Tailored Training Victoria
Industry Training by Industry Specialists

Smart Water Fund

Laundrette Association of Australia

Our Water, Our Future ~ Reduce, Recycle and Reclaim

Smart Water Laundry Training Notes and Workbook

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The series of notes and workbooks written for laundry operations may be modified as a result of continuous improvement. Comments relating to recommendation on the improvement to the series may be sent to Tailored Training Victoria, 12 Carey Court, Sunbury, Victoria 3429.

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LAUNDRY TRAINING

CONSERVING WATER

Melbourne's Water Catchment and Reservoirs

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Introduction

Welcome to this educational session covering laundries and the use of water. As you work through the workbook, you will develop the skills essential for successful completion and use in your daily work activities. You will also learn about protecting the environment.

If you have any questions or issues in relation to an activity, ask your trainer. Write down questions when you think of them and ask your trainer, mentor or workplace supervisor at an appropriate time. No question should be too small, sound too silly or seem like you should already know it.

Learning is about asking questions and absorbing information for recall at the appropriate moment in your daily work. By learning you will acquire new information to change old habits and start using water more effectively, which will help you to be more efficient at work and protect our environment.

It is important that you learn and develop new skills required to keep up with an ever-changing world. The way we performed operations yesterday may not be the most effective way tomorrow.

Technology in laundry operation has come a long way in the last 10 years; new production procedures and simple old-fashioned ideas are being adopted to improve competitiveness, conforming to government and environmental regulations are all part of a changing industry for the better.

Gaining your Certificate

To gain your certificate for successful completion, you will need to complete all activities/questionnaire in your workbook. Your trainer will also need to discuss your answers with you, which demonstrates that you have understood the ever-growing need to conserve water.

The evidence you will need to provide to successfully achieve your certificate of completion will be based on:

- Completion of the activities in this workbook
- Verbal discussion and questioning by your trainer
- Mentor or Supervisor verification of your competence

Ensure that your evidence workbook is neat, tidy and organised as this reflects the quality of work you produce in your workplace.

1. WATER FACTS

Did you know?

Where does our water come from?

Melbourne's drinking water is universally recognised as some of the best in the world. The main reason for this is the purity and cleanliness of our natural catchments that rely on significant rainfall to remain full. Melbourne's drinking water comes from streams and rivers running naturally through these uninhabited catchment areas that have been closed to the public for up to 100 years. The water is collected from more than 140,000 hectares of natural forest in the Yarra Ranges. It is then stored for up to five years to help purify it through a natural settling process. The result is water so pure that it requires only minimal treatment. And that is why Melbourne's water tastes so good.

Why is there so much focus on water conservation?

Melbourne has endured eight years of below average rainfall while the population and business communities have continued to grow and consume more water each year. Scientists predict Melbourne's rainfall will vary by +3% to –10% by the year 2030.

There are approximately 200 Victorian regional and rural towns on water restrictions, some of which are on stage 4 restrictions.

In May 2004, Melbourne's water storages were only 48% of capacity. The Thompson Dam, which acts as our drought reserve, was only 39% of capacity. As at mid November Melbourne's storage levels were at 60% of capacity, which is after our wet season. While Melbourne's storage has made some gains in 2004, in will be still necessary to save water in 2005 and beyond.

If Melbourne grows at the current rate and does nothing to conserve water, there will not be enough water in the year 2020 to supply our demands and our water storages will continue to be seriously depleted.

We use the same quality water to flush the toilet, water the garden, shower in, and brush our teeth, to drink and to use in your workplace to wash the textiles.

Our river and estuary systems have continued to decline in quality and are desperate for greater water flows.

If we built a new dam, this would take even more water from our rivers, estuaries, bays and wetlands. The cost of building a new dam the same size as the Thompson Reservoir would cost Victorians more than $1 billion.

Currently only 11% of Melbourne's water is recycled.

The message is clear, we need to find smarter ways to use and manage our water supplies. We must ensure all Victorians are able to do more with less water.

2.WATER AND ITS ROLE IN LAUNDRY

Why do we need water?

The most important chemical as far as washing is concerned is water. Water is a chemical consisting of two elements hydrogen and oxygen. The second most important is the detergent and its composition.

Washing in water alone, with agitation provided by hand or machine, will remove some loose dirt and particulate soils. Wetting or soaking in water softens some water-soluble soils, such as mud, making it easier to remove them.

However, water alone cannot remove soils that are not soluble in water. Such soils include automotive oils and greases; cooking fats, oils and greases; and body liquids, oils and perspiration that cause "ring around the collar" and underarm stains on shirts. Neither can water alone remove colour stains, such as fruit juice, grass, blood, sauce, etc. and perhaps most importantly, yet least considered, water also has no sanitizing effect.

Clean water has a high surface tension, which makes it difficult for the water to penetrate the textile fibres and into the dirt/stain.

What role does water play in the washing process?

Water is primarily used in the laundering process to:

- Dissolve some basic soils
- Wet the textiles and carry the detergents into contact with the textiles
- Hold the soil in suspension with the aid of suspension agents
- Flush the soil away
- Rinse out the detergent

How does water work with detergents?

