



**MINING &
PROCESS
SOLUTIONS**

*Innovative Thinking
& Technology*



Australian Minerals Research Centre

GLYCINE LEACHING PROCESS

Australian Mineral Research Centre
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Glycine Leaching Process

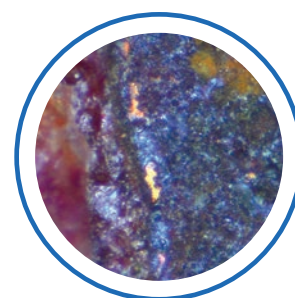
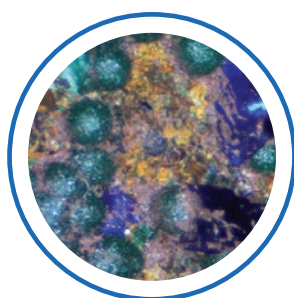
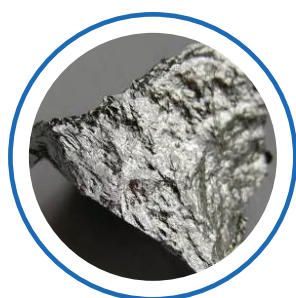
The Glycine Leaching Process is an environmentally benign hydrometallurgical process that will leach base and precious metal oxides, mixed oxides, and sulphide ores.

Glycine is:

- the simplest and cheapest amino acid and is available in bulk in different grades
- **an environmentally safe and stable reagent** and is biodegradable and easily metabolized in most living organisms
- **selective on which metals it leaches** and does not leach common gangue minerals
- **easily recovered and recycled.** This means low reagent consumption costs.
- A simple process that can be used with **“off the shelf” items of equipment.** This means low capital costs when building plants.

Leaching characteristics of metals under consideration at pH values between 9 and 12 with Sodium Glycinate as solvent

25 Mn Manganese 54.9	26 Fe Iron 55.9	27 Co Cobalt 58.9	28 Ni Nickel 58.7	29 Cu Copper 63.5	30 Zn Zinc 65.4	31 Ga Gallium 69.7	32 Ge Germanium 72.6	33 As Arsenic 74.9	34 Se Selenium 79.0
44 Ru Ruthenium 101.0	45 Rh Rhodium 102.9	46 Pd Palladium 106.4	47 Ag Silver 107.9	48 Cd Cadmium 112.4	49 In Indium 114.8	50 Sn Tin 118.7	51 Sb Antimony 121.8	52 Te Tellurium 127.6	
76 Os Osmium 190.2	77 Ir Iridium 192.2	78 Pt Platinum 195.1	79 Au Gold 197.0	80 Hg Mercury 200.6	81 Tl Thallium 204.4	82 Pb Lead 207.2	83 Bi Bismuth 209.0		
Limited Data on Glycine Solubility		Known Glycine Insoluble		Known Glycine Soluble		Selectively Removable			



Base and Precious Metals Leaching Applications

Several applications of the technology are being developed.

GlyLeach™ Turns Orphan Deposits and Wastes into Viable Opportunities	<ul style="list-style-type: none">• Leaching of base and precious metal ores and tailings• Particularly suitable to oxides and transition ores but also attractive for some sulphides• Step change capability to turn remote stranded deposits into viable projects
GlySmelt™ A Mine-to-Metal Production Solution	<ul style="list-style-type: none">• Leaching of Concentrates – capture precious metal value• On site alternative to transporting and exporting bulk concentrates to Smelters• Removal of As from concentrates exceeding threshold values
GlyMine™ The Enabler to In-place and Insitu Leaching	<ul style="list-style-type: none">• ISL or In-Place Leaching of base and precious metals• Could be the enabling Lixivant due to its environmentally benign nature
GlyCat™ Catalysed Leaching for Mixed Precious and Base Metal Deposits	<ul style="list-style-type: none">• Substantial reduction in cyanide for Au/Ag ores where copper content ‘consumes’ cyanide• Recovery of both base and precious metals in same flow sheet• Opportunity for reagent suppliers to commercialise as a hybrid reagent with a disruptive business model
GlySlag™ Turning Waste Slags into Metal	<ul style="list-style-type: none">• Stockpiled copper slags around the world typically contain 1% copper that cannot be recovered efficiently with conventional processes• GlySlag™ recovers 90% of copper in most slags

GlyLeach™ - Turning orphan deposits and wastes into viable opportunities

GlyLeach™ is the application of Glycine to leach fresh base and precious metal ore sources. These include the use of Glycine as a Lixivant in Dump/Heap Leaching, Continuous Vat Leaching, Traditional Vat Leaching, and Agitated Leaching flow sheets.

GlySmelt™ - A Solution for Mine-to-Metal Production

GlySmelt™ is the application of Glycine as a method to leach concentrates, specifically ‘dirty concentrates’ and is a potentially disruptive technology to change the current paradigm from a mine-to-concentrate value chain to a mine-to-metal model. It also offers opportunity to improve on suboptimal gold and copper recovery for existing plants that use flotation.

GlyMine™ - The enabler to in place and insitu leaching

GlyMine™ is the application of Glycine as a Lixivant in applications where leaching of valuable metals can be carried out by circulating the lixiviant through bore holes into a permeable or semi-permeable rock mass (in situ) or directly on broken ore (in place) with minimal handling and size reduction. Glycine is attractive over other known Lixivants due to its low toxicity and biodegradable nature.

GlyCat™- Catalysed leach for mixed base and precious metals

GlyCat™ is the application of Glycine with cyanide to mixed base metal and precious metal ores. The presence of copper minerals in with gold is known to lead to many challenges during the cyanidation of gold ores, such as high consumption of cyanide with low gold extraction and undesirable impacts on gold recovery during the downstream processes. GlyCat™ is a process to enhance the dissolution of gold and copper in gold/copper ores where glycine is used as a catalyst in a cyanide starved leaching environment.

GlySlag™ - Turning waste slag into viable opportunities

GlySlag™ is the application of Glycine to leach residual metals contained in slags, a by-product of the smelting process. Typically, these slags are stockpiled and in the case of copper slags can contain upwards of 1% copper in a form that does not respond well to traditional processing.



OUR TECHNOLOGY IS BACKED BY A LEADING RESEARCH GROUP

Mining & Process Solutions (MPS), through its collaboration and commercialisation agreement with Curtin University, has the backing and support of a leading minerals research group continuing to undertake fundamental research into Glycine leaching.



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