SO_2 Control Capabilities

May 2025

HATCH

About Hatch

Our Vision

We are passionately committed to the pursuit of a better world through ***positive change***.

Our Values

We believe in ***exceptional ideas*** delivered with ***exceptional service***.

Our Mission

Together we create unprecedented outcomes for our clients by partnering with them to develop better ideas.

Our exceptional, diverse teams combine vast engineering and business knowledge, applying them to the ***world's toughest challenges***.

We build practical solutions that are ***safe, innovative, and sustainable***.

Our Manifesto

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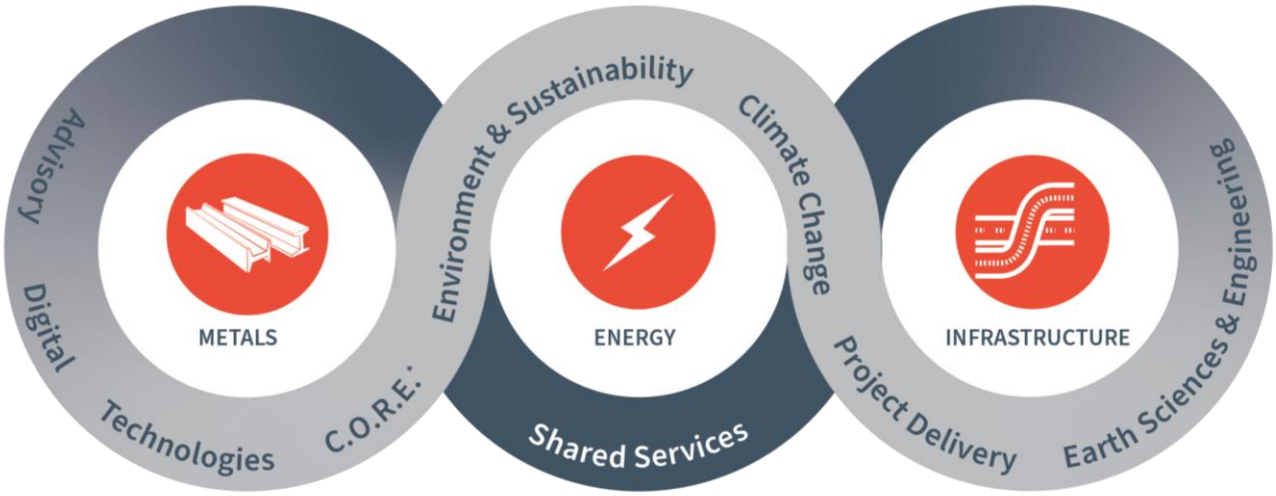
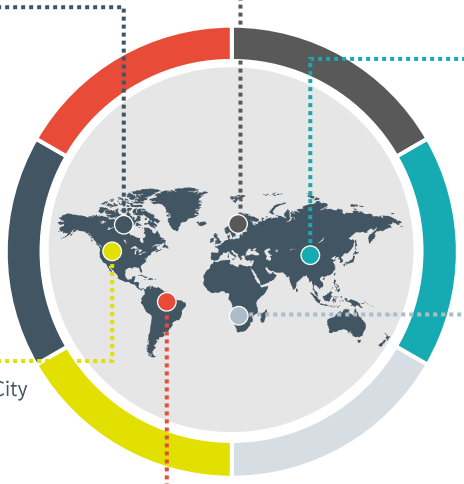
Our Sectors and Practices



Our Global Presence



Canada

Calgary
Edmonton
Kitimat
Mississauga (GDC)
Regina
Saskatoon
Trail
Vancouver
Winnipeg
Fredericton
Halifax
Montreal (GDC)
Niagara Falls
Port Elgin
Saguenay
Saint John
Sorel-Tracy
St. John's
Sudbury

USA

Ambler
Amherst
Atlanta
Boston
Brooklyn
Chicago
Columbus
Dallas
Denver
Houston
Los Angeles
Minneapolis
Newark
Oakland
Pittsburgh (GDC)
Portland
Rochester
Salt Lake City
Seattle
Tampa
Tarentum
Washington
White River