Detergent chemicals have several functions in the washing process:

- They lower the surface tension which enables the water to penetrate the textiles and carry the chemicals into contact with the soil/stain more thoroughly
- They dissolve the dirt/stain much quicker
- They can bleach the stain where the stain is difficult to remove
- They keep soil “floating” to prevent it sticking to the fabric again.

Detergent or, more specifically, the detergent surfactant (a surface active agent), has the unique ability to remove both water-soluble and non-water-soluble soils and is a very important component of detergent. One end of the surfactant molecule (the lipophilic or oil-loving end) penetrates oily soils, while the opposite end of the molecule (the

hydrophilic or water-loving end) solubilizes the oils. This action loosens soils and disperses them in the water.

Surfactants and other ingredients in laundry detergents also work to keep the removed soils suspended in the wash water so they don't redeposit onto the cleaned fabrics. This prevents fabrics greying and dulling of colour. Other laundry detergent ingredients, such as enzymes and bleach, work to remove coloured stains.

There are two types of surfactants:

- Soap: consisting of sodium or potassium salts. Soap is highly sensitive to hard water and it is characterised by very heavy foaming with excellent dispersing ability. Soap however, is not commonly used in the laundry process since the development of mass-produced synthetic detergents.
- Synthetic Surfactants: which are non-ionic, anionic or cationic. Non-ionic are Surfactants characterised by a moderate foaming or no foaming at all. The dispersing and emulsifying abilities of non-ionic are very good. Anionic Surfactants foam very heavily although their dispersing ability is very good. Cationic Surfactants are mainly used in Fabric Softeners.

Synthetic Surfactants are readily soluble in cold water and leave no lime deposits and work well in salt, alkaline or acidic water.

When the textiles are put into water they are slightly negatively charged. The dirt particles are also charged. By adding Surfactants to the water, the negative charge will increase. When the concentrations of Surfactants reaches a certain level “micelles” are formed which envelop the dirt particles. The “micelles” are also negatively charged which repels from the negatively charged textile fibres and from each other (like the negative forces from two magnets). Providing the washing time is not exceptionally long, this negative charge allows the particles to float around in the water and a prevented from sticking back onto the textile fibres. Should the negatively charged particles try to jump back onto the textiles, the negative charge of the textiles pushes it away (again, like two negative magnets trying to be pushed together). If the wash time is too long the negative charge is lost and the dirt can then stick back onto the fibres.

Detergents are effective at washing away many germs. Sodium hypochlorite (chlorine) bleach remains the most common way to sanitize laundry where germs and bacteria are a concern, such as with nappies, healthcare or when there is illness in the home. Chlorine is also particularly strong bleach and is not suitable to use of coloured fabrics.

Powder detergents vs. automatic liquid detergent injection

Large commercial laundries, hospitality and healthcare laundries have been using liquid chemicals via peristaltic pumps for many years now. This is the preferred method of delivery for the following reasons:

- Accuracy of dose ~ There are many reasons why accuracy is important to laundry.
    - Reduces rewash
    - Improves quality
    - Guarantees infection control benchmarks
    - Staff can't forget, saves time (money)
    - Eliminates over usage of detergents and bleaches

- No mixing and guesswork, chemical dosages and mixtures are calibrated and programmed by your chosen liquid chemical supplier

- Legislation ~ Healthcare accreditation guidelines often specify automatic dosing, which is in turn used for documentation and accreditation purposes

- Trade waste authorities often require pH guidelines for wastewater discharge.

- OH&S ~ Less risk of harm to staff, minimal direct contact with chemicals. Less chance of adverse skin reactions for recipients of linen/clothing

3. SOIL TYPES ~ ACIDS, ALKALIS AND SOLVENTS

Different soil types

There are various types of soiling and differing types need different methods to remove them from textiles. We can categorise soiling types into three categories:

- Acidic based
- Alkali based
- Fats oils and greases (commonly referred to as FOG's or oil based stains)

Acidic based

Acidic based soiling is soil, which generally come from plants. Think for an Orange or Lemon (citric acid)

Alkali based

Alkali based soiling is soil which generally comes from the body of humans and animals.

Fats Oils and Greases (FOG's)

Animal fat, vegetable fat, petroleum based greases, natural, petroleum and synthetic based oils make up this group. Other items, which are derivatives of these base elements, consist of lipstick, make up, some inks, some glues, wax, some dyes and oil based paints.

How is this relevant to laundries?

We need to understand the type of soiling on the textiles in order to evaluate how it should be washed to successfully remove the soiling.

There are several different methods we can use in the wash process to provide the best opportunity to remove the soiling without the need to rewash.

Alkali stains are generally the easiest to remove because all the detergents (soap) we use in a laundry are alkali based which assist to dissolve alkali based soiling. Detergents containing enzymes are particularly good for removing body type soiling. We generally need to have the pH value at around 11 to sufficiently remove most alkali stains first time. If the pH is any higher we start to cause excess fabric wear.

Acid base stains often contain dye (colour) which is very difficult to remove and the best way to remove such soiling to bleach the stain.

FOG's, particularly light types of FOG's, can to a degree be removed using a high temperature and a detergent containing an emulsifier which breaks down the FOG's into very small particles.

The most difficult type of dirt to remove is pigment such as carbon black, carbonates and silicates. In many cases the soiling can consist of substances that are not susceptible to chemical treatment. The two ways to try and dislodge the soiling by interrelated processes using a combination of mechanical action and chemical action (as well as suspending agents in the detergent to hold the soiling in the water once removed from the garment so the soiling will not redeposit back onto the textiles) or utilising a new technology such as ozone which will oxidise the pigment.

