IHC Mining

Tailings capability statement

Opportunities for safe and efficient tailings rehandling and reprocessing

Tailings deposits are found everywhere in the world where there is ongoing or legacy mining activity. These man-made deposits can present challenges for the owners, but can also hold interesting opportunities. Either way, sustainable rehandling and reprocessing of tailings is becoming a more prominent part of mining operations.

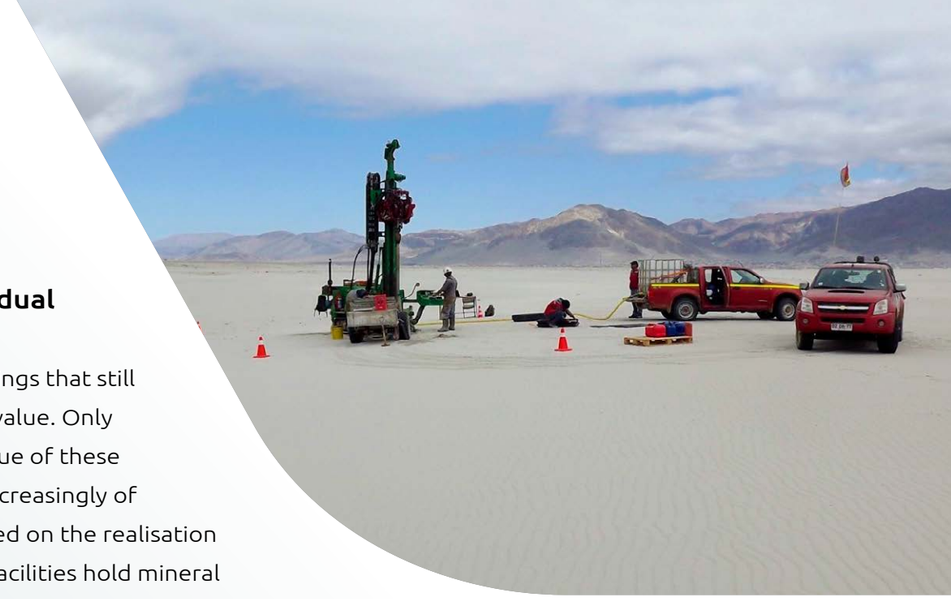
De-risking tailings storage facilities

Unfortunately, (recent) history has proven that tailings storage facilities pose significant risks, such as potential dam breaches or failures, groundwater and surrounding ecosystem contamination, and post-closure costs and balance sheet liabilities. IHC Mining can support companies in sustainable and effective tailings management in order to mitigate these risks and facilitate profitable project development.

Optimising water use

Water is a scarce resource. Many mining sites face challenging limits on their freshwater intake, as well as discharge qualities. Focusing on water use and recycling of used water is more important than ever.

Alongside that, miners battle with the risks associated with excess rainfall, which can result in flooding of tailings storage facilities. With more water required to extract the same amount of ore, this also presents challenges in water use and storage. IHC Mining has water management solutions available for both end-of-pipe tailings and existing tailings storage facilities to optimise water use and recovery at mine sites.



Leveraging residual value

Many sites hold tailings that still contain significant value. Only recently has the value of these deposits become increasingly of interest. This is based on the realisation that many tailings facilities hold mineral grades comparable with competing virgin deposits and/or minerals, particularly in cases where virgin ore quality is deteriorating.

The key challenge is to economically and effectively recover the resources. IHC Mining offers a wide range of services and products to convert the potential of these deposits into real opportunities.

Why IHC Mining

IHC Mining understands that tailings management requires a careful approach and integrated solutions in which all aspects relating to rehandling, water management and reprocessing are taken into account in a sustainable way. We offer a complete range of studies, and engineering and equipment solutions to support mining companies in addressing the ever-increasing challenges associated with tailings.

Expertise in safe and efficient tailings rehandling

IHC Mining understands the importance of clear and sound advice to support customers in the development of tailings projects with regards to derisking, rehandling, water management and rehabilitation. With our proven track record in alluvial- and marine-mining, and tailings rehandling projects, we provide a suite of services focused on safe, efficient and effective operations to unlock the potential of these mining legacies.

