Education and Culture
Leonardo da Vinci

Sustainability in commercial laundering processes

Module 2
Machine technology

Chapter 3

Tunnel washers

Content

- History of tunnel washers
- Principle flow diagram
- Standing baths compared to counterflow washing
- Straight drum walls compared to helix design
- Oscillating and rotating wash action
- Optimizing the rinse process
- Counterflow rinsing and bath exchange rinsing
- Summary - Optimizing according to Sinner's circle

Learning targets

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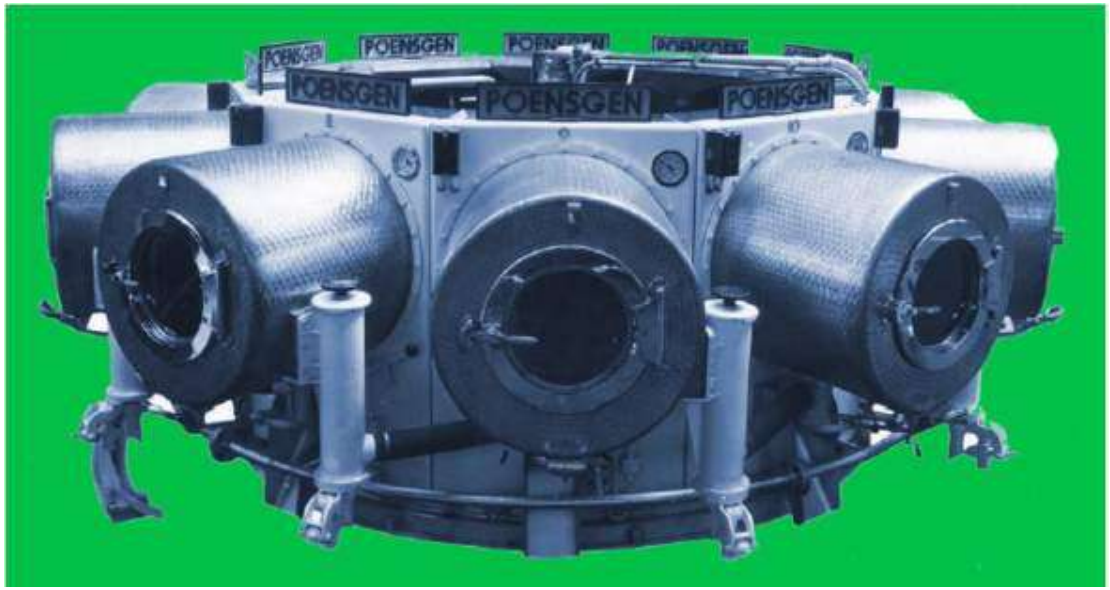
After finishing the module you will

- know the principle layout of tunnel washers.
- be able to evaluate the water consumption by viewing the tunnel washer as a black box.
- know the main characteristics of washing in standing bath and of counterflow washing.
- be able to distinguish the principles of oscillating and rotating wash action.
- know influencing factors for optimizing the rinse quality in tunnel washers.

History

- History of Tunnel washers

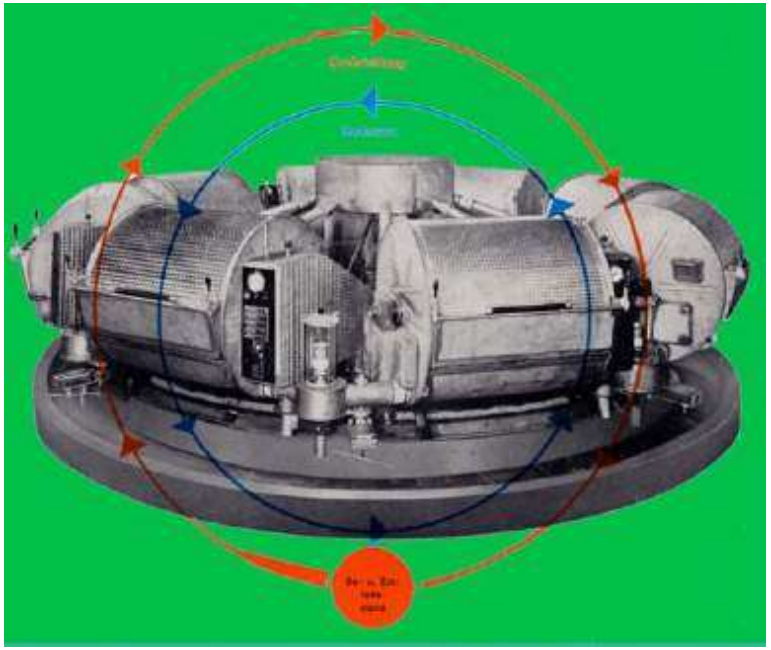


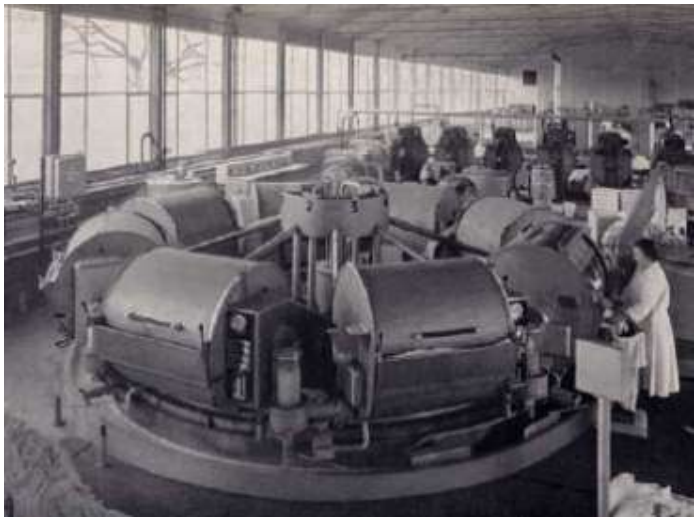
Poensgen counterflow carousel washer
Type WSK with 10 units (1950)

The first time that a counterflow principle was used in industrial washing

History

- History of Tunnel washers



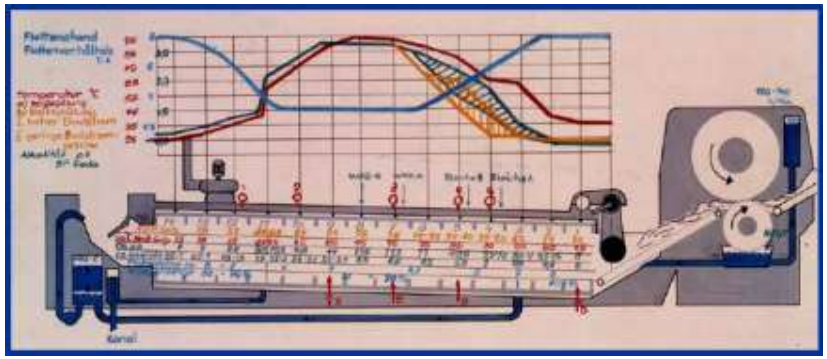


Poensgen D-pocket "Pullman" counterflow carousel system (1957)

History

- History of Tunnel washers

14-19 ltr/kg



Invention of the first washing line – the Poensgen Flowline (1965)

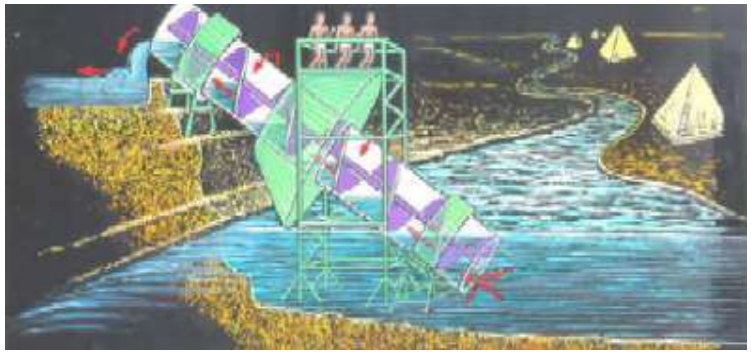
History

- History of Tunnel washers

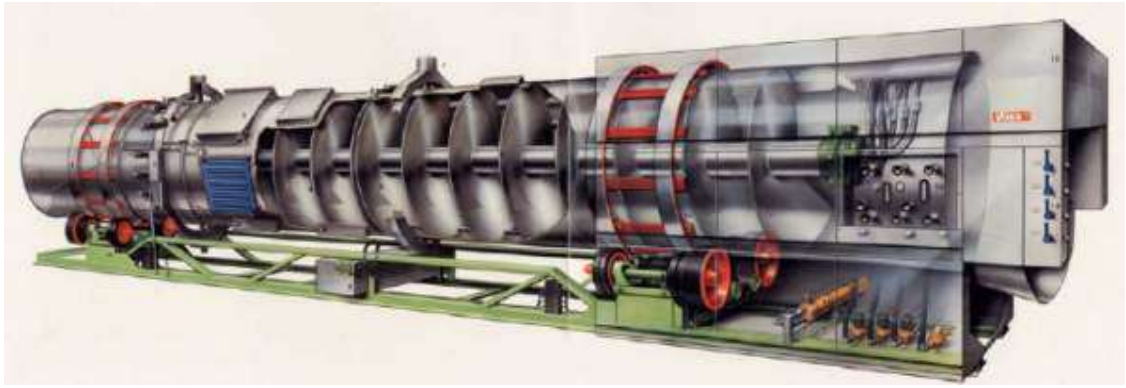
The prototype of the Voss Archimedia in the Sarstedt factory (1970)

History

- History of Tunnel washers



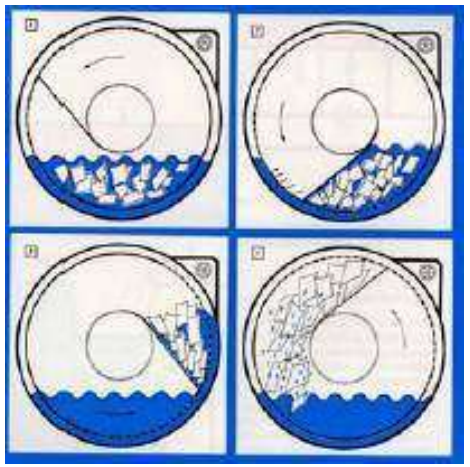
The Archimedean screw is a water lifting unit devised by the Greek scholar Archimedes (287-212 B.C.).



