Methyl Bromide Recapture.

If we loaded the logs Genera fumigated in NZ in 1 year onto trucks, the traffic jam would stretch from NZ to China.
For about 1/5 of these logs methyl bromide is the only available and practical phytosanitary treatment.

Regulatory management of Methyl bromide

Montreal Protocol on substances that deplete the ozone layer (effective from 1989).

Ozone layer Protection Act 1996

Resource Management Act 1991

Health and Safety at Work act 2015

Health and Safety in Employment Regulations 2000

Environmental Risk Management Authority Decision

Reassessment of Hazardous substance
28 October 2010

"The committee acknowledged that the current management regime adequately managed the risks"

"The committee strongly recommends and appeals for research on both recapture technology and alternatives to methyl bromide"

The EPA reasserted that this is still their position February 2017.

Methyl Bromide recapture

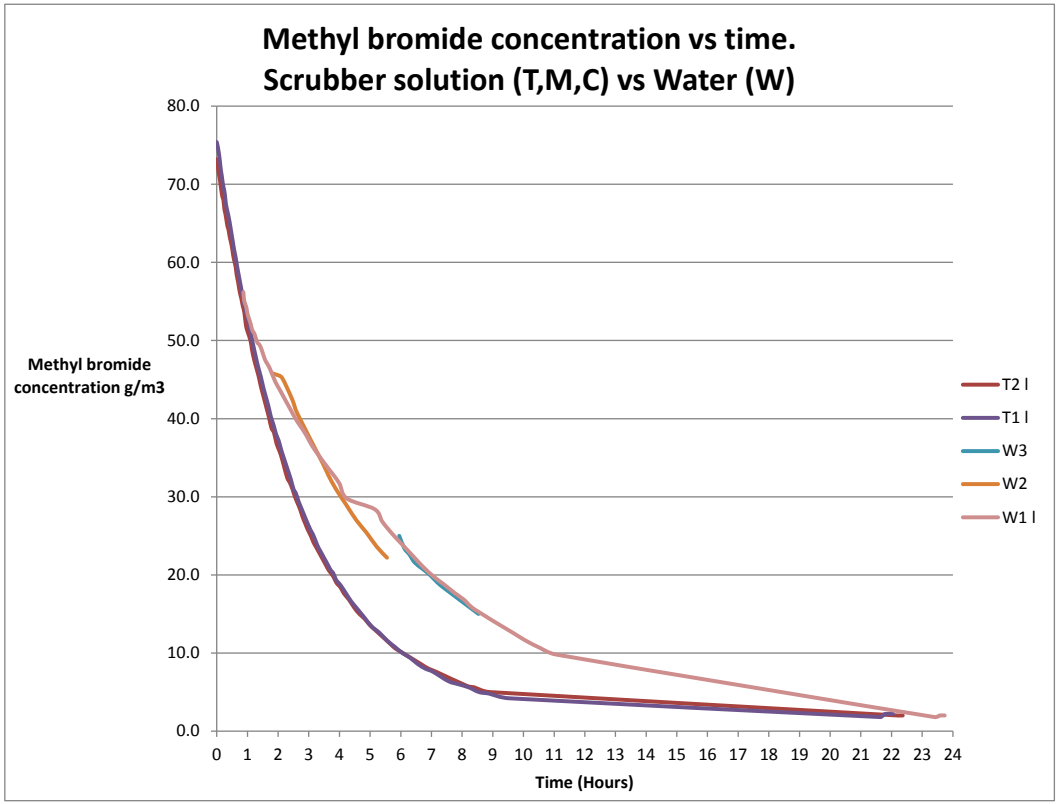
In 27 years since the Montreal Protocol the world has been littered with promises of methyl bromide recapture:

Genera has engaged with all credible providers of available and potential recapture technology anywhere in the world: Nordiko, Insects Limited, Desclean, Value Recovery, BioDesorb, Biofume, Salience Solutions, MeBrom, Biofume

There is no system anywhere in the World that can economically recapture methyl bromide from large scale fumigations and effectively deal with residues.

Genera invested heavily in a development programme.

