Sustainability in commercial laundering processes

Module 3
Washing process

Chapter 3

Washing process in tunnel washers

Content

Education and Culture

Leonardo da Vinci

- Basics: Washing process in tunnel washers
- Water flow
- Bath exchange
- Carry-over of liquor
- Spreading of detergent
- Mechanical effects
- Settings (zones)
- Effects of temperature
- bleaching
- Special processes

Learning targets

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After finishing this chapter, you will

- Have basic knowledge about the washing process in tunnel washers
- Know several possibilities how to use of bath flow and bath exchange
- Know the problem of the carry-over of the liquor
- Know mechanical effects in tunnel washers
- Know the effects of temperature
- Know several bleaching processes (hydrogenperoxide, perborate, peracetic acids, chlorine)

Washing technology - important aspects

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- Kind, finish and manufacturing quality of the textiles
- Kind and amount of soiling
- Kind of washing machine, construction
- Water quality
- Detergents and washing aids
- Demands on washing quality standard

Soiling

- **Easily removable**
  - E.g. dust, earth
- **Hard removable**
  - E.g. oils, fats, small pigments
- **Protein-containing soil**
- **Soil to be “removed” by bleach**

Demands on machinery

- **Possibility to choose temperature**
  - Heating of particular zones, heat transfer due to conduction/ carry-over
- **Possibility to vary liquor level**
- **Possibilities concerning dosage of detergents**
  - Into several compartments
- **Kind of laundry transportation within the tunnel washer**
  - Carry-over of liquor

Characteristics tunnel washers

- **Counterflow principle: Constantly dilution of liquor**
  - Corrective: standing bath, bath exchange
- **Liquor level nearly not alterable**
- **Low mechanics** (oscillating)
- **Diversification of mechanics and cycle time effects all compartments.**

Bath flow settings

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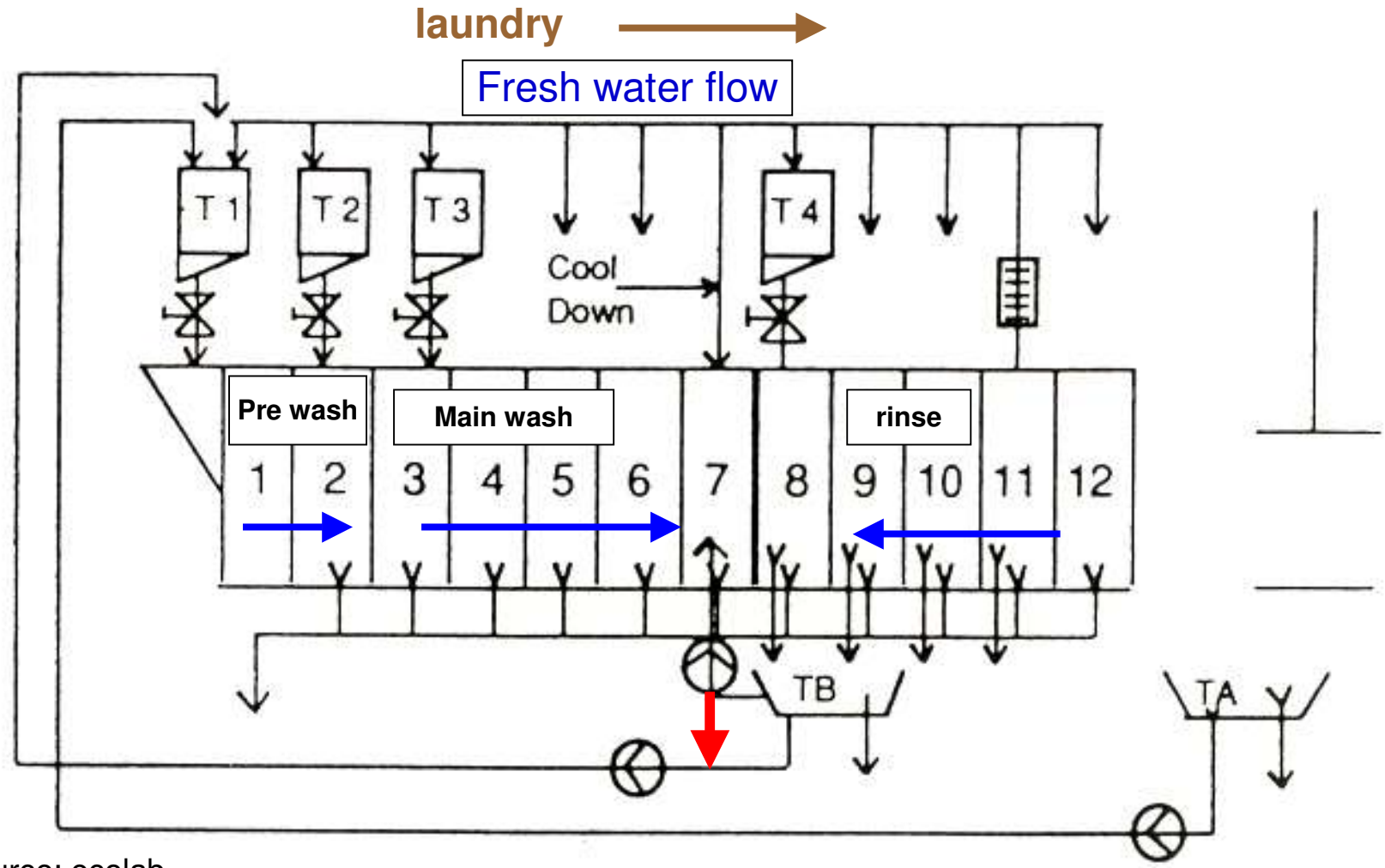
- **Current flow**
  - **Pre wash zone, main wash zone (if bath exchange is applied)**
- **Counterflow principle**
  - **Water flows against textiles**
  - **Rinsing zone, main wash zone**
- **Standing bath**
  - **pre wash zone, main wash zone, finish zone**
- **Bath exchange**
  - **Last compartment of main wash, rinsing zone**