Voss Archimedia single drum batch washer

History

- History of Tunnel washers

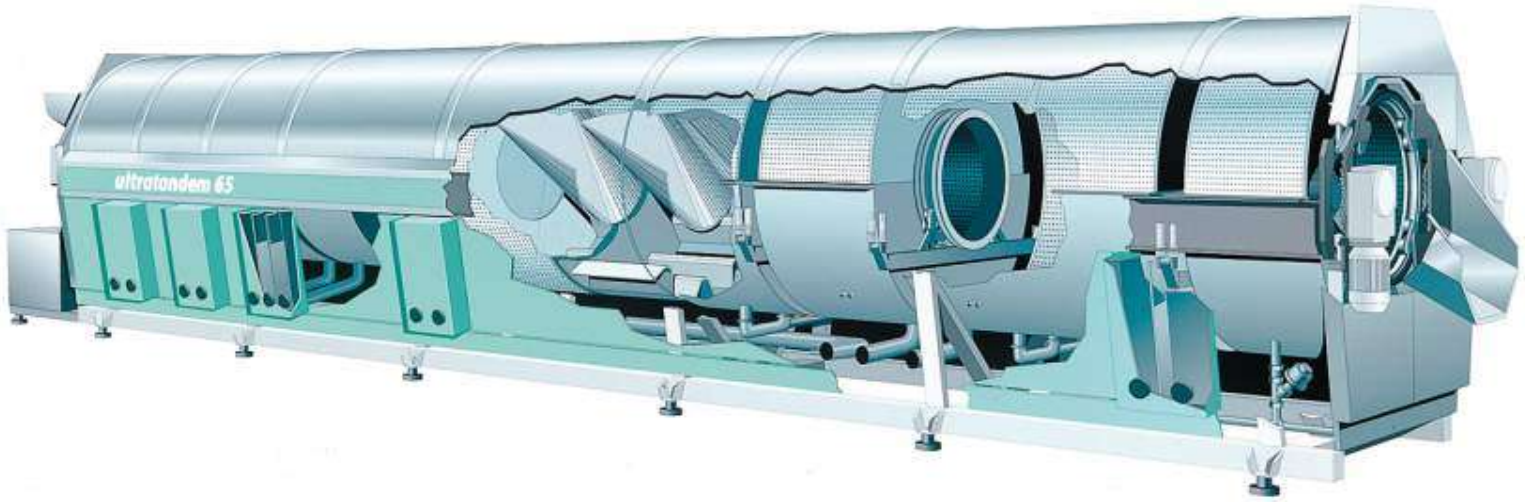


Poensgen modular continuous washing line PWZ (1975)

First tunnel washer with rotating wash action!

History

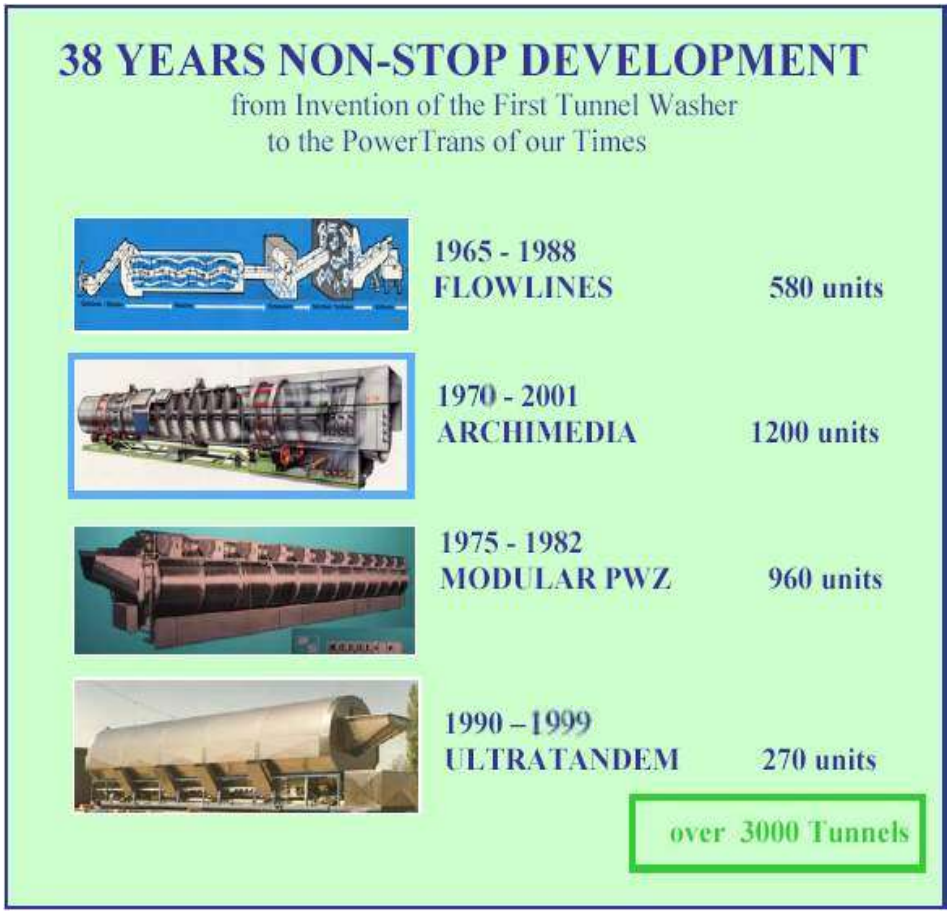
- History of Tunnel washers



Ultratandem continuous washing line by Boewe-Passat (1990)