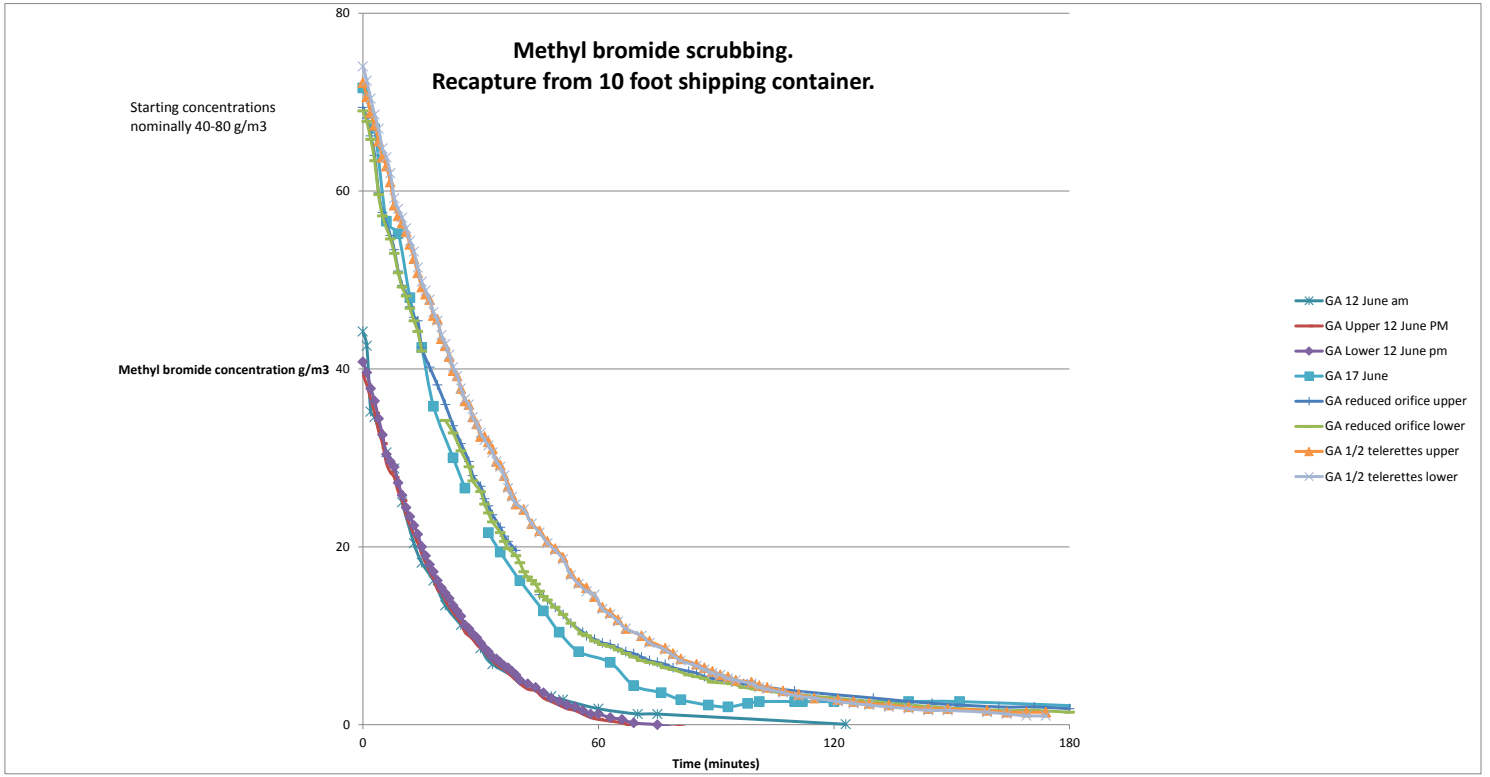
Gas-liquid scrubber, trials on hydrolysis



Early trials focussing on hydrolysis of methyl bromide showed some activity, but scrubbing using chemical used previously and referred to in literature was not sufficiently better than control (water) to pursue.

This is essentially the same process as used by previous innovators and from which they moved on to carbon.