Europe

London
Manchester
Surrey
Düren
Essen
Katowice

Australia/Asia

Beijing
Shanghai
Shenyang
Jakarta
Newcastle
Adelaide
Brisbane (GDC)
Melbourne
Perth
Wollongong
Sydney
Tuggerah

Africa/ India/ ME

Cape Town
Durban
East London
Gaborone
Gqeberha
Johannesburg (GDC)
Maputo
Secunda
Abu Dhabi
Al Khobar
Muscat
Jubail
Gurugram

South America

Belo Horizonte
Calama
Santiago (GDC)
Medellin
Bogota
Villavicencio
Lima

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Our Capabilities

Business & Engineering Consulting

- Business planning
- Market and economic trends
- Roadmaps and strategies for climate change, decarbonisation and technology investment
- End-to-end value chain coordination
- Due diligence
- Technical audits and risk assessments
- Owner's engineering

Process Design

- Engineering for all project phases
- Subject matter experts on multiple subjects in multiple commodities
- Simulation
- Data analysis

Technology development

- Process research and development
- Pilot plant and bench scale trials
- Technology development, scale-up, and commercialisation
- Custom equipment design, packaging, and supply
- Partnerships with researchers, government, funding organisations, and end users

Project Delivery

- Desktop and conceptual studies
- Technology evaluations & equipment trade-off studies
- PFS, FS, FEED & EPCM services
- Project management & controls
- Construction & commissioning management
- System design and plant integration
- Safety assessments (HAZIDs, HAZOPs, etc.), permitting, and regulatory compliance

Operational Support

- Operational readiness
- Asset management
- Performance enhancement and debottlenecking
- Digitalisation
- Ongoing engineering support

Project Delivery +

Hatch professionals deliver projects grouped by the following primary capabilities

Engineering

Process
Mechanical
Piping
Electrical
Control & Automation
Architectural
Concrete
Structural
Differentiated Services

Project Management & Project Services

Project Management
Health & Safety
Environmental
Project Controls
Quality Management
Risk Management

Procurement & Supply chain Management

Purchasing
Expediting
Logistics
Materials Management
Contract Administration

Construction Management

Construction Management
Construction Technology
Site Deployment
Industrial Relations
Site Materials
Site Quality
Site Project Controls

