

Sustainability in commercial laundering processes

Module 1
Usage of water

Chapter 2

Use of water for washing

- Types of water supply in laundries
- General effects on water consumption
 - liquor ratio/total liquor
 - rinsing
 - types of washing machines
 - types of textiles
- Usage of water in tunnel washers
 - bath flow principle
 - counter current flow
 - bath exchange
 - re-use of water

Learning targets

After finishing this chapter, you will

- know and be able to refer the different types of water supply in laundries
- know influencing factors on water consumption
- know the effects of washing liquor and liquor ratio on washing process
- know how to calculate the liquor ratio
- be acquainted with application of water flow in tunnel washers
- have taken note of the possibility of water re-use in washer extractors

Types of water supply

- **Municipal supply**
 - fresh water prepared by community (general supply)

- **Self supply by usage of**
 - fresh water taken from wells, springs, rivers and rain water mainly has to be pre-treated before application in laundry

■ **Advantages**

- simple
- without risks
- no special treatment necessary

■ **Disadvantages**

- expensive
(costs for supply and for discharge in municipal sewage system)
- only economical if fresh water and effluent water charges are at a low level

Types of water supply

self supply

■ **Advantages**

- lower price or free of charge
- usage without treatment in non hygienic sensible processes only (washing of wiping cloths, mats)
- often economical if fresh water costs are high

■ **Disadvantages**

- risks in presence of heavy metals, germs or other hazardous substances
- treatment often necessary
- therefore special facilities/devices are needed (wells, tanks, pipe systems, analytical installations to control water quality, treatment facilities)

General effects on water consumption

■ **Washing machine**

(washer extractor/batch washer, tunnel washer, see module 3)

- design of wash program

liquor ratio (chart no. 9) affects mechanical action (water flow through textiles, swimming, falling) during washing and rinse phase

■ **Textile** (wool, silk, cotton, PES, blended fabric)

- water uptake of load depends on type of fibre, textile construction and age of textile
- water uptake affects liquor ratio
(liquor ratio: see water demand for different laundry, chart no.12)
- lint generation caused by low water level

■ **Type and amount of soil**

■ **Application** (of textiles)

- e.g. textiles for medical use and clean room garments need good rinse efficiency → high water consumption as consequence

General effects on water consumption

rinsing

- Rinsing needs highest amount of water during wash process

- Fresh water is used for each rinse step (independent of machine type)

- Reasons
 - rinse determines kind and amount of residuals on laundry
 - residuals may cause different problems, e.g.
 - skin irritation
 - unacceptable appearance of laundry
 - ironing problems at mangles

General effects on water consumption

liquor ratio

- **Liquor ratio**

$$\textit{Liquor ratio} = \frac{\text{water volume in drum [l]}}{\text{dry load [kg]}}$$

- **Example:**

10 kg cotton load need 40 l of water.

Liquor ratio is 40 l/10 kg = 4 l/kg

the commonly used notation is 1:4

- Liquor ratio depends on kind of washing machine and textile
- Common liquor ratio of 5 l/kg shows good wash performance

General effects on water consumption

liquor ratio

Liquor ratio determines

- Movement of load
- Water flow through and along textiles
- Swimming of load
- Falling intensity of load
- Heating up rate
- Concentration of detergent
- Intensity of soil removal and textile damage
- Rinsing efficiency
- Consumption of water and electricity

Bound liquor, examples



Education and Culture

Leonardo da Vinci

Examples for bound liquor per kg dry textile

Kind of textile	Bound liquor per kg dry textile in l/kg
Cotton	2,5
Terry materials	4
Blended fabric	1,5-2

Total liquor, examples



Education and Culture

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Examples for total liquor

Kind of textile	Active liquor in l/kg (wash liquor in drum)	Total liquor in l/kg (wash liquor in drum and space between drum and tub)
Cotton	2 – 3	3 - 5
Blended fabrics, easy care	3 – 5	5 – 8
Sensitive materials	15 – 20	15 – 30

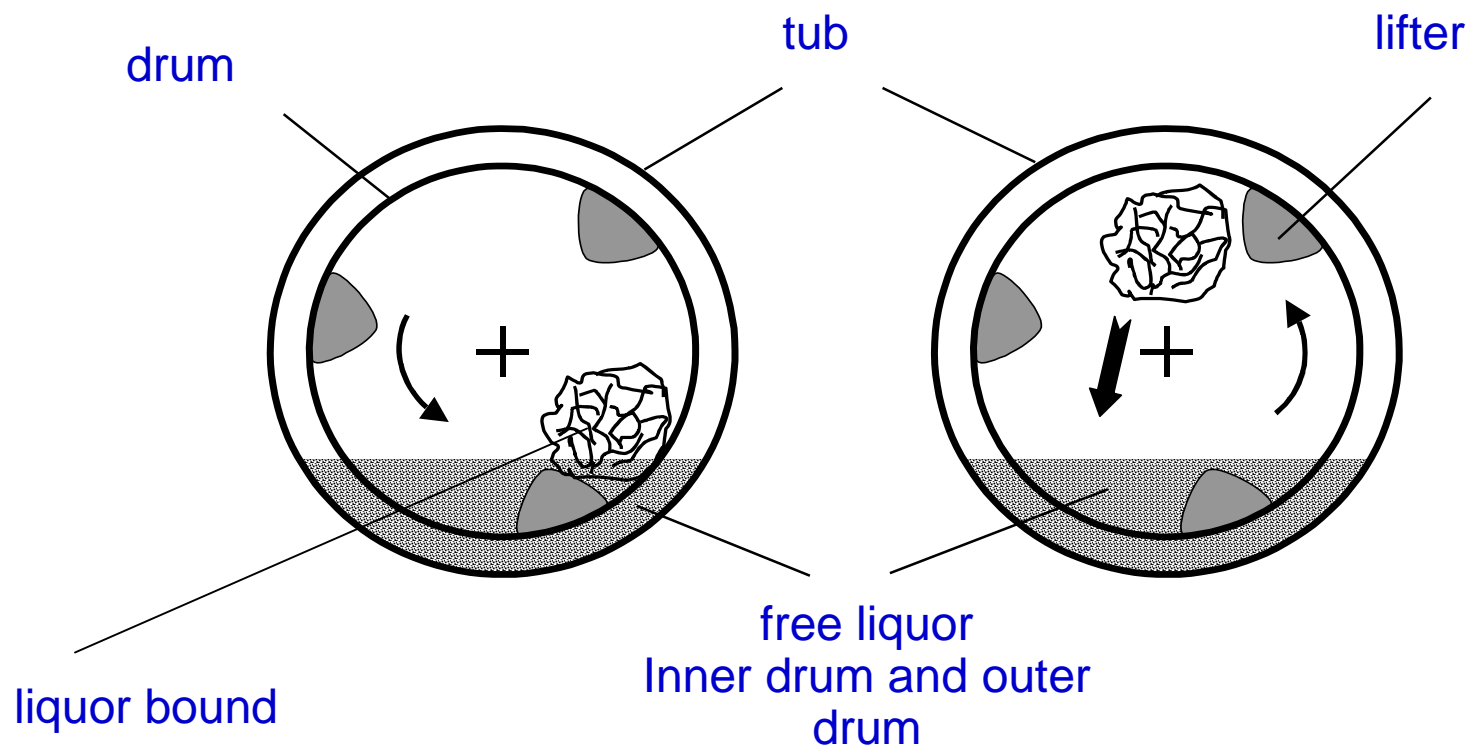
Washing liquor: definitions



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Total liquor = bound liquor (by textile) + free liquor



Common water consumptions

... in a washer extractor



20 – 30 l/kg dry textile

... in a tunnel washer



4 - 10 l/kg dry textile

Fresh water demand for washing

Fresh water inlet for conventional washing program:

Pre wash	e.g. 250 l
Main wash	180 l
rinses	600 l (3X 200 l)
total	1030 l

⇒ specific water consumption if values are related to 50 kg load size (water consumption/kg dry textile)

$$1030 \text{ l}/50 \text{ kg} = 20,6 \text{ l/kg}$$

Water demand

... for different kinds of textiles

Kind of textile	Water consumption in l/kg
OP theatre, clean room garments	10 to 20
Dark garments	8 to 25
White garments	7 to 12
Mats	5 to 10
Terry towels	4,5 to 10
Hotel linen	4 to 10

Usage of water in tunnel washers

bath flow principle

- Continuous bath flow is applied
 - Using counter current flow
 - Using standing bath (water flow in parallel to load transportation)

- In a tunnel washer
 - Continuous flow of water into compartments during wash and rinse

- In a washer extractor
 - Only at the start of the wash step water is running into drum

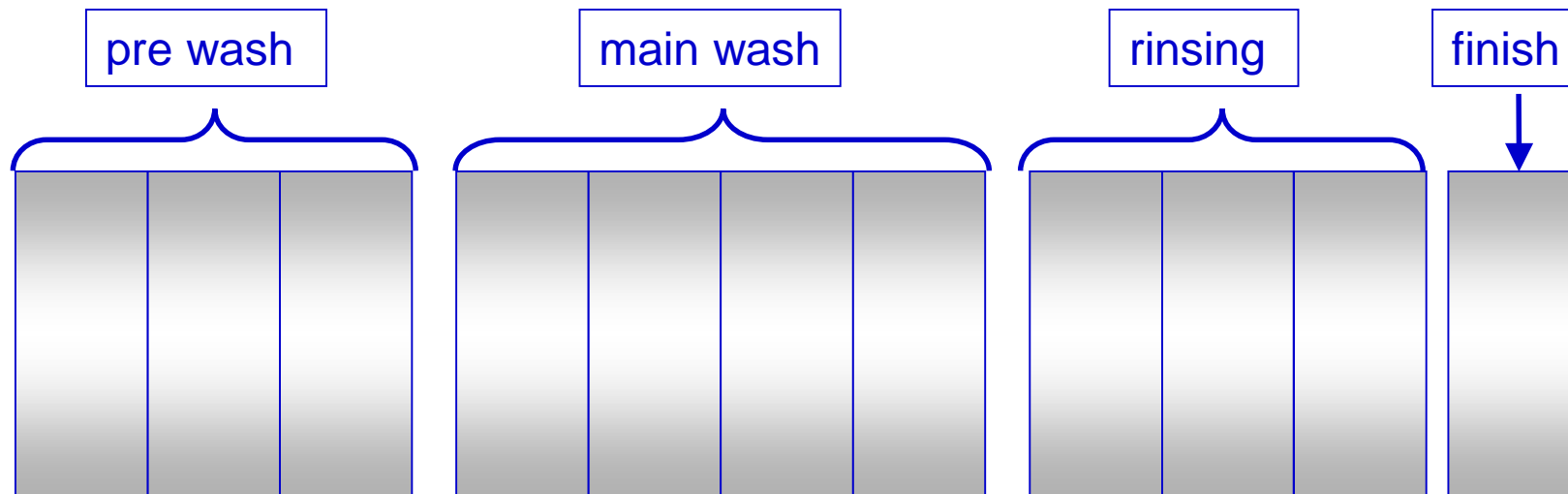
Usage of water in tunnel washers

- Tunnel washers are divided into the following zones according to a common wash program, also see module 2 and 3
 - pre wash
 - main wash
 - rinse
 - finishing (e.g. softener, starch)

- Different ways of water application exist for whole tunnel washer or separated zones (see module 2 and 3)
 - counter current flow
 - standing bath
 - bath exchange

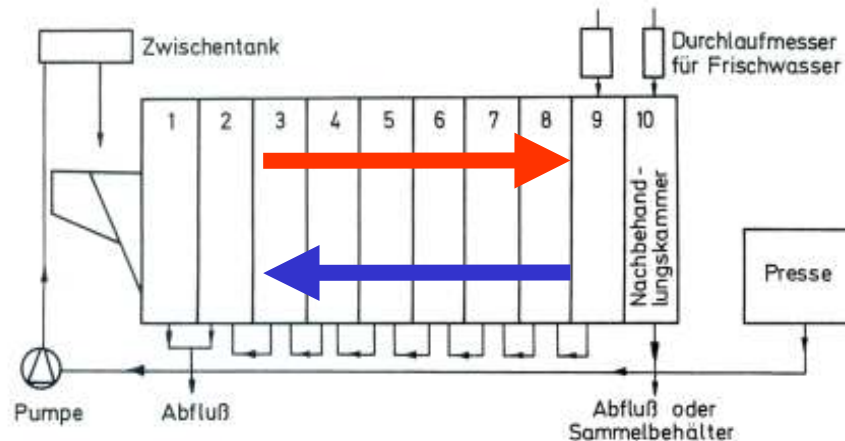
Usage of water in tunnel washers principle

- Load is transported stepwise from compartment to compartment
 - ⇒ Tunnel consists of compartments
 - ⇒ Single compartments are combined to zones



Usage of water in tunnel washers counter flow

- Counter flow means
 - water used in the last compartment (e.g. number 10) is reused in compartment 9
 - water used in compartment 9 is reused in compartment 8
 - water used in compartment 8 is reused in compartment 7
 - and so on...



⇒ It is therefore a process with low water consumption

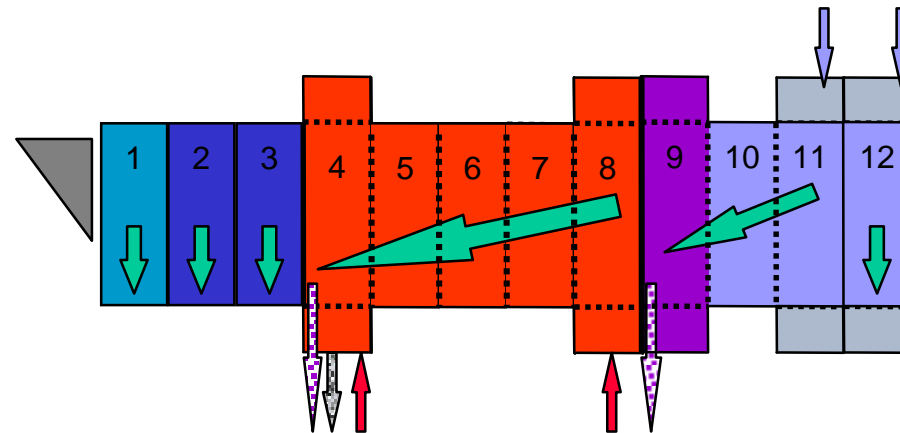
Usage of water in tunnel washers counter flow

- Problematically:
 - Concentration of detergent in wash liquor is continuously diluted
 - It is not possible to apply different water levels (liquor ratios) in compartments within one zone
 - Hence no more application of one counter flow in relation to the whole tunnel washer

Usage of water in tunnel washers

counter flow

- **2 counter flows**
- Once in rinse, once in main wash



- pre wash: in parallel to laundry
- re-use of 2/3rds of extracted water in pre wash
- use of 1/3rd of rinse in main wash

Usage of water in tunnel washers

counter flow

- Fresh water is used for rinse (compartment 11)
- Rinse water is drained in compartment 9
- Part (1/3) of the rinse water is used for main wash in compartment 8
- 2/3rds of rinse water are used for pre wash in compartment 1
- Main wash water is drained in compartment 4 into sewage
- Pre wash water is transferred from compartment 1 in parallel to load
- Water from rinse zone (compartment 9) and press water (mechanical extraction in press or centrifuge) is transferred into pre wash (compartment 1)
 - if this is not sufficient: fresh water supply

Usage of water in tunnel washers

counter flow

- Continuous bath flow application
 - In counter current flow
 - Water flow parallel to load transportation

- Flow means
 - Continuous flow of water into compartment during the whole wash or rinse step

 - ⇒ Contrary to common washing in a washer extractor
 - only at the start of the wash step water is running into the drum

Usage of water in tunnel washers

bath exchange

- Bath exchange means
 - Start of the wash duration: in a single compartment or a zone water is added
 - End of wash duration: water in compartment is drained
 - Fresh water feed
 - If drained water is not re-used, bath exchange is more expensive than counter current flow

- Bath exchange
 - To remove soil load (end of wash/beginning of main wash)
 - To drain alkalinity (end of main wash/beginning of rinse)

Usage of water in tunnel washers

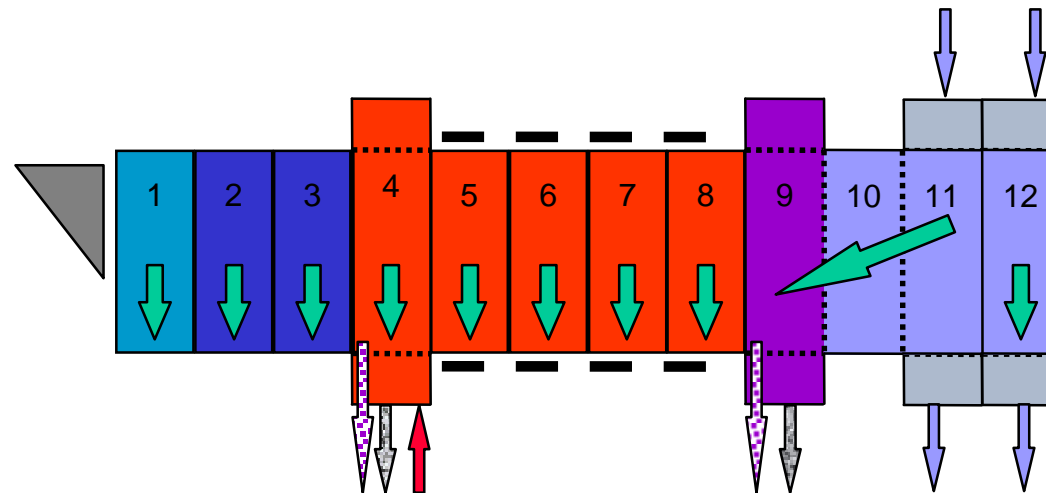
Bath exchange

- Applying bath exchange,
 - water is drained and
 - water has to be renewed
 - if no re-use of drained water, it is more expensive than counter current flow
 - no exchange of water between neighbouring compartments
 - therefore possibility of washing different types of laundry within one zone
 - no transfer of lints and/or dye pigments from coloured laundry to white/light laundry
 - example:
 - compartment 5: blue garments
 - compartment 6: white garments
 - compartment 7: green linen

Counter current flow with bath exchange

Combination example

Rinse (compartment 11 to 9): counter current flow), at the **start of rinse** in compartment 9 part of the water is drained (bath exchange)



At the start of **main wash** in compartment 4 part of the water is drained (bath exchange)

- Part of rinse water is used for main wash in compartment 4 and remains in compartment 4 during the whole main wash
- see module 2 and/or 3

- Washer extractor
 - last rinse for pre-/main wash (explained in module 2 and 3)
 - need of devices/tanks to collect water

- Tunnel washer
 - counter flow, re-use of press water
 - see chart 17-20 and module 2/3

- Whole laundry
 - „cascade system“
 - drain water from hotel laundry is used for garments (garage overalls), drain water from garments laundry is used for mat washing
 - application of rinsing water of hygienic sensible laundry in pre- and main wash of hygienic non-sensitive laundry
 - (see module 3)

Water recycling

- Is only economical if fresh water and/ or effluent water charges are at high level
- Need of additional complex facilities and expensive equipment (different tanks, pipe system, heating/cooling facilities, pumps, installed devices for controlling of water quality, etc.)
- Risky if water contains special ingredients
 - heavy metals, germs or other hazardous substances
 - see module 6