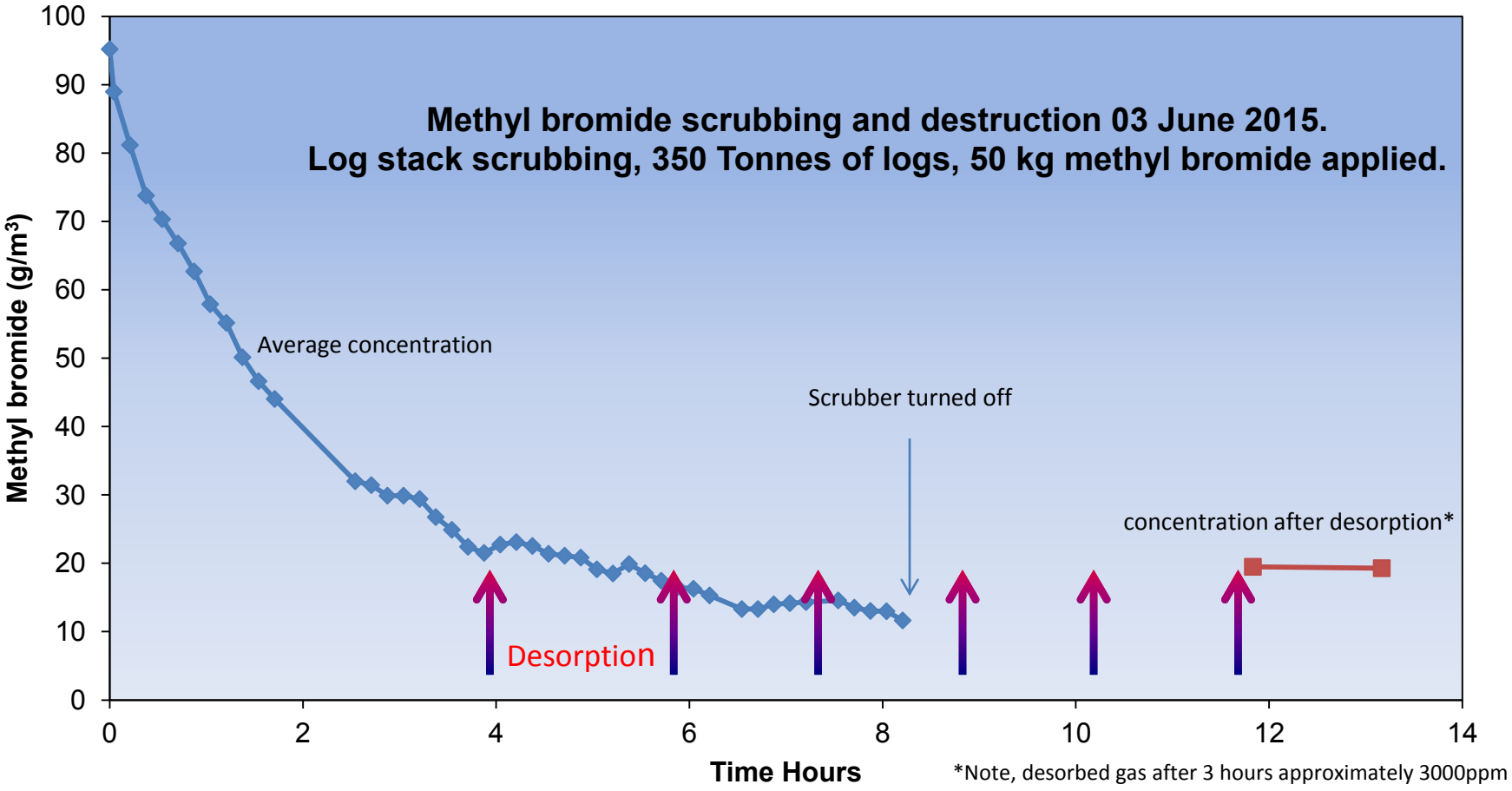
Gas-liquid scrubber, focus moving to phase transfer



A change in focus from hydrolysis to phase transfer followed by hydrolysis provided significantly faster scrubbing rates. Note X-axis scale is 3 hours vs 24 hours in previous graph.

