



**BEST PRACTICE
GUIDE IN
WATER
EFFICIENCY**

COMMERCIAL LAUNDRY SECTOR

VERSION 1

PREFACE

Singapore's water consumption stands at 430 million gallons a day, with the domestic sector accounting for 45% of total water use, while the remaining 55% comes from the non-domestic sector. By 2060, Singapore's water consumption is expected to double, with the non-domestic sector making up 70% of total water demand. Therefore, it is important that PUB's partners in the non-domestic sector join us in the move to conserve water, and reduce water demand. This will help Singapore in its water sustainability journey.

The aim of this **Best Practice Guide in Water Efficiency – Commercial Laundry Sector** is to provide professional engineers, developers, plant owners and facilities operators involved in water management, with the basic knowledge of designing, maintaining and operating a water-efficient laundry facility.

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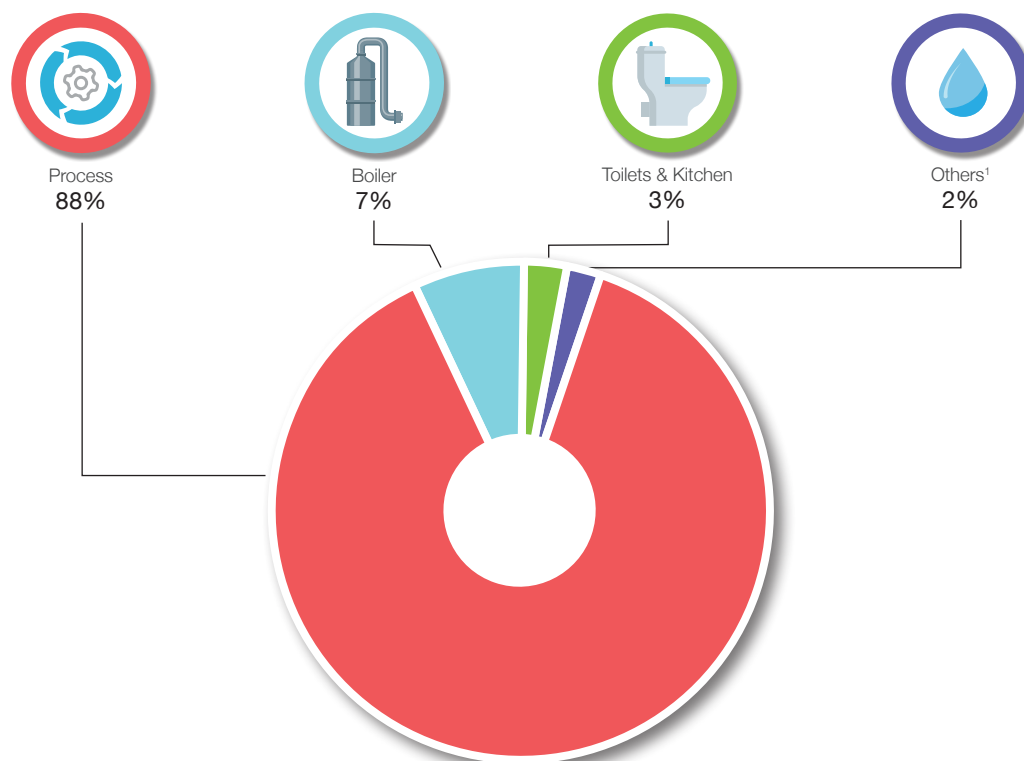
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The commercial laundry sector is one of the major water consumers in Singapore. Commercial laundries derive their primary income through processing laundry for third party organisations such as hotels, hospitals and restaurants, where laundry is ancillary. Since commercial laundries consume a significant amount of water, they have an important role to play in Singapore's effort to conserve water. The water usage breakdown for this sector is shown in Fig.1.



► Fig. 1 Water Usage Breakdown for Commercial Laundry Sector

¹ Others include general washing, cold water to heat pump system etc

Washer extractors, as well as large scale continuous batch washers, are typically employed by laundries to process large volume of wash load that are soiled in various substances such as stains; bacteria; chemicals; biological hazards; often of higher concentration than residential clothes.

