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Hazardous / Industrial Waste Processing Using SCW

Exec Overview:

Sub-Critical Water (SCW) technology may provide a pathway to chemically break down hazardous organic waste streams that are currently buried in landfill, potentially transforming long-term containment liabilities into manageable treatment processes.

Hazardous Waste Market Context (New Zealand)

Hazardous waste management represents a significant sector within the New Zealand waste industry.

Industry estimates suggest:

- ***approximately 1.3 million tonnes of hazardous waste generated annually in New Zealand***
- ***the national hazardous waste management market valued at approximately NZD \$1.1 billion per year***

Hazardous waste categories typically include:

- *industrial chemical residues*
- *contaminated sludges*
- *solvent and hydrocarbon wastes*
- *hazardous construction materials*
- *medical and laboratory wastes*
- *contaminated soils*

Auckland typically represents 35–40% of national waste generation, suggesting that a substantial portion of this hazardous waste stream is generated within the region.

Relevant Hazardous Waste Streams

Not all hazardous waste is suitable for hydrothermal processing. However, several common categories appear potentially compatible with SCW treatment, particularly those containing significant organic content.

Examples include:

1. Oily Waste and Contaminated Absorbents

Generated from:

- *vehicle workshops*
- *industrial maintenance*
- *marine operations*
- *mechanical engineering facilities*

Typical materials:

- *oily rags and absorbents*
- *grease trap residues*
- *oil-water sludges*

Typical disposal cost:

\$600 – \$1,200 per tonne

2. Industrial Wastewater Sludges

Generated from:

- *food processing facilities*
- *chemical manufacturing plants*

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- *plating operations*
- *industrial laundries*

These materials are typically:

- *high moisture content*
- *organic-contaminated*
- *difficult to treat biologically*

Typical disposal cost:

\$200 – \$800 per tonne

3. Polymer and Chemical Process Residues

Examples observed include polymer-based anti-foaming agents and other process chemicals.

These materials often originate from:

- *chemical distributors*
- *coatings and adhesives manufacturers*
- *industrial wastewater treatment processes*

Typical disposal cost:

\$800 – \$3,000 per tonne depending on hazard classification.

Key Issue: Current Disposal Practice is Containment, Not Destruction

Sub-Critical Water (SCW) Technology – Potential Opportunity in Hazardous and Difficult Waste Streams

This document outlines a **preliminary opportunity** to apply **Sub-Critical Water (SCW) technology** to treat difficult waste streams that are currently managed through containment and landfill disposal.

Initial discussions with the technology developer in Japan suggest that SCW processing may be capable of breaking down several challenging waste types, including:

- **chlorinated organic compounds** (e.g., chloroethylene / vinyl chloride type materials)
- **polymer-based chemicals** such as polyfoamer
- **oil-contaminated materials** such as rags, absorbents and similar wastes
- other mixed organic waste streams.

SCW operates in a **high-temperature water environment (approximately 250–260°C and 5–6 MPa)**, where hazardous organic molecules may be broken down into simpler compounds while chlorine contained in the molecules may convert into **stable chloride salts within the aqueous phase**, rather than being released through combustion gases.

Unlike traditional thermal destruction systems, SCW processes occur in a **water-based hydrothermal environment**, which may reduce the formation of undesirable combustion by-products while allowing the treatment of **high-moisture and mixed waste streams with minimal pre-treatment**.

A further theoretical advantage may arise through **co-processing with construction and demolition (C&D) waste**, which contains alkaline mineral components that may help buffer acidic reactions and assist in stabilising chlorine released during treatment.

If confirmed through testing and further technical validation, this approach could potentially allow a transition from the current **landfill containment model** toward a **treatment and reuse model**, where:

- hazardous organic compounds are **chemically broken down**
- water may remain largely **within a managed onsite loop**
- portions of treated water may be **reused within the SCW process**
- excess treated water, if proven safe, may have **controlled onsite uses**
- C&D waste may serve as a **blending and buffering material for hazardous feedstocks**.

