FASHION FOR GOOD

A GROUND-BREAKING INNOVATION IN WASTEWATER TREATMENT

Piloting a new solution in South Asia that eliminates sludge from wastewater streams

JULY 2020

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PARTICIPATING BRAND PARTNERS

Arvind BESTSELLER C&A PVH

INTRODUCTION

The fashion industry contributes 20% of industrial water pollution[1]. With a high water footprint, massive chemical use and atmospheric, water and greenhouse gas (GHG) emissions, dyehouse operations are the most environmentally damaging component of the apparel supply chain[2]. Global brands are responding by requiring manufacturers to treat wastewater and reduce effluent. Paradoxically, conventional water treatment systems generate toxic sludge, trading water pollution for solid, chemical discharge that is landfilled and emits GHG – mostly methane.

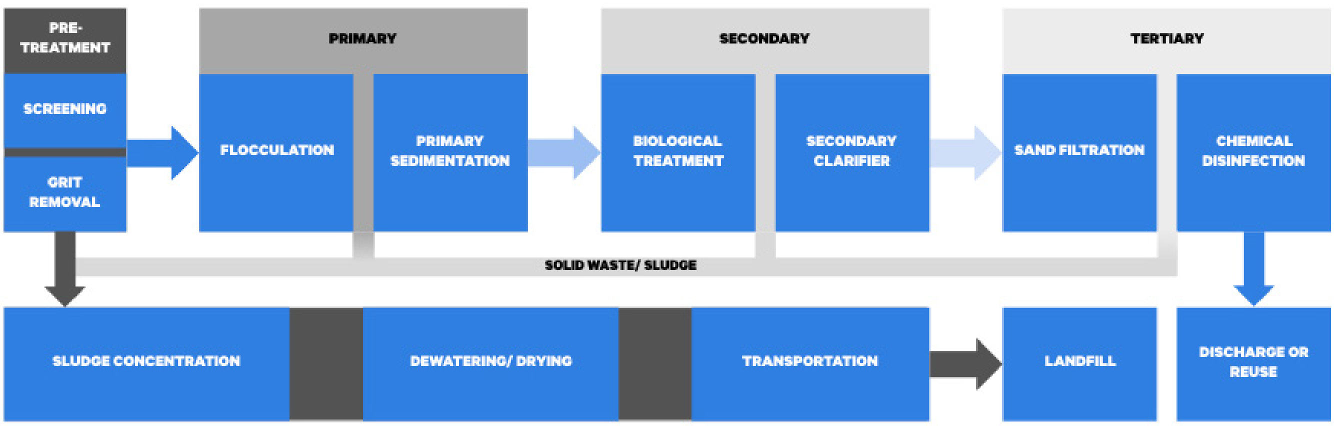


Figure 1: Conventional apparel wastewater treatment process which typically requires pre-treatment, primary, secondary and tertiary treatment to treat various contaminants present in the effluent. Solid waste and sludge extracted from each stage is then concentrated, dried, and sent to landfill for disposal.

A typical Southeast Asian dyehouse generates 1-3 tonnes of sludge per day from wastewater treatment, **see figure 2**, costing over $200,000 to dispose of annually and generating over 5,000 tonnes of GHG annually[3]. Across thousands of suppliers/dyehouses, the costs are tremendous and increasing as options for its safe disposal become more limited under public pressure to improve sustainability.

