

SALINE WASTE



A RESOURCE.
IMPACTUS.
TREAT.
VALUE ADDED PRODUCTS.



Statement of Qualifications

(January 2025)



Pact Renewables
Pty Ltd

www.pactrenewables.com

SALINE WASTE

Pact Renewables SALINE WASTE Capability Overview



A RESOURCE.
IMPACTUS.
TREAT.
VALUE ADDED PRODUCTS.
MANAGE.

Pact Renewables has performed numerous SALINE WASTE investigations, ranging from scoping studies to laboratory testing and field piloting/demonstration on behalf of many industry sectors and their advisors, governments, and communities around the globe to assess, identify options and implement sustainable SALINE WASTE solutions that minimise impacts on operations and the environment, whilst generating value to offset treatment costs.

Areas of SALINE WASTE Expertise:

- > Characterisation
- > Definition of impacts and management options
- > Treatment technology feasibility assessments
- > Development of optimised technology-based solutions for water and product recovery, as well as the removal of toxic and hazardous wastes
- > On-site evaluations from test rig to pilot scale and demonstration

What are SALINE WASTES?

Saline wastes are liquid, slurry, or solid waste streams with elevated concentration of dissolved ions, ranging in salinity from 10 g/L total dissolved solids (TDS) to several fold the salinity of seawater (> 35 g/L TDS). The chemical makeup, level of salinity, pH, hardness, turbidity, and the concentration of hazardous metals and organic matter in a saline waste stream depends on the waste source, and subsequent changes resulting from impoundment causing exposure to diurnal and seasonal evaporation and cooling effects, as well as physical mixing/agitation by wind action.

Learn more about our SALINE WASTE management solutions at www.pactrenewables.com or contact us for more information: info@pactrenewables.com



World Economic Forum
January 2023, Davos



Sources of SALINE WASTE

Industries generating saline waste, in brine, slurry, or solid forms that are often stored in surface impoundments, with some containing elevated concentration of metals, include:

- > Mining and mineral processing operations generating saline effluents, often with complex chemistries
- > Desalination, including various seawater and inland desalination processes co-producing reject brine
- > Oil/gas exploration and production from conventional and unconventional sources, generating saline produced water and fracking effluents
- > Energy generation by coal combustion, waste-to-energy, and geothermal energy production methods, generating flyash and air pollution control residue (APCr) often characterised by elevated soluble salt and hazardous metals requiring removal and safe land disposal
- > Hazardous waste treatment companies, providing PFAS treatment solutions but faced with the challenge safe disposal of saline waste containing PFAS residue, in an evolving regulatory environment
- > Municipal/industrial sewage waste incineration operations generating fly ash containing elevated concentration of soluble salt and heavy metals
- > Petrochemical/metallurgical processes, generating various types of brine effluent
- > Mineral extraction from saline sources, such as lithium and potassium sulphate, generating spent brines that require pretreatment prior to reinjection, or dilution before disposal
- > Cement manufacturing operations producing cement kiln dust, often requiring removal of soluble salts and hazardous metals prior to land disposal

Environmental and Operational Challenges

- > High salinity damages landscapes and has negative impacts on waterways and coastal ecology
- > Discharge of untreated brine to the environment also incurs a high carbon footprint
- > Potential for liabilities, damage to both corporate reputation and ESG commitments to shareholders
- > Increased regulatory requirements for reducing risks by treatment to remove toxic elements and discharge minimisation through application of one or more of reuse, recycle, dissolved salt load and metals reduction, and volume minimisation steps
- > When disposed saline effluent becomes a wasted resource
- > Climate change impacts in water-stressed regions increasingly necessitate the treatment of saline effluents for water production

Resource Recovery

Saline wastes are a long-neglected resource increasingly being identified as valuable for:

- > Production of industrial minerals, mineral compounds, and metals, with some identified as critical for emerging renewable energy and energy transition technologies
- > Integrated recovery of water and minerals from the leachates of flyash and APCr subjected to freshwater washing to allow safe land disposal of waste water and hazardous residuals
- > Integration of safe hazardous waste disposal practices with recovery of saleable salts, metals, and water from saline waste generated by industrial operation, which in turn offers opportunities for deploying sustainable waste management solutions



Areas of Expertise - Detailed Description

CHARACTERISATION

SALINE WASTE characterisation requires precise sampling to avoid contamination and ensure sample representativeness, based on results obtained using validated analytical methods. Drawing from over three decades of industry experience of Dr. Aharon Arakel, Company's director and chief technologist, Pact Renewables has assembled its own sampling protocols, laboratory analytical methods, and monitoring and data reporting procedures that form a core component of the Company's QA/QC system. Further, Pact Renewables employs a proprietary predictive brine model that enables a better understanding of changing diurnal and seasonal temperatures and mixing conditions on saline wastes. This model has been rigorously calibrated and validated using data from various dynamic hydrological basins and industrial operations around the globe, thus covers nearly all possible inorganic saline waste types from industrial operations.