This concept remains **preliminary and subject to further technical verification**, including historical data currently being reviewed by the technology developer and potential pilot-scale testing.

If validated, SCW technology may offer a pathway to **reduce long-term hazardous waste containment liabilities while improving treatment of difficult waste streams**.

Readers seeking further technical details, process explanations, and supporting analysis are encouraged to **refer to the main body of this document and accompanying materials**.

This paper outlines a preliminary opportunity to apply SCW processing to hazardous organic waste streams currently managed through containment and landfill disposal in New Zealand.

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Hazardous / Industrial Waste Processing Using SCW - Details

This note summarises a potential additional opportunity relating to hazardous and industrial waste streams in Auckland that may also be suitable for Sub-Critical Water (SCW) processing.

The intention is not to replace existing hazardous waste collection and management systems, but to consider whether SCW technology could provide an additional treatment pathway for certain difficult organic waste streams that currently require landfill disposal or export for treatment.

*This potential opportunity would be explored **in parallel with the ongoing C&D waste and slurry processing discussions.***

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- solvent and hydrocarbon wastes
- hazardous construction materials
- medical and laboratory wastes
- contaminated soils

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Relevant Hazardous Waste Streams

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Examples include:

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Typical materials:

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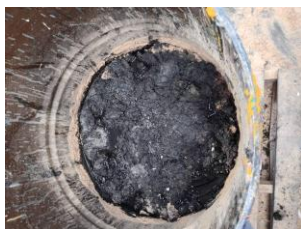
\$800 – \$3,000 per tonne depending on hazard classification.

Background

During recent operational observations at the KiwiWaste facility, a number of hazardous or chemically contaminated waste streams were observed entering the site.

These included:

- chemical residues stored in sealed drums
- oily textile and rag waste
- polymer-based chemical waste (for example anti-foaming agents)
- industrial sludge and contaminated absorbent materials



In some cases, liquid chemical wastes are currently **stabilised prior to landfill disposal** by mixing them with absorbent materials such as sawdust before sealing the containers with concrete. This stabilisation approach prevents the waste from leaking but does **not destroy the underlying chemical compounds**, meaning the material ultimately remains stored in landfill.

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Potential Role for SCW

Sub-Critical Water processing may offer advantages when treating organic hazardous waste streams because:

- high moisture content is acceptable for processing
 - organic compounds can be broken down through hydrothermal reactions
 - carbon fractions may convert into stable char material
 - chlorine, sulphur and other elements may be converted into inorganic salts in the aqueous phase
- SCW would not replace upstream waste separation systems, but could potentially provide a **treatment stage for organic hazardous residues** that are otherwise stabilised and landfilled.

Indicative Processing Opportunity

Even relatively small volumes of hazardous waste can represent significant treatment value due to higher disposal costs.

For example, a single SCW reactor operating at approximately:

8,000 tonnes per year feedstock capacity

could potentially process a mixed feedstock such as:

Waste Stream	Example Volume
Industrial sludge	3,000 t
Oily waste	2,000 t
Polymer chemical waste	1,000 t
Septic sludge	2,000 t

Total feedstock: **8,000 tonnes per year**

This type of blended feedstock approach could allow the plant to treat both **wet waste streams and higher-value hazardous materials**.

Potential Industry Context

Hazardous waste in New Zealand is currently managed by several specialist companies providing treatment, stabilisation and disposal services.

These include operators involved in:

- hazardous waste collection
- chemical stabilisation
- landfill disposal
- export of hazardous waste for treatment overseas

Where organic hazardous wastes cannot be treated domestically, they may require **export for incineration or specialised destruction**, which can significantly increase disposal costs.

Technologies capable of destroying the organic component of these wastes locally could therefore represent an additional option within the waste management system.

Potential Relationship with Existing Waste Streams

The hazardous waste opportunity should be considered **complementary to the slurry and C&D waste pathways** currently being explored.