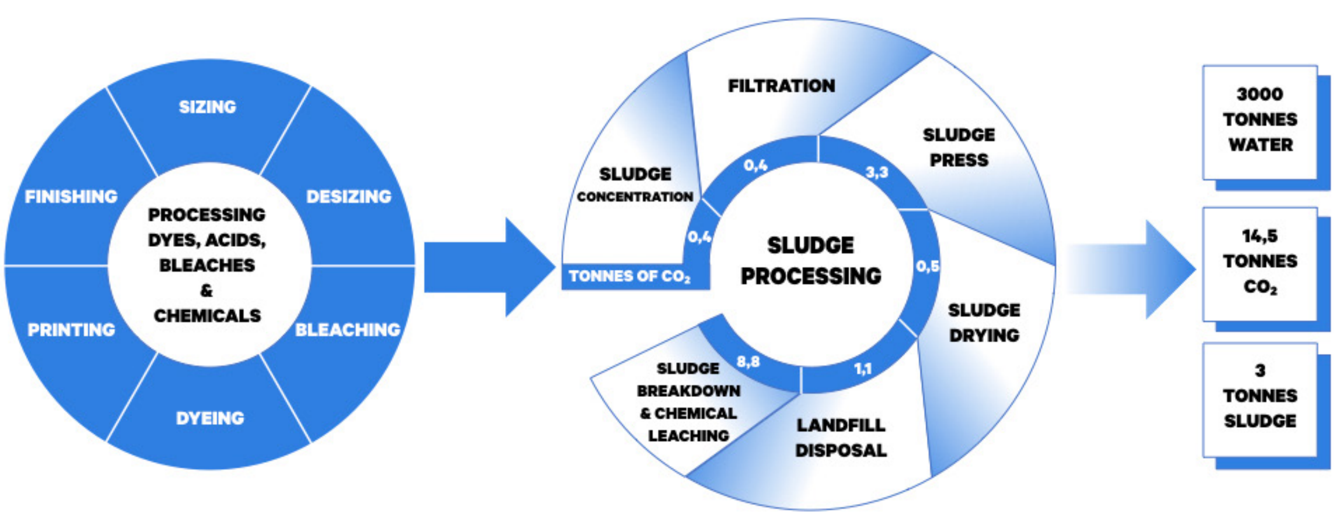


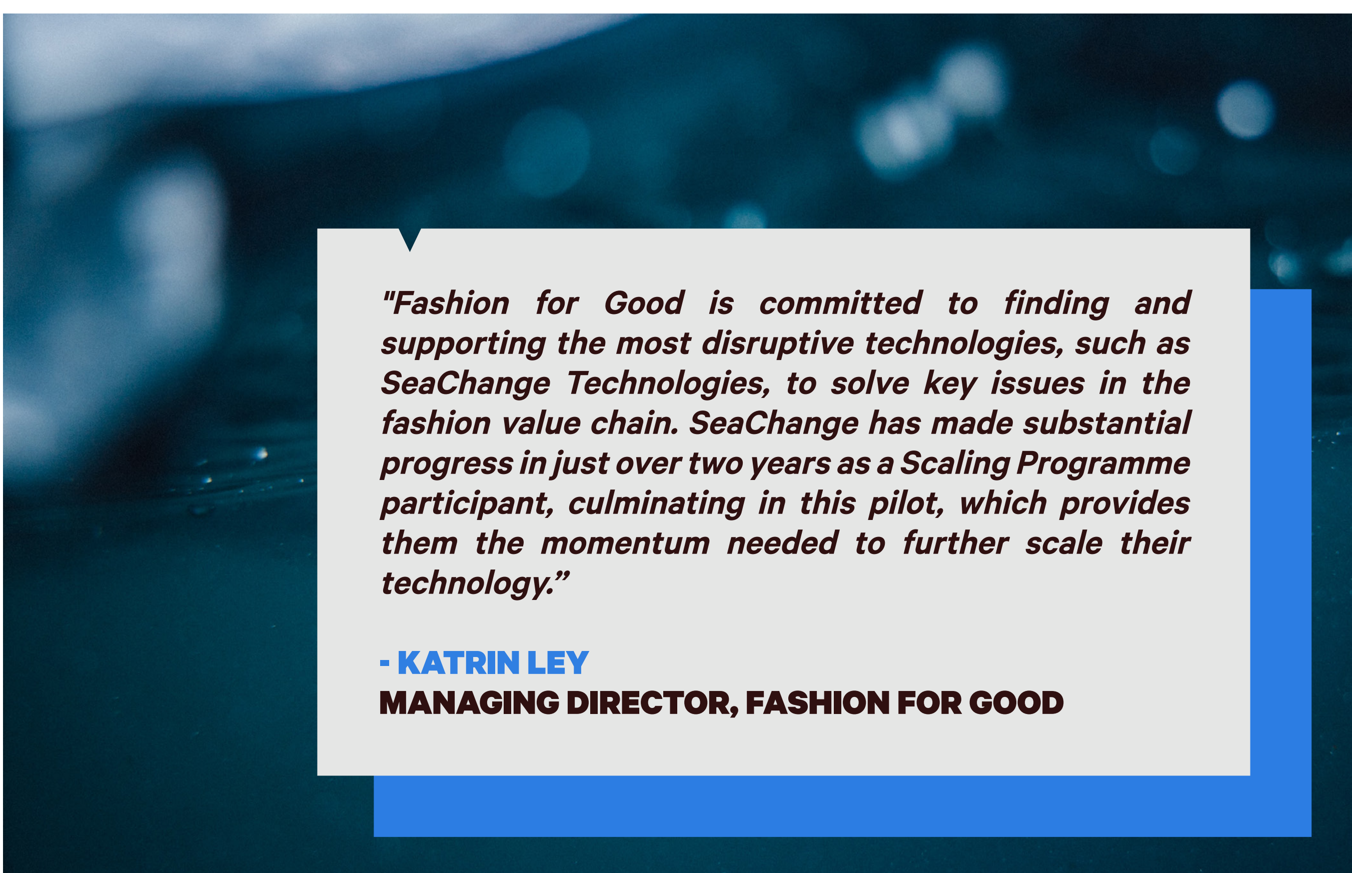
Figure 2: Typical midsize apparel dyehouse generates approximately 3000 tonnes of wastewater per day, resulting in 1-3 tonnes of sludge daily, as well as 14.5 tonnes of carbon emissions annually through traditional sludge disposal[4].