Soiling removed from textiles and redeposited back onto the textiles is called redeposition in the laundry industry. This is when white textiles look slightly grey and coloured linen looks very dull.

Sour or neutraliser such as acetic acid or acid salts which is added to the final rinse to bring the pH back close to pH 6.0 and 7.5 otherwise a high residual of alkali would cause yellowing of the textiles especially after thermal treatment and/or drying. This can cause skin irritations and make people feel itchy from wearing the textiles or sleeping between bed sheets.

Alkalinity

The alkalinity/acidity of water is given as pH value (potentii Hydrogenium), which is a logarithmic index for the hydrogen ion concentration in an aqueous solution.

The pH value is measured on a scale of 0 – 14.

pH 7 is neutral, being the pH value of distilled water at 20°C. Values above pH 7 indicate alkalinity and values below pH 7 indicate acidity.

To avoid discolouration, “acidify” the water in the last rinse. Adding acetic acid, which will neutralise the alkalinity, does this. For further information, please contact your washing agent supplier.

Metals

Water also contains metal. Iron and Manganese are two metals, which can cause problems in the washing process.

When high levels of Iron and Manganese occur in the water, the cause:

- Discolouration of the laundry (precipitation)
- Damage to textile fibres

By installing special filters or filters in combination with softening filters, these problems may be avoided.

Prior to the next wash of the discoloured laundry, the linen must be treated with a special rust-dissolving agent. This special agent is a solution containing 2 % oxalic acid.

Detergent Contents

Surfactants

As previously mentioned in this document on page 8.

Alkaline builders

Alkaline builders support detergent action and eliminate calcium and magnesium ions. The calcium and magnesium ions arise mainly from water and occasionally from dirt and fabrics.

To dissolve and remove grease and proteins, a certain degree of alkalinity in the washing liquid is necessary. The dissolving and removal procedure is performed by ionisation and saponification. Usually, the alkaline products are:

- **Sodium carbonate**
  - Not sensitive to hardness
  - pH value 11.3
  - **Note:** hazardous substance
- **Crystallin trisodium phosphate**
  - Not very sensitive to hard water
  - pH value 11
- **Complex phosphates**
  - Not sensitive to hard water
  - pH value 9 – 10
  - Softening ability
  - Good dispersion ability

- **Zeolite A**
  - Good detergency characteristics (water softening ability)
  - Particularly advantageous environmental compatibility
  - Requires a co-builder in order to work effectively

Zeolite A for environmental soundness

During the last 20 years, the use of phosphates in detergents has been criticised. This is due to the fact that phosphates contribute to the over fertilisation of surface waters, thus eventually causing eutrophication of rivers and lakes.

While looking for phosphate substitutes, Zeolite A was discovered in 1976. The discovery was a milestone in the development of phosphate substitutes. Today, Zeolite A is used worldwide in several detergents.

In general, zeolite will eliminate water hardness and prevent deposits on the fibres. However, in order to achieve these results, Zeolite has to be combined with a co-builder, such as polycarboxylate and carbonate.

Today, the use of carbonate and phosphate is again becoming increasingly common. This is due to the fact that purifying plants are more commonly used.

Bleaching Agents

Chemical bleaching is employed to remove colouring matter left on the textile after washing. These stains are very similar to a dye or very similar to a dye. When the fabric is discoloured, a bleaching agent is used to restore the original colour. Bleachable "dirt" includes a broad spectrum of substances. Most of them are of vegetable origin, such as grass, tomatoes, food dyes and dyestuffs used in paper serviettes.

Common bleaching agents

All bleaching agents will cause some degree of fabric damage depending on concentrations and temperatures of the bleach bath. The most common bleaching agents are:

- **Sodium perborate**
  This agent is found in powder washing detergents. The detergent is effective from 70°C and above
- **TAED**
  TAED (tetradiethylethylendiamine) activates perborate, which is effective at 40°C, and has good bleaching effect below 60°C
- **Sodium percarbonate**
  The product is activated at 40-60°C and is very active at even higher temperatures. The salt is unstable and is added separately to the wash
- **Sodium hypochlorite**
  Commonly known as chlorine bleach, this bleaching agent acts as a powerful oxidation detergent and may only be used on white goods in high concentrations otherwise the bleach will reduce the colour or even bleach it

white over time. Bleaching should be carried out after the main wash (first wash clean and then bleach white). Chlorine is effective in the temperature range of 40–65°C, and at a pH value of 9.5 – 10.5 **Note:** At too high temperatures, Sodium Hypochlorite becomes extremely active at temperatures above 70°C and will cause excessive damage to cotton fibres. Correct dosage is also important to prevent unnecessary decomposition of fibres.

- **Hydrogen peroxide**
  This bleaching agent replaces hypochlorite and prevents a considerably more environmentally friendly bleaching detergent. It is most effective in a temperature range of 75–85°C and at a pH value of 10 – 12
- **Sodium hydrosulphate**
  This is a reducing bleaching detergent, effective in the temperature range 80-95°C and at pH values of around 3.5–5. Sodium hydrosulphate is not included in power detergents. **Note:** Sodium hydrosulphate is highly corrosive and must be used in an alkaline bath

  NOTE: In the presence of rust, all bleaches may cause excessive damage to fibres.