Principle of bath flow settings

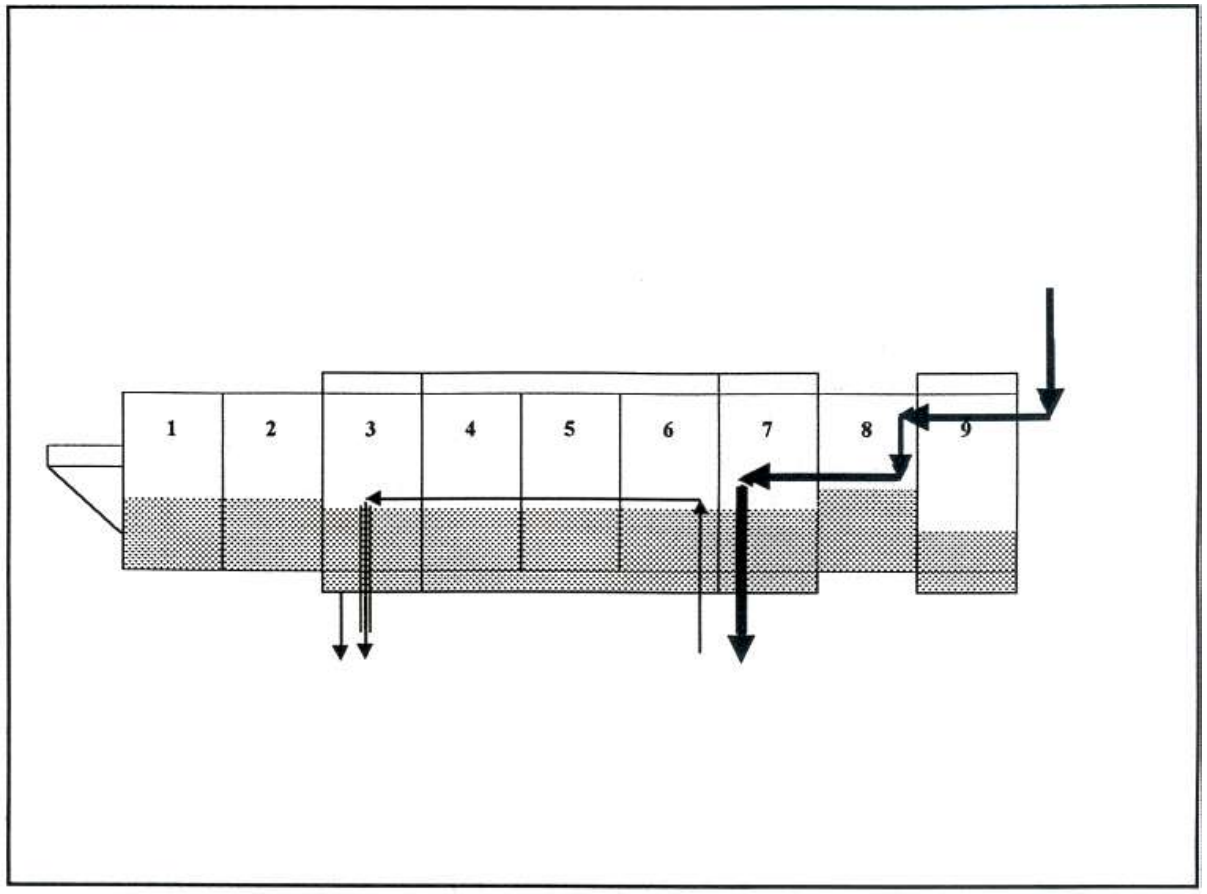
- **Fresh water in rinsing zone**
- **Partly usage of it in main wash zone**
- **Rest for pre wash**