Methyl Bromide recapture research by Genera

Methyl Bromide recapture by Genera



Operationalising Methyl Bromide recapture
Focus of process development

Chemistry

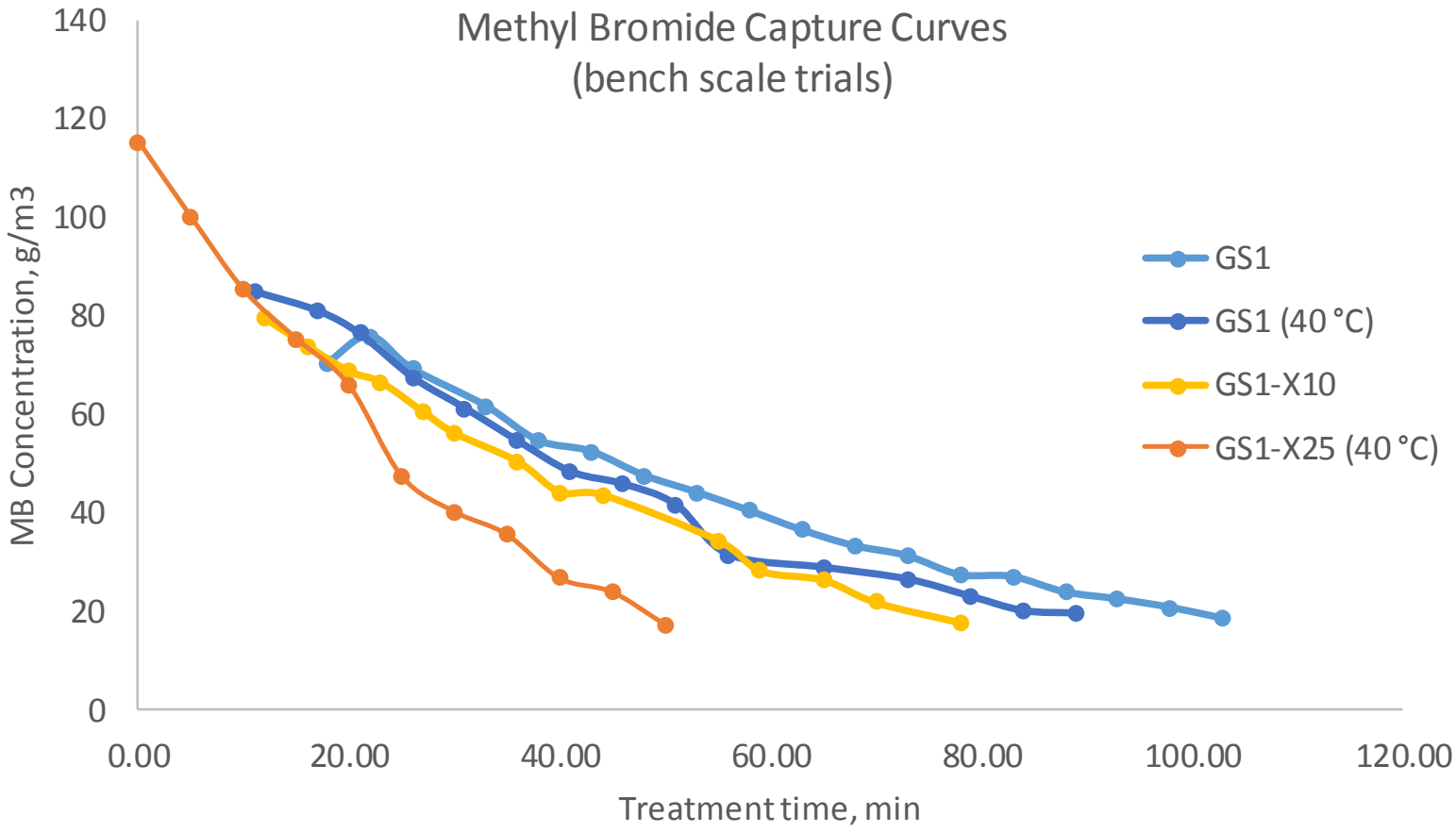
Physics

Scalability

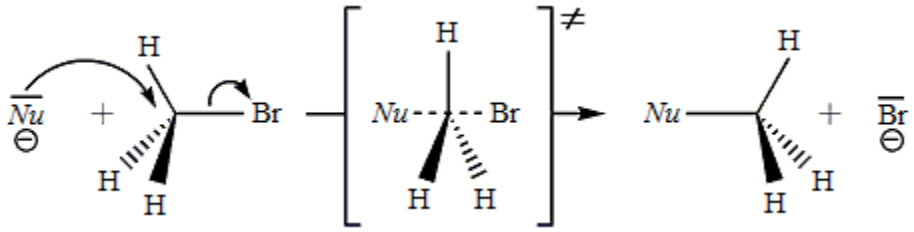
Residue disposal

Operational logistics

Gas-liquid scrubber, chemistry 2017 data



Solvent Chemistry – a Systematic approach



$$r = k \cdot [Nu] \cdot [CH_3Br] \qquad (1)$$

$$log_{10}\left(\frac{k}{k_0}\right) = n \qquad (2)$$

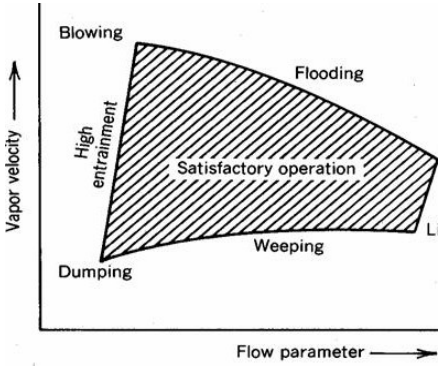
Higher nucleophilicity: less treatment time, less labour cost, higher throughput