DEFINITION OF IMPACTS AND MANAGEMENT OPTIONS

Pact Renewables has, in collaboration with expert environmental impact assessors, performed numerous reviews of SALINE WASTE impacts on terrestrial, groundwater, and coastal ecosystems, and uses the generated knowledge for timely and cost-effective tracking of the impact pathways of saline wastes on discharge areas. Using this approach, along with our expertise and datasets, we are uniquely positioned to avoid the use of default values and information, thus reducing unnecessary and costly management needs. Further, the saline waste management options we offer are all based on consideration of best-fit application of integrated saline waste treatment, recovery of valuable products and removal of toxic elements from impoundments or leachates from washing of flyash, APCr and cement kiln dust (CKD). Thus, our solutions for the sustainable management of saline waste incorporate a substantial cost offsetting component through the recovery of water and generation of commercial-grade mineral and metal products. In addition our saline waste solution enable safe removal and disposal of toxic and heavy metals, by applying our state-of-the-art technology platform (see opposite diagram).

TREATMENT TECHNOLOGY FEASIBILITY ASSESSMENT

A two-way engagement process with our clients to ensure that their requirements and project information are fully understood and communicated before commencement. Our feasibility assessment of the technology-based solutions involves three main components, namely (1) information collection and screening, (2) description of the proposed treatment system option and conceptual system design, and (3) cost-benefit analysis of the proposed treatment system and comparative lifecycle assessments. These are commonly carried out in the following two steps:

- (a) Desktop pre-feasibility/scoping study incorporating definition of benchmark values, toxic or hazardous waste removal, carbon offsetting options, preliminary specifications and value of products from treatment, and reporting of preliminary techno-economic and lifecycle cost evaluation findings.
- (b) Verification of technology-based solutions incorporating:
 - > Laboratory-based process and products trials, compilation of resource and product inventories, preliminary products market demand and risk analysis
 - > Where required, preparation of a preliminary technology applicability envelope
 - > Indicative carbon offset values
 - > Reporting the findings of technology verification assessments to address client requirements, including treatment plant design parameters and recommendations for follow up field-based piloting and technology/solution demonstration.

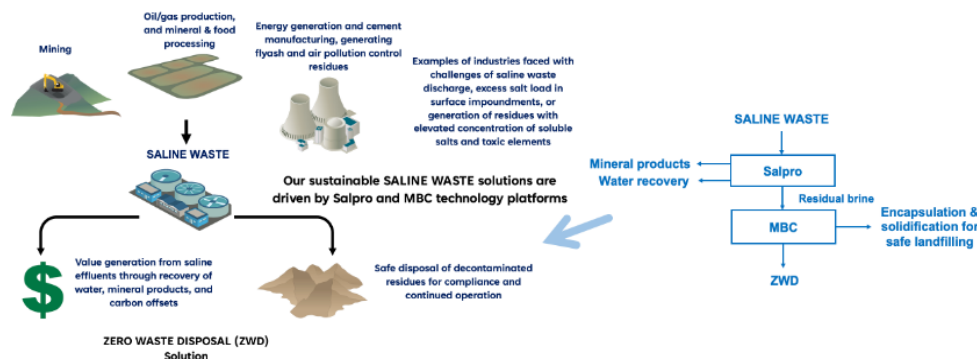
DEVELOPMENT OF TREATMENT TECHNOLOGIES FOR SITE SPECIFIC APPLICATION

Sustainable management of SALINE WASTE from industrial operations is commonly a site-specific challenge, and addressing it increasingly becoming urgent. This is particularly the case where the removal and safe disposal of hazardous saline waste is part of the challenge, and the options for appropriate waste reduction technologies are limited. Drawing from our proven technology platform, Pact Renewables develops and designs treatment systems under amicable contract R&D arrangements with clients or their advisers, seeking optimised site-specific technology solutions. Pact Renewables has demonstrable technical capabilities to address SALINE WASTE challenges at sites regulated by state or national regulatory agencies, to minimise the environmental liabilities of its clients.

