

## Testing Services

### Sample Preparation and Grinding

The laboratory is equipped with a 12" x 7" single toggle Jaw Crusher and 12" Roller Mill for crushing. Sample splitting and blending is conducted using a rotary splitter and 100 kg capacity rotary blender. Three Kason multideck vibrating screens are available for screening and splitting, ranging in diameter from 220 mm up to 720 mm. All crushing equipment is housed in soundproof enclosures which are vented to a dust extraction baghouse.

A continuous ball mill and regrind milling pilot plant is available. The pilot plant can treat 300 kg per hour of crushed ore in a 12 kW continuous ball mill that is 70 cm in diameter and 60 cm long. The ball mill is fitted with a 4 tonne capacity feed hopper, vibratory feeder and feed conveyor. A range of pilot hydrocyclones are also available for classification. The pilot regrind mill is a 4.5 kW continuous ball mill that is 50 cm in diameter and 50 cm long.

The laboratory has a range of smaller scale rod and ball mill units for preparation of 2 to 5 kg batch samples. Mills are available in mild steel, stainless steel and ceramic.

The laboratory has a range of ultrafine grinding equipment, with both a 1 and 4 litre Netzsch (IsaMill) horizontal bead mill, a 10 litre Metprotech vertically stirred mill and a 2 litre English China Clay mill available for fine and ultrafine grinding.

### Flotation

A range of Agitair flotation units are available for bench scale flotation testing. Cell and impeller sizes are available in the range from 0.5 to 15 litres.

A fully continuous pilot flotation plant is available. The pilot plant is capable of treating 500 kg per hour of dry feed. The pilot plant uses 4 x 60 litre Denver cells for rougher/scavenger duties and 150 or 300 mm Jameson cells for retreat and cleaning. The pilot plant has a range of stainless steel conditioning tanks ranging from 40 to 500 litres and Warman slurry pumps for all pumping duties.

### Gravity Separation

The laboratory has a 3 inch Knelson centrifugal bowl gravity concentrator and a 6 inch Falcon centrifugal bowl concentrator. A Gemini table and Super-panner are also available for further upgrading of gravity concentrates.

### Heap Leaching

A constant temperature room is available for heap leaching testwork. The room can be held at a constant temperature within the range 20 to 50 degrees Celsius for simulation of heap or in-situ leach conditions. The laboratory has an extensive inventory of clear columns of various sizes and variable dosing pumps to enable column leach tests to be carried out on samples ranging from 15 to 300 kg. For all base metal column tests, daily solvent extraction procedures can be carried out using batch 40 litre solvent extraction units.

A range of bacterial inocula is also maintained at the laboratory for bacterial oxidation leach testwork.



## Gold Leaching

Several laboratory scale baffled agitated leach vessels with capacities ranging from 0.5 to 20 litres are available. The laboratory has cyanide, pH probes and controllers for automated operation of batch leach tests and carbon traps for CIL operation. Bottle roll apparatus is available, along with a set of pachuca reactors for lower agitation intensity.

Gold leach columns with diameters ranging from 150 to 350mm, carbon traps and feed pumps are available for gold heap leach testwork.

## Agitated Leaching – General Laboratory

Laboratory scale baffled agitated leach vessels are available in the range 0.5 to 20 litres. All vessels can be heated, and come in HDPE, glass or 316 stainless steel. A range of mixers and impeller types are available. All reactors can be fitted with automatic pH and Eh control equipment and can be operated in continuous or batch mode. A distributed control system (DCS) is also available for monitored, 24 hour operation.

Two small scale continuous leach trains are available in sizes of 3 x 5 litres and 4 x 2.5 litres. Each train has agitators and impellers, and all reactors are jacketed for temperature control.

## Bacterial Leaching

A full range of bacterial leach equipment is available along with bacterial counting and characterisation apparatus. Bench and pilot scale bacterial reactors are available up to 300 litres in capacity.

## Leach Pilot Plant Equipment

The pilot plant equipment available can process nominally 10 to 1000 kg of feed solids per day using agitated leach vessels ranging from 20 to 2000 litres. The reactors are manufactured from stainless steel and can be heated as necessary by direct steam injection, or using heating jackets. Alternative reactors in HDPE, Fibreglass-reinforced plastic (FRP) coated stainless steel or butyl rubber lined stainless steel are also available for processing corrosive leach solutions. Gas injection systems are available, along with a range of impeller types. Fume control facilities and scrubbing units are available for tests involving production of toxic off gasses.

A fully continuous pilot leaching facility is available featuring agitated reactors, filtration, solvent extraction and electrowinning operations. The facility is fully instrumented and controlled by a distributed control system. Capacity of the plant can be varied from 100 to 20 000 litres.

## Pressure Leaching

Two (3 and 10 litre) batch PARR autoclaves are available for pressure leach testwork. The autoclaves are suitable for operating at pressures of up to 40 atm, and temperatures up to 350 degrees Celsius. External pressure bombs have been fitted to allow sampling without flashing during pressure leach trials. The autoclaves also have facilities for reagent addition (such as sulphuric acid) at pressure.

A 20 kW electric boiler provides steam to the autoclaves for startup and temperature control. Each autoclave also has electric heating.

## Solvent Extraction

Fully continuous solvent extraction (SX) process development can be undertaken at two scales. Initial small scale trials can be simulated on a Bell unit mini pilot plant, with eight units, each consisting of a 0.5 litre mixer and 1 litre settler. Typical feed throughputs for the mini pilot are 2 to 8 litres/hour.