$$k = 10^n \cdot k_0 \qquad (3)$$

- r, rate of this reaction
- k, rate constant for reaction with nucleophilic reagent
- k_0, rate constant for reaction with water
- n, nucleophilic constant, is characteristic of only the nucleophilic reagent and defined as 0.00 for water.

Scrubber physics, optimisation and scale up *(500x)*

New packing material & Improved operating parameters



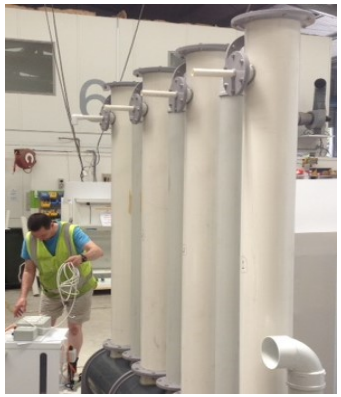
- **New packing material**

Selected a packing material with a higher surface area (**80% increase**), lower pressure loss and HETP-value (height equivalent to a theoretical plate) for further evaluation.

- **Negative pressure scrubbing**

Modified the scrubber design to create a slight vacuum, helps to intensify the mass transfer when using the new packing material.

Pilot Scale	Full Scale	Large Scale
Scale factor ***1x***	***70x***	***500x***



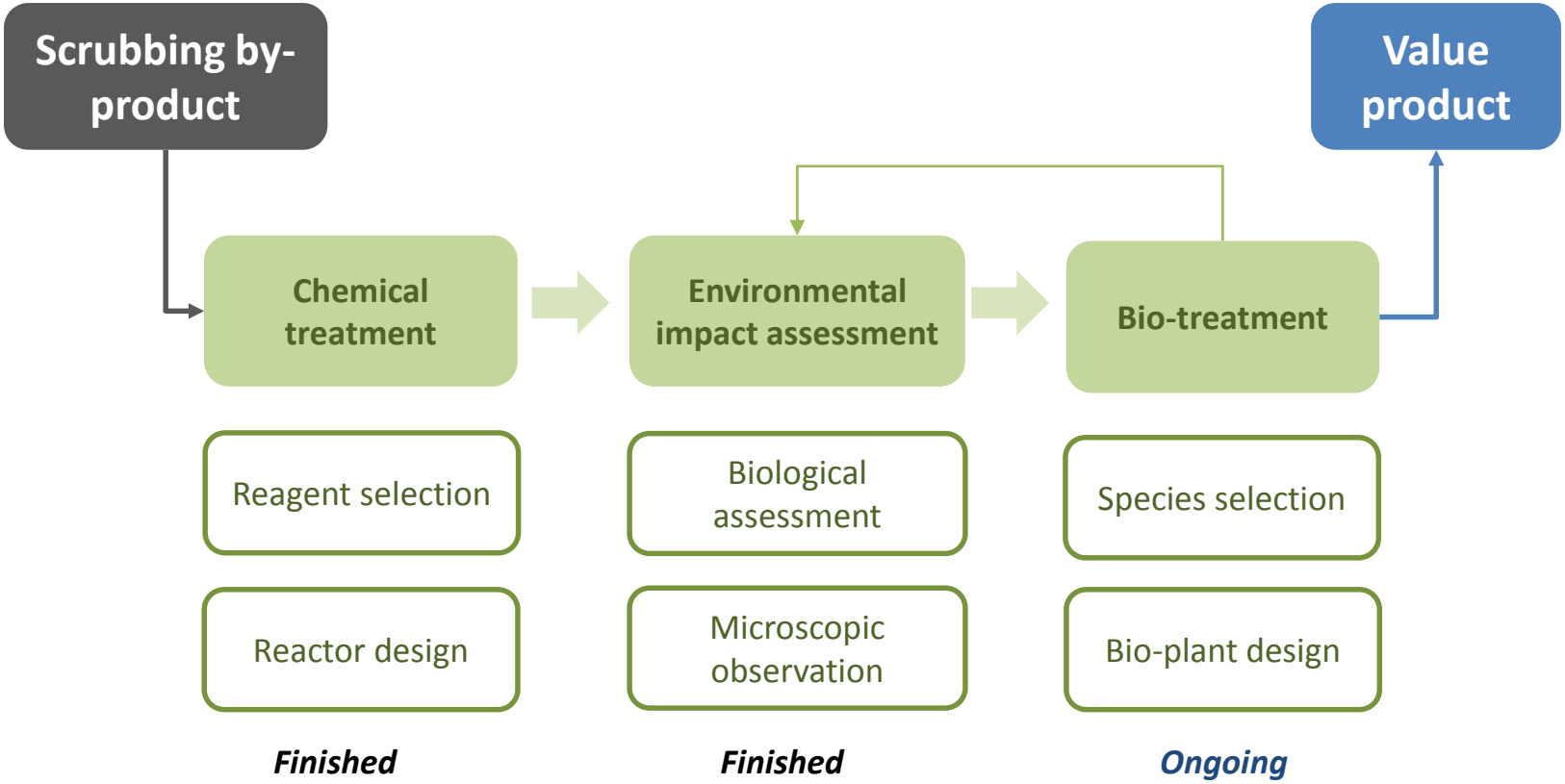
Genera Limited

Up scaling- largest operational scrubber
To be deployed scrubbing from ships holds

Waste Treatment Roadmap

- **Preliminary results suggest the by-product is biodegradable**

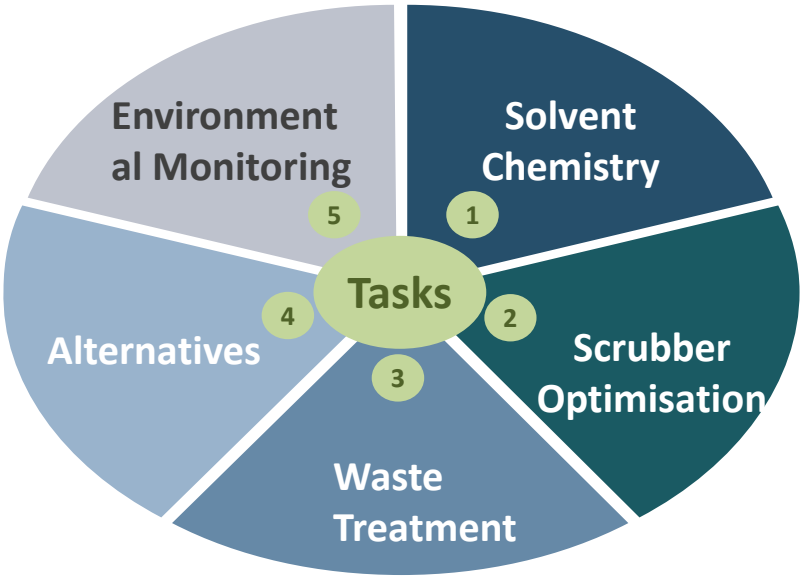
The scrubbing by-product sample was diluted (100x), then treated with selected microorganisms. Biomass was growing fine in the sample, which suggested the bio-treatment is feasible.



Genera Science and Technology R&D Capability