Bath exchange



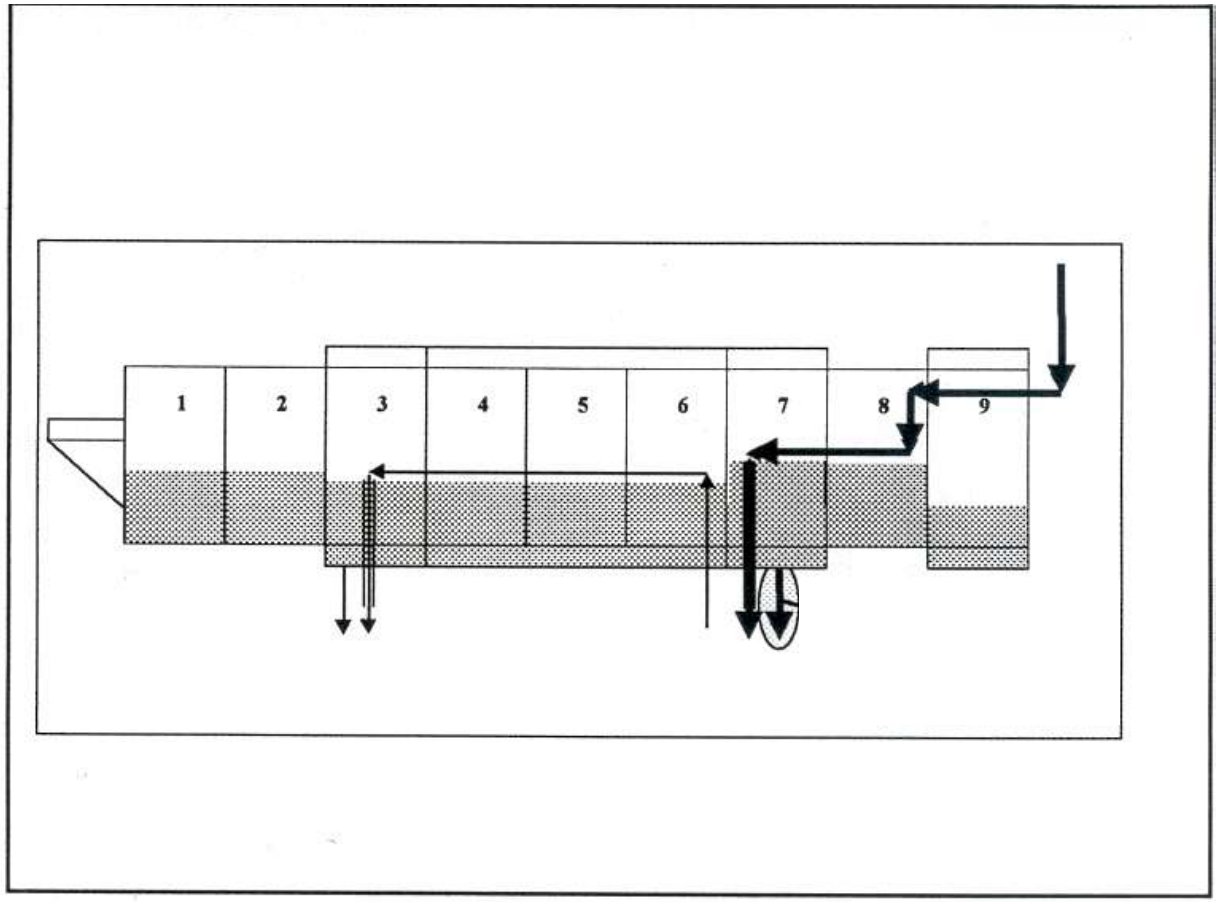
source: ecolab

Bath exchange



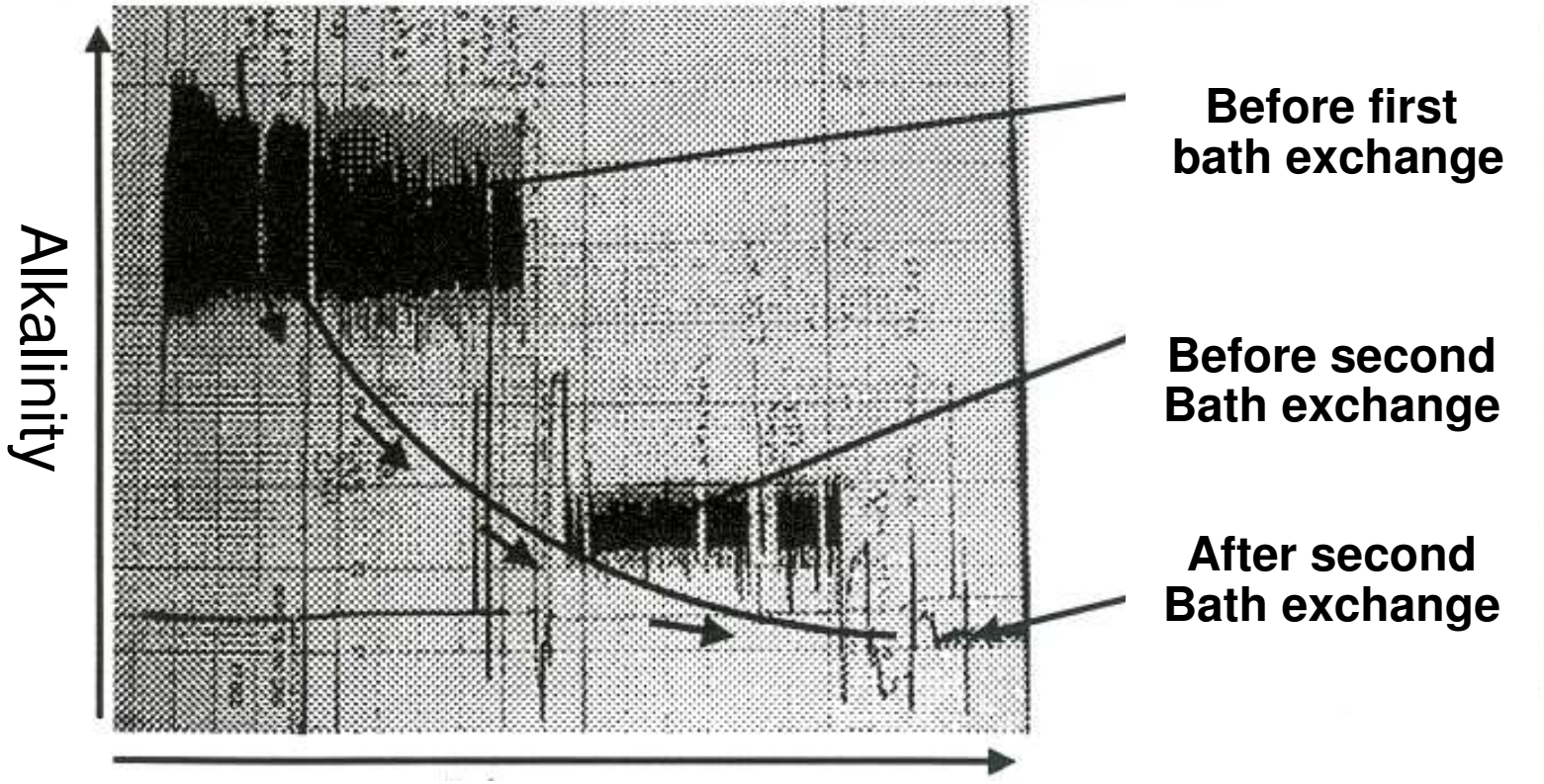
Source: Jensen Gruppe

Bath exchange

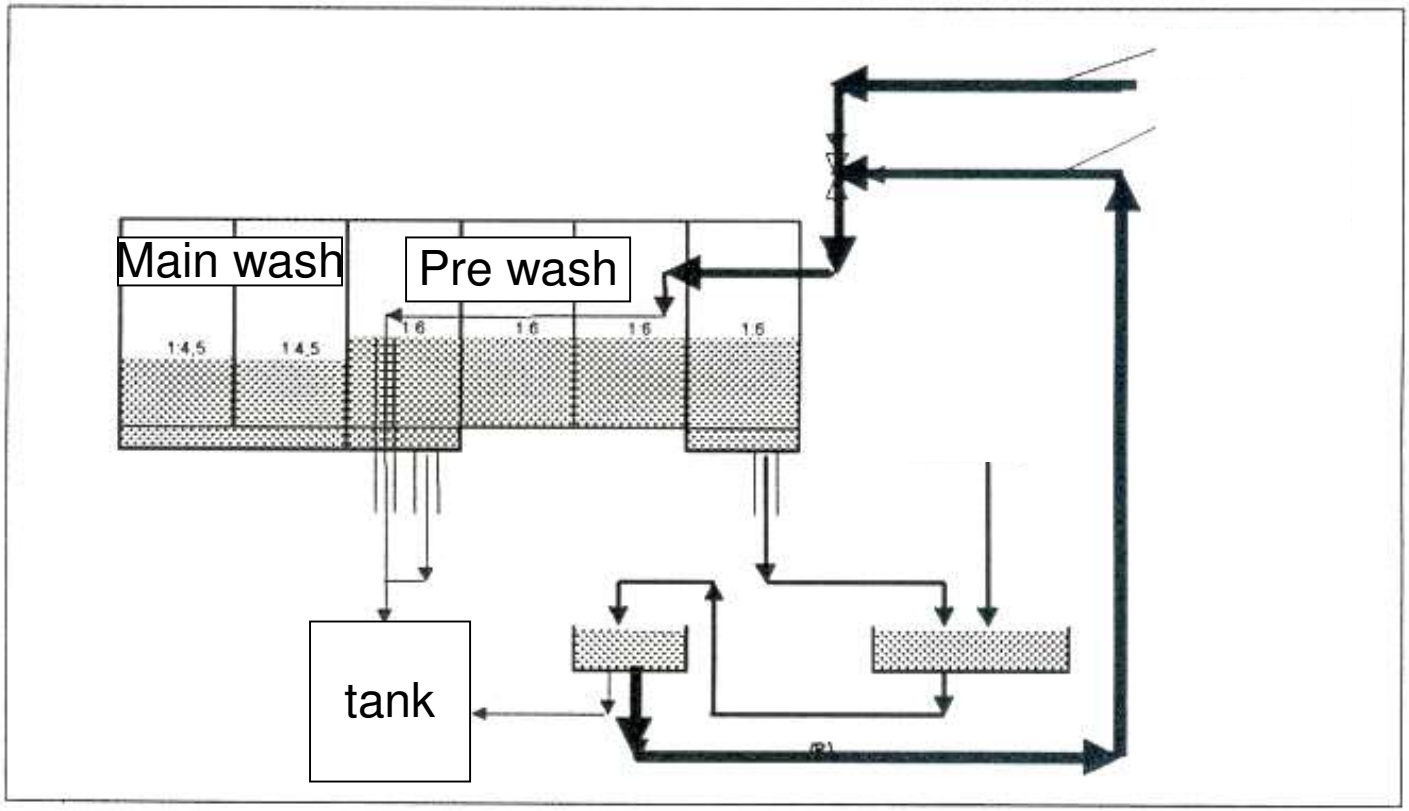


Source: Jensen Gruppe

Alkalinity measurements
Source: DIVERSEY LEVER



Pre wash with press water



Carry-over of liquor

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- **Carry-over by laundry** (bound liquor)