Additives

The content of additives varies according to the water, the textiles and the washing method. When comparing different types of detergents, the contents and the concentration can vary greatly.

However, the normal additives can generally be grouped as follows:

- **Anti-corrosion agents**
  This additive forms a thin aluminium or zinc silicate layer, which protects the washer extractor against corrosion.
- **Dirt anti-redeposition agents**
  After repeated washing, a distinct greying of the laundry is often noticed. The greying is due to finely dispersed dirt that has been deposited on the fine textile fibres. To prevent this deposit, anti-deposition agents are added to the detergent. The most common anti-deposition agent is CMC, carboxymethyl cellulose.
- **Foam regulators**
  Long ago, foam was perceived as an important element in washing power. With modern detergents based on synthetic surfactants, foam has lost virtually all its former significance. However, it is common to expect the detergent to produce voluminous foam, formed by millions of small bubbles.
  On the contrary, large volumes of foam can reduce the mechanical action on the laundry and cause overflowing in the machine. This is why foam regulators are commonly used to minimise detergent foaming tendencies.
- **Enzymes**
  Protein stains such, as milk, egg, blood and the like are resistant to removal from fibres by simple detergents, especially after the stains have dried.
  Proteolythic enzymes are catalysts, which will speed up the chemical reaction even in very low quantities. This eliminates the protein stains even at

moderate temperatures. Some enzymes are common in the detergents of today, such as lipolase, which catalyses fat, and amylase which catalyses starch.

- **Dyes**
  Today most detergents are coloured, being blue, green or pink. The addition of colouring agents will provide good storage stability to the detergent with respect to other detergent components and to light. The colouring agent has no significant tendency to affect textile fibres. Colouring of detergents is mainly done for a cosmetic reason or as an identification code.
- **Fragrances**
  Fragrances are used to make washing more pleasant. Part of their function is to provide detergents with an agreeable scent. However, they also prevent unpleasant odours arising from the washing solution.

Detergent

Emulsifies the dirt
Detergent loosens and emulsifies dirt from the textiles, while also ensuring the dirt remains floating in the water in order not to stick to the linen again. Occasionally, the detergent also restores the whiteness of white textiles.
Great efforts are continuously being made to develop modern detergents, which have less impact on the environment.
However, this is not an easy task, since washing procedures and practice vary from country to country. Moreover, certain additives are not allowed in some countries, while permitted and used in other parts of the world.

Contents of the detergent
Usually, washing detergents contain four main components:

- Surfactants (tensides)
- Alkaline builders
- Bleaching agents
- Various types of additive

Each component contributes to the washing effect, and to some extent the components will provide for synergistic effects.

Furthermore, detergents are categorised as being alkaline, neutral or acidic depending on the pH value. The pH value determines the area of use of the detergent. The illustration shows a summary of the qualities and therefore the area of application for various types of detergent.

Rinsing Agents

Used in the final rinse
Rinsing agents are used in the final rinse. The purposes of the rinsing agents are:

- To soften the goods
- To prevent the goods from becoming statically charged
- To prevent bacteria growth through biocide effects

4: TEXTILE TYPES

Natural fibres

There are two types of natural fibres: vegetable and animal.

The most common natural vegetable fibre is cotton.

Cotton is cheap to produce and its range of applications are almost endless, Clothes, towels, bed linen, furnishing fabrics, etc. 99% of the fibre consists of cellulose and the remaining 1% is fat, mineral salts, wax and pectin. The fibre consists of just one cell and the shape is uneven making it look a little dull with dirt sticking to the fibre easily. When cotton is laundered, it therefore requires quite a heavy wash process to clean the textile.

Cotton has relatively low elasticity compared to other fibres and wrinkles easily, particularly as moisture is being removed. Cotton requires ironing under almost all circumstances. Bleaching agents can be used reasonable aggressively, particularly alkali based bleaches. If necessary, cotton can be washed as high as 90°C.

Wool is a common natural animal fibre.

Wool is a hair fibre and the most common is sheep wool. Other hair fibres such as goat and camel wool are only used to a limited extent. The fibre is knurled and elastic and as a result air is contained in the fibre providing excellent heat insulation in both wet and dry conditions. One of wool is its very good flame redundancy.

Because wool is elastic it does not wrinkle like cotton, however wool will easily shrink and strong alkalis will damage wool fibres.

Man-made synthetic fibres

The first synthetic fibres were manufactured in Germany in 1930. Today, man-made synthetic fibres are very common in a great deal of variations.

The benefits of synthetic fibres are:

- Strength both when wet or dry 2-4 times higher than cotton
- Built in memory shape
- Wrinkle resistant
- Low shrinkage and stretching
- Low absorption
- Not as affected by mould or insects eating the fibre

The disadvantages are:

- Easily charged with static electricity
- Soils easily with oil and grease

- Sensitive to heat causing wrinkling and creasing
- Pilling

Today, polyester is generally blended with cotton to give added strength in the structured shape of the textile and repel some of the soiling.

Polyester blended textiles can be washed on very high heat however a cool down process must be used in order to restore the built in memory of the polyester.