SUPPORT WITH ON-SITE TREATMENT TECHNOLOGY EVALUATION AND DEMONSTRATION

As part of our saline waste solution services, we perform a range of feasibility assessments of our technologies, which may include one or more of desktop scoping studies, feasibility assessments, design of piloting and demonstration plants to generate real-time data for detailed techno-economic and lifecycle cost analyses, as well as participation in independent audits of the processes and products prior to entering licensing and service arrangements.

For more information please contact Dr. Aharon Arakel at aharon.arakel@pactrenewables.com





Technology Platform

Salpro: an enabling technology for selective or sequential recovery of commercial-grade mineral products from inorganic saline streams by a combination of chemical reaction, evaporation, and separation process steps, using conventional mineral processing equipment. The technology is highly scalable and capable of achieving zero liquid discharge, by converting the bulk of impactful waste into low carbon footprint resources for downstream value adding.

Synpotash: a sustainable technology for the production of high-value, variable solubility potash fertilisers and compounds for use in alkaline-based fuel cell batteries from potassium containing saline waters and waste brines in a proprietary mineral conversion process using conventional processing equipment.

MBC: a unique technology for manufacture of mineral-based composites and application to sustainable management of hard to abate waste streams (including bittern residues) by encapsulation process (via aggregation or granulation of the waste residue) for safe landfilling.

Pact Renewables actively facilitates a paradigm change in governance of saline waste by industries who seek sustainable SALINE WASTE solutions.

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Key Attributes

- > Conducted numerous client projects, globally in multiple industries that required sustainable management of SALINE WASTE, and involved one or more of characterisation, process options study, techno-economic evaluation of waste reduction methods, lifecycle assessments, pilot trials, client/agency briefing, and demonstration.
- > Flexibility in delivery of saline waste solutions through consulting, contract R&D, testing and test-rig scale evaluations, and support with client's piloting/demonstration projects.
- > Fit-for-purpose solutions due to flexibility in selection of process and products options, depending on client objectives. These options may include hazardous or toxic waste removal, saline waste minimisation, revenue generation, or carbon credits/offsetting components.
- > Saline wastewater solutions based on technologies that are proven through piloting and public demonstration, and licensed.
- > Salpro was selected by the U.S. Bureau of Reclamation as the highest ranking ZLD technology, for saline waste management in terms of its technical and operational feasibility, environmental acceptability, and economic grounds.

What Services We Offer

- > **Consulting:** Expert advice on saline water cycle management from design, planning to monitoring, regulatory reporting, and treatment of a wide range of effluents areas fitting our expertise, including:
 - Recovery of mineral products and water for waste minimisation
 - Assessment of options for treatment of effluents generated by washing of APCr and flyash residues, for either safe disposal or reuse of washed solid residues
 - Reduction of the salt load of saline impoundments, through mineral recovery for extending the operating life of the impoundments.
- > **Desktop Studies:** Including prefeasibility and feasibility studies. As an expert advisory service and provider of appropriate technologies that drive our sustainable solutions for saline waste and hazardous residuals management, we are uniquely placed to perform integrated lifecycle and techno-economic assessments on behalf of our clients, like no body else.

- > **Testing and test-rig scale evaluations** for preparing design packages for piloting projects.
- > **Contract R&D** performed on behalf of companies seeking site-specific solutions that are optimised for compatibility with local, state, and national regulatory guidelines, whilst minimising the environmental liabilities, leading to eneration of proprietary IP, owned by the project funder.

Why Choose Pact Renewables

- > Deep knowledge of all scientific, technical, and environmental aspects related to saline waste
- > Focused on technological solutions, using the proprietary proven technology platform developed by Dr Aharon Arakel (who was recently selected as a Top Innovator by the World Economic Forum) and his team
- > The Company follows a fundamental approach based on saline waste minimisation through integrated recovery of products (minerals and water products) for footprint reduction via cost reduction and carbon offsets generation
- > We provide unique technology-based solutions for sustainable management of problematic contaminated saline waste streams
- > Worldwide experience, past performance, and technology reputation developed over decades with a project delivery capabilities backed up by specialised in-house facilities for analytical, process/product evaluations to test-rig stage.

Examples of Past Clients

BHP Billiton (South Africa), City of Aurora, Southern Nevada Water Authority, Eastern Municipal Water District (USA), Department of Agriculture, Fisheries and Forestry (Australia), Environment Protection Authority (USA), Hallett Group (Australia), Melbourne Water (Australia), Murray Darling Basin Commission (Australia), Occidental Petroleum (USA), Origin Energy (Australia), Petroleum Development Oman (Middle East), Placer Dome (Australia), Ragn-Sells (Sweden), Santos (Australia), Takata Corporation (Japan), WateReuse Foundation (USA).