IHC Mining's consultants can provide leading expertise to evaluate your project and deliver in-depth studies, ranging from resource assessment and operational design and planning, to dewatering and final storage of rehandled tailings. This adds value to any mining project at any stage of development.

References

- oil sands in Canada
- coal in Africa
- iron ore in Brazil
- copper beach sand in Chile
- base metals (Cu, Co) in Africa
- remediation in Spain
- gold rehandling in Russia.

Our tailings advisory services

Identifying and proving tailings resource potential

Tailings resources are special due to the method of deposition. IHC Mining recognises the value that can be obtained from the deposits. For this we offer:

- professional and highly experienced geological services
- resource assessments to confirm the value potential in the tailings
- exploration support to enhance resource estimation.

Selecting extraction equipment for dry and wet operations

Tailings differ from fresh ore, by being (very) fine grained material and containing high amounts of liquid. This calls for an adapted approach when selecting the right equipment. IHC Mining can advise on:

- mining methods suited to specific operational circumstances
- analysis regarding the steps in the process
- equipment for either wet or dry mining.

Advising on mineral processing and water management

IHC Mining has in-house experts on mineral processing and dewatering questions. Our services include:

- defining flow sheets and selecting mineral processing equipment for the extraction of valuable materials
- advising on methods to efficiently use and recover water from rehandled tailings
- optimising existing processing and dewatering plants.

Defining the most efficient operational plan

As with any mining project, a tailings rehandling operation needs careful operational planning, taking into account the structural integrity of the dam. IHC Mining offers:

- expertise in efficient mine planning
- operational plans that enable feasible and low-cost operations
- geotechnical knowledge to ensure a safe operation.

Cost-effective equipment for wet tailings

Tailings storage facilities (TSFs) that are (partly) submerged are inaccessible for conventional mining equipment. By means of dredging equipment however, tailings rehandling is still possible.

Since tailings consist of already processed material, they are predominantly loose. The material is often fine grained, which makes it ideally suited for slurry transport, especially when the tailings are stored in a submerged environment. Dredgers are primarily used in low-value, high-production projects such as sand and soil mining. Tailings rehandling can benefit from dredging due to low OPEX and high production rates, which support the feasibility of tailings rehandling business cases.

IHC Mining is part of Royal IHC, the market leader in dredging, with over 300 years of experience. We design and build a variety of standardised (Beaver®) and custom-built cutter suction dredgers (CSDs).

References

- custom-built dredgers for Cu/Co tailings in Africa
- Beaver® dredgers for iron ore tailings in Brazil
- Beaver® dredgers for oil sands tailings in Canada.

Rehandling tailings with IHC Dredgers

Standard equipment

The Beaver® CSD is well known for its robust construction, reliable operation and excellent performance, resulting in the best value for money. All of Royal IHC's standard Beaver® CSDs can be delivered from stock and are reliable, fuel efficient, have low maintenance costs and a production range from 150m³/h (Beaver 30) to 1,500m³/h (Beaver 65) of in-situ solids.

Custom-built solutions

Royal IHC designs and builds CSDs specifically to suit any customer needs, irrespective of the project's location. The vessels are outfitted to work in specific environments, such as the cold arctic climate or humid tropical regions. Furthermore, these CSDs are tailored to operate in specific soil conditions and guarantee an optimal production rate.

Dredging benefits:

Low OPEX operation

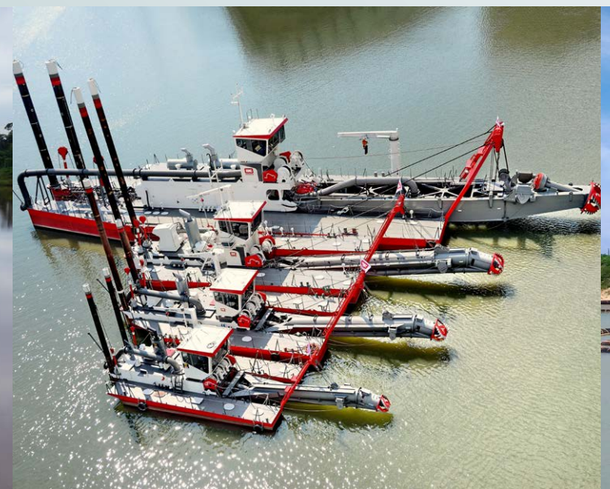
Slurry transport is considered to be the most cost-effective method of material transport, especially when it is already stored in a submerged state.