  - Kind of fibre
  - construction
  - Manufacturing quality of the textile

- **Carry over my mechanism of transport** (free liquor)
  - Liquor ratio
  - Bottom transfer, centre transfer
  - Perforated/ non-perforated drum wall

Dosage of detergents

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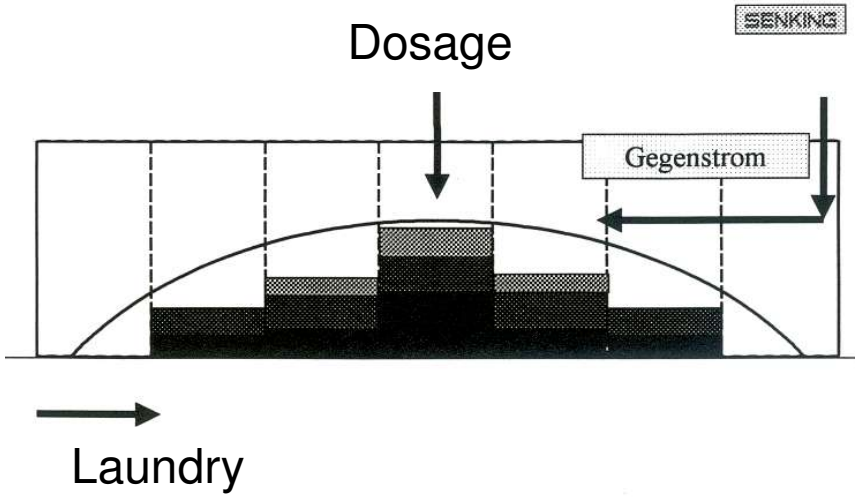
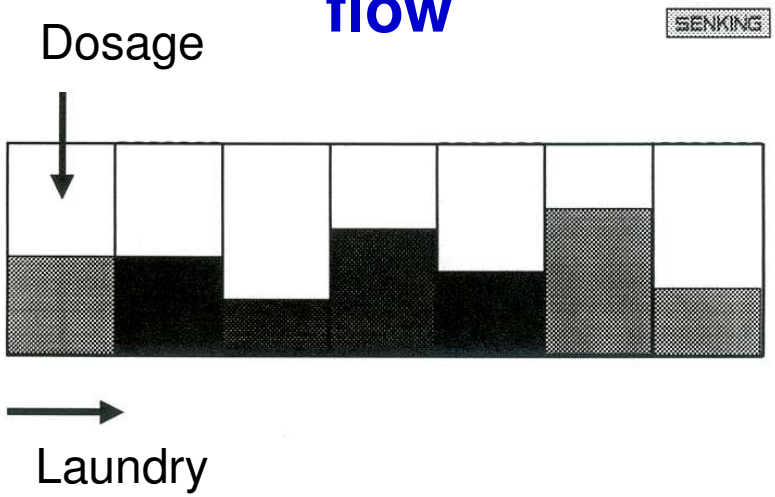
Counterflow