5:WATER QUALITY

Various substances in the earth are dissolved in water. The most important of these substances, as far as washing is concerned, are the water hardeners (salts of calcium and magnesium. Water hardness is rated to a dH scale, which is a German degree of hardness. Water rated at 1dH contains as much soluble calcium per litre as 10mg of quicklime (CaO) In Australia, the water hardness is expressed as PPM Calcium Carbonate (CaCO3). Based on laundering conditions, the following ratings are generally used to describe water hardness:

Soft water	0-50 PPM
Medium hard water	51-100 PPM
Hard water	101+ PPM

The harder the water the bigger the decrease in washing effect which is due to the hardeners mixing with the surfactants in the washing detergents, causing the washing detergent to lose its washing effect. Hardening compounds tend to stick to the fibres causing a dulling of the brightness of the fabric.

6.WASH PROGRAMS

Mankind has always washed things. In ancient times, and still in some third world countries, washing was done by the sea, at a riverside, near a well or wherever water was available. In order to obtain good quality, effective wash results, some key information about the textiles and the washing conditions are necessary.

A good washing result is determined by:

- The type of the textile fibres
- The type of the soiling
- The quality of the water
- The detergent and additives
- A correct washing program

When washing soiled textiles we are restoring some qualities and preserving other qualities.

Qualities to be restored are:

- Cleanliness
- Feel
- Sanitation
- Brightness
- Odour free

Qualities to be preserved are:

- Smoothness
- Size
- Colour and finish
- Absorption ability
- Strength

These basic principles apply to any form of cleaning textiles from domestic washing, professional laundering to dry cleaning.

Filling Factors for washing machines

A proper filling factor is essential to achieve good economy and a good washing result. To obtain the best washing result, it is essential not to overload the washer.

On the other hand, to achieve the best washing economy it is essential not to under-load the machine. In other words, it is necessary to optimise the filling factor.

There are even more reasons to carefully calculate the filling factor:

- **Overloading will cause low mechanical action and poor soil removal**
  The mechanical action is a very important aspect, which affects the washing result. The rotating drum that lifts the washing load above the water level creates the mechanical action. Before the load reaches the top of the drum, it falls back into the water again. If the drum is overloaded, there will be nowhere for the load to fall. As a result, the mechanical action will become lower and the wash result will not be satisfactory resulting in higher rewash rates.

- **Overloading will cause bad rinsing**
  As there is no, or at best too little free space in the drum, the water will not be able to penetrate the load sufficiently. Consequently, the alkalis will not be properly removed from the textiles.

- **Overloading may cause wrinkles in the textiles**
  As the poly cotton load should normally have quite low residual moisture after extracting, wrinkles will occur and be made permanent if the drum is overfilled. In these cases, the textiles will require ironing. One of the great advantages of using poly cotton is that it will not be necessary to iron the textiles or at least a reduction in the time and effort to make the textiles presentable.

Depends on the textile
The optimal washing load is determined by the filling factor. The type of linen, the degree of soiling and other factors determines the proper filing factor.

Synthetics and blended fabrics usually require a filling factor of 1:12-1:15. This corresponds to a drum, which is possibly only 66-80% of the machines rated capacity.

As example cotton textiles normally require a filling factor of 1:10, which is a full drum.

Calculating the filling capacity

Cotton
When the inner drum volume is 100 litres and the filling factor is said to be 1:10, the filling capacity expressed in kilos would be 10 kg. The filling capacity applies to cotton only.

Poly/Cotton blends
When the items to be washed are made of poly/cotton material, the filling capacity would instead be approximately 8.3 kg at a filling factor of 1:12. Some poly/cotton materials require a filling factor of 1:14, which would correspond to a wash load of 7.1 kg.

Note: It is very important to understand that a washer's capacity must be considered by the volume of the drum not a kilos capacity rating by the manufacturer and this rating changes by fabric type. 10 kilos of polyester takes up much more space than 10 kilos of cotton.

Today, some washer extractors weigh the laundry goods before the cycle begins. In this way, the amount of water can be measured accurately according to the wash load. As a result, no waste of water will occur and rewash levels will be minimised, which is both environmentally sound and cost effective.

Sinner's Circle

Obtaining a good washing result
When textiles are being washed, the process is basically a combination of mechanical and chemical processing, time and temperature. This is graphically visualised in a circle diagram, with the different parameters in varying ratios.

The purpose of the circle is to show that the total sum of these factors – mechanical and chemical processing, time and temperature – correspond to the energy required to wash a certain amount of a certain type of textile. If one washing parameter is changed, the others must be altered correspondingly. The parameters can be explained as follows:

- **Time and temperature**
  The time and temperature of the process are compiled in a washing program. The washing program determines what characteristics and consequently what field of application the actual washing process is given.

- **Mechanical action**

The mechanical action is performed by the washing machine

- **Chemicals**

The chemical process is performed using water combined with some sort of washing detergent.

The washing process is divided into different phases, such as pre-wash, main wash and rinsing. In order to obtain a good washing result, it is important to acquire the correct balance between the mechanical and chemical process and the time and temperature in each washing phase.