History

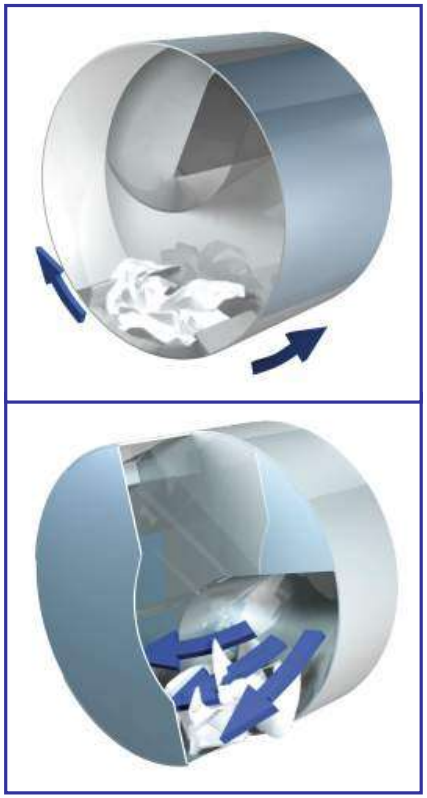
- History of Tunnel washers



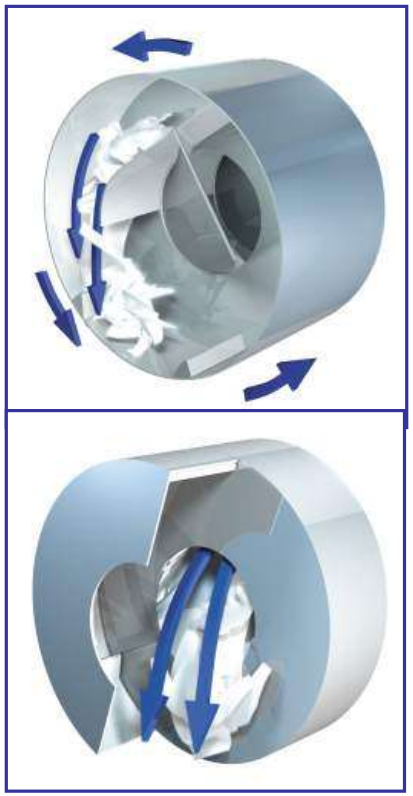
- History of Tunnel washers

Kannegiesser PowerTrans - The new generation of tunnel washers

Design prinziples

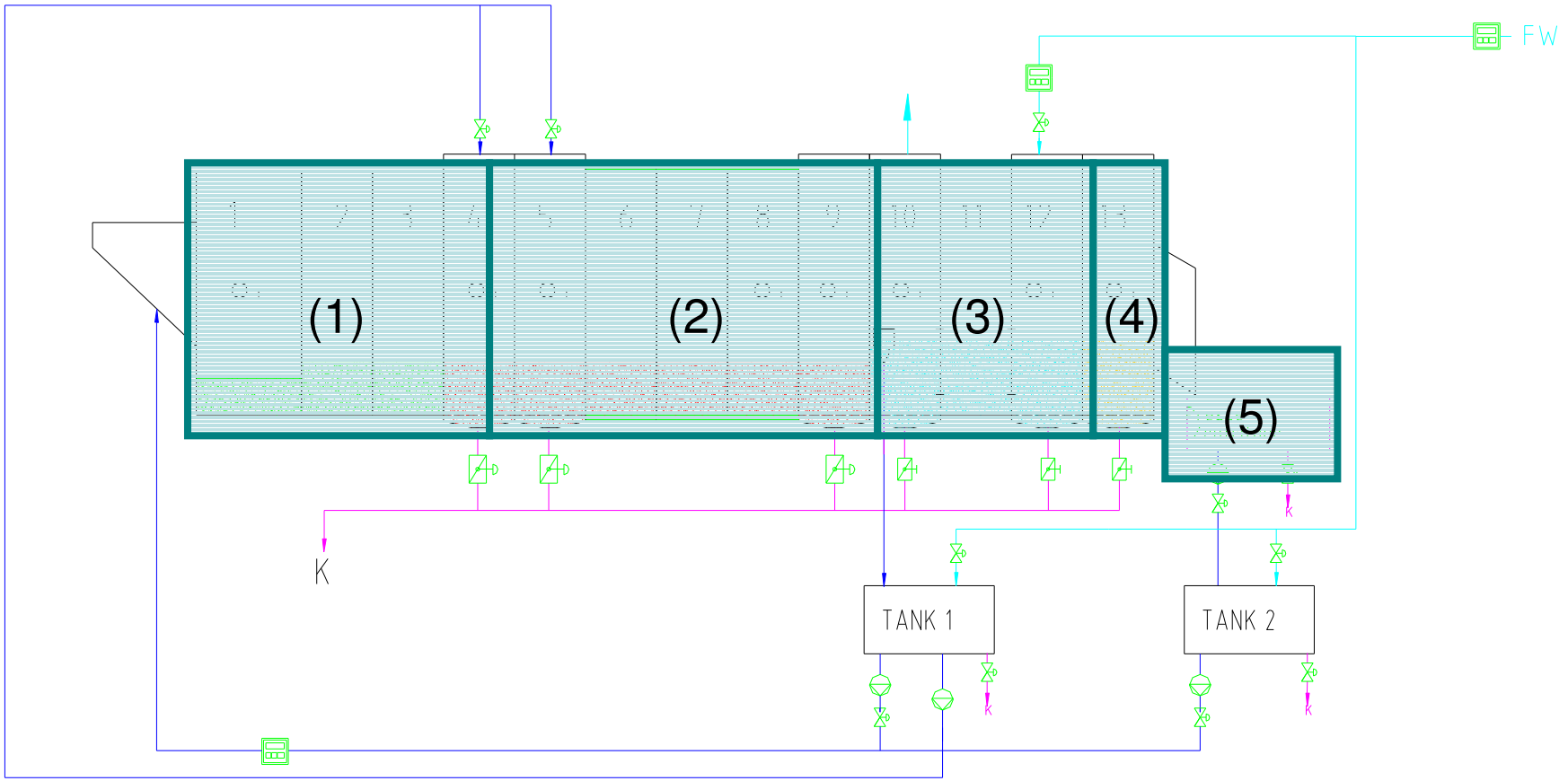


Osciallating washing action
with bottom transfer



Rotating washing action
with centre transfer

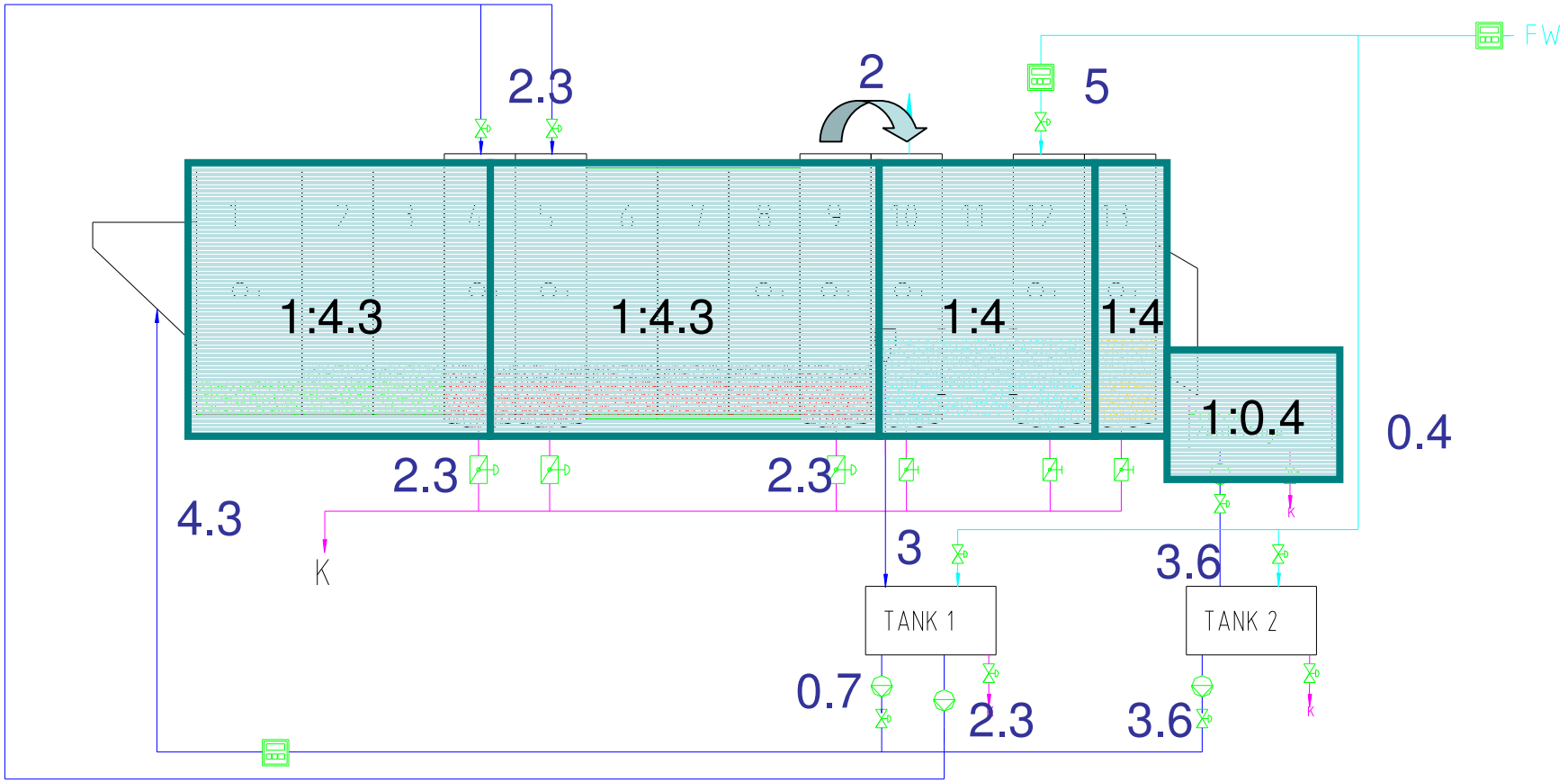
Water management



- Principle configuration (Example: 2 tank solution)

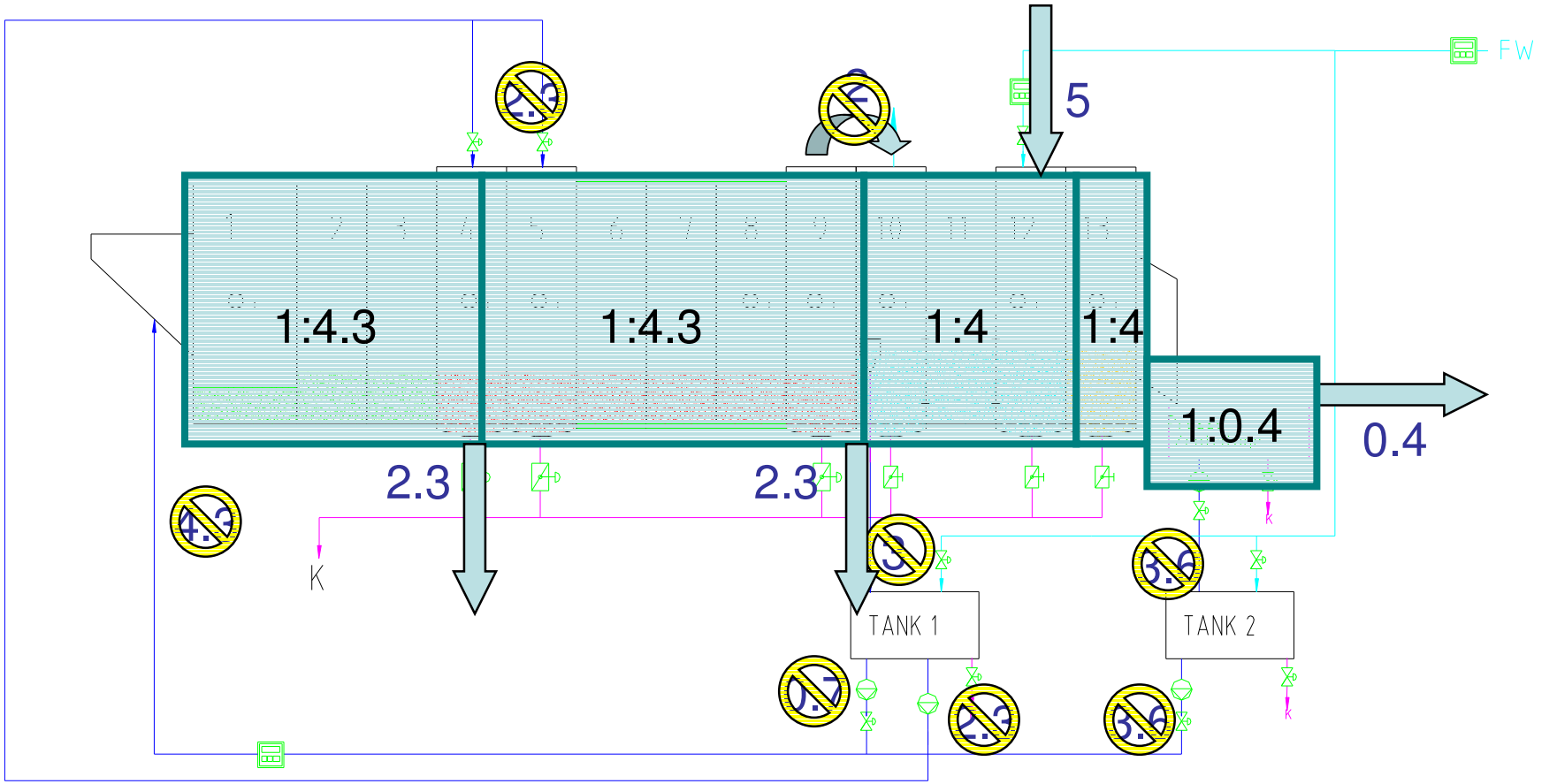
(1) Pre-wash (2) Main wash (3) Rinse (4) Neutralisation (5) Extraction