The continuous batch washer is designed to process large volume of similar fabrics. To optimise the operation, the fabrics washed are generally non-colour transferrable to prevent staining in other compartments; lightly soiled to avoid rewash; and do not embody zips or buttons to prevent any damages when they are mechanically compressed into a large cake at the end of the washing process. Some laundries utilise continuous batch washers to process the coloured fabrics in separate batches from the white ones, or allocate a specific continuous batch washer to wash colour transferrable fabrics only.

Although the continuous batch washer is inherently water efficient and highly automated, laundries evidently still require washer extractors to handle smaller pieces of fabrics with lower volume such as napkins and face

towels, as well as fabrics that are not suitable to be washed by the continuous batch washer. Depending on the type of fabric and the degree of soiling, different wash programs are developed by the laundry's chemical supplier to optimise the wash quality.

Given Singapore's limited water resources, PUB encourages industries to improve water efficiency through the 3Rs – Reduce, Reuse and Recycle. The key is to ensure that water conservation efforts do not detriment the wash quality which is essential to the laundry business.

Hence, this guide seeks to share the water efficiency strategies that are available and applicable to the sector, and provide practical guidance for efficient water management. It is not intended to be prescriptive nor does it set an industry standard. The content of this guide is also not intended for residential application.

Companies may wish to read this guide in conjunction with the following standards:

- ISO 46001:2019 Water Efficiency Management Systems

The Water Efficiency Index (WEI) serves as the performance indicator for water efficiency. For a commercial laundry, WEI is defined as the amount of supplied water used to process each wash load based on the following formula:

$$\text{Water Efficiency Index} = \frac{\text{Annual Water Consumption (m}^3\text{)}}{\text{Annual Amount of Wash Load (tonnes)}}$$

Commercial laundries can adopt WEI to compare their year-on-year water efficiency performance and to determine where their company stands in the commercial laundry sector in terms of water efficiency. Having a lower WEI indicates that the laundry is relatively more water efficient. This can be achieved by implementing recycling systems; using of water efficient washing machines and adopting good water efficiency practices.

AMOUNT OF WASH LOAD COMPUTATION

To enhance the accuracy of the wash load declared, every batch of soiled fabrics that arrives at the laundry premises should be weighed and recorded daily.

Alternatively, the following wash load computation method can be applied to all the washing machines operating in the laundry premises.

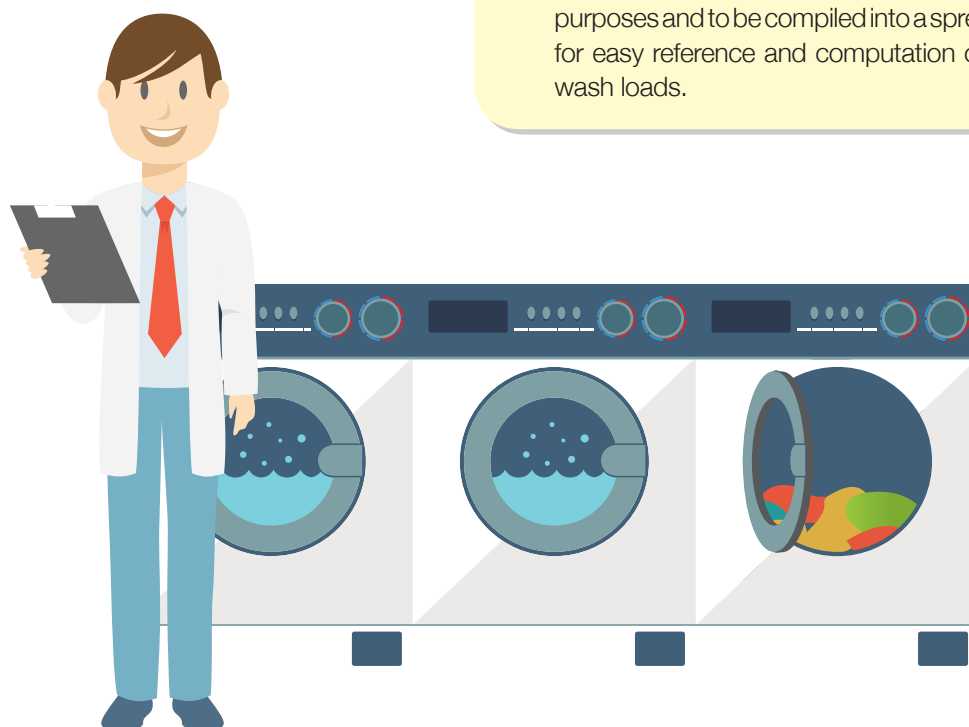
Washer Extractor

The amount of wash load processed by each washer extractor will be determined by the number of wash cycles operated in a day and the recommended loading capacity of the washer extractor, assuming it is loaded to its recommended loading capacity for every wash cycle.