Temperature

Heat increases the chemical action

Temperature affects the washing result in several respects. A high temperature will:

- Decrease the water surface tension
- Dissolve fat stains more easily
- Increase the bleaching effect

In general, heat will also increase the chemical action of the detergent. The proper washing temperature depends on:

- The type of textile
- Whether the textile is white or coloured
- The degree of soiling
- The textile quality
- Local hygiene demands

Hygiene Demands

Hygiene demands as stated in local regulations refer to a relative time and temperature or achieving the necessary hygiene standards. These standards vary from country to country, but as a rule of thumb, the following formula can be used:

Calculating relative time/temperature for a thermal hygienic washing result (Temperature –55) x Time > 180

There are two methods of disinfection:

- Thermic disinfection, which is carried out with the aid of high temperature
- The chemo thermic disinfection, which requires a chemical

The table below shows the hygiene demands in different countries.

Country	Type of disinfection	Temp. (C)	Time (min)
BGA, Bundesgesund-heitamtes, Germany	Chemothermic	64 (60)	20 min
BGA, Germany	Thermic	92 (90)	10 min

ISTCL, International Scientific & Technical Committee on Laundering, United Kingdom	Chemothermic	65	18min
ISTCL, United Kingdom	Thermic	71	11min
HSS, Sweden Halso-och Sjukvards Standardisering	Thermic	70	10min

European temperatures are dropping
In Western Europe, clothes are commonly washed in the wide temperature range of 60–95°C. In the US and Japan temperatures are considerably lower: US are approx 55°C and Japan is 25°C.

The differences in temperature are mainly based on tradition. However, the trend is that the European washing temperatures are dropping towards 30–60°C. There are three main reasons for this:

- Manufactures are developing detergents which are effective at lower temperatures
- When washing at a lower temperature, energy consumption will be lower. This is better for the environment
- New technologies such as Ozone laundering allow for a lower temperature while still achieving excellent bacteria kill rates.

Mechanical Action

Created by the washer extractor
The washing creates the mechanical action. In brief, the mechanical action has the following functions in the washing process:

- To release the stain by loosening the dirt's grip on the fibres
- To start the "stream" of detergent through the textile
- To keep the pigment and fat separate in the fluid

In this respect, drum machines are most advantageous since:

- Water consumption is low
- Energy consumption is low
- The washing result is excellent

The mechanical action varies
Changing either the rhythm of alteration, or the water level in the drum can alter the mechanical action imparted to the laundry. The mechanical action is performed in different ways, depending on the type of washing machine:

- **Normal action**
  A low water level and a rapid reversing rhythm have a great mechanical effect on the laundry. A time relation of 12 seconds of rotation and 3 seconds of pause

before starting the time count again is very common, although other relative times can be used.

- **Gentle action**
  A high water level and slow reversal provide less mechanical action and this combination is therefore called “gentle action”. A time relation of 3 seconds of rotation and 12 seconds of pause is very common, but other relative times can also be used.

When the drum rotates, the textiles are lifted above the water level. Before reaching maximum height, the laundry falls down into the water again.

The reversing movement will keep the textiles apart. This prevents an inseparable mass of textiles in the drum once the washing program is complete.

Front-loading drum machines
Front-loading drum machines are the most advantageous kind of traditional washing machine. Both water and energy consumption are low and the washing result is excellent.

The illustration shows the principle of the drum machine. The laundry is loaded through a door in the side of the drum or through its open front. Part of the drum is filled with water.

When the drum rotates, the textiles are fed through the liquid and when they reach the top of the drum they fall down into the liquid again. The liquid therefore penetrates the textiles thoroughly and effective mechanical action is achieved.

There are also several kinds of washing machines used for different purposes and professional needs:

- Front loaders
- Side loaders
- Tunnel washers

Front and side loaders
Front and side loaded washers’ work in the same way; only the direction of loading the machine varies between the two models. For this reason, the design of the machine varies as well.

The beaters in the inner drum create a lifting action and the drum rotates in the reverse direction. When the drum rotates, the laundry is transported through the water to the top of the drum. Then it falls back down into the water. The friction caused by the laundry and the water provides the mechanical action in the machine.

Tunnel Washers
Tunnel washers operate somewhat differently and are primarily used for large quantities of laundry.

Initially, the laundry is loaded into the machine by a conveyor in sling bags or similar. The tunnel in the machine consists of several sections, each with it's own function; pre-wash, main wash and rinse.

The laundry is transported through the sections of the tunnel, each section of the tunnel leading the laundry on to the next section. As the water flows in the opposite direction to the laundry, the laundry becomes thoroughly soaked and washed.

The result of this procedure is a significant saving of energy, water and detergent.

7: WHERE IS WATER WASTED IN A LAUNDRY

There are many areas that water can be wasted in the laundry. Simple ideas are often the most productive and a review of your operations may find several ways to reduce the total water consumption in the laundry. We have taken each area individually and reviewed who water is wasted and what you can do to eliminate wastage.

Collection and Receiving goods

We must maintain an efficient system of collecting and receiving soiled textiles. The longer we leave the textiles soiled before processing the more difficult it is to remove the soil and staining. Mould and mildew grow on the fibres and stains have the time to set bonding to the fibres, making rewash rates, water, energy and detergent consumption significantly higher.

Ideally if soiled textiles are to be left for periods of more than 24 hours, they should be stored in a cool room. There are several examples of storing soiled linen in cool rooms before processing and these laundries have extremely low rewash rates. Bacteria and virus growth is also inhibited significantly.