Operational Readiness, Commissioning & Start up support

Operational Readiness
Commissioning
Process Support / Ramp up

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Commodities

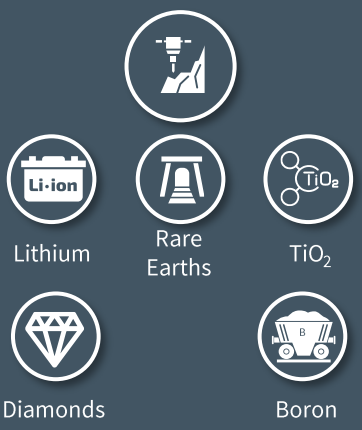
Copper and Gold

Ferrous metals

Light metals

Nickel and PGMs

Minerals



Fertilizers and EVs

Metals Sector Practices

Pyrometallurgy

Minerals Processing

Manufacturing

Tailings

Mining

Downstream

Simulation

High Pressure Metallurgy

Hydrometallurgy

Project Development

Industrial Clean Technology

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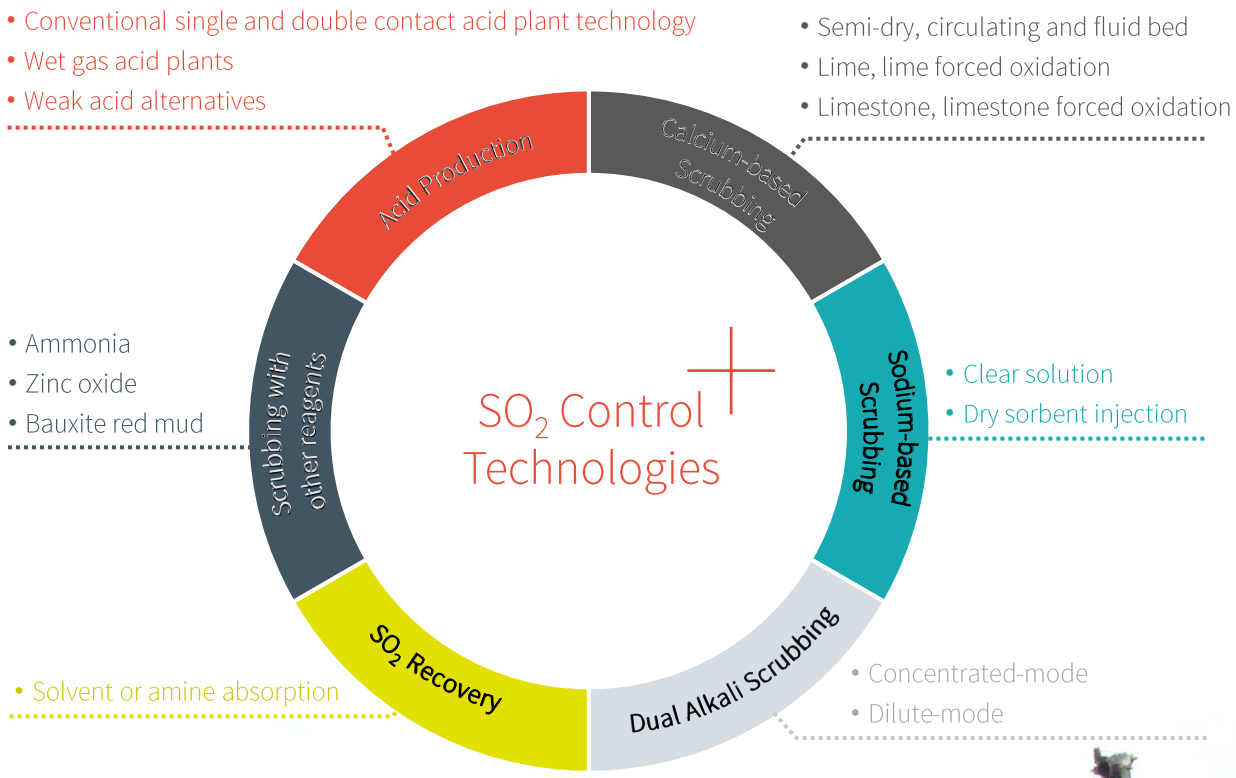
Our Experience with SO_2 Control

The industry continues to change in many ways. Both existing operations and new projects must recognise and address increasingly stringent environmental emission limits, while remaining competitive. For operations around the world, limits on sulphur dioxide and particulate emissions, including other priority metals, are a major focus.

Hatch's SO_2 control experience covers various industries and processes, including the production of copper, nickel, platinum group metals, lead/zinc, gold, aluminum, ferroalloy, rare-earth metals, titanium dioxide, and uranium. Hatch has evaluated and assisted our clients in various industries with scrubbing systems using most major control technologies.

Our SO_2 control capability ranges from technology screening and selection to basic/detailed engineering for both greenfield and brownfield implementation projects.



Acid Production

Hatch's expertise in acid production includes conventional contact acid plants, wet gas sulphuric acid plants, carbon adsorption and peroxide scrubbing.

Conventional contact acid plants are typical in applications with process gas containing high SO_2 concentrations. These plants are considered reliable and efficient in producing sulphuric acid through the catalytic oxidation of sulphur dioxide to sulphur trioxide, followed by absorption of sulphur trioxide in high strength sulphuric acid. The wet gas sulphuric acid plants also transforms SO_2 into high-quality sulphuric acid. This flowsheet is usually considered for applications with lower SO_2 concentrations.