Water management



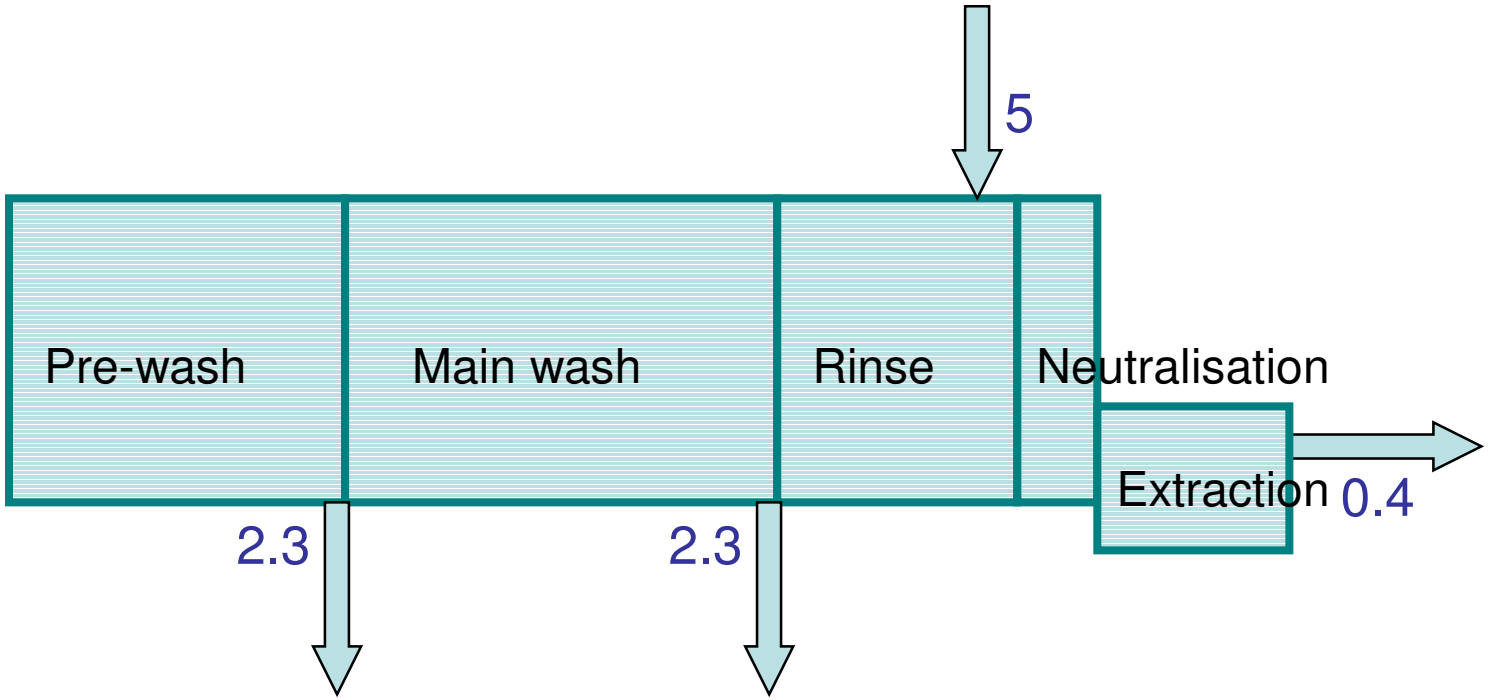
- Water management within the maschine (in litres per kg loading weight)

Water management



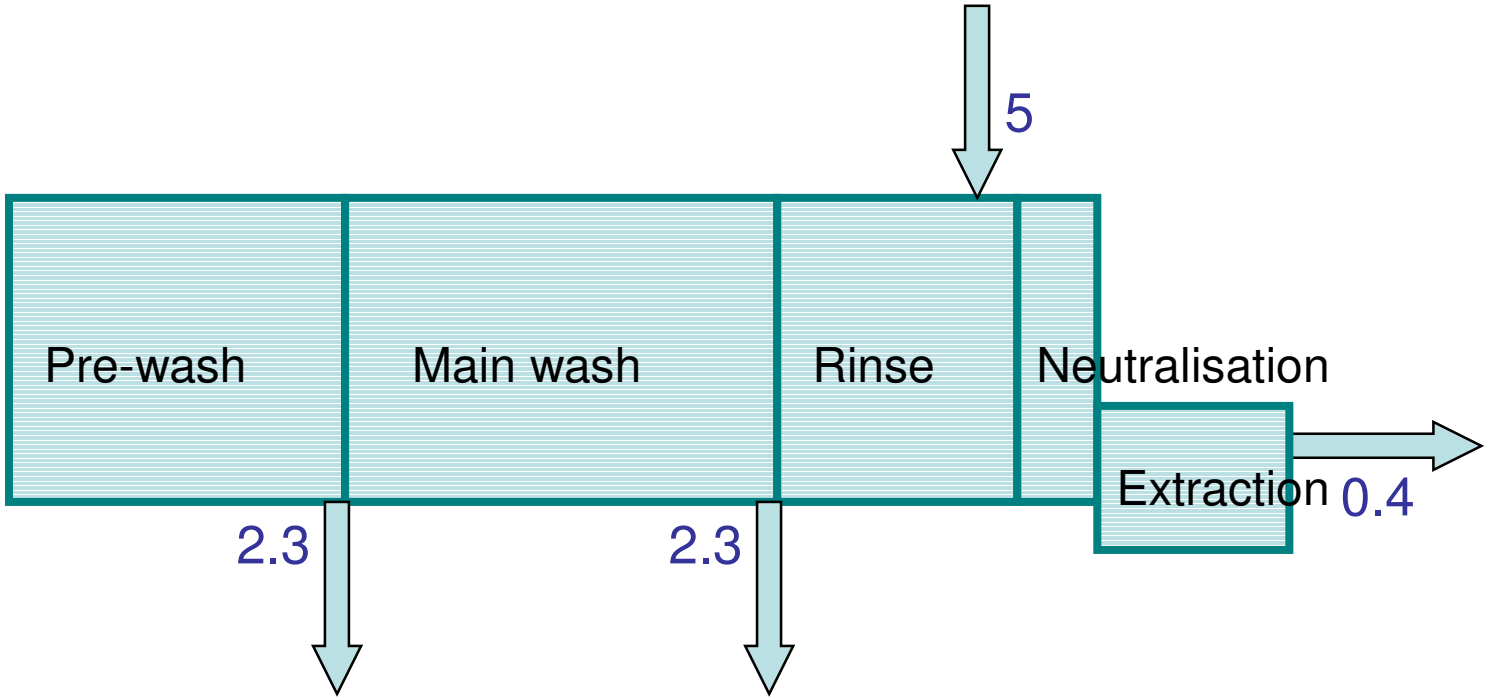
- "Black Box" – view

Water management



In a continuous wash prozess with a balanced water management, fresh water is added at one position only!

Water management



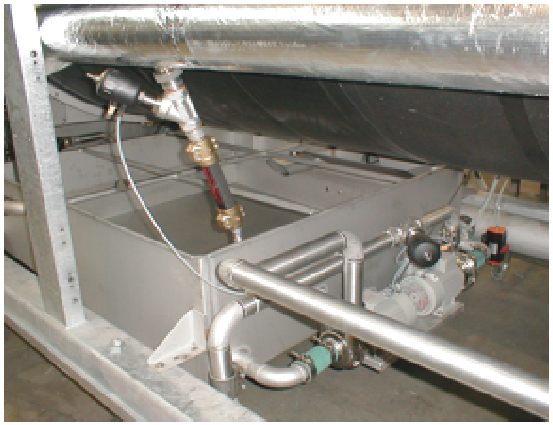
In practice, deviations to this are possible due to:

- Different water levels, bounded water or moisture retentions
- More or less bath changes, colour changes, water recovery
- Over- or underloading, empty compartments, ...