Current flow



Spreading of detergents – influence parameters

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Contruction parameters	Operating parameters	Dosage
▪ Kind of drums ▪ compartments ▪ Bathflow ▪ Finish ▪ Fresh water inlet	▪ Carry-over ▪ Residual moisture ▪ Load ▪ liquor ratios ▪ Cycle time	▪ Simple dosage ▪ Conductivity measures ▪ Time - amount measures (dual)

Mechanics – influence parameters

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Mechanics is determinated by:

- Drum diameter
- Revolutions of drum (amount)
- Kind of drum revolution (oscillating, rotating)
- Falling angle
- Reversing (cycle time – interval time)
- Ribs: form, height, arrangement
- Load ratio (amount of load)
- Liquor ratio

Mechanics – influence parameters

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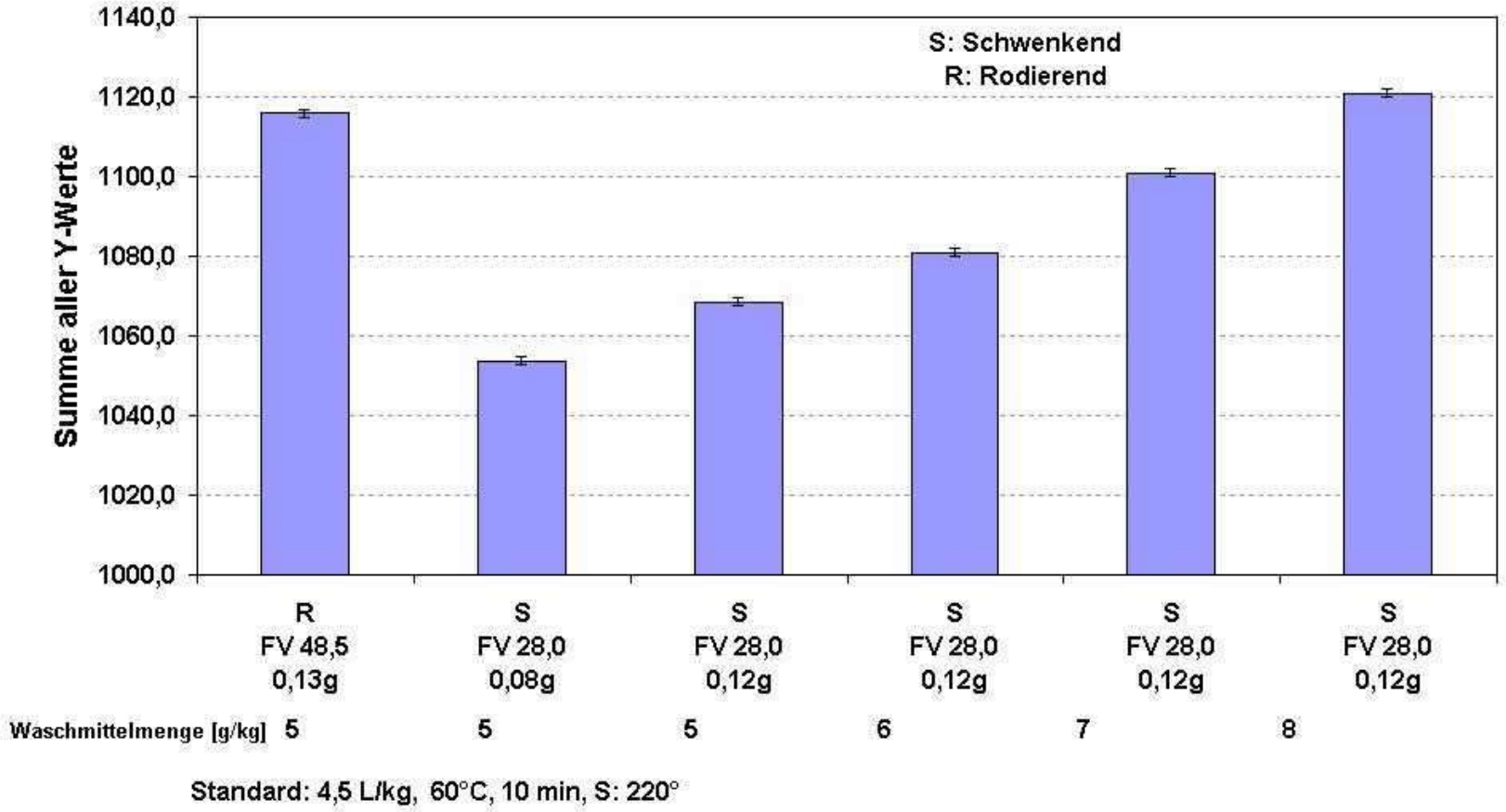
Parameters

- Height, Falling
- Impact speed
- Liquor flow, liquor turbulences

Tunnel washer – rotation of drum



Rotating – oscillating: comparison

⇨ **Higher mechanics** important for some kinds of soiling, e.g.

- **work wear**
  fat from skin, motor oil, mineral oils
- **Linen** with soil from food (eggs, pigments, starch, oil, milk, cacao)

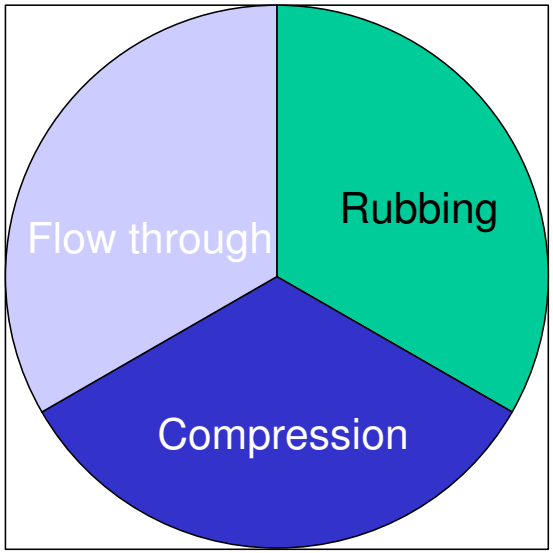
**„Rubbing"
of laundry**

La Reine des Blanchisseusses
Queen of washer
„Le Petit Journal" 1893

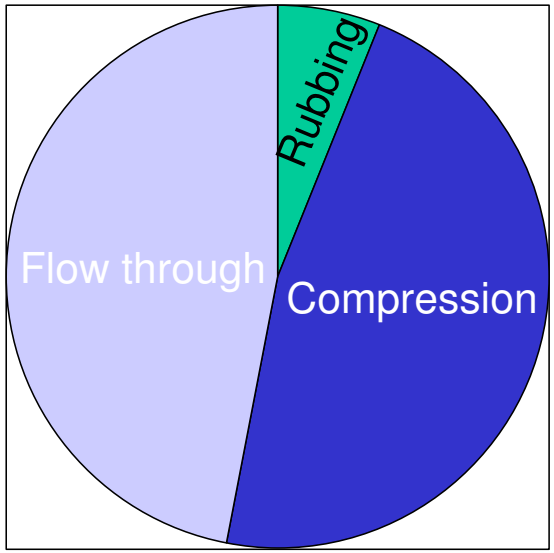
**„slatting"
of laundry**

Components of mechanical action:

- Rubbing
- Compression
- Flow through



Oscillating washing action



Rotating washing action

Advantages of compression in comparison to rubbing?

- **Faster absorption of chemistry**
- **Faster dilution of chemistry**
- **Less keying of textile`s surface**
- **Less generation of „pilling“**
- **No distortion of textiles**

⇨ **Rotating wash movement is more effective and more gentle than rubbing.**

Compartments

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	amount of compartments
⇨ **Soaking** (optional)	**1 - 2**
⇨ **Pre wash zone**	**2 - 4**
⇨ **Main wash zone**	**3 - 6**
⇨ **Rinsing zone**	**2 - 6**
⇨ **Finishing**	**1 - 2**
⇨ **(Dewatering)**	

Pre wash - parameters

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Liquor level	intermediate to high
Bath flow	current flow
Intensity of bath flow	intermediate
Origin of water	from rinse zone (2/3), dewatering, eventually cold water
Drainage	into sewage
Amount of detergents	high
Temperature	< 40 °C, or high (depends on kind of soil)
Number of compartment, duration	2 to 3 compartments

Main wash - parameters

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Liquor level	low
Bath flow	Counterflow, bath exchange
Intensity of bath flow	low
Origin of water	from rinsing zone (1/3)
Drainage	from first compartment into sewage
Amount of detergents	intermediate
Temperature	high
Number of compartment, duration	15 min (disinfection), at least 3 compartments
Blended fabric	Cool Down

Rinsing - Parameter

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Liquor level	intermediate to high
Bath flow	Counterflow, eventually with bath exchange
Intensity of bath flow	high
Origin of water	fresh water, eventually press water
drainage	from the first compartment of pre wash zone and main wash zone, respectively, into sewage
Temperature	dropping down, Cool down for blended fabrics
Number of compartment, duration	at least three compartments

Rinsing in counterflow process

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- **Load ratio** 50 L/kg
- **Liquor ratio** 2 L/kg
- **Liquor capacity** 14 L/kg