Alternative sulphuric acid production flowsheets such as carbon adsorption and hydrogen peroxide scrubbing can be considered for tail gas (or low gas strength) applications to produce a weak sulphuric acid, particularly where they can be integrated with a conventional acid plant.

Contact Acid Plant Technology

Freeport McMoRan

Hatch supported Freeport McMoRan in the fast-track installation of a 1,400 tpd sulphuric acid plant with a 20 MW waste heat power generation system at Tenke Fungurume Mining in DRC. This project aimed to reduce dependence on external acid supplies and a limited power grid. Hatch's services included:

- Selecting the acid plant technology provider
- Comprehensive engineering for various systems (earthworks, sulphur handling, water circuits, acid storage, electrical infrastructure, steam distribution and the steam turbine generator)
- Managing procurement and vendors for all equipment, including non-proprietary acid plant components.

Acid Plant 2 While Under Construction at Tenke Fungurume Mining in the DRC

Anglo Platinum's Converting Plant

Hatch provided comprehensive engineering services for modernising Anglo Platinum's converting operations at it's Waterval Smelter in South Africa. The project included an Ausmelt-based converting plant, a new casting facility and an acid plant.

Hatch developed the process design basis and designed environmental systems such as secondary gas handling, process building ventilation and acid plant effluent neutralisation. This project highlights Hatch's expertise in selecting and engineering optimal systems for various applications.

Anglo Platinum Polokwane Smelter WSA Plant

Wet Gas Acid Plant Technology

Polokwane Smelter WSA Plant

Hatch completed the technology screening and selection, system design and implementation of a Wet gas Sulphuric Acid (WSA) plant at Anglo Platinum's Polokwane smelter.

Hatch evaluated and compared various SO_2 control technologies for its suitability for this PGM metallurgical application. The selected WSA process achieves high SO_2 removal efficiencies at lower autothermal inlet concentrations than traditional contact acid plants while still producing saleable concentrated sulphuric acid. Hatch was responsible for full EPCM services for the new SO_2 Abatement Plant which included:

- Technology supplier design integration and implementation for the wet gas cleaning and acid plants
- Detailed engineering, construction and implementation of the remaining facilities:
  - New spray cooler, ESP and hot gas fans
  - Effluent treatment plant
  - Cooling water plant.

Zimplats Smelter Expansion and SO_2 Abatement Plant

Zimplats has partnered with Hatch to embark on an expansion of the Selous Metallurgical Complex (SMC). The required gas handling upgrades were included in various phases alongside expansion of smelting production facilities. Hatch designed and implemented systems to capture secondary off-gas from furnace tapping and converters.

Hatch has also progressed detailed engineering and fabrication of all major equipment of a new SO_2 abatement plant again based on Topsoe's WSA process to achieve compliance to South African emission standards. This plant will produce sulphuric acid that is expected to be used in local fertilizer production, and will be implemented in future, following execution of the core smelting equipment as part of the SMC expansion project.

Illustration of the Zimplats WSA Plant

Alternative Acid Plant Technology

Anglo American Platinum Hydrogen Peroxide Tail Gas Scrubber

Hatch provided engineering services (to feasibility level) for a tail gas scrubber that will primarily reduce SO_2 emissions from the existing acid plant. A weak acid will be produced and can be re-introduced as dilution water in the existing acid plant, while excess acid produced will be neutralised.

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Calcium-Based Scrubbing

Kamoto Na-enhanced Lime Slurry Scrubber Installation

Lime Slurry Scrubbing

Kamoto Project

Hatch completed the technology selection for a sodium-enhanced lime slurry SO_2 scrubber of $CuSO_4$ roaster gases, followed by detailed engineering of the system and startup support. Scope Included:

- To minimize operating cost, the original system was designed to use primarily lime but with sodium addition to overcome low buffering capability in the system chemistry. The system was subsequently converted to run on sodium alone.
- The process and SO_2 absorber were custom-designed by Hatch
- Fast-track project schedule.

Limestone Slurry Scrubbing

Limestone slurry scrubbing is ideal for steady, low SO_2 concentration gases. Among various limestone processes, limestone slurry forced oxidation is the most common. Hatch possesses extensive expertise on the limestone slurry forced oxidation process and its engineering applications.

Britannia Zinc

Hatch completed basic engineering for Britannia Zinc of a limestone slurry forced oxidation scrubbing system treating their acid plant tail gas, after an initial technology assessment to select the preferred scrubbing process. Key drivers for the technology selection included:

- SO_2 concentrations are within acceptable ranges for limestone scrubbing
- It can be configured to produce a saleable gypsum byproduct
- Waste heat recovery from the acid plant was available to increase the scrubbing liquid temperature and oxidation rates.

Advanced Metallurgical Group CDS System

Circulating Dry Scrubbing

Advanced Metallurgical Group CDS

Hatch assisted AMG in Zanesvill Ohio in 2022 with design and implementation of an off-gas systems for their multi-hearth roaster and electric arc furnace. The scope included the following:

- Primary gas handling systems included custom design of a movable emissions capture enclosure for the furnaces, roaster off-gas spray cooler, mixing chamber and all ductwork. The work also included specification and integration of a vendor supplied circulating dry scrubber system complete with 8 module baghouse, fan, and stack.
- Secondary gas handling systems included a feed preparation hygiene baghouse, as well as secondary emissions capture enclosures for both furnaces, and the associated 14 module baghouse, fan and stack.

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Sodium-Based Scrubbing

Sodium-based clear solution scrubbing is a wet scrubbing technology widely implemented across various industries. It is suitable for applications requiring high removal efficiency and handling variable SO_2 concentrations with high reliability. While reagent costs are higher compared to lime or limestone-based technologies and effluent disposal is more challenging due to its solubility, sodium-based clear solution scrubbing remains a preferred choice for its simplicity and versatility. Due to their high reactivity, sodium compounds are also frequently used in dry sorbent injection applications where the sodium reacts with SO_2 before being caught in a baghouse.

Freeport's Miami Copper Smelter Environmental Project

Hatch was involved from concept development through execution and successful start-up, achieving SO_2 emissions among the lowest of any copper smelters in the world. Hatch's scope included:

- Quantification of emissions, including extensive stack sampling and smelter building fugitive gas sampling.
- Definition of a range of potential solutions to meet SO_2 ground level concentration objectives and selection of the preferred solution, consisting of:
  - Brownfield modifications to the acid plant tail gas SO_2 scrubber including recirculation pumps, conversion to NaOH reagent, and a new stack for improved efficiency and reduced ground level concentrations.
  - Brownfield modifications to the secondary ventilation system including additional hooding, SO_2 scrubber upgrades (recirculation pumps, packing, conversion to NaOH reagent, and a new stack)
  - A new open spray tower SO_2 scrubber with integrated stack treating converter aisle ventilation gas, anode furnace process gas and acid plant process bypass gas during planned startups/shutdowns and unplanned malfunction events.
  - A new NaOH reagent system, including receiving via rail car or truck, dilution to 20% NaOH, storage and distribution to all three SO_2 scrubbers.

Freeport Miami Aisle SO_2 Scrubber During Construction

Port Kembla Copper Tail Gas Scrubber Installation

Port Kembla Copper Smelter Project

Hatch completed the installation of a sodium hydroxide-based scrubbing system, upstream of the tail gas stack and eliminated the plant stoppages experienced due to poor performance of the plant's environmental systems. This project included:

- Custom design of the process and equipment, including the SO_2 abatement absorption tower
- A unique gas fired reheater to prevent corrosion of the existing carbon steel stack.

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Dual Alkali Scrubbing

Dual alkali scrubbing processes combine the advantages of soluble reagents and slurry-based scrubbing (e.g., calcium-based reagents), achieving high efficiency and reliability under fluctuating operations. In these processes, a soluble reagent is used in the scrubbing tower. The blowdown is then reacted with lime to recover most of the soluble reagent, which is returned to the scrubber. The solids produced are either landfilled or sold.