Recommended Steps

1. To identify the number of washer extractors operating in the premises.
2. To label all washer extractors and identify the respective design capacity and recommended loading capacity provided by chemical supplier.
3. To record the number of wash cycles that each washer extractor operates every day.
4. Records are to be kept properly for audit purposes and to be compiled into a spreadsheet for easy reference and computation of annual wash loads.



An example of the compiled spreadsheet is shown below.

Washer Extractors	Washer A	Washer B	Washer C	Washer D
Design capacity (kg)	25	50	75	100
Recommended loading capacity (kg)	22.5	45	67.5	90
Year 2019	Number of wash cycles			
1-Jan	$A_1 = 1$	$B_1 = 1$	$C_1 = 1$	$D_1 = 1$
2-Jan	$A_2 = 2$	$B_2 = 1$	$C_2 = 2$	$D_2 = 1$
...
31-Dec	$A_{365} = 1$	$B_{365} = 2$	$C_{365} = 2$	$D_{365} = 2$
Total wash load for 2019 (kg)	$= 22.5 \times (A_1 + A_2 + \dots + A_{365})$	$= 45 \times (B_1 + B_2 + \dots + B_{365})$	$= 67.5 \times (C_1 + C_2 + \dots + C_{365})$	$= 90 \times (D_1 + D_2 + \dots + D_{365})$

Continuous Batch Washer

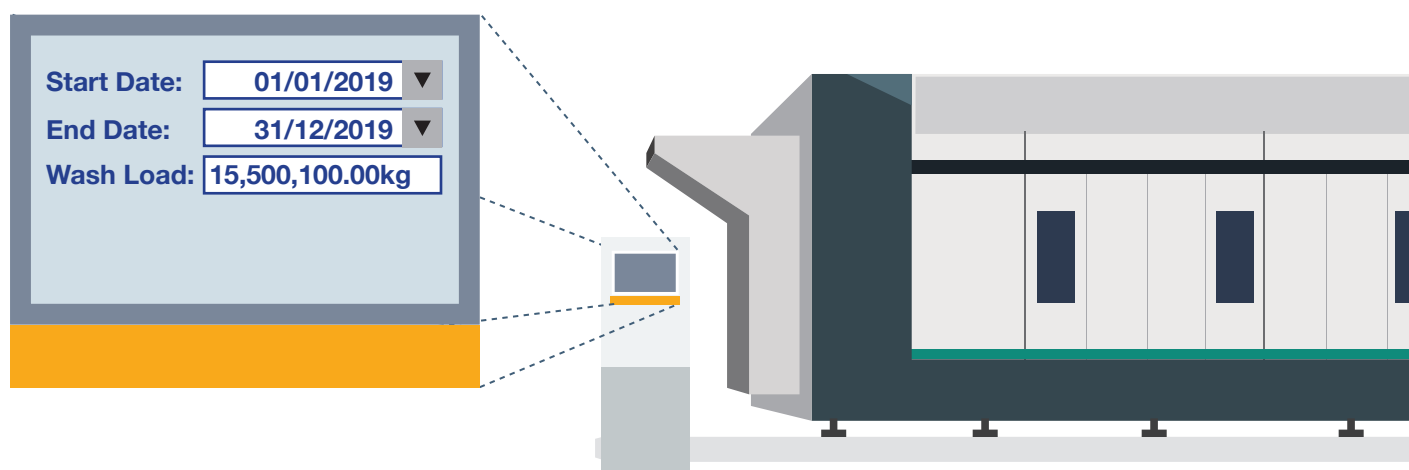
The continuous batch washer consists of an overhead bag or conveyor system which automatically transports and loads batches of soiled fabrics, by weight, into the compartments. Operators can easily load the soiled fabrics into the conveyor's first compartment or the bag and monitor the loading weight through a control panel which can also be programmed to store data on the amount of wash load processed by the continuous batch washer. This automated process reduces the manpower required to load and manually record the amount of wash load.



