optimum droplet distribution,
- lower tip speed,
- and greatly decrease operational expenses.

These advances will allow design engineers and end-users to move away from traditionally limited designs toward cost-effective, high-technology solutions for increasing the production rate of today's plant and tomorrow's larger mining operations.

The second patent is for the combination of the R320 pumper impeller and the A310 high-efficiency auxiliary impeller.

The R320/A310 combination has proven itself in everything from 6-inch lab scale to 89-inch full-scale at flow rates above 15,000 gpm. This performance is predictable within  $\pm 3\%$  and is backed by LIGHTNIN's guarantee (including developed head and flow) for complete confidence in design.

## China Mixing Expert Joins LIGHTNIN Solvent Extraction Team



*Dr. Shen Zujun (Z. Jesse Shen), Vice President of Mixing Technology, LIGHTNIN (China) Mixers Co. Ltd., has joined the LIGHTNIN Solvent Extraction team.*

Jesse has worked in solvent extraction since 1978, when he began studying mixer-settler configuration design and hydrodynamic performance of solvent extraction process. His 1980 design of the EC-D Mixer-Settler with a Delta-type impeller

was patented in 1988 and awarded a National Prize in Science & Technology Progress issued by Chinese State Commission of Education.

A graduate of Jiaotong University with a degree in Machine Manufacturing Engineering, Jesse earned his Ph.D. in Chemical Engineering from the East China

University of Chemical Technology (ECUCT). He has twice been a visiting scholar at McMaster University in Canada, where he conducted extensive research work on solvent extraction equipment.

From 1984 to 1989, Jesse was Deputy Chairman of Chemical Engineering Research Centre of ECUCT and worked with one of the well-known chemical engineering leaders in China, the late Prof. Y.F. Su. He joined LIGHTNIN in 1990 as the Manager of LIGHTNIN China Shanghai Representative Office and in 1994 was named Vice President of Mixing Technology in China.

The son of one of China's pioneer chemical engineers, Jesse was one of the founders and the authors of the Chinese text book, "Mechanical Design of Chemical Process Equipment," as well as co-author of "Handbook of Chemical Engineering." He has also published a number of research papers and has participated in many international academic conferences worldwide.

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Visit LIGHTNIN on the Internet: [www.LIGHTNIN-MIXERS.com](http://www.LIGHTNIN-MIXERS.com)

# LIGHTNIN Mineral Recovery Systems Going

Recent issues of the *LIGHTNIN Extraction News* have described exciting developments in *LIGHTNIN's* successful copper solvent extraction program. *LIGHTNIN's* superior research and development of the new R320 family of pumper impellers has expanded copper mining applications worldwide. SX technology is adaptable to a wide range of mineral recovery applications and may ultimately be applied to 40% of the elements in the Periodic Table.

Although SX technology has been our current focus, *LIGHTNIN's* expertise in other mining industries is diverse and global. *LIGHTNIN's* extensive testing facilities - including a 25-gallon high pressure autoclave - allow us to model alumina, coal, gold, silver, copper, and phosphoric acid processes from preparation to purification. As always - mechanical reliability and process results are guaranteed 100 percent.

In our next several issues, we'll provide a brief overview of other major mineral recovery programs that *LIGHTNIN* has pilot tested, scaled up, and designed for full-scale mixer requirements.

## Gold

Ore processing requirements in the gold industry are similar to those in other sectors of the minerals industry. In all cases, the processes revolve around the handling of large volumes of ore slurry and incorporating physical processing or chemical processing steps that are related to distinct mixing application classes. The complexity of the applications range from simple blending and solids suspension to the more complicated multiphase reactor systems.

Solids suspension, which predominates in gold recovery processes, is a flow-controlled application where process results are directly proportional to the flow produced by the impeller.

## Carbon-In-Pulp and Carbon-In-Leach

Carbon-in-pulp (CIP) is the sequential leach and adsorption of gold from ore. Depending on the ore characteristics, the pulp may be conditioned with air and lime for several hours to make it more amenable to leaching. During the leaching stage, pulp flows through agitated tanks where lime slurry, sodium cyanide, and oxygen dissolve the gold into solution. The solution flows through agitated adsorption tanks, where the gold adsorbs onto activated carbon, flowing counter-current to the pulp.

Carbon-in-leach (CIL) involves simultaneous leach and adsorption. CIL is essentially a modified CIP process where the leaching and adsorption stages are combined into one. It was originally used on highly refractory gold ores, those that contain gold-robbing substances such as naturally adsorptive carbon or clays. In the leach section of the conventional CIP circuit, these gold robbing substances would deplete the process of gold by adsorbing gold themselves, decreasing the effective yield. The CIL process is designed to circumvent this by adding the carbon as the leaching occurs, thus gold recovery is improved.