Never leave soiled textiles in a hot sunny position. Check your site and review your soiled textile storage area. Remember to look for sunlight streaming through windows.

Is there a better way to store your soiled textiles? Can an improved collection method be adopted?

The wash process

Washing is not simply throwing the textiles into a washer and crossing your fingers hoping the result will be acceptable. There are many factors involved as we have already covered in this manual.

It is extremely important to classify into fabric types and preferably into soil types. A wash formula is set up to remove 95-97% of the staining on the first wash as we expect 3-5% rewash rates in order to preserve the qualities of the textiles. However we know that some types of soiling are going to take a lot more effort to be removed. There is no point placing highly soiled items in a general wash as the wash formula will not be set up for such soiling and will be rejected somewhere along the quality checkpoint chain.

Make sure heavy soiled items are separated and washed in a separate wash, specifically designed for heavy soiled items.

Do not skip part of the wash process! The wash formula is set up for a reason, usually set to a minimum for efficiency reasons and skipping steps in the formula will result in a poor quality wash. Some of the problems that are caused by skipping steps are:

- **Skipping the prewash** ~ protein stains will not be removed and become set making it very difficult to remove in the rewash cycle. High quantities of bleach and very high temperatures will be required in the rewash. Oxalic acid may be required to successfully remove the protein staining in the rewash.
- **Skipping a rinse** ~ this usually causes the linen to turn yellow during drying or ironing. The textiles will then need to be re-rinsed and processed again.
- **Ending the cycle before the spin has completed** ~ the textiles will not be dry after drying and/or ironing and reprocessing may turn the textiles yellow due to extended exposure to heat. The textiles will then need to be re-rinsed and processed again.

Often, this is the cause of many issues in the laundry wasting all resources and is totally unnecessary. Trying to take a short cut in the washing process will in fact make the time longer and the costs greater.

The drying and ironing process

Many people can't conceive problems in the drying process can cause wastage of water.

Textiles placed in the tumbler dryer have already been through a complete wash cycle. If you are preconditioning flat linen for the roller ironer you are removing a specific amount of water before ironing.

If too little moisture is removed in the dryer the textiles remain wet after ironing and need to be re-ironed which exposes the textiles to double the exposure to heat and risking yellowing the textiles. They will then need to be rinsed (consuming unnecessary quantities of water), dried again and ironed.

If too much moisture is removed in the dryer the textiles are exposed to heat and risking yellowing the textiles and too little steam will be created, resulting in wrinkling. They will then need to be rinsed (consuming unnecessary quantities of water), dried again and ironed.

Packing and Dispatch

There are many times when individuals because of personal standards when reject items. It may very well be acceptable to the customer to use the textile in the condition it was in before someone rejected it. Items with small imperfections near sheet edges that are going to be tucked under the bed and other such instances are not necessary to reject. It is a complete waste of water as well as energy and labour to reject such items.

Does your laundry have a policy or training program to identify acceptable quality?

Wash programs

Washing programs, at times, can be excessive in their length and quantity of water utilised. Have you experimented with slightly lowering water levels, reformulating rinsing incorporating an intermediate extract? Savings in shorter wash times, reduced energy and reduced water consumption can be found if you look hard enough. Experiment a little and you may find significant savings.

New equipment

When purchasing new equipment, what is the criterion that was undertaken in the review of the purchase? Did you consider?

- Water consumption for a standard wash
- Fully programmable control of water levels
- Optional extras that assist in water reduction such as water reuse

Have you considered upgrading your old machinery on the basis of operational cost savings? Have you ever undertaken feasibility studies on current consumption verses new technology? Reviewing current practices often reveals benefits you never expected because you have never looked.

The following table suggest indicative savings on water consumption from machinery of different eras:

Type of washer (age in years)	Volume of water used per kilo washed
Washer 20+ years	30+ litres
Washer 10 + years	20+ litres
Washer 3+ years	15+ litres
Tunnel 20+ years	15+ litres
Tunnel 10+ years	10+ litres
Tunnel 3 + years	7-8 litres

The above table clearly shows that water consumption has halved over the last 20 years. This also means a corresponding savings in energy to heat the water when using hot water in various wash programs and trade waste costs. Less heating, less fill time and drain time equates to shorter wash cycles and labour savings.

When buying a new washer, do not expect that all new equipment offer the same efficiency. Comparisons between current manufacturers can vary from 5-20%. Some machines are far more efficient than others.

Maintenance

Many laundry implement preventative maintenance programs however very few include water conservation measure in maintenance. When was the last time maintenance checked for leaking water inlet valves and drain valves? These items do

require maintenance and it is hard to tell if the machine is leaking due to the drain valve being hard plumbed to the sewer. Have maintenance check these items regularly.

8: IMPLEMENTING CHANGES

Making a Plan

You cannot successfully achieve long-term water savings unless you make a plan, follow the plan and implement necessary modification to the plan as needed.

Ideally, you should contact your local water authority and involve the water authority in the process. They have many years of experience and have seen many different laundries and seen many different ideas on how to save water and improve your trade waste discharge to sewer.

Being by making a calculation of where you are currently using water and how much water is being used in different areas of the business and in different washing machines. You may have a particular wash quality problem arising from one program in one machine. You may have a problem with one of the machines and the wash quality it is producing. If so, can this be remedied by changing the wash formula or processing a particular type of textiles through a different machine? Is it more economical to replace the machine?