Research Capability at Genera

Multi-disciplinary Research & development



Newly formed Science and Innovation company

- 2 FT research scientists (1 environmental scientist, 1 chemical engineer).
- 1 FT Research and design Engineer.
- 2 FT Manufacturing Engineers.
- Two environmental technicians.
- 1 environmental technician/Auditor (contract).
- Two consulting engineers (available on contract).
- 7 Gas liquid scrubbers (4 operational, 3 research).
- 7 Carbon scrubbers.
- Mobile Research Lab with Gas Liquid Chromatograph.
- Full lab facilities at Macrae Avenue Mount Maunganui.
- Full engineering/fabrication workshop at Macrae Avenue Mount Maunganui.
- Dedicated GLC air monitoring vehicle.
- Strong relationships with: Callaghan Innovation, EPA, Worksafe, Massey University, Plant and Food, Scion, STIMBR, University of Waikato, NORDIKO.

What Does Genera need from the Forest Industry

- An understanding that this is a significant pan-industry issue.
- Understanding that no matter who provides the technical solution, the entire supply chain must be engaged in implementation.
- Positive approach and advocacy as individuals and as an industry. Eg. Lobbying Tauranga City Council to work with us on installation of an effluent disposal plant at their wastewater plant.
- Actively pushing for support from ministers and regional councilors.