CIP and CIL mixers must provide high flow to enhance reaction kinetics, and low shear, to minimize carbon degradation. The A310 impeller is ideal for these applications because it was specifically designed to maximize flow while minimizing shear.

## Pressure Oxidation Autoclaves

Developed for refractory ores where gold is occluded in sulphide minerals, pressure oxidation frees the gold, allowing economical recovery by conventional CIP/CIL circuits.

This application is much more complex than typical mineral solids suspension applications. When selecting a mixer, you must consider the primary mass transfer function, which will vary by job and ore body, and therefore requires a comprehensive process model for proper evaluation. At the same time, the scale up involves gas dispersion and solid suspension needs, which must be satisfied throughout the reactor volume. Radial flow

## New Uses for Oldshue-Rushton CMContactor Column

By Mike Preston

Although it's nearly 50 years old, the Oldshue-Rushton counter current extraction column is still one of the most effective, economical method for liquid-liquid and liquid-gas type extractions.

The subject of Dr. James Y. Oldshue's doctoral thesis in 1949, the Oldshue-Rushton counter-current extraction column is one of three methods currently used today. The others are the rotating disk (Karr) and York-Scheibel columns.

The CMContactor is used to achieve a desired mass transfer rate in a much more compact system than a conventional mixer-settler design. Advantages of the column design over the traditional mixer-settler design include accurate scale-up, improved volumetric mass transfer rates, and self-cleaning operation. Operation of the column is a continuous phase dispersion, maintained in every stage to accomplish the mass

transfer with phase separation at the dispersed phase outlet end of the column.

The column design has several variables that can be adjusted to obtain the most economic design. The area between the stages (AO), residence time, and pilot plant stage efficiency all play important roles in selecting proper column size and geometry. In copper solvent extraction, the flow rates are very large and traditional design has used mixer settlers for extraction, scrubbing and stripping. Disadvantages of large settling tanks are a restriction on the chemical composition of a solvent and the difficulty of protecting the settler from rain water infiltration. Engineers are now comparing the vertical multi-stage columns, such as the Oldshue-Rushton CM with the economic and process characteristics of mixer settlers.

Presently, many process applications in the SX market use Oldshue-Rushton columns. The lower flow rates for metals

# Beyond Copper

R100 turbines are used for gas dispersion, either alone or in combination with upper pitched-blade A200 axial flow turbines.

## Biological Oxidation

A number of mineral extraction processes involve oxidation reactions which are carried out in slurry with oxygen supplied from injected air or oxygen gas. Mixers are required to suspend the slurry, disperse the gas, maintain pH and control the temperature.

One such complex process is the biological leaching of refractory gold ore. This is a natural alternative to pressure oxidation in which bacteria oxidize and break down sulphide materials.

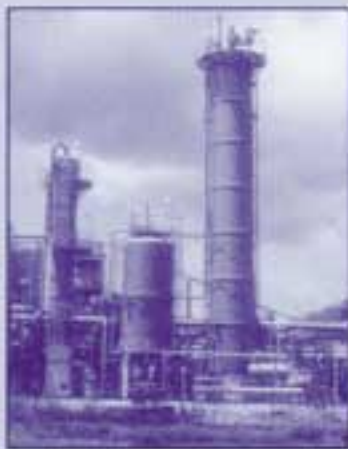
In the past, the radial-flow Rushton impeller was typically employed in this application because of its strong gas handling capabilities, but at the expense of uniform blending and solids suspension. Today, LIGHTNIN's highly effective A315 impeller accomplishes the necessary gas handling for this process and couples it with uniform blending, heat transfer and solids suspension.

The A315 has produced significant oxygen transfer enhancement in several demonstrative and commercial scale bacterial oxidation plants in South Africa and Australia. Interviews with operations personnel indicated that the A315 achieved equal process result (i.e., oxygen transfer) at 35-50% of the power of the conventional Rushton radial flow turbine.

More than 70 years of mixing experience and the most efficient equipment available are two reasons why LIGHTNIN customers get higher productivity from their gold recovery processes. By running through agitation studies of your ore samples, we ensure that we recommend the right equipment for your process, whether it involves carbon-in-leach, carbon-in-pulp, pressure oxidation or biological leaching.