1. Wastewater Treatment Technologies by ZDHC
2. https://quantis-intl.com/report/measuring-fashion-report/
3 & 4. SeaChange Analysis.

BACKGROUND: WHY THIS PILOT?

Fashion brands and their suppliers need a cost-effective solution for sustainable wastewater treatment. The high expense and environmental impact associated with water treatment creates an attractive opportunity for innovation. To investigate solutions in this area, Fashion for Good initiated a pilot project with Scaling Programme innovator SeaChange Technologies, whose focus is the treatment of industrial effluent. Fashion for Good partners Arvind Limited, BESTSELLER, C&A and PVH Corp. provided support, development funding and expertise to the pilot.

As a global leader in apparel manufacturing and with a focus on textiles, advanced materials, and environmental solutions, Arvind Limited provided access to their Effluent Treatment Plant (ETP) near Gujarat, India, one the world's largest textile manufacturing operations, to conduct a field evaluation. The SeaChange system was implemented over a period of three months to test and evaluate the feasibility of widescale implementation of the system.



"Fashion for Good is committed to finding and supporting the most disruptive technologies, such as SeaChange Technologies, to solve key issues in the fashion value chain. SeaChange has made substantial progress in just over two years as a Scaling Programme participant, culminating in this pilot, which provides them the momentum needed to further scale their technology."

- KATRIN LEY
MANAGING DIRECTOR, FASHION FOR GOOD

THE SEACHANGE PROCESS

Image 1: Founder Dipak Mahato on-site at Arvind Limited's Effluent Treatment Plant in India with the the SeaChange Technologies prototype equipment, codenamed Starling. The system is powered by an innovative turbocharger-based turbine engine, efficiently providing the air movement required for the process.

SeaChange Technologies has developed a revolutionary solution to address the logistical cost and environmental impact of wastewater treatment, specifically with its toxic sludge disposal. The 'Starling' water treatment system is designed to evaporate effluent, safely oxidise toxic organic contaminants and capture dissolved and suspended minerals in a single step process.

Wastewater or sludge is heated, pressurised and injected as an aerosol into a cyclonic separator. This single-step process uses the cyclonic separation technique to draw out unwanted materials, microplastics and other non-biodegradable components from the water itself. Due to heat and presence of oxygen in the air, these organic compounds then undergo thermal oxidisation causing them to degrade to CO_2.

This is done by generating near-critical water conditions, where about 5-10% of the water mass becomes ionised. When water ionises, it creates free radicals that can destroy most organic material. By using heat from the organic oxidation process, energy use in maintaining this near-critical environment is incredibly efficient, using only about 60% of what would otherwise be required for water vapourisation.

Image 2: Above: Evaluating wastewater components at the Arvind Limited's Effluent Treatment Plant near Gujarat, India.
Image 3: Below: Wastewater before the SeaChange treatment (right) and remaining minerals after (left).