- low amount of maintenance required on the pipelines
- reduced dependence on manual operators
- significant cost savings across the entire operation.

Automation and operational safety

A high degree of automation and use of artificial intelligence (AI) guarantees a safe dredging operation.

- without many individually moving units, such as trucks, the risk of accidents is significantly reduced
- dredgers are equipped with the highest safety measures available, creating a safe working environment for all personnel
- many of the control and monitoring tasks can be done remotely or by use of AI.



Dry mining combined with low OPEX slurry transport

Tailings with a dry surface can be rehandled using conventional mining equipment, such as trucks and excavators. However, climate change and the need for environmentally responsible, cost-effective, high production, and efficient methods to transport material place great demands on the mining industry.

In order to overcome these challenges, IHC Mining has developed several slurrification options to transport tailings over short and long distances.

Some of the key reasons to consider a slurrification unit include:

- **operational safety:** systems can be controlled remotely from a safe control room with no personnel required in the dam
- **lower cost per tonne:** when using hydraulic transport, no trucks or drivers are required, resulting in a lower cost per tonne compared to a truck and shovel operation
- **minimal downtime and lower risk:** the system can be equipped with an automatic pump control system to regulate the slurry velocity in the pipeline (minimising the risk of clogging and facilitating minimal downtime)
- **low carbon footprint:** one completely electrified slurrification unit replaces a dozen trucks, which significantly reduces CO_2 emissions.

Solutions for all production demands

Tailings slurrification units (TSUs)

TSUs are container-sized slurry transport systems that can be fed by a conventional excavator and transport tailings over large distances with ease.

- easy to transport due to 40ft container dimensions
- low operating costs
- can transport up to 250m³/h (solids) over large distances and elevation differences.

Dry mining slurrification units (DMSUs)

IHC Mining's DMSUs provide a solution for high-capacity tailings re-handling operations that can compete with truck-and-shovel operations.

- ramp-free design
- low ground pressure footing, for use on unstable grounds
- suitable for high-throughput applications
- ease of unit relocation
- can transport up to 750m³/h (or 1,400t/h) of solids by means of slurry transport.

TT-pump and cutterhead

The IHC TT-pump with cutterhead is the smallest unit in the slurrification product family.

- ideal for cleaning storage ponds close to mineral processing plants
- equipment can be mounted on an excavator, resulting in both a low CAPEX and OPEX
- production ranges from 50 to 250m³/h (solids).

Water recycling and dry storage of tailings

Water is a scarce resource in many parts of the world, which makes water management vital for a sustainable mining operation. Mines use water primarily for mineral processing, dust suppression, slurry transport and to meet the needs of employees.

In most mining operations, water is obtained from groundwater, rivers and lakes, or through commercial water service suppliers. However, mine sites are often located in areas where water is already scarce and face challenging limits on their fresh water intake, as well as on their discharge qualities. To enhance water reuse, IHC Mining has developed solutions to recover water from the tailings and return it back into the process to create a closed water loop.

With water scarcity in mind, some sites are looking to move towards the dry stacking of tailings in order to recover as much water as possible. In addition, dewatering of tailings reduces the risk of dam failures due to liquefaction of tailings in the impoundment. Therefore, dewatering of tailings streams coming from the processing plant, or from existing stored tailings, becomes a high priority for miners.

IHC Mining uses extensive knowledge about soft sediments, slurry transport and rheology of non-Newtonian fluids to develop innovative technologies for water management and the beneficial reuse of tailings to create a circular solution. We are continuously seeking new methods to stabilise soft sediments into useful building materials, such as compressed building blocks.

IHC Mining has both in-house solutions and partnerships in place to achieve cost-effective and sustainable solutions for tailings.

Integrated dewatering solutions

IHC Mining is a technology integrator and has strategic partnerships in place to provide customers with complete dewatering plants, equipped with:

- dewatering screens and cyclones
- lamella thickeners, sedimentation tanks and other thickeners
- filter belt presses and pressure filters.

Dewatering for every situation

Geotextile tubes

NETICS (part of Royal IHC) is the world leader in low-tech dewatering solutions. One of these makes use of tubes made of geotextile. These can dewater and filter large amounts of tailings in two weeks. NETICS has invented a reusable system that uses geotextile for cyclic dewatering of tailings, resulting in semi-solid soil.

Geotextile tubes are ideal for dewatering fine-grained material. Hazardous material in the tailings becomes trapped in the tubes and, in combination with binders, immobilised. Using geotextile tubes for tailings dewatering has the following benefits:

- ease of operation
- efficient retention of solids
- compliance with environmental regulations
- cost optimisation
- passive system – does not require constant monitoring and maintenance of equipment.

Controlling water use

IHC Mining is an expert on slurry rheology and has developed technologies to ensure optimal water extraction in dewatering processes. Furthermore, we have partnerships in place with industry experts, with regards to binding and flocculation agents, to optimise water recovery. By combining these fields of expertise, IHC Mining creates the most optimal dewatering solution.

Turning waste into a valuable resource

Legacy tailings are often considered as waste, even after the original mining operation is finished. However, legacy grades in tailings could potentially provide secondary world-class deposits for the original metal or for metals that were previously ignored or discarded. Reprocessing tailings can turn the perceived waste into a valuable resource.

By treating tailings as ‘potential ore’ instead of waste, customers are able to extract valuables, without opening new greenfield deposits and save significant costs on milling and grinding. Furthermore, reprocessing of tailings can cover (part) of the cost of removing and/or relocating TSFs due to environmental and safety reasons.

IHC Mining has in-house mineral processing knowledge, as well as strategic partnerships to provide our customers with complete solutions for extracting valuable materials from mine tailings. Together, we provide the most practical and cost effective solution. We use a comprehensive project management plan that comprises the necessary tools to deliver a successful project on specification, on time and within budget.

In addition, IHC Mining provides a range of project delivery solutions, from integrated to turn-key mineral processing, in order to extract maximum value from tailings.

Tailings as a modern resource

In-house laboratory

IHC Mining has an in-house laboratory for both metallurgical and mineral separation test work. It offers:

- a wide range of metallurgical testing services, such as size characterisation, screening tests, chemical and mineralogical analysis
- bench-scale evaluations
- flow sheet delineation services to determine the optimal separation circuit for tailings reprocessing.

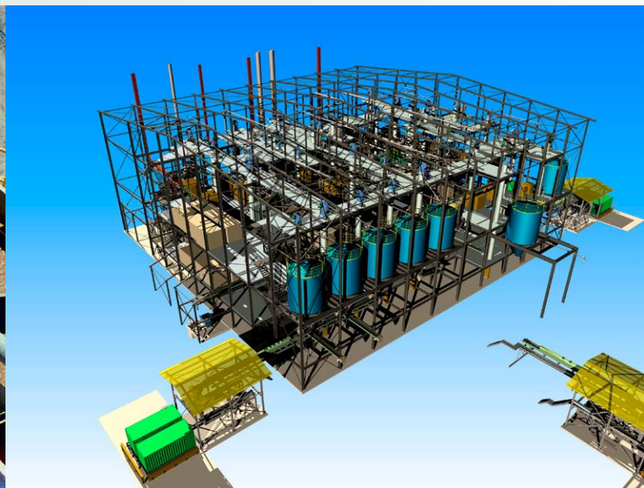
Gravity separation specialists

IHC Mining is regarded as a specialist in separating minerals based on their specific weight. We have a long history in supplying equipment for mineral sands, gold, tin, tungsten and diamond recovery and offer a wide range of products and services:

- gravity separation equipment, such as screens, high-recovery jigs and trommels, suitable for recovering valuables from tailings
- design and optimisation of processing plants.