Dilute Mode Sodium-Lime Dual Alkali

Montana Smelter Secondary Gas System

Dilute mode systems operate with lower concentrations of active sodium and include an oxidation step before regenerating the scrubber bleed, producing calcium sulphate. Dilute mode systems are typically better suited for applications with lower SO_2 concentrations and loads, produce a potentially saleable byproduct and can also achieve exceptionally low discharge concentrations.

Sibanye Stillwater Mining Expansion

Sibanye's major expansion at their Montana, USA smelter included the addition of a new furnace, converters and dryers, along with new process and secondary gas handling systems. These systems use baghouses for particulate collection and PGM recovery, followed by a dilute mode dual alkali SO_2 scrubbing system.

Concentrated Mode Sodium-Lime Dual Alkali

Hatch has designed the Concentrated Mode Dual Alkali systems for Barrick Goldstrike, an oxygen roasting plant in Nevada, USA, and Lonmin (now Sibanye), a PGM smelter operating an electric furnace and Peirce-Smith converters in Marikana, South Africa. Both systems use similar chemistry and equipment, but Barrick prioritises simplicity over operating costs, operating in "open-loop" mode. In contrast, Lonmin focuses on minimising sodium losses and reagent costs, operating in "closed-loop" mode.

Hatch provided complete EPCM services for both projects. Both systems have met or exceeded expectations, achieving lower than design SO_2 emissions and very high plant availabilities. Notably, the Barrick system handles gas volumes that typical exceed the original design values by 20%.

Marikana Smelter Dual Alkali Regeneration System

Dry Sorbent Injection

Teck Metals SBC Scrubbing Expansion (Dry Sorbent Injection)

Hatch completed the installation of a dry sorbent injection system for the Teck Metals smelter in Trail, BC. The project included a new storage silo and dosing systems to inject finely milled sodium bicarbonate into the existing off-gas systems for SO_2 capture from two fuming furnaces.

Scrubbing with Other Reagents

Hatch has experience with various alternative scrubbing technologies including ammonia, 'blue powder' (ZnO) and 'red mud' (alkali waste from aluminum production). Key projects include the following:

- Orano's McClean Lake Uranium Mill in Northern Saskatchewan

  Hatch upgraded a venturi particulate scrubber to use ammonia for over 90% SO_2 removal and implemented a peroxide (H_2O_2) oxidation system to convert effluent to ammonium sulphate for packaging. Onsite test work validated the concept for oxidation using air or peroxide and established design parameters for the peroxide system that was installed.

- Pasminco Cockle Creek Smelter

  Hatch provided EPCM services for an SO_2 scrubbing system using a 'blue powder' slurry, installed on the acid plant's tail gas to meet environmental standards. This system has been successfully operating since 2000.

- Teck Metals Ltd. Absorption Optimization Project

  Teck captures the SO_2 emitted from their operation with acid plants and the absorption plant, producing, respectively, sulphuric acid and ammonium sulphate fertilizer for sale. With the installation of a new acid plant, the composition of the off-gas to the absorption plant changed. Hatch completed a process assessment to optimize absorption performance under the new operating conditions, justifying the installation of a make-up air damper, executed by Hatch in 2019.

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EMPLOYEE-OWNED
partners who think like owners

9,000
professionals worldwide

Projects in
150
countries

USB$75b
In projects

70 years
of experience

About Hatch

Whatever our clients envision, our engineers can design and build. With seven decades of business and technical experience in the mining, energy, and infrastructure sectors, we know your business and understand that your challenges are changing rapidly.

We respond quickly with solutions that are smarter, more efficient, and innovative. We draw upon our 9,000 staff with experience in over 150 countries to challenge the status quo and create positive change for our clients, our employees, and the communities we serve.

hatch.com

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