Review work methods and look at where, what fabric types and the quantity of rewash you are experiencing. Perhaps there is a consistency in the rewash you are experiencing such as a particular clients textiles, a particular wash program on a particular washing machine.

Are you using a significant amount of water for reasons other than washing? If so, how can you reduce the volume to achieve the same outcome?

The water authorities have an excellent template to begin your water plan. Also consider what possibilities are present in your workplace that is not mentioned in this plan. Be objective and make a list of every last idea you have.

Implementation and Monitoring

If you don't monitor and review the data you gather, you cannot possibly make a difference in reducing the water consumption.

Most times, you will require a change or workplace cultural habits in order to bring about effective change. This is most likely the hardest issue to tackle. Consistency in your work methods and constant reinforcing the changes necessary is the only way to success. As they say, "old habits die hard" however without long term change in working habits and more importantly, employee attitudes is the way to successfully reducing your water consumption and quality of trade waste discharge.

9: SUMMARY

Where to start?

You can't improve what you don't measure and manage. Identify where your water usage is and calculate water usage rates per machine against quantities of textiles laundered.

What can you do?

Almost anything given your openness to what the outcome of your findings. If you are prepared to look, you will find savings. Remember, there is always room to improve upon current practices, no matter how well managed your business is.

New Technologies as well as Old Ideas Revisited

Before we commence on discussing new technologies and old ideas revisited, I would like to talk about timepieces, as many people are sceptical about new innovation.

There was a gentleman who discovered a far more cost effective way to an instrument to keep the time of day. He packed his bags and flew to the centre of time keeping instrument manufacturing, Switzerland. He saw every manufacturer in the whole country and received the same answer each time he spoke … what could you tell us about making time keeping instruments, we have made our products the same way from hundreds of years and our hand made craftsmanship is the only way people would accept a watch or clock. After becoming very frustrated the gentleman decided he would visit a different country, one that was an emerging country manufacturing things more effectively than anyone else, Japan. The gentleman sold his idea to a company, which is now known a Seiko; the largest manufacturer of Quartz Crystal watches in the world, almost wiping gout the Swiss watchmaker.

The moral to the story is today's opportunities are tomorrows everyday way of life. Don't miss out and become a bankrupt Swiss watchmaker because you wouldn't listen to a good idea that was a different way of doing things to the way you currently do them.

Investigate new technologies and all those good old ideas that we have forgotten about to the fullest extent. If you are never looking at what is new, you will never know the opportunities that may exist. Implementation of new technologies is often cost effective and provides greater savings than you can imagine.

Rainwater

You may remember once upon a time, every house had a rainwater tank and even another tank on the shed down the back yard. It seems the idea of collecting rainwater had almost disappeared from our modern society a few years ago.

Whist a significant number of laundries are too large to make economic use a rainwater system, there will be applications where this could be viable. In fact, there is a

commercial laundry in Melbourne who is currently capturing the rainwater and using it to wash with.

If your particular laundry is located next to other factories with a sizable roof space and some space at the rear of your laundry building, investigate the possibilities. Here is a general rule of thumb for Melbourne Metropolitan laundries processing eight (6) wash loads per day ~ to capture two (2) months supply of your annual water consumption, you need approximately 7 square meters of roof area per kilo of washing capacity. And you need somewhere to install a water storage tank.

Low pH laundering
It seems we have all forgotten about the way chemistry can be applied in laundries. We do not consistently need to wash at pH levels of 10-11 to achieve a good washing result.

CO_2 treatment of the wastewater
If you are having trouble with meeting trade waste guidelines for pH trade waste levels talk to your detergent supplier about installing a CO_2 treatment system.

Ozone
Perhaps one of the brightest available technologies for laundries currently available is Ozone. It has been proven that water consumption can be cut by up to 35% and energy reduction in the washer by up to 80%.

Reverse Osmosis
On-site water treatment of wastewater for reuse back to the washers is an excellent option for very large commercial laundries. A working model can be seen in operation in Sydney.

Waste Heat Transfer Systems
Reusing the heat from hot washing water going to the sewer to preheat the incoming cold water before going to the heating system. This will assist in meeting the maximum discharge to sewer temperature regulation of 38°C and a significant cost savings against energy used to heat the water.

Magnetics
Small applications can utilise magnetics on the incoming water supply affecting all the impurities in the water to become electrically neutral. The impurities lose the attraction for any other atoms or molecules and they therefore become inert and naturally precipitate out of the water. Suspended solids no longer have an attraction for the water or each other. Basically it is softening the water without removing the impurities, instead, controlling how the impurities behave.

Help and assistance available

There are many places that are able to assist you with the conservation of water. We have listed details that you might find useful.

Common to all laundry applications

Your detergent supplier can assist in reviewing wash formulas and the possibilities of reducing water consumption by reformulating the wash programs and quality of trade waste by possibly changing the types of detergents, bleaches and additives.

Laundry equipment suppliers can discuss the cost benefits of installing the latest technology equipment. Quite often the lease costs of new machinery can almost pay for itself by lower water, energy and other operational costs.

The trade waste department of your local water authority. You can discuss what technologies they know of and even technologies used by other industries that can be adapted for use in laundries.

Notes: