Altilium

FUELLING THE FUTURE

INTRODUCING THE DNi PROCESS™

FUELLING A FUTURE OF GREENER MOTORING

NICKEL SHORTFALLINGS?

HPAL FAILINGS?

TOXIC TAILINGS?

PROBLEMS SOLVED...

THE DNi PROCESS™

FUELLING A FUTURE OF GREENER MOTORING

Our ground-breaking, patented technology extracts valuable metals without costing the earth. Ensuring a constant supply of nickel, cobalt, and more, to power the mass production of EV batteries.

SAFER

Eliminating the need to heat acid to dangerously high temperatures under hazardous pressures.

SIMPLER

With straightforward set-up, our process is flexible and scalable with minimal risk.

GREENER

Over 99% of the nitric acid is recycled, producing a nitrogen-rich residue which can be returned to the mine to rehabilitate the land.

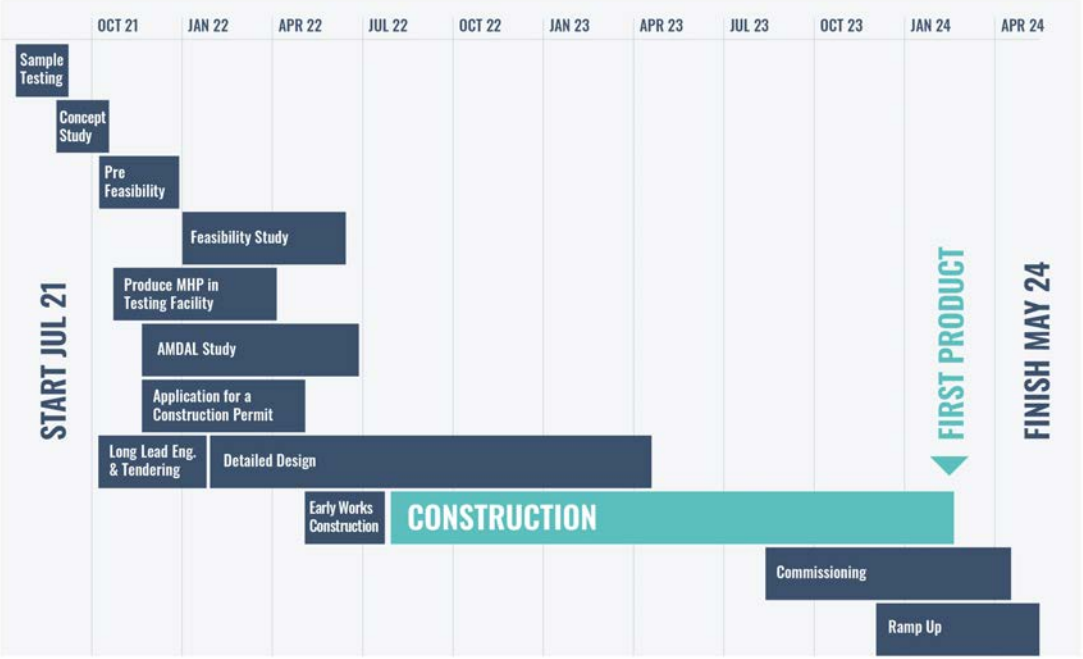
LEANER

With significantly lower capital and operating costs, and fast, efficient plant construction.

CRITICALLY, THE DNi PROCESS™ IS ALSO FASTER

A DNi Process™ plant from Altilium is the fastest possible route to market from a standing start. And that's by some way! Take for example Queensland Pacific Metals' plant which will be ready to commission within just 14 months of breaking ground.

The timeline on the right shows how, by using the DNi Process™, this plant is on-course to deliver battery-grade MHP (supplying 16,000 tonnes of nickel per annum) to meet the expected surge in demand by early 2024.



Queensland Pacific Metals TECH Project Plant Timeline.

PROBLEMS SOLVED...

PROBLEM #1:

THERE IS A SHORTAGE OF NICKEL WHICH COULD SEVERELY IMPACT THE GLOBAL SWITCH TO ELECTRIC VEHICLES

'Although the battery sector share of nickel demand is much smaller than other metals, getting the quantity of nickel that EVs will need by the mid-2020s will be a challenge. A low nickel price has hindered any project development and with lead times often up to 10 years, investment needs to happen now.'

Gavin Montgomery, Wood Mackenzie Research Director, July 2019

SOLUTION:

THE DNi PROCESS™ IS THE FUTURE FOR PROCESSING LATERITIC ORE

The DNi Process™:

- extracts **all saleable metals** from lateritic ore (Ni, Co, Sc, Fe, Al)
- economically processes ore with low Ni grades
- reprocesses tailings to unlock all hidden value, including Rare Earth Elements (REEs)
- processes the entire laterite ore body - limonite, saprolite and transition zone
- recycles over 99% of the nitric acid used to dissolve the contained metals;
  - Operates at atmospheric pressure; and
  - Returns a dry and inert residue, which is around half the volume of the ore feed.

All in all providing a constant source of nickel, cobalt and much more.

PROBLEMS SOLVED...

PROBLEM #2:
HPAL FAILINGS

The history of HPAL plants is littered with stories of failure and cost overruns:

'A number of HPAL projects in the past have failed and therefore new nickel supply for the battery industry is far from guaranteed.'

US Senate Committee on Energy and Natural Resources Committee, 116th Cong., 6-7 (February 5, 2019) testimony of Simon Moores, Managing Director, Benchmark Mineral Intelligence.

Benchmark Minerals report: Laterites that are processed via hydrometallurgy (such as HPAL) generate inordinate amounts of waste residue that can be highly toxic if not properly treated. In addition, the liquid effluent from an HPAL operation far exceeds the facility's ability to recycle, and great quantities of solution must be disposed of. Time and money can be spent on tailings and other processes to make projects more environmentally sustainable. It is worth noting however, that in many cases this is unlikely as the financial burden to make these changes would make production uneconomic at the current nickel price.

THE DNi PROCESS™	HPAL
MAIN PRODUCT: Mixed (Ni-Co) Hydroxide Product	**MAIN PRODUCT:** Mixed (Ni-Co) Hydroxide Product
CO-PRODUCTS: Hematite, Magnesia, Aluminium Hydroxide, Manganese, Scandium	**CO-PRODUCTS:** Ammonium Sulfate, Scandium
ORE FEED: Processes full lateritic ore profile (limonite, saprolite and transition zone)	**ORE FEED:** Primarily processes the limonite ore because Mg in the saprolite increases acid consumption
PRESSURE: Operates at 1 atmosphere	**PRESSURE:** Requires at least 40 atmospheres
TEMPERATURE: Extracts metals at 110°C	**TEMPERATURE:** Extracts metals at 250°C
PLANT MATERIALS: Simple materials of construction, mainly 304 grade stainless steel	**PLANT MATERIALS:** Requires one or more submarine-sized titanium autoclaves which are then lined with exotic ceramic bricks to prevent the H2S04 from damaging the autoclave
TECHNOLOGY: Easily scalable (stirred tanks, not complex pressure vessels)	**TECHNOLOGY:** Challenging technology with historical projects generating poor returns – there are currently no plants smaller than 30,000t per annum of Ni
ACID CONSUMPTION: 30–80kg of nitric acid per tonne of processed ore is consumed, while over 99% of the added acid is reused	**ACID CONSUMPTION:** 250-500kg of sulphuric acid per tonne of processed ore is consumed, most of which needs to be neutralised before being disposed in a tailings dam or the sea
WASTE MATERIALS: Generates around 200kg of residue from every 1,000kg of ore processed* – the residue is inert and mainly consists of silicates and can be dry-stacked and returned to the mine	**WASTE MATERIALS:** After neutralising with the addition of limestone, the tailings equal around 1.5 times the weight of the ore feed. These are then deposited into a tailings dam or the sea
CAPEX: In the range of $25,000 to $30,000/t and delivers significantly more value in saleable products	**CAPEX:** Averages $42,000/t of Ni and delivers only Ni, Co & some Sc

*Actual volume is largely determined by the iron content of the ore.

PROBLEMS SOLVED...

PROBLEM #3: TOXIC TAILINGS

The extraction of nickel comes at an environmental and health cost. As reported by the Guardian: 'Plumes of sulphur dioxide choking the skies, churned earth blanketed in cancerous dust, rivers running blood-red – environmental campaigners have painted a grim picture of the nickel mines and smelters feeding the electric vehicle industry.'

'We have to get smarter at recovering and reusing the vast quantities that we have already extracted from the earth, rather than relying on continued pursuit of new reserves of ever poorer quality and at substantial environmental cost.'

Dr David Santillo, senior scientist at Greenpeace Research Laboratories

'We are sitting on a time bomb. The big problem is that we don't know which (tailings facilities) offer the greatest threat and where they are situated.'

Dr Stephen Edwards of University College London's Hazard Centre,

SOLUTION: THE DNi PROCESS™ IS FAR KINDER TO THE ENVIRONMENT

- The DNi Process™ is the only ore processing technology which delivers a **positive environmental legacy** with its residue.
- The DNi leach residue (what's left after extraction of all the saleable products) is around one-third of that produced by high-pressure acid leaching ("HPAL").
- The DNi leach residue contains a small quantity of magnesium nitrate (a fertiliser) and is able to be dry-stacked and stockpiled or used to rehabilitate mine workings.
- Apart from lateritic ore, the DNi Process™ is also able to reprocess tailings with high extraction rates of nickel, cobalt and iron.

FINALLY IT'S POSSIBLE TO EXTRACT ALL THE VALUE

Only the DNi Process™ extracts all the metals contained in the feedstock. By processing optimal volumes of metal the DNi Process™ unlocks an abundance of hidden profit from valuable co-products.

THE DNi PROCESS™ THE SAFER, GREENER, MORE PROFITABLE ALTERNATIVE

Sustainably producing MHP; facilitating the mass adoption of electric vehicles; promoting rehabilitation of mine sites; and delivering value to all stakeholders.

Altilium

FUELLING THE FUTURE

THE DNi PROCESS™

Invented in the US.
Developed in Australia.
Owned and managed
by a British company.

FOR FURTHER INFORMATION PLEASE CONTACT OUR COO, ORESTES TRIFILIO:

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