Water management

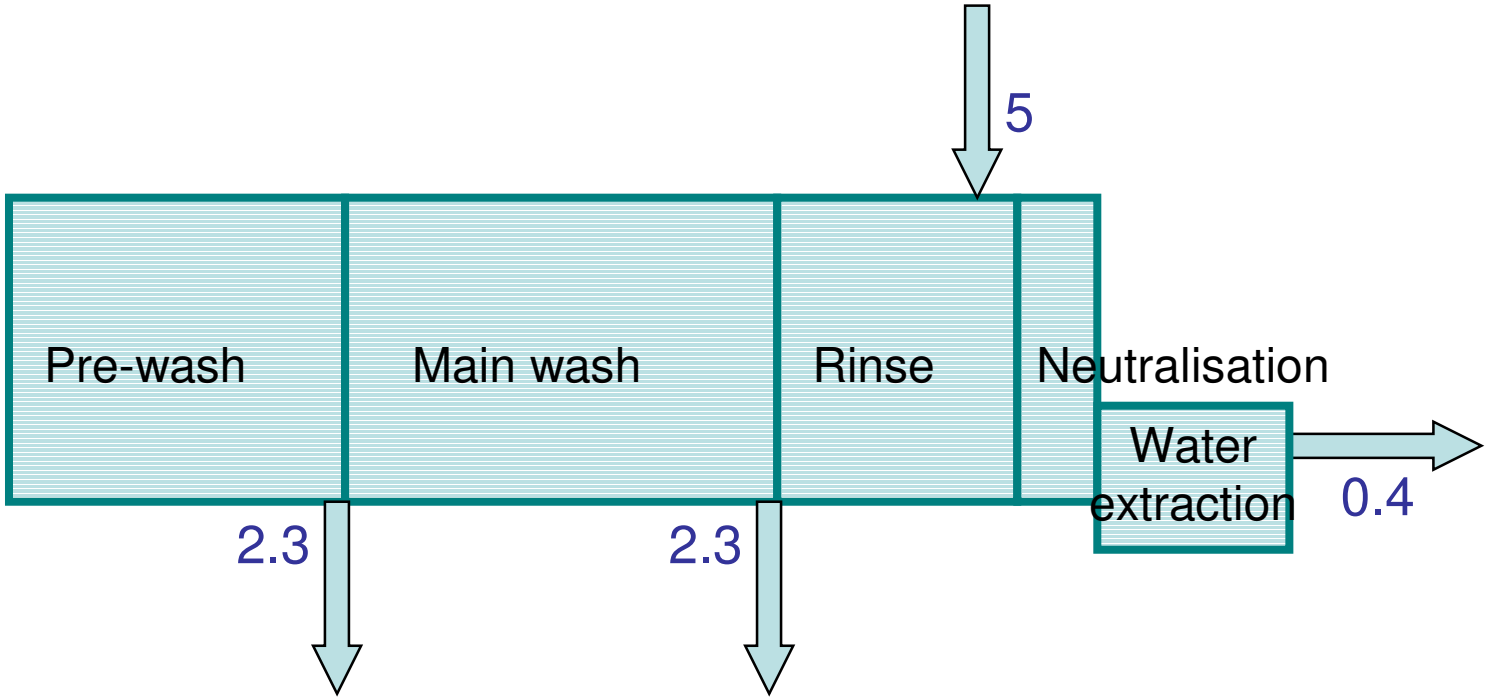
Deviations to a balanced water management (e.g. over- or underloading) are buffered by using intelligente recovery tank systems:

Traditional: Tank under the machine



***NEW:** Silo tank system*

- Silo tank system for single washers or for the connection of diverse washers (e.g. washer extractor and tunnel washer)
- Silo shape ideal for heavily soiled process water from workwear
- Sedimentation principle with cleaning valves at lowest points



How is a rinsing flow of only approx. 5 l/kg achieved?

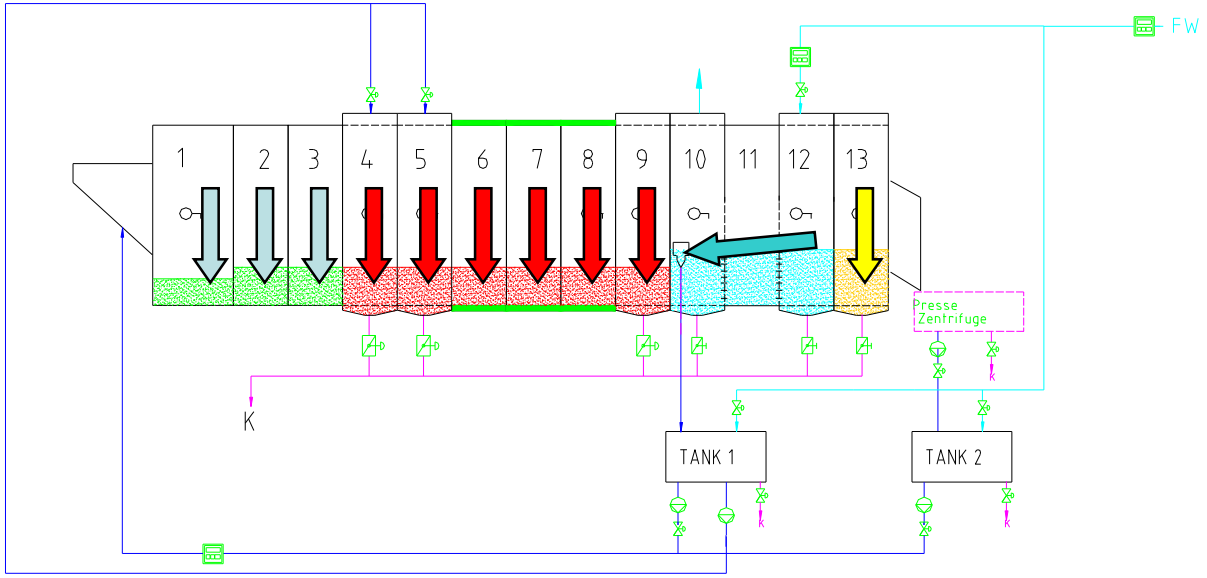
A) Optimized wash processes

B) Less soiled liquor transported into the rinsing zone

C) Optimized rinsing

Optimized wash prozesses

Washing in standing baths



- Strict bath seperation
- Weight depended water supply and chemical dosing
- Liquor is transported with the items
- Constant detergent concentrations

Optimized wash prozesses

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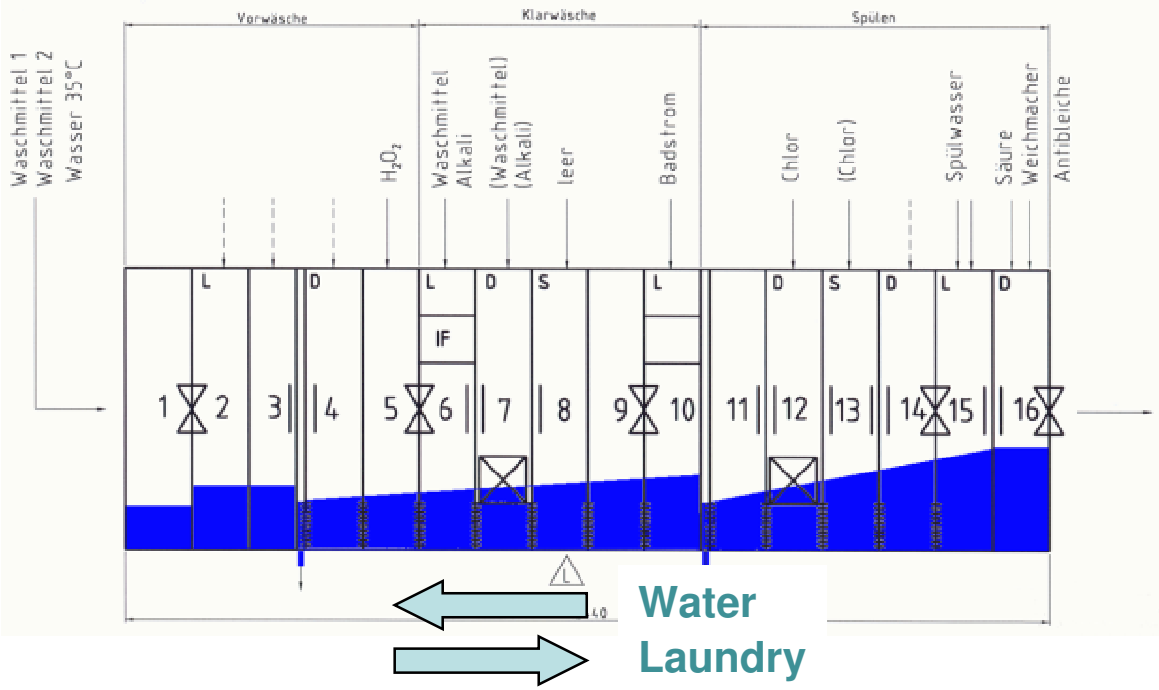
In comparison: Counterflow principle (Archimedia)



- Chemicals dosing in the middle of the main wash zone
- Undefined chemical concentrations, especially after stopping the machine!
- A weight dependent bath level is not possible
- Consequence: Tendency to overdose