THE SEACHANGE PROCESS

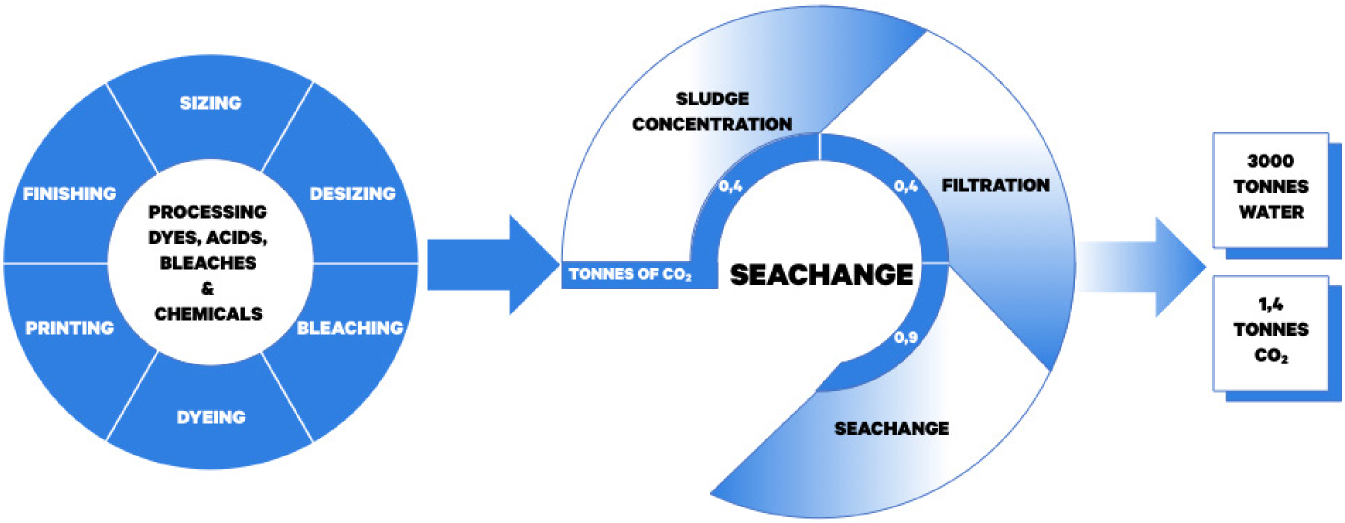


Figure 3: The SeaChange process is able to safely treat the concentrated sludge from the wastewater treatment process eliminating the need for landfill disposal and significantly decreasing carbon emissions. This example is based on the requirements of a midsize Southeast Asian dyehouse.

The process enables treatment of wastewater while eliminating the production of sludge and mitigating GHG emissions; the CO_2 generated is just a small fraction of the GHG generated by conventional processes.

"The Fashion for Good Scaling Programme gave us the opportunity to show the potential of our technology in the field by working with leading apparel brands."

- DIPAK MAHATO,
FOUNDER, SEACHANGE TECHNOLOGIES

THE SEACHANGE PROCESS

The SeaChange process has three key components of GHG emissions:

1) electricity (very low usage, only for controls and water pumping),
2) exhaust emissions from natural gas combustion (about 400 tons/year system depending on application), and
3) sludge oxidation to CO_2 (variable amounts).

The projected differences/benefits in production that may be realised from using the SeaChange to process dyehouse wastewater are based on the current SeaChange prototype configuration (Starling).

The Starling configuration can offer around 4000 tonnes/year GHG reductions based on sludge elimination, but still generates some emissions from electricity use and natural gas combustion. Several opportunities and potential improvements have been identified that can further reduce the carbon footprint, but will involve further research and development. In the event that renewable gas sources are available (such as landfill/waste gas, or compressed natural gas from renewable sources), the current configuration would virtually eliminate all GHG emissions. Nonetheless, research plans include heat exchange for water recovery and GHG scrubbing (recapture) and incorporating electricity production to further offset energy use and emissions from other dyehouse operations.