*We invite you to call for a free assessment of your current mining process at 1-800-320-3526, ext. 633.*

such as uranium, nickel, cobalt and rare earth readily lend themselves to the Oldshue-Rushton Column. Other applications include organic washing, crud treatment and de-chlorination of high chloride PLS all can be readily adapted to the Oldshue-Rushton Extraction Column. In northern climates, putting a building over a mixer-settler plant is normally uneconomical, and the easy installation of vertical Oldshue-Rushton Columns is very appropriate for these conditions. For more information on extraction columns, please contact your local LIGHTNIN sales engineer.



## Special Report on SME and ISEC

*By Mike Giralico*

With more than 400 exhibitors and 70 technical sessions, the recent Society for Mining Engineering (SME) meeting and exhibition in Phoenix demonstrated the worldwide interest and profit potential in mining.

Make no mistake: Competition will be fierce, with rewards going to companies that supply the latest technology and the most dependable products and services.

These rewards will require responsibility, if the keynote session is any indication. "Measuring Environmental Performance in the Global Arena," clearly illustrates everyone's responsibility to make major strides in protecting the environment. This is magnified by the many projected grass root investments and expansions. Our lives and jobs will be much easier if we guard and guarantee our industry's worldwide environmental reputation.

This is especially true in today's agitator/mixer/aerator business. In each of the numerous mining-related mixer applications, we see daily challenges to the processes that require new technology. LIGHTNIN is actively inquiring, studying and developing mixer systems to solve our customers' future mixing requirements.

Besides the keynote and technical sessions, the annual program included field trips, short courses, tours, workshops and socializing—a well-attended, well-organized event.

Attendance was high at more than 70 extremely educational sessions, in which an average of five papers were presented per session.

LIGHTNIN's Mike Preston presented a paper on optimizing the performance of solvent extraction systems which was very well received.

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LIGHTNIN also participated in the ISEC '96 solvent extraction conference held in Melbourne, Australia, March 19-23.

Tom Post presented a paper, "Copper Solvent Extraction Process: Optimization of the Design and Operation of Pumper and Auxiliary Impellers," that was included in a practical experience session chaired by Alan Taylor of Alta Metallurgical Services.

The keynote speaker, Professor Ritcey of Canada, commented that a major cause of SX plant concerning crud formation and entrainment was the over-design of agitators. He said LIGHTNIN's design that limits excess shear and turbulence was a good solution.

## Jesse Shen joins LIGHTNIN SX Team

(From page 1.)

Jesse is the Senior Member of Chinese Society of Mechanical Engineering, member of Shanghai Chemistry and Chemical Engineering Society, and a member of the American Institute of Chemical Engineering. He is also a Life Fellow of International Biographical Association (Cambridge) and a Fellow of the American Biographical Institute.

Jesse and his wife, Ding Yanwen, a bio-science engineer, are the parents of three children, Shen Yingcong (Jeff), Song Wei (Sherry), and Shen Yingyi (Annie).

### Jesse Shen Publications

Following is a partial list of papers written by Jesse Shen on Solvent Extraction technology. Call your local LIGHTNIN sales engineer for more information.

- EC-D Mixer-Settlers
- A Study on Selection of Agitator Types and Power Consumption of Mixer-Settlers
- Study of Agitator Types in Mixer-Settlers
- Study of Coalescence and Settler Design in Mixers-Settlers
- Activity Correction Factor for Copper-based Catalyst in Methanol Synthesis Reactors
- EC-D Mixer-Settler and Its Application to Rare Earth Industry

## LIGHTNIN Minerals Recovery Systems. A World of Experience.

Just about every step in minerals recovery depends on separating solids or uniformly mixing a flow stream with a liquid or gas. That's why you need a mixing partner that can take your recovery process to a higher level.

For more than 75 years, thousands of customers around the world have relied on LIGHTNIN Minerals Recovery Systems to provide high-tech solutions to manage the many variables that influence the throughput of their entire process.

In our extensive testing facilities, we'll identify rheological characteristics and run thorough agitation tests on any type of ore sample. With these results, we'll determine the right mixing intensity and equipment, including the agitator type, quantity and location of impellers.

In the field, LIGHTNIN equipment has the highest industry rating for durability and performance. Our mixer drives are easy to handle and designed to tolerate all types of rugged, dependable service.

### 100% Guarantee

Whatever your process, we guarantee that LIGHTNIN equipment will do the job we say it will do and that you'll achieve your desired mixing result.

To reach the LIGHTNIN Minerals Recovery Systems Team, call 716-436-2300.

**YOU AND LIGHTNIN.  
THE RIGHT MIX.**

**LIGHTNIN**

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