Recommended Steps

1. To extract the amount of wash load from the continuous batch washer system regularly and compile it into a separate database.
2. To monitor the water efficiency of the continuous batch washer based on the wash load data and meter reading records.

For older models of continuous batch washer that are not able to store the wash load data, it is recommended to consult the equipment suppliers on the possibility of retrofitting this capability. Otherwise, a manual recording method of the daily wash load, similar to the method suggested for washer extractors, is required.



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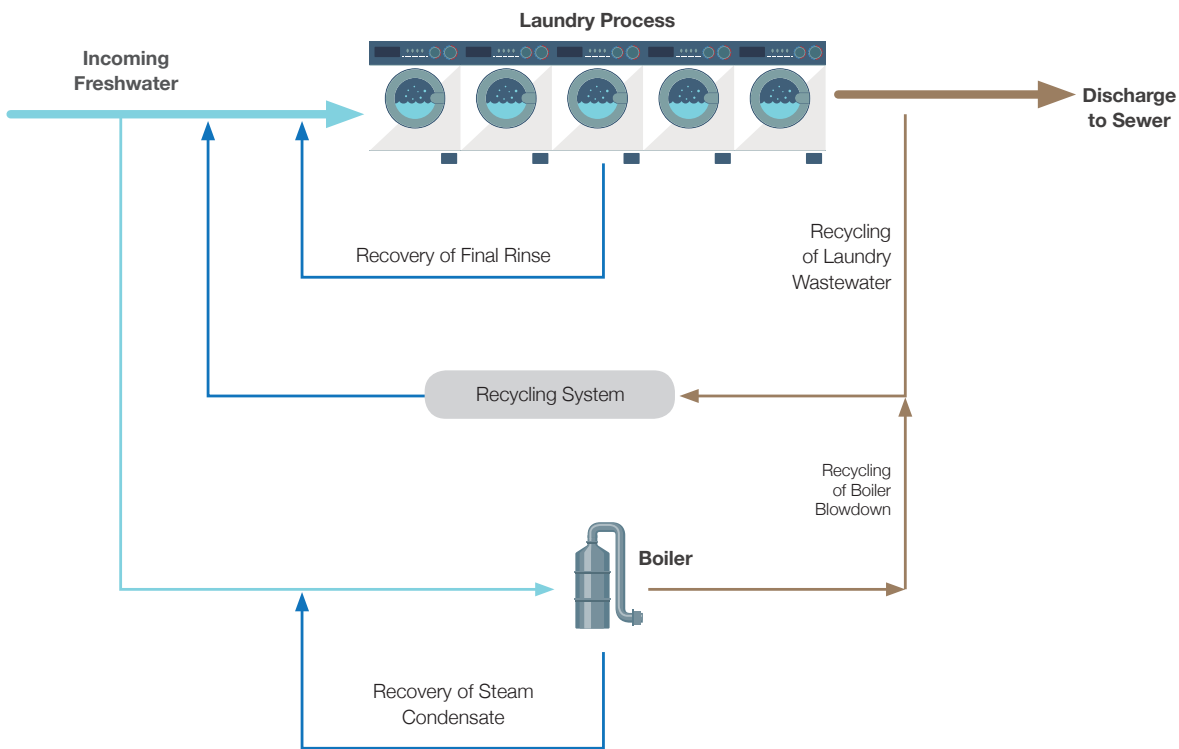
WATER RECYCLING OPPORTUNITIES

Some commercial laundries incorporate water reuse and recycling efforts in their facilities. Based on 2018 reported data, the recycling rate² of the sector varies from 0% to 43% with an average recycling rate of 7.4%. Recycling rate is defined as:

$$\text{Recycling rate (\%)} = \frac{\text{Total amount of water recycled}}{\text{Total amount of water recycled} + \text{Total supplied water}}$$

The large variation in recycling rate is the result of various degree of recycling adopted by laundries. For instance, there are laundries that adopt recycling of waste laundry water, and such initiative may help laundries save up to 300m³ of water a day. Hence, laundries are strongly encouraged to reuse and recycle water where possible. This will help laundries rely less on PUB supplied water and reduce water costs in the long run. Fig. 2 below illustrates the recycling potential in a typical laundry facility.