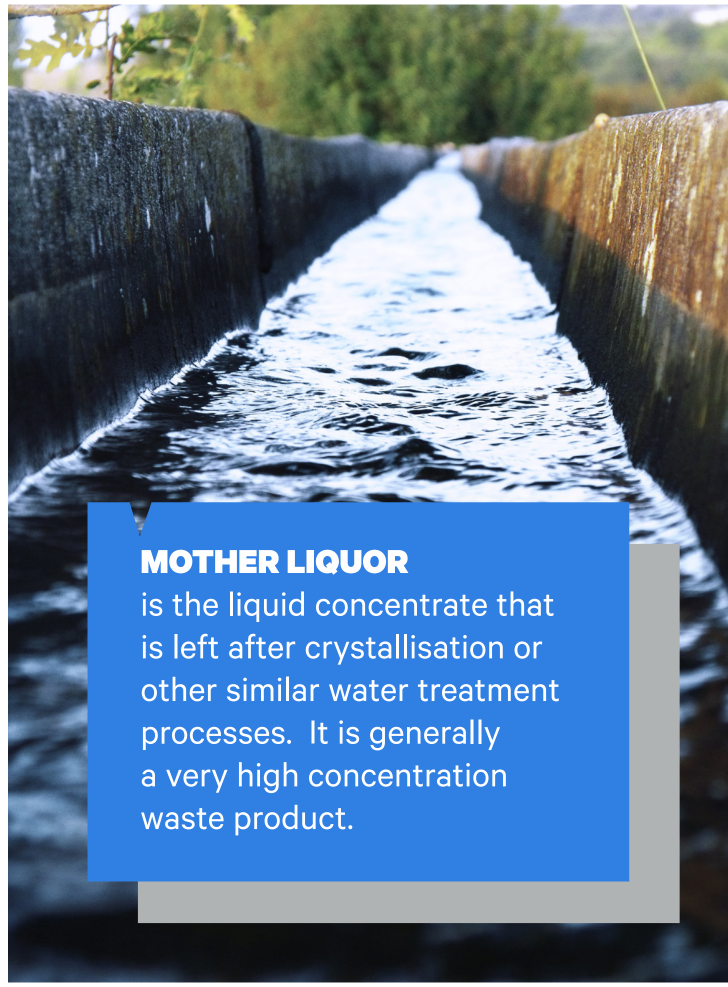
"Partnership and innovation are key to finding scalable solutions to industry challenges. This pilot allowed us to test and further understand some of the steps needed as we work to completely remove water pollution from wet processors. To drive fashion forward, we cannot stop at simply reducing our negative impacts; we must work to eliminate them."

- MARISSA PAGNANI MCGOWAN,
SENIOR VICE PRESIDENT
OF CORPORATE RESPONSIBILITY, PVH CORP.

PILOT OVERVIEW

Arvind Limited's Effluent Treatment Plant is a 17,000 tonne/day treatment facility, supporting one the world's largest textile manufacturing operations. The facility allowed testing wastewater streams from different manufacturing processes and from different stages of traditional wastewater treatment.

Manufacturing effluent included dyeing concentrates and combined effluent, different treatment stages included sludge, Reverse Osmosis (RO) reject and Mother Liquor from Multiple Effect Evaporation. All waste streams were successfully treated using the SeaChange process and reduced to minerals in a single pass.



MOTHER LIQUOR is the liquid concentrate that is left after crystallisation or other similar water treatment processes. It is generally a very high concentration waste product.