In practice, a future SCW facility could potentially accept a **blended feedstock**, including:

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- C&D fines and organic waste
- slurry-derived sludge
- septic sludge
- selected hazardous organic residues

This type of feedstock diversification could help maintain consistent reactor utilisation while addressing multiple waste streams.

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SCW use answers to date from Kaneo Ishimori of Arinkai - 15 March 2026:

Disposal of chloroethylene (vinyl chloride type) waste liquid

Current practice

The waste liquid is: mixed with sawdust absorbed and turned into a semi-solid placed into steel drums the top is sealed with concrete then buried in landfill

Disposal of oily cloth / oily rags

Current practice

Waste liquids such as these, along with polyfoamer (polymer-based anti-foaming agent) chloroethylene-type waste are solidified and buried in landfill without treatment.

Questions raised

What would happen if these were processed using the SCW system?

Would the chlorine component mainly become chloride salts (NaCl etc.) in the water phase?

What happens when polymer chemicals like polyfoamer are processed by SCW?

Are oil-contaminated cloths converted into char and organic compounds in the liquid phase?

What kind of pre-treatment is required?

Ishimori's response

Characteristics of the SCW system

The SCW system:

- has more than 26 years of history*
- is a batch hydrolysis system*
- operates using high temperature saturated steam*
- approx 256°C and 5–6 MPa*
- protected by international patents*

Decomposition of chloroethylene

Because of the strong hydrolysis capability and solvent power of SCW: hazardous compounds such as chloroethylene (vinyl chloride monomer) are easily decomposed into low-molecular compounds and rendered harmless.

Polymer materials such as:

- plastics*
 - polymer chemicals*
- are broken down to low-molecular compounds within minutes.*

Chlorine behaviour

Due to the large ionic product of water under SCW conditions, water strongly dissociates into:

- hydrogen ions*
- oxide ions*

This promotes dechlorination reactions, allowing chlorine atoms in the molecules to:

- detach*
- ionise*
- become harmless chloride ions.*

Handling oil and salt in the exhaust stream

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Steam and condensate leaving the system pass through a condenser.

From the condensate:

- *oil is recovered using an oil-water separator*
- *the treated water is adjusted to meet discharge standards*

Then it can either:

- *be discharged to the sewer, or recycled as boiler feedwater.*

Pretreatment requirements

One major feature of the SCW system is that pretreatment is minimal.

Even wastes that contain:

- *foreign materials*
- *high moisture*
- *large amounts of oil*

can be processed without sorting or dehydration.

Decomposition typically completes in 2–30 minutes.

Final statement

Therefore the SCW system is: not simply a waste disposal system, but a chemical recycling system.

Because of this classification:

- *only boiler notification to the fire department is required*
- *no special waste processing permits are required for installation.*

For a waste company such as KiwiWaste, the SCW system could therefore be installed as a recycling device rather than a waste disposal facility.

Information received from the SCW system developer in Japan indicates that chlorinated waste streams such as chloroethylene (vinyl chloride type compounds), polymer additives such as polyfoamer, and oil-contaminated materials can be effectively decomposed under Sub-Critical Water (SCW) conditions. The system operates at approximately 250–260°C and 5–6 MPa, where the ionic properties of water promote rapid hydrolysis and dechlorination reactions. Hazardous organic compounds are broken down into low-molecular organic products, while chlorine is released and stabilised as chloride ions in the aqueous phase. Oils are separated through condensation and oil-water separation systems, and treated water can be either discharged to sewer within regulatory limits or recycled as process water. According to the developer, the SCW process requires minimal pretreatment and can handle mixed, high-moisture waste streams such as plastics, polymer chemicals, oily materials and chlorinated organics, typically achieving decomposition within 2–30 minutes.

Takeaway after reading Kaneo Ishimori's note

The most important technical confirmations here are:

Chloroethylene / vinyl chloride → decomposed

Chlorine → becomes chloride ions in water

Polymer chemicals → break down quickly

Oily materials → separable / processable

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Very little pretreatment required

Technical Overview – Potential Treatment of Chlorinated and Hazardous Wastes Using SCW

Based on initial discussions with the technology developer in Japan, Sub-Critical Water (SCW) processing may offer a viable method for treating several difficult waste streams currently managed through landfill containment systems. These include chlorinated organic compounds such as chloroethylene (vinyl chloride type materials), polymer additives such as polyfoamer, and oil-contaminated materials including rags and absorbents.