Continuous SX processes can be simulated on the automated SX pilot unit which is available. The unit comprises 8 mixer-settlers with 16 litre mixers and 100 litre settlers. Features of the mixers include variable speed agitators and height adjustment on all impellers. Settler features include picket fences on all units, aqueous recycle capabilities, visual aqueous-organic interfaces and a variable settler area. The solvent extraction pilot plant is fitted with control equipment and can be operated by a distributed control system. It can typically treat 2 to 4 litres/minute of feed liquor.





## Electrowinning

Laboratory electrolytic cells ranging from 0.5 to 10 ampere are available for testwork.

A fully instrumented 200 litre/1000 ampere pilot cell, complete with a constant current DC rectifier (0 to 1500 A) is available for pilot scale testwork. The pilot cell is suitable for producing up to 30 kg of cathode product per day. Cathode and anode materials are available for copper, zinc, nickel, cobalt and antimony plating.

A second fully instrumented 1500 litre/8000 ampere pilot cell is also available for pilot scale testwork. The cell comes complete with a constant current DC rectifier (0 to 8000 A) and is suitable for producing up to 200 kg per day of cathode product. Cathode and anode materials are available for copper and zinc plating.

## Filtration and Thickening

The laboratory has a range of sample filtration units for small scale testwork and a set of 16 pressure pot filters for larger samples. Vacuum leaf and pressure leaf filter apparatus is available for design of filtration systems.

Laboratory thickening testwork can be carried out in batch mode in a wide range of graduated measuring cylinders or in fully continuous 100 mm diameter columns with an active height of 2 metres. The continuous thickening columns each have individual rakes and separate slurry feed and withdrawal pumps. Small and large fixed bowl centrifuges are available for centrifuge testwork.

Fully continuous pilot thickening and settling units are available at 0.5, 1 and 2 m diameter. Three pilot scale plate and frame filtration units are available for pilot plant work. The smaller pilot filters vary in area from 1 to 5 m<sup>2</sup>. For larger scale operations, the laboratory has a PLC controlled 40 m<sup>2</sup> automated filter press, with hydraulic pressing, conveyor belt cake discharge, and programmable washing cycles. A pilot scale pressure leaf filter is also available.

## Calcination/Furnace Work

Several muffle and tube furnaces are available for laboratory scale calcination testwork. A pilot scale fluidised bed calcination unit is available for pilot work, sized at a feed rate of 5 to 15 kg/hour.

## Distillation

The laboratory has several bench and pilot scale distillation and fractionation units capable of treating up to 50 litres per hour of feed. Fully enclosed and fireproofed rooms are available for distillation of volatile components.

## Utilities

All laboratories and pilot plant areas are fitted with process air, vacuum and steam. Boiler sizes range from 30 to 300 kW. De-ionised water is available in all laboratories. A 24 m<sup>3</sup> tailings dam is available for pilot plant testwork to capture all spillage and waste. The laboratory is equipped with bulk waste neutralisation facilities for waste treatment, and both laboratory buildings are fitted with marble chip beds to treat drainage.

The laboratory has a security system installed in all premises, and all premises have internal smoke and heat detectors.

## Analytical Equipment

**hrltesting** offers a range of analytical services for testwork, control and reporting. The services include mixed acid digest / AA finish, acid digest / fusion with ICPOES and XRF. On a limited basis **hrltesting** is now also offering analytical services to external clients. The services on offer are suited for those cases where high accuracy and precision are required and the numbers of samples are limited.

A Karl Fischer titration unit is available for determination of water levels in organic phases. A Malvern Mastersizer unit is available for particle size determination. The laboratory also has an extensive range of wet chemical analysis equipment. A Metrohm automatic titrator is available for titrimetric and potentiometric analysis.





### Optical Mineralogy

Optical mineralogy is provided by a well qualified mineralogist (John Knights). Examination of polished section grain mounts and/or petrological thin section mounts are catered for along with a particular focus on diagnosing process problems and recognizing opportunities and potential pitfalls arising from the habit and character of minerals presented in process products or residues.

### Process Control

A Paragon distributed control system is available for pilot plant control and monitoring. The system is connected to a local security network for after hours monitoring of continuous testwork. Fully continuous control of pH, Eh, temperature, tank level, flowrate and pressure is available. The Paragon control system is supplemented with a communications system consisting of mobile phones and pagers to ensure efficient monitoring of continuous testwork.

Several stand alone process controllers are available for pH or ORP control of laboratory and small scale continuous testwork.

### Waste Handling

All leaching pilot plants are operated on a suspended concrete floor with Bunding and floor drains to capture all spills. The floor is coated in an acid resistant epoxy surface. Spills are captured in a tailings sump on the level below the leaching area, and solids are settled out of the slurry. The tailings sump is regularly cleaned out using a local waste contractor approved by the Brisbane City Industrial Waste Management division. Solution from the tailings sump is neutralised to pH 7 to 10 using hydrated lime in a treatment tank and discharged from the laboratory. Monitoring of the discharge is carried out regularly by the laboratory and by the Brisbane City Industrial Waste Management division.

### Manual Handling

The laboratory has a 2 tonne gas forklift and 2 tonne Toyota Utility available for sample and equipment movements. The pilot plant area has an electric 2 tonne overhead crane, 1 and 2 tonne travelling cranes, as well as several jib cranes located in high lift areas. The laboratory also has two mobile walkie stackers for sample movement, as well as mobile cranes, trolleys and pallet jacks.

### Sample Storage

The laboratory has in excess of 150 m<sup>2</sup> of storage space for storage of testwork samples.

### Quarantine

**hrltesting** laboratories are AQIS approved premises for the importation and storage of samples under quarantine.

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