PROJECT TIMELINE

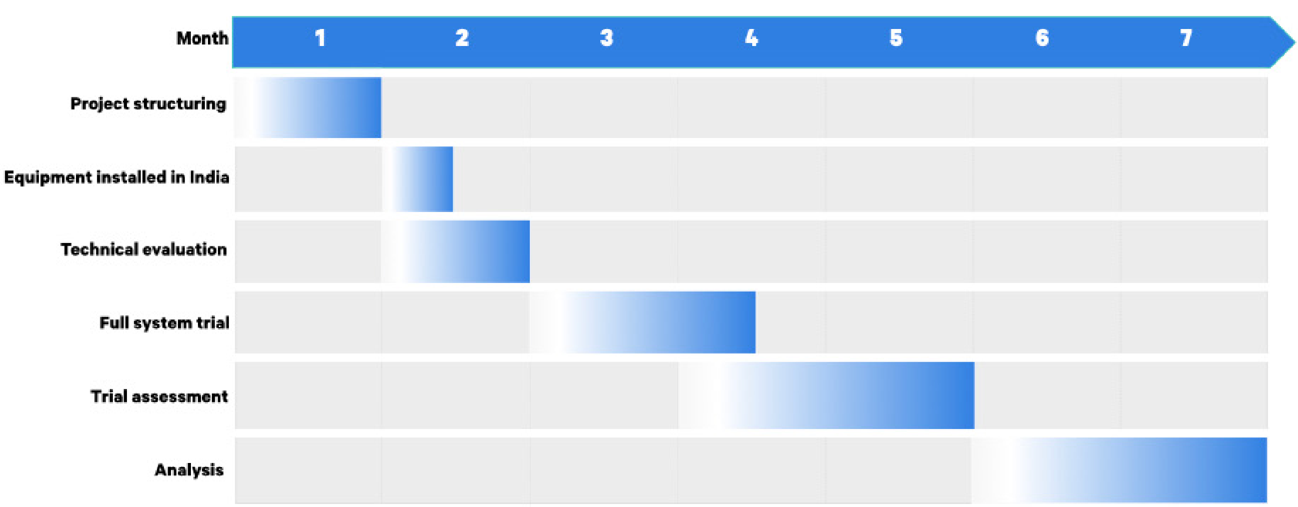


Figure 4: Pilot Project timeline: The technical evaluation was the initial evaluation of many different streams or types of wastewater upon initial arrival at the facility, largely for technical feasibility. The full system trial and trial assesment periods were geared towards the reliability of the system and determining the economics based on the operating expense of the system.

PILOT OVERVIEW

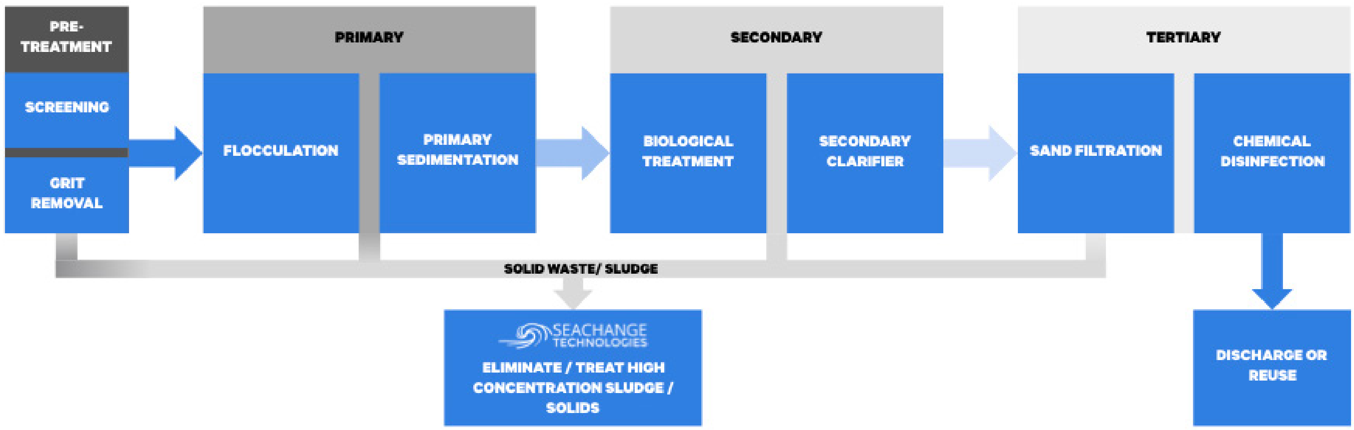


Figure 5: Conventional apparel wastewater treatment process which typically requires pre-treatment, primary, secondary and tertiary treatment to treat various contaminants present in the effluent. Solid waste and sludge extracted from each stage is then concentrated, dried, and sent to landfill for disposal. The SeaChange process is focused at the point where sludge is collected from various conventional processes.

"Effective wastewater treatment remains a big challenge for the textile and apparel industry, finding an efficient solution is crucial for the industry. C&A is committed to achieve zero discharge of hazardous chemicals throughout the supply chain and supporting its suppliers in their continuous improvements to achieve it."