Water quality requirements are subject to individual facility requirements. Interested companies can approach independent consultants or PUB’s in-house Industrial Water Solutions Project Unit team to review the feasibility of water efficiency improvements at process areas. A comprehensive water usage audit can also be conducted to identify and prioritize potential areas of water efficiency, reuse and recycling.




▲ Fig. 2 Water Recycling Opportunities in a Typical Commercial Laundry facility

² Recycling rate does not take into account in-built reuse/recycling function of washing equipment

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RECOMMENDED WATER EFFICIENCY PRACTICES




a. Process

<p>Operation and Maintenance</p> 	<ul style="list-style-type: none"> Operate washing machines only when loaded according to manufacturer's recommended specification. Avoid under-loading and overloading. Choose the appropriate water level setting for the load as recommended by the manufacturer, if the washer extractors do not have load sensing feature that automatically determines the amount of water required for the load size. Correct water levels assist in the mechanical action during washing.  <ul style="list-style-type: none"> Pre-sort the fabrics based on the degree of soiling prior to washing so that the right and appropriate wash program can be used for heavily soiled and lightly soiled fabrics respectively. This will prevent over washing of lightly soiled fabrics and unnecessary rewash of heavily soiled fabrics. Ensure that the chemicals / detergents are dosed at an appropriate concentration for each wash program as recommended by their chemical supplier to avoid rewashing when the solution is diluted and to avoid deposition of chemical residue when the solution is too concentrated. Remove excessive number of rinse cycles that do not significantly improve wash quality. Regularly check the meter readings and monitor water usage patterns to promptly identify potential leaks or maintenance issues with the pipes or washing machines. Develop a regular maintenance schedule to keep track of the washing machines' efficiency as it deteriorates with age and make an informed choice on whether to replace it.
<p>Equipment Refinement/ Retrofitting</p> 	<ul style="list-style-type: none"> Convert the cooling operation of dry cleaning machine to a closed or air cooled system if the existing machine operates on water cooled system. Retrofit a storage tank within the washer extractor or attach a standalone tank connected by pump to save the final rinse water for reuse in prewash for the subsequent load. Due to the difference in water quality of the final rinse and water required for washing, wash parameters such as pH, detergent and chemical dosage have to be adjusted to maintain the wash quality. In some cases, some form of filtering or treatment is required prior to reuse. Incorporate laundry wastewater recycling system to recycle wastewater back to laundry process using a combination of Multimedia Filter (MMF), Advance Oxidation Process (AOP), Ultrafiltration (UF), Nanofiltration (NF) / Reverse Osmosis (RO) processes. However, care must be taken to ensure that the final treated effluent discharged to the sewers can still meet the trade effluent discharge requirements.
<p>Equipment Replacement</p> 	<ul style="list-style-type: none"> Use front loading or side loading washing extractors which are significantly more water efficient than their top loading counterpart. Adopt washer extractors that have load sensing feature which automatically determines the amount of water required for the load size. Replace old washer extractors with water efficient washer extractors and/or continuous batch washers whenever possible, if the age of the washer extractor and/or excessive quantities of wash load calls for their replacement. Continuous batch washer is significantly more water efficient and the automated process reduces labour cost. PUB has partnered with Singapore Environment Council (SEC) to develop water efficiency criteria for commercial washer extractors under the Singapore Green Labelling Scheme (SGLS). New and existing commercial laundries are strongly encouraged to purchase green labelled commercial washer extractors given the potential cost savings from reduced water and energy usage.