Integrated processing solutions

IHC Mining has strategic partnerships in place for hydrometallurgical testing and process plant design. We are a well-known technology integrator and together with our partners can deliver turnkey tailings processing solutions.



Wet mining experts with a proven track record

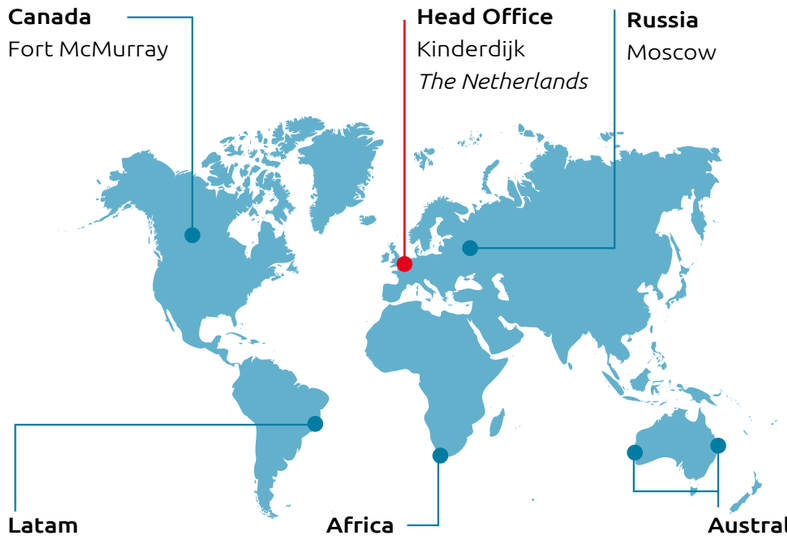
For every phase in the mining life cycle for raw materials, IHC Mining provides reliable, integrated solutions, fully tailored to specific demand for mineral resources. By means of the state-of-the-art equipment that we design and build – and the services we deliver – our customers can improve operational efficiency, lower the cost per tonne and make their activities more sustainable.

We have a proven track record in solutions for mineral sands, tailings rehabilitation, battery minerals, gold, diamonds, tin and other commodities. In addition, with our experts working on a global basis, we guarantee a local presence and industry leading support on every continent.

IHC Mining is part of Royal IHC, a leading designer, builder and supplier of integrated vessels, equipment and services to customers in the dredging, offshore, mining and defence industries. We deliver reliable solutions that improve operational efficiency and allow for a more sustainable performance. Our aim remains unchanged: to discover the smartest and safest way forward for both our customers and our people.

Together, we create the mining future.

Regional offices



Products and services

Geology
- resource assessment and estimations
- geological and exploration services
- mine planning.

Metallurgy
- laboratory test work
- ore and mineral characterisation
- process flow delineation.

Engineering services
- scoping studies
- pre-feasibility studies
- definitive feasibility studies
- FEED (Front-End Engineering Design)
- detailed design.

Mining equipment
- mining dredgers
- mobile slurrification units
- cable reelers.

Mineral separation equipment
- jigs
- upstreamer classifiers
- surge bins
- stationary screens
- screening towers and unloading systems
- trommel screens
- scrubber trommels
- bucket elevators
- fluid bed dryers
- shaking tables.

Integrated separation and processing equipment solutions
- feed preparation systems
- land-based plants
- pilot and demonstration plants
- floating plants
- gravity separation plants
- concentrate upgrading units
- dewatering plants.

Marine and deep-sea mining equipment
- seabed mining crawlers
- launch and recovery systems
- mining-processing and support vessels
- riser systems
- sieve towers
- unloading systems.

Life-cycle support
- spare parts and logistics
- maintenance support
- repairs and renovations
- remote solutions and monitoring
- crewing
- training
- rentals.

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