- **Cycle time** at least 1,5 min
- **Kind of textile** PES/BW

Finish - parameters

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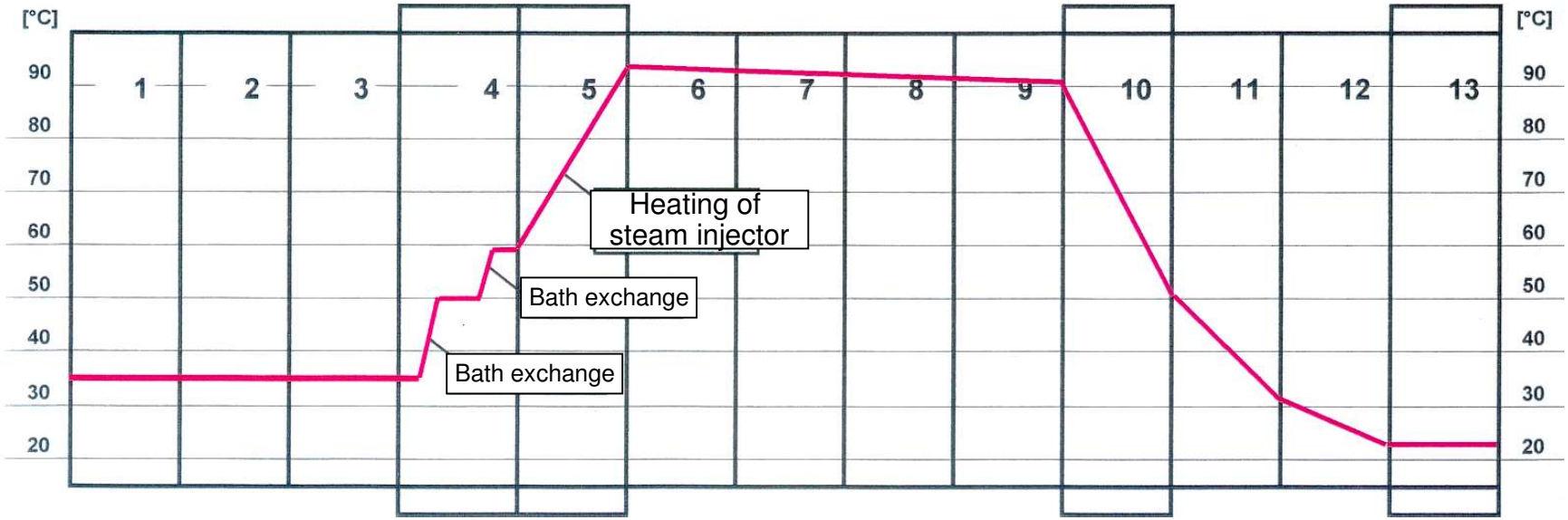
Liquor level	low
Bath flow	standing bath
Intensity of bath flow	without
Origin of water	fresh water, from tanks eventually
drainage	in tanks
Temperature	low
Number of compartment, duration	at least one compartment

Disinfection

thermal disinfection	chemical-thermal disinfection	chemical disinfection
temperature	Temperature and disinfection agent	disinfection agent
92°C, 10 min 85°C, 15 min	30-70°C	Room temperature, 12 hours time
for cotton	Cotton and polyester-cotton blended fibre	

source: Hychem

Allocation of temperature



Allocation of temperature

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- **Cool Down** for blended materials like PES/CO
  3 to 4 K/min

- **Thermal disinfection**
  - Observation of heating and mixing-up rate
  - Machines with one drum: temperature differences may occur

Bleaching

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- **H_2O_2, Na-perborate, Na-percarbonate**

  - in main wash zone
  - temperature 80 to 90 °C
  - dosage 80 to 120 mg/l O_2
  - duration 8 to 12 min
  - pH- value 8 to 12