For new premises

- ◆ Design your laundry facility to incorporate water saving equipment such as water efficient washer extractors with built in recycling system that stores the final rinse water and reuses it for prewash or main wash of subsequent loads.

b. Boiler

<p>Operation and Maintenance</p> 	<ul style="list-style-type: none">◆ Isolate the steam supply to washing equipment when not in use to maintain boiler temperature and pressure. This will reduce leaks as well as the make-up water required by the boilers.◆ Implement good boiler management system to maintain low temperature of flue gas and minimise combustibles in the combustion process.◆ Implement maintenance program to regularly check for steam traps failure and leaks so that rectification action can be taken as soon as possible.◆ Ensure steam and condensate return pipes and centralised storage tank (if any) are properly insulated to conserve heat.◆ Consider the use of gas instead of steam to generate heat required for washing equipment.
<p>Equipment Refinement/ Retrofitting</p> 	<ul style="list-style-type: none">◆ Install automatic boiler blow-down controls that can determine if blow-down is required based on conductivity or total dissolved solids (TDS) level.◆ Install blow-down heat exchangers to allow some heat transfer from the blow-down back to the boiler feed water. This will produce low pressure steam that can be recycled back to steam system.◆ Install a simple water treatment system before the boiler to improve the boiler feed water quality and reduce the frequency of blow-down required.◆ As the steam condensate water from the boiler is typically free of contaminants, a condensate recovery system can be installed to recover the condensate water for reuse as make up water to the boiler without any treatment required. This reduces the energy required to reheat the boiler make-up water and reduces the amount of freshwater required.◆ Boiler blowdown can be treated via a combination of Membrane Filtration (MF) / UF and NF / RO processes and be reused as make-up water for the laundry process.
<p>Equipment Replacement</p> 	<ul style="list-style-type: none">◆ Purchase the most cost effective boiler and ensure that the boiler is of an appropriate size. Reducing the boiler size can reduce the water requirement.

c. Toilets/Pantries/Domestic Use

To install water saving devices at basin taps, sink/wash area and shower taps so as to meet the water efficient flow rates stipulated by PUB or replace these water fittings with those labelled 2-ticks and above under the Mandatory Water Efficiency Labelling Scheme.