Optimized wash prozesses

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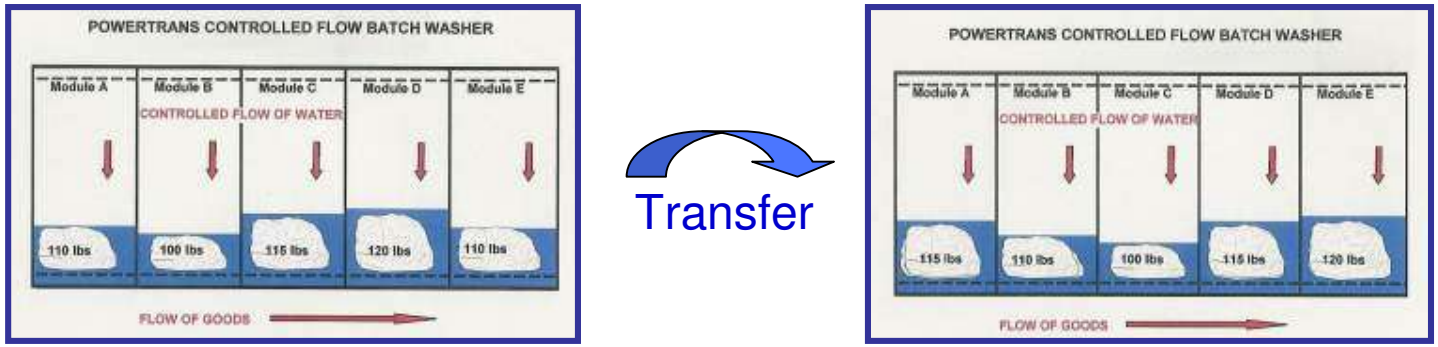
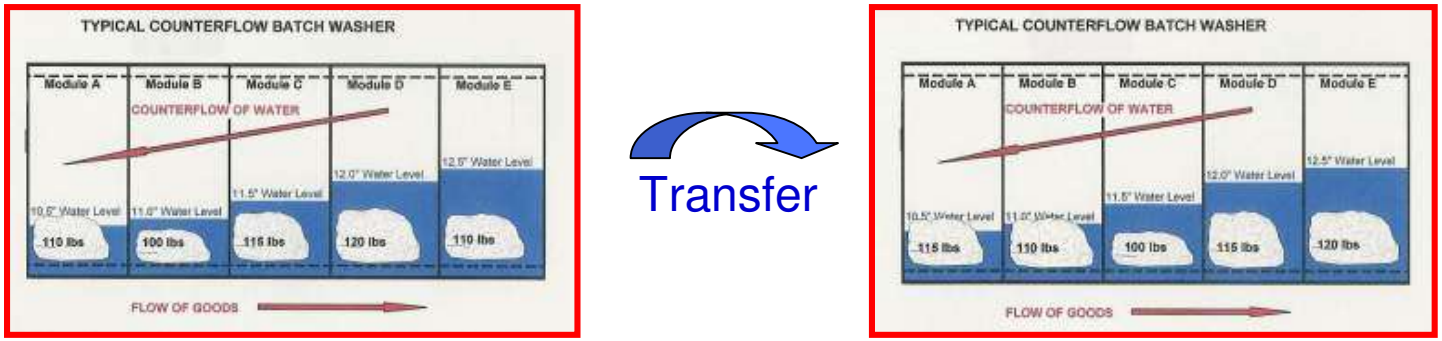
Standing baths:



Counterflow:



Optimized wash prozesses

Effective range A: Killing of bacterial germs
Effective range B: Inactivating of viruses

(Excerpt)

Name	Konzentration (g auf 1 Liter Flotte)		Flotten-verhältnis	Desin-fektions-temperatur	Einwir-kungszeit in Min.	Wirkungs-bereich	Hersteller bzw. Lieferfirma
	Waschmittel	Desinfektionsmittel					
Bleix peracid-Verfahren	3–6 g Solvit spezial oder Teut A spezial oder 3–5 g Flüsson extra oder Orlit PF	2 ml Bleix peracid[1]	1:5	60°C	15	AB	Christeyns
Bleix peracid-Verfahren	3–5 g Orlit	2 ml Bleix peracid[1]	1:5	65°C	15	A	Christeyns
Bleix peracid-Verfahren	3–5 g DK 100, Flüsson extra, GT 12, Orlit PF, Solvit Spezial oder Teut A Spezial oder 3–5 ml Flüsson Liquid	2 ml Bleix peracid[1]	1:5	70°C	10	AB	Christeyns

Source: http://www.rki.de/GESUND/DESINF/DESINFLI.HTM

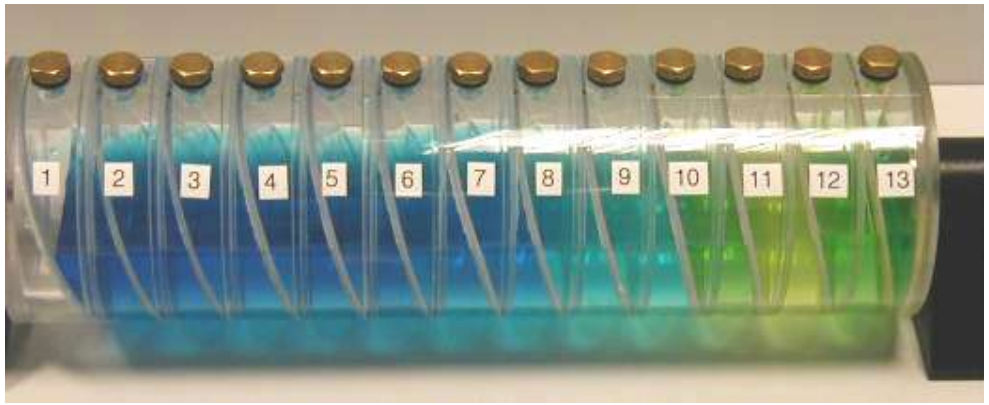
According to §18 of the German infections protection law validated processes with defined products, concentrations, temperatures and treatment times are mandatory!

Standing bath ⇨ Exact process control for each batch

Optimized wash prozesses

Standing baths

Defined wash process



Counterflow

"Diluting process"

Optimized wash prozesses

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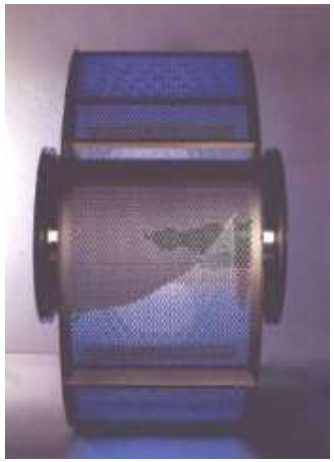
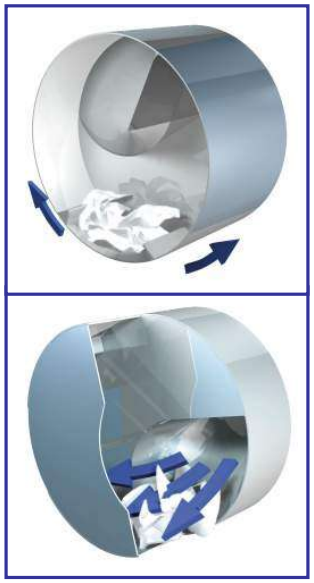
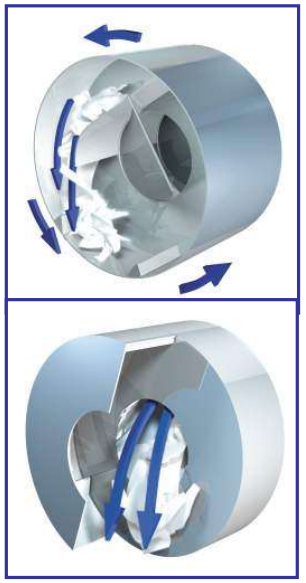
Drum wall design:

Poensgen
PWZ



Passat
Ultratandem



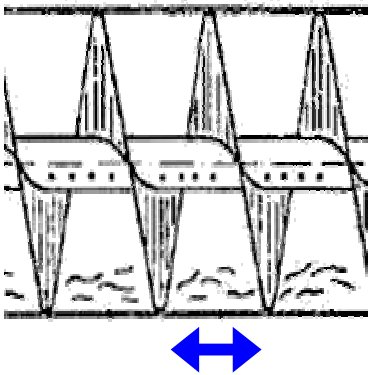


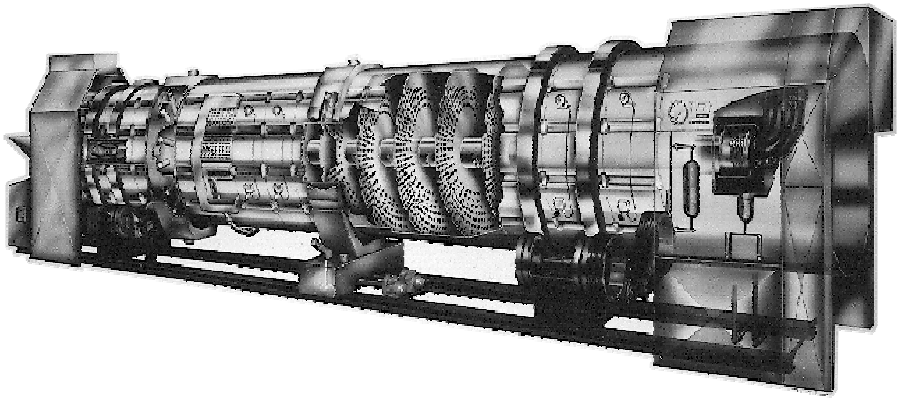
Kannegiesser PowerTrans,
PowerTrans *Classic* and *Rotaflex*

Straight drum walls allow a free linen movement and a wash motion as in a washer extractor !

Optimized wash prozesses

In comparison:



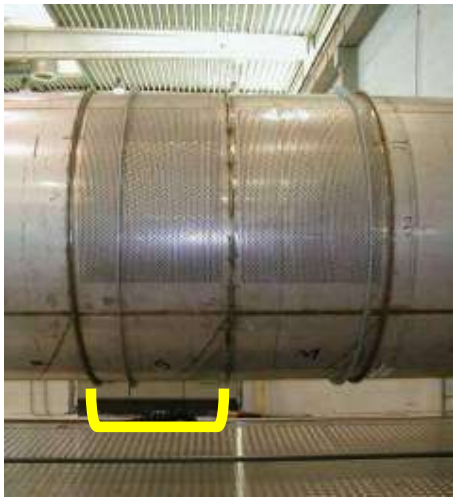


Slanted drum walls of the Archimedean helix

- Additional wash movement in axial direction
- Items friction on and creep up the drum wall
- Consequences: Additional friction, suppressed drop movement, items tangle, increased danger of blockage
- Drum core reduces the chamber volume and limits the item falling curve
  ⇨ reduced mechanical washing action

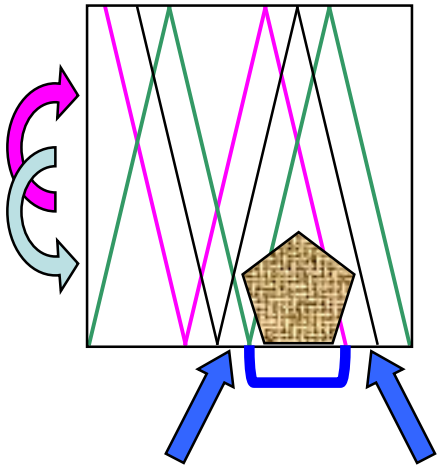
Media exchange between inner and outer drum

Straight drum walls:



⇒ The entire drum width can be used for the media exchange!

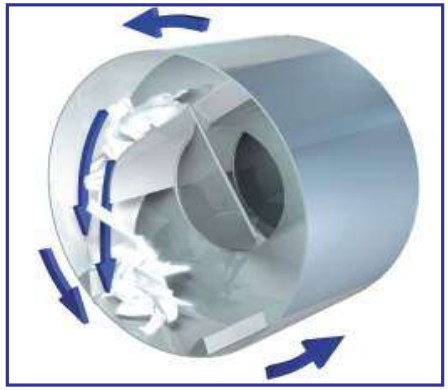
Slanted drum walls:



⇒ Smaller surface available for the media exchange, i.e. longer ancillary times or liquor exchange via the outer drums!

Oscillating or rotating drum movement

Oscillating washing action



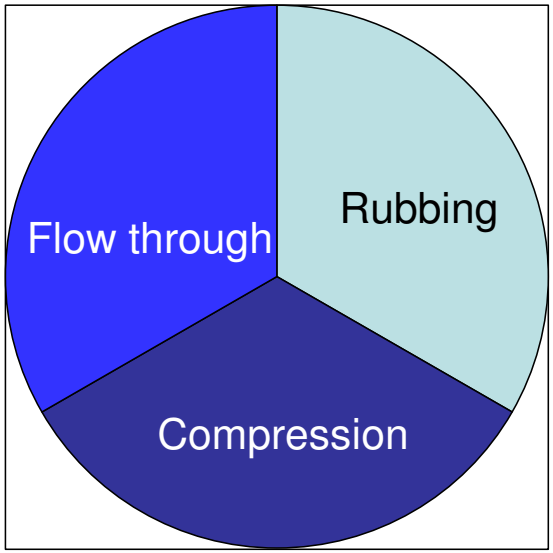
Rotating washing action

- Linen movement by beaters
- Constant fold-over and friction
- Mechanical action on the textile surface

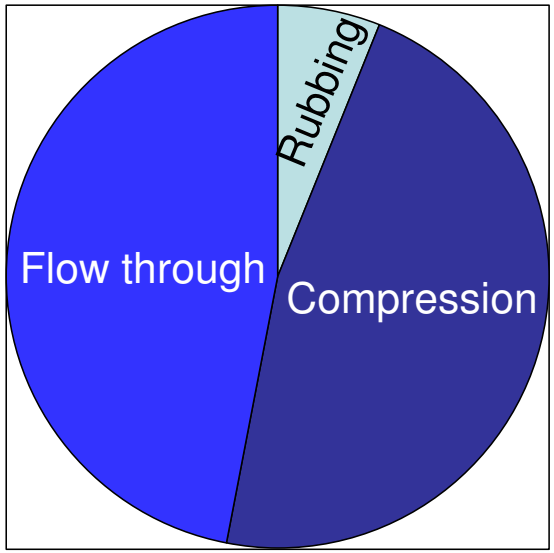
- Free falling of the linen
- Compression of the items
- Penetrative mechanical action

Components of mechanical action:

- Rubbing
- Compression
- Flow through



Oscillating washing action



Rotating washing action

Advantages of squeezing action over friction

- Faster adsorption of detergents
- Faster dilution of chemicals in the rinsing zone
- Much less surface abrasion on textiles
- Less pilling
- No roping of fabrics

⇨ Rotating cylinder movements yield more efficient and softer mechanical wash action!

Optimized wash prozesses

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BMBF-Project 0339957: "Reduction of energy and detergent consumption"
Conducted through: wfk Cleaning Technology Research Institute, Krefeld

Results of comparing rotating with oscillating washing action: (excerpt)

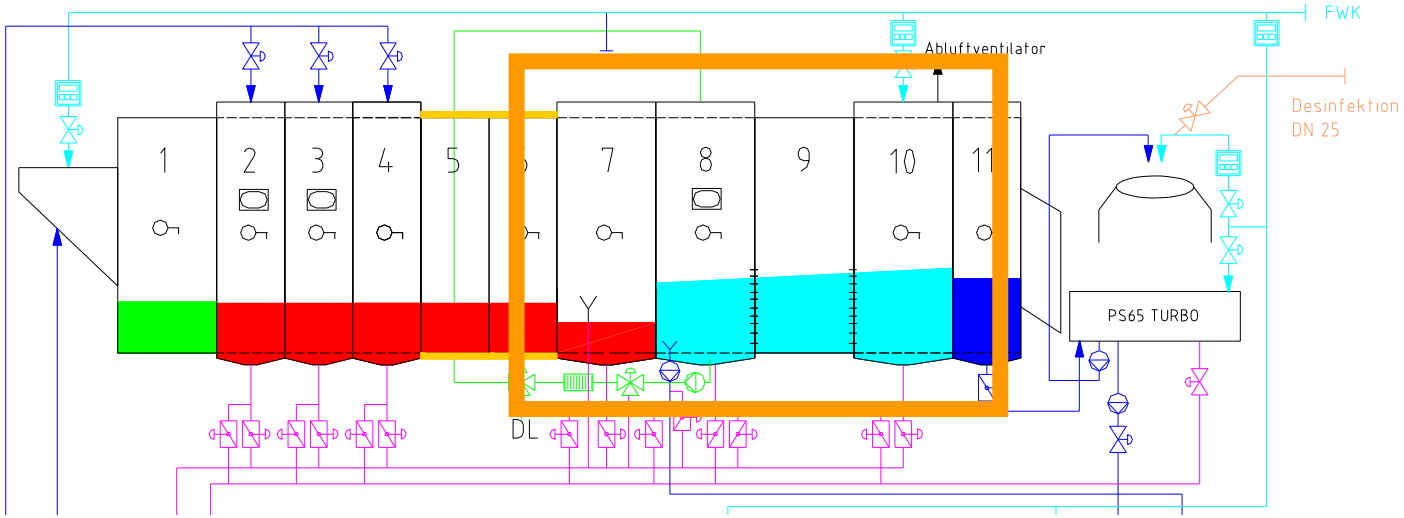
- Rotating cylinder movements **enhance the wash and rinse effect**
- Especially visible advantages with types of staining which are easier removable in combination with high mechanical action
- e.g. following stainings of test tissue PCMS55:
  - ✓ from **workwear** (skin fat, lanolin, motor oil, soot/mineral oil)
  - ✓ from **table linen** with food stainings (egg/pigment, starch/pigment, vegetable oil/milk/pigment, milk/cocoa)
- Hereby **no elevated fibre damage** was ascertained!

Further design aspects:

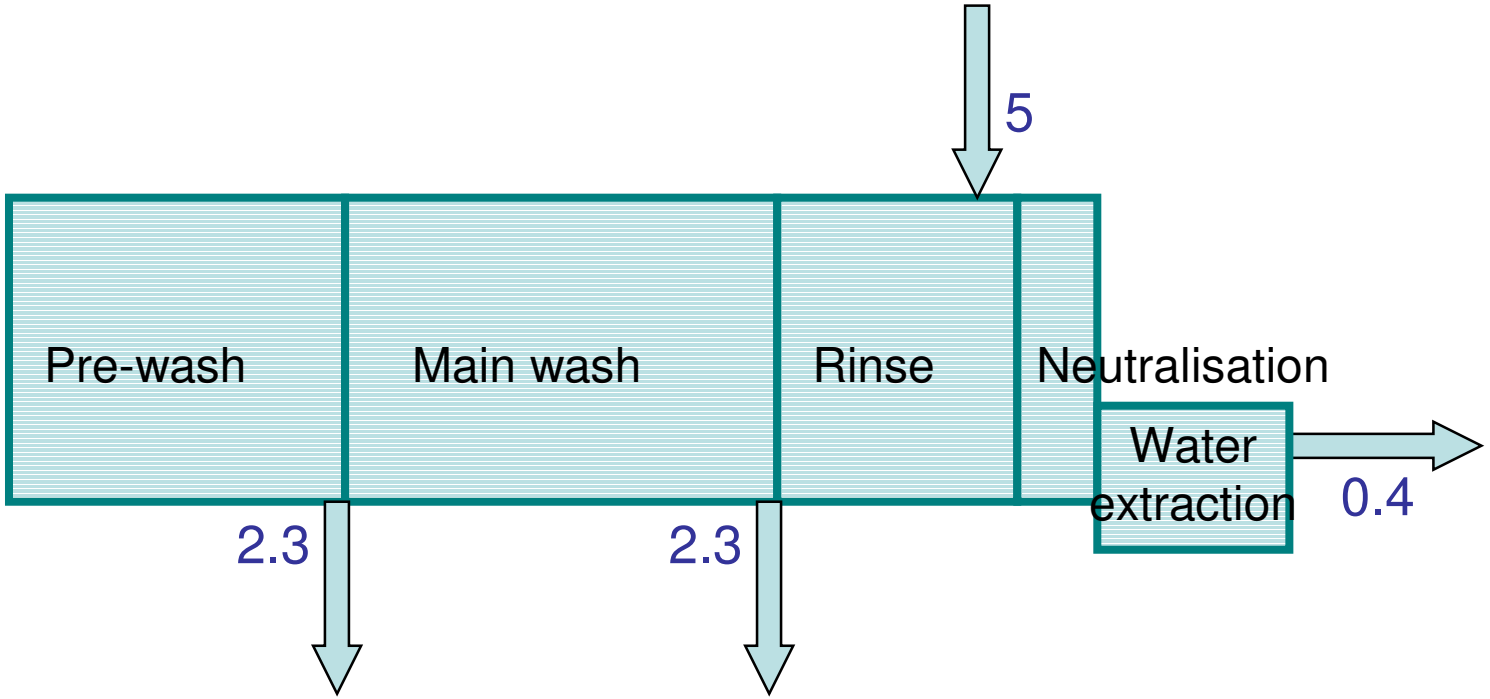
Drum diameter and volume

- Direct influence on the mechanical action
- Large diameter ⇒ high g factor and drop height
- PowerTrans Ø 1.635 and 1.907 m
- g factor program dependent possible up to 0.23 (Voss Archimedia 0.08)
- Large drum volume ⇒ better item movement, gentle item treatment, overload protection and reliable transport
- Load ratio ≈ 1:36 with the oscillating and ≈ 1:50 with the rotating version

Enlarged cool-down compartments:



- For free textile movement and less creasing
- Comparison of loading ratios:
  - oscillating tunnel washers ≈ 1:30 to 1:36
  - rotating tunnel washer "PowerTrans Rotaflex" ≈ 1:50
  - Enlarged cool-down compartments of the Rotaflex ≈ 1:75



How is a rinsing flow of only approx. 5 l/kg achieved?