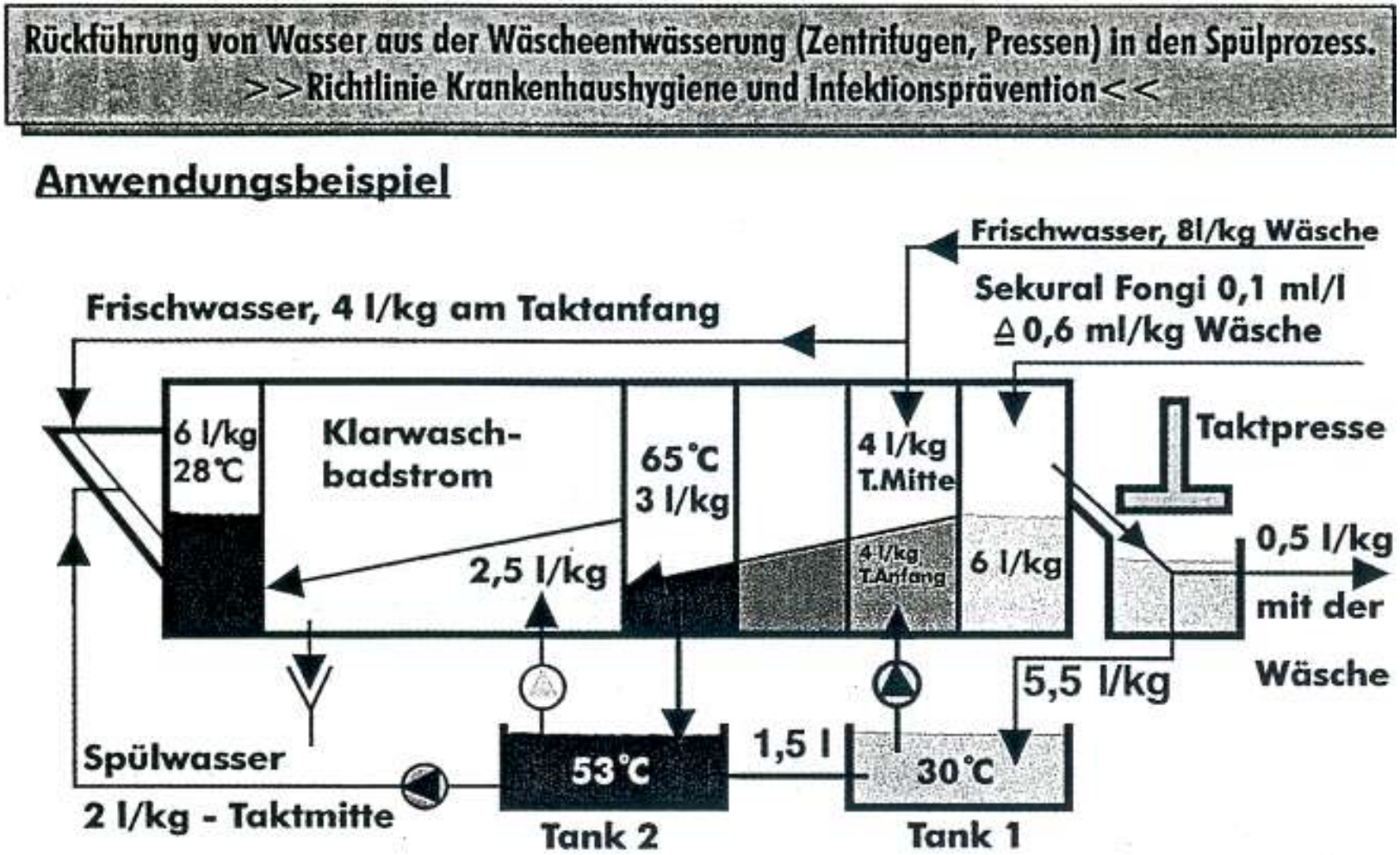
- **Peracetic acids**

  - in main wash- or rinse section
  - temperature 40 to 70 °C
  - Dosage 600 to 250 mg/l O_2
  - Duration 20 to 15 min
  - pH- value 6,5 to 12
  - high dosage due to low temperatures and low ph-value

Bleaching

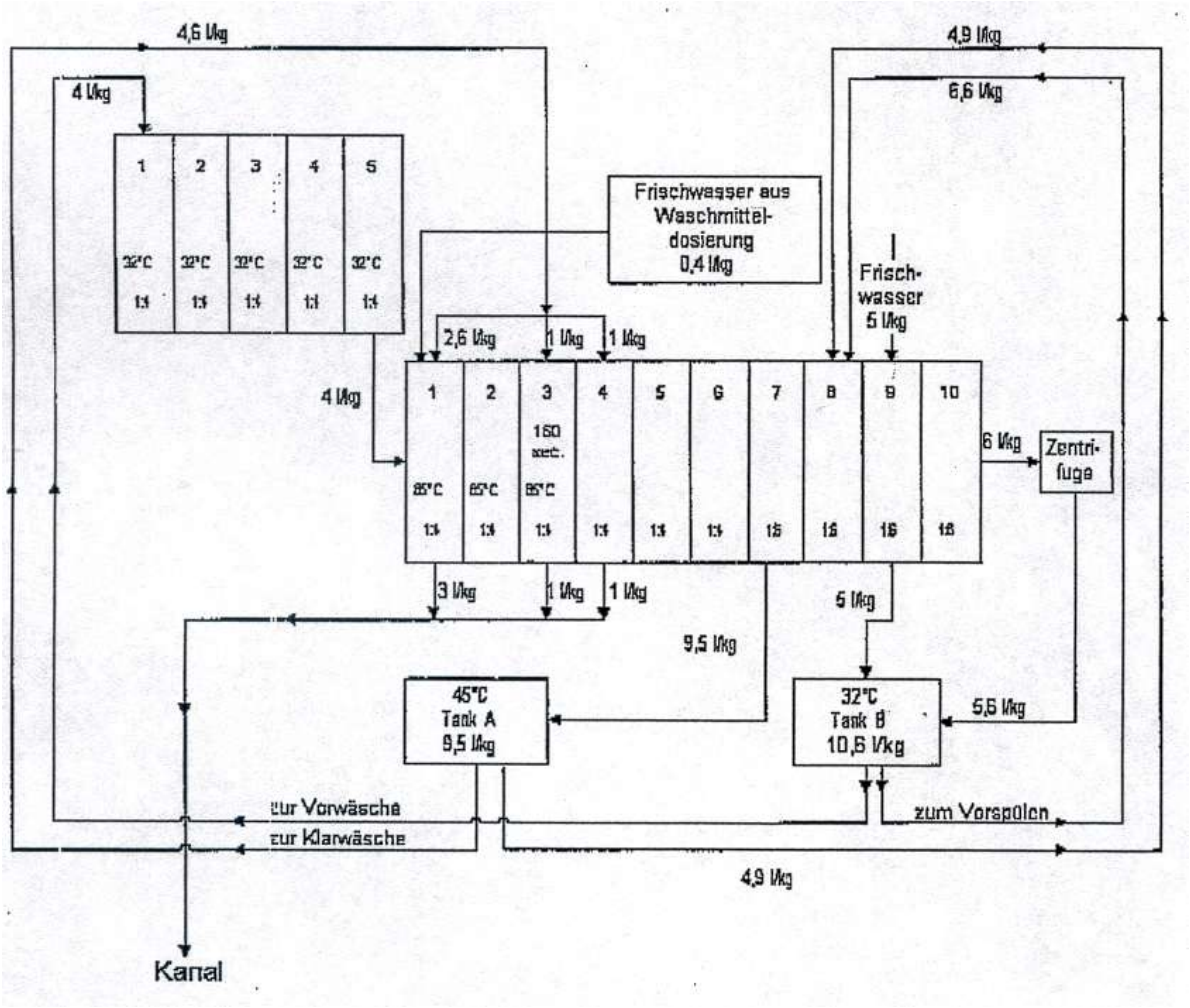
- **Chlorine**
  - In ultimate or penultimate rinse compartment
  - Temperature 25 to 30 °C
  - Dosage 250 to 400 mg/l active chlorine
  - Duration 5 to 8 min
  - pH- value 9 to 10

Usage of press water



Krankenhaus Technik, 12/1997

Special: „Konti“ cold-wet technique



Wasch-verfahrensablauf

Cold-wet mechanics

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- **principle**
  - Usage of storage period of laundry for wetting before real washing. Dosage of detergents for heavily soiled work wear

- **consequence**
  - Smaller pre-wash zone
  - Fewer detergents
  - Fewer rinsing water (5 - 7 L/kg)
  - Fewer waste water load