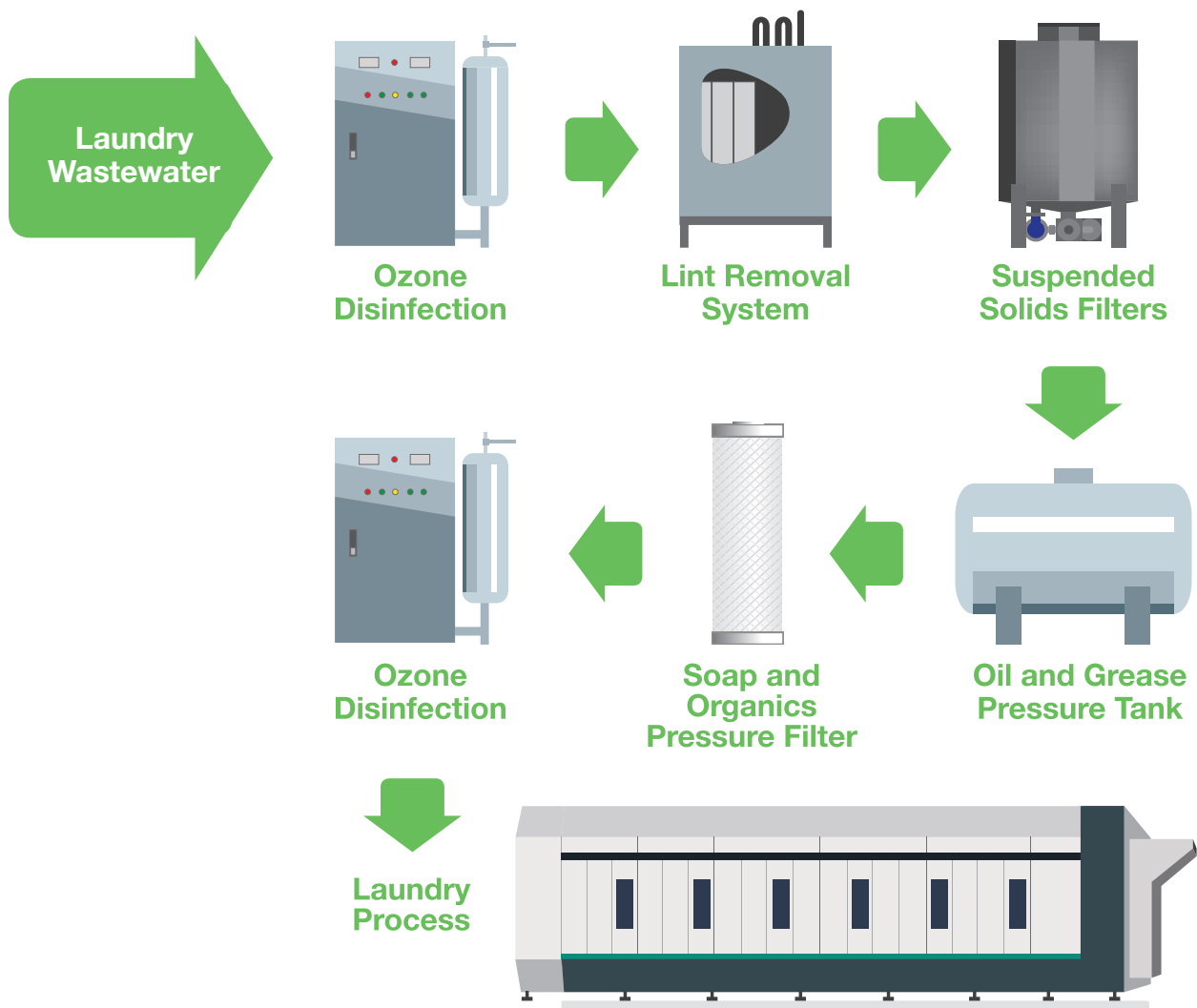
a. YR Industries Pte Ltd

Singapore Corporation of Rehabilitative Enterprises (SCORE) provided commercial laundry services to Changi Prison, as well as the healthcare and hospitality sectors from 1976 to 2016. Their contribution to water conservation and commitment to make a positive impact to the environment led to SCORE achieving the Watermark Award in 2012.

In 2008, SCORE tapped onto PUB's Water Efficiency Fund (WEF) to conduct a water recycling feasibility study on their laundry operation and the results indicated that it is feasible to recycle laundry wastewater back to laundry process. Shortly after, SCORE implemented the AQUARecycle system through WEF in 2009. In this system, wastewater first go through a vibrating lint removal system to remove solids larger than 100 microns then through suspended solids filters which

removes particles larger than 2 microns. After solids removal, wastewater is further treated by the Oil and Grease Pressure Tank as well as the Soaps and Organics Pressure Filter which removes the oil, grease and other contaminants in the processed water. Finally, Ozone is used to disinfect the processed water as post treatment and in the upstream treatment prior to solids removal. The recycling system is able to treat the laundry wastewater adequately for reuse in the pre-rinse of their washer extractors and tunnel washers which results in an annual NEWater savings of 100,000m³.

In 2016, SCORE set up a wholly-owned subsidiary company, YR Industries Pte Ltd (YRI), to manage its commercial laundry services. In 2017, YRI achieved a recycling rate of 43.0% for this water efficiency initiative, which is the highest in the industry.



▲ Fig. 3 Flow Diagram of the AQUARecycle System

* The diagram above is for illustrative purpose only.

b. Hotel Laundry Pte Ltd

Hotel Laundry is a commercial laundry which provides laundry services to hotels under Worldwide Hotels. Being the second commercial laundry to embark on the wastewater recycling project through WEF, they have inspired other laundries to consider implementing wastewater recycling system following the successful operation of the system since 2017.

Their recycling system, known as the Blue Ocean System, is a simple filtration system which pumps

wastewater through a pre-filter tank, then a filtration system, and finally into a filtered tank, before the reclaimed water is recycled back to the continuous batch washers and washer extractors as pre-rinsed water. As they do not require the water to be treated to the NEWater standard, the simple filtration system is sufficient. With the implementation of the recycling system, the recycling rate has increased from 0% to 28% in 2017. The recycled quantum and recycling rate are expected to increase further in the coming years.



▲ Fig. 4 Blue Ocean System

Support and Resources

PUB provides funding and technical support as part of PUB's effort to encourage companies to explore ways to improve water efficiency.

For technical support, interested companies may contact PUB's in-house Industrial Water Solutions Project Unit team at PUB_One@pub.gov.sg.

For information on funding available from PUB including Water Efficiency Fund and Industrial Water Solutions Demonstration Fund, please refer to PUB's website at www.pub.gov.sg.



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