- ALEIX BUSQUETS GONZALEZ
HEAD OF GLOBAL SUSTAINABILITY, C&A

TECHNICAL FEASIBILITY

For the full system trial (see figure 5, page 9), SeaChange worked with Arvind Limited to identify potential applications (i.e. waste streams) from textile processing that may be economically compelling and technically feasible to address with the SeaChange process.

REVERSE OSMOSIS
is a process by which a solvent passes through a porous membrane in the direction opposite to that for natural osmosis when subjected to a hydrostatic pressure greater than the osmotic pressure.

It was agreed that more concentrated waste streams, such as sludge disposal and reverse osmosis (RO) reject would be more likely to achieve economic feasibility. Additionally, the SeaChange process performs more efficiently with high concentration waste streams such as these. Therefore, the primary interest in this research was the evaluation of high concentration by-products of traditional wastewater treatment (sludge, RO reject and Mother Liquor).

While the prototype equipment used in this pilot study was able to process high concentration wastewater on site, there were opportunities for improvements.

For example, because the prototype is manually controlled and monitored (to save costs during research, development, and testing), staff was required to monitor the equipment continuously. The learnings from this trial will be incorporated into our commercial launch version.

"I am happy to have had the opportunity to assess this unique technology to address not only wastewater but also sludge. Textile wastewater sludge disposal in a responsible manner is serious issue given the limited options available for its disposal. If SeaChange can rise to its potential by economically recovering energy and water whilst treating wastewater and sludge then it will be a true game changer in the industry."

- MOHAN SENEVIRATNE,
PRINCIPAL CONSULTANT, MOHAN SENEVIRATNE CONSULTING.

ECONOMIC FEASIBILITY

While SeaChange was able to effectively treat all waste streams, the relatively low levels of environmental regulation regarding waste disposal in India results in a very low disposal cost for hazardous waste, meaning facilities are able to dispose of waste in landfill with minimum penalties.

For market entry, SeaChange has targeted other countries across Asia, such as Taiwan, which have significantly higher sludge disposal costs. Further research and development may reduce costs of the SeaChange process by up to 20%, allowing for more profitable installations in countries with lower regulations.

This finding as part of the pilot demonstrates the need for more targeted legislation in order to foster and support innovation that drives sustainability forwards in fashion and indeed all other industries. Key stakeholders across the industry, including multi-stakeholder initiatives and NGOs must continue to lobby governments around the world to adopt forward-thinking legislation to enable technologies like SeaChange to thrive and avoid the escape of these toxic compounds into the environment.

ENTRY INTO OTHER MARKETS

In February 2020, students from Imperial College London concluded an investigation into opportunities for SeaChange to enter the market in 5 key countries; Taiwan, Vietnam, Ethiopia, China and Indonesia. Their three recommendations for SeaChange were:

1) To pursue market entry in Taiwan and Vietnam. Both countries have favourable wastewater treatment, carbon and sludge reduction policies, as well as a strong ecosystem set within a textile industry that has signaled its ambitions to become more environmentally focused.

2) To create and maintain relationships with key stakeholders in Ethiopia, China and Indonesia but to focus efforts on entering markets in Taiwan and Vietnam.

3) To focus efforts on targeting multinational parent companies with manufacturing facilities in various countries.

SUSTAINABILITY

With a high water footprint, massive chemical use and atmospheric, water and GHG emissions, dyehouse operations are the most environmentally damaging component of the apparel supply chain[2]. However, every individual dyehouse has different operating procedures and characteristics.

There was a highly detailed technical and economic analysis of fabric dyeing and finishing factories (exploring current dyehouse operations) where the SeaChange system operates as part of the field programme. By doing so, SeaChange can determine the exact impacts of their process on power consumption, landfill waste, carbon emissions, effluent volumes, operating costs, chemical use and other factors.

In planning for such a transition to commercial installations, SeaChange will offer potential customers a Production Proposal, in which they document the projected economic and sustainability benefits that the SeaChange system can generate in their operation.