*The SCW system operates at approximately **250–260°C and 5–6 MPa**, where water exhibits enhanced ionic behaviour and strong hydrolysis capability. Under these conditions, many hazardous organic compounds can theoretically be broken down into **low-molecular organic products**, while chlorine contained within the molecules is released and stabilised as **chloride ions in the aqueous phase**. Oils and hydrocarbons may separate during condensation through conventional **oil-water separation systems**, and treated water can potentially be discharged under regulatory limits or recycled within the process.*

*One important characteristic of SCW systems is their ability to process **high-moisture and mixed waste streams** with minimal pre-treatment. Materials such as plastics, polymer chemicals, oily wastes, and contaminated absorbents can theoretically decompose within **minutes under hydrothermal conditions**, reducing the need for drying, shredding, or extensive mechanical sorting prior to treatment.*

*From a chemical perspective, the presence of **chlorinated compounds** is often a challenge for conventional thermal destruction technologies due to the formation of acidic gases and the potential generation of undesirable combustion by-products. In contrast, hydrothermal systems such as SCW operate in a **water-based environment rather than oxygen-rich combustion conditions**, which may promote dechlorination reactions and convert chlorine atoms into **stable chloride salts dissolved in water**, rather than releasing them into the atmosphere.*

*An additional theoretical benefit may arise when chlorinated wastes are processed alongside **mineral-rich materials such as construction and demolition (C&D) waste**, which commonly contains calcium-based compounds derived from concrete and cement. These alkaline materials may assist in buffering acidic intermediates formed during hydrolysis reactions and help stabilise chlorine in the form of salts such as **calcium chloride**. This concept requires further verification but may represent a useful operational strategy when processing mixed waste streams.*

*At this stage, these observations should be regarded as **preliminary and theoretical**. Further confirmation is expected through historical processing data currently being reviewed by the technology developer, particularly regarding the behaviour of **chlorinated plastics such as PVC** under SCW conditions.*

*Additional validation would also be required through **testing of output streams**, including analysis of treated water, salts, and residual solids, to confirm the destruction efficiency of hazardous organic compounds and the stability of remaining residues.*

*If confirmed through further technical data and pilot-scale testing, SCW technology could potentially provide an alternative approach to the current practice of **solidifying hazardous liquids in absorbent materials and burying them in sealed containers within landfill cells**, allowing hazardous organic molecules to be chemically broken down while reducing long-term containment liabilities.*

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The theoretical advantage of this type of SCW setup is that we may be able to move away from a simple disposal model and toward a contained treatment-and-reuse model. Hazardous organic compounds could potentially be broken down within the SCW process, while much of the water could remain onsite within a managed loop. After treatment and testing, part of the water may be reusable within the SCW process itself, and any excess water that meets acceptable quality standards could potentially have controlled site uses such as dust suppression on C&D stockpiles.

At the same time, the large available volume of C&D waste may provide a practical blending material for hazardous feedstocks, helping to dilute difficult chemicals, provide alkaline buffering, and reduce unnecessary wear on the system.

This remains theoretical at present, but subject to testing and further advice from Arinkai Japan, it appears technically plausible and testable.

References / Data Sources

New Zealand hazardous waste market overview:

<https://www.kenresearch.com/new-zealand-hazardous-waste-management-market>

Stormwater sediment research:

<https://www.aucklandcouncil.govt.nz>

<https://knowledgeauckland.org.nz>

Road-derived sediment research:

<https://niwa.co.nz/>

Wastewater infrastructure: <https://www.watercare.co.nz/>

Operational observations:

KiwiWaste – www.kwar.co.nz

Arinkai Japan – Mr Kaneo Ishimori <https://arinkai.jp/>