NEXT STEPS

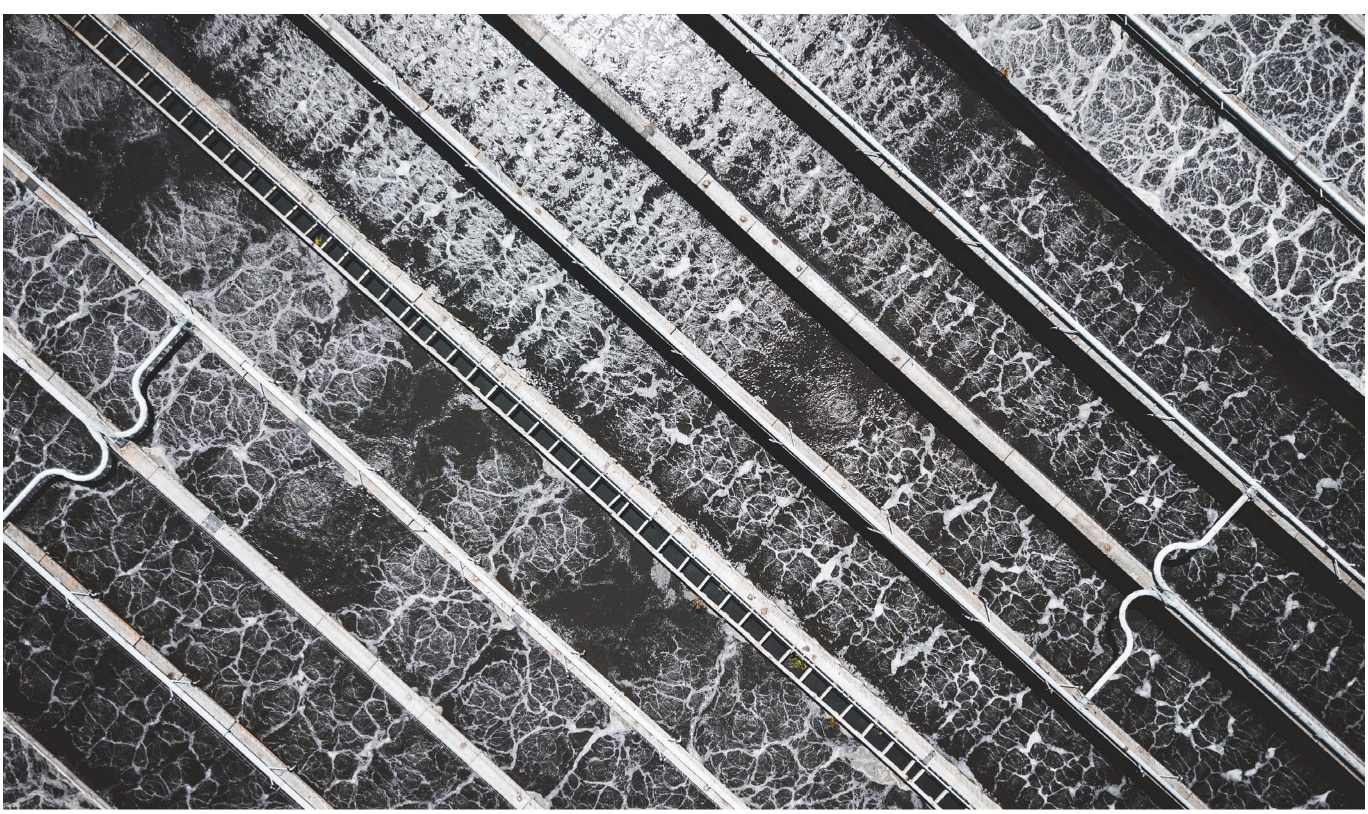
Transitioning from a very lean and low cost start-up, the primary challenges facing SeaChange are around growing the team, gaining funding and establishing the partnerships that they need to support commercial launch.

In the following year, SeaChange aims to:

- Complete their first commercial installation
- Establish partnership(s) and grow team to support manufacture, installation and support of commercial SeaChange systems
- Raise equity investment, ideally from strategic brand partners
- Incorporate engineering modifications to address pilot trial learnings, such as unified controls with cloud-based telemetry and monitoring.

To support the development of technologies like SeaChange in the wastewater treatment field, the wider community should:

- Lobby for a more forward-looking and progressive policy landscape, with harsher legislation with regards to disposal of hazardous waste.
- Catalyse funding to de-risk the installation of CAPEX-heavy machines.
- Supply chain players should engage with normative standards such as the ZDHC Wastewater Guidelines, to go beyond regulatory conformance.
- Industry players should look beyond fashion to other sectors for best practices.



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