A) Optimmized wash processes

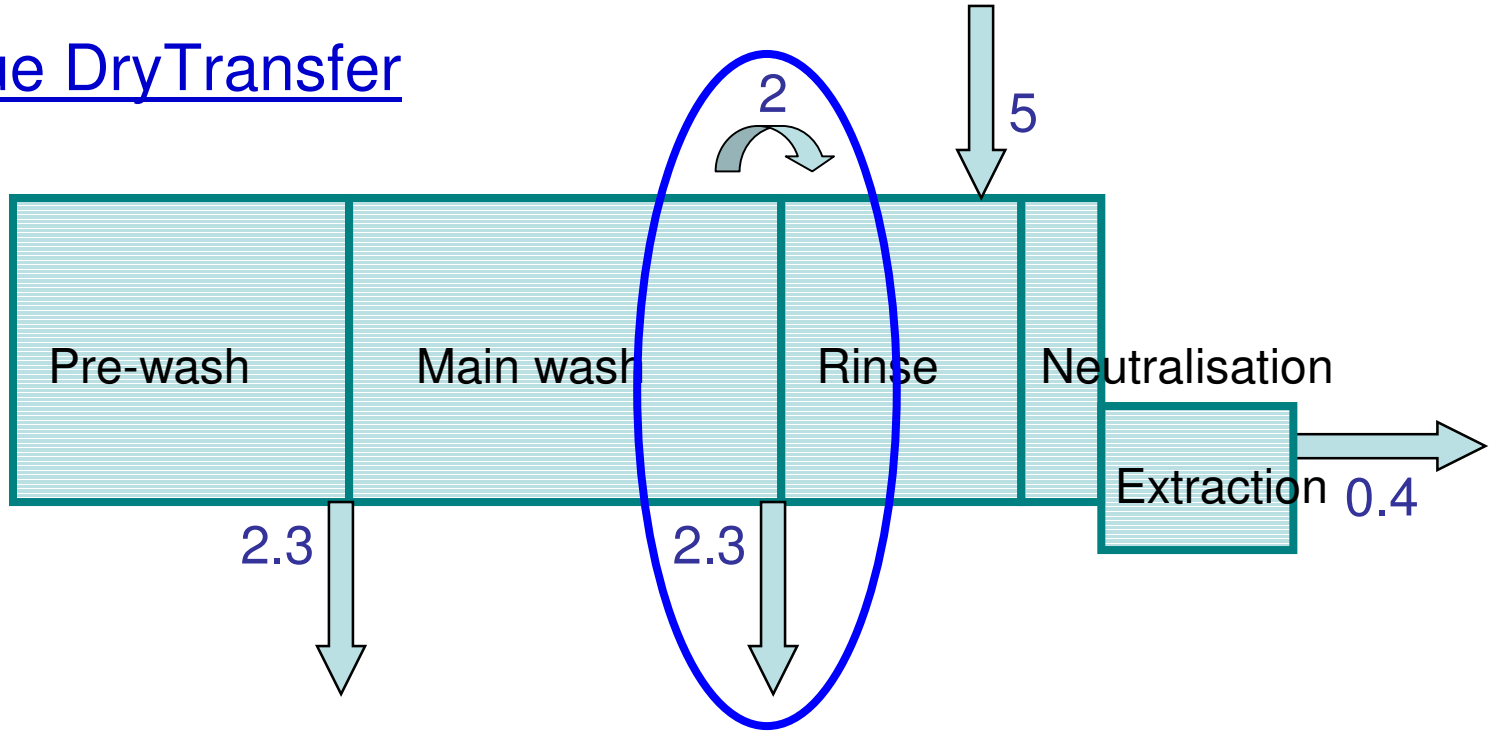
B) Less soiled liquor transported into the rinsing zone

C) Optimized rinsing

Transport into the rinsing zone

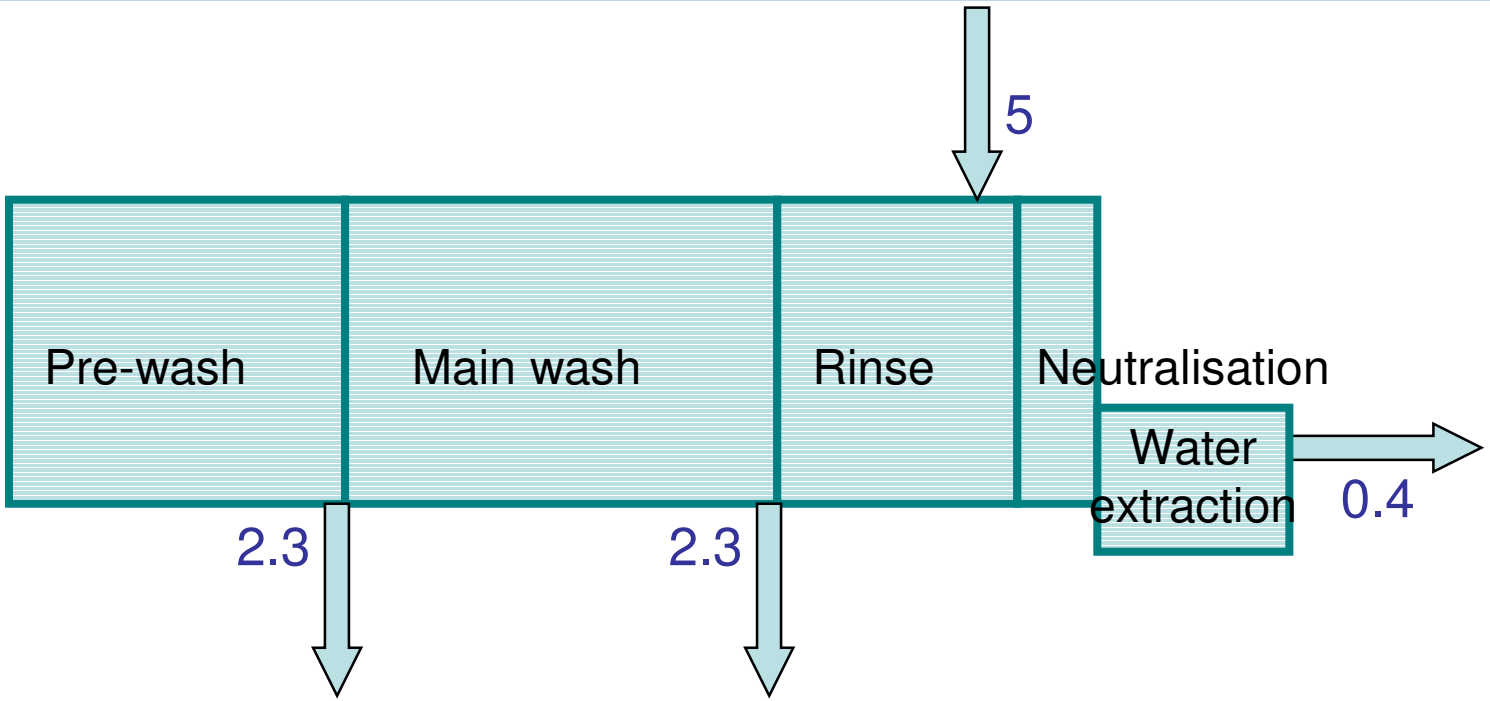
Education and Culture
Leonardo da Vinci

Unique DryTransfer



- Drain of the soiled liquor after main wash is completed (Oscillating or rotating with the drain open)
- Transfer into the rinse section without free liquor!
- No soiling of the rinse section, no drain in the rinse section!

Optimized rinsing



How is a rinsing flow of only approx. 5 l/kg achieved?

A) Optimized wash processes

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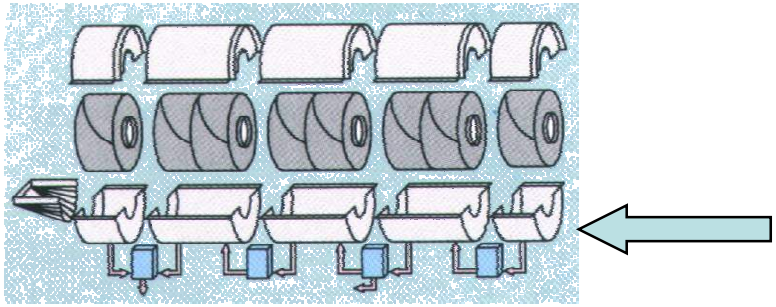
C) Optimized rinsing

Optimized rinsing

Rinse flow

- Depending on weight and wash program, controlled by inductive flow meters
- Either constant rinse flow or pulsing along the cycle time possible
- Forced rinse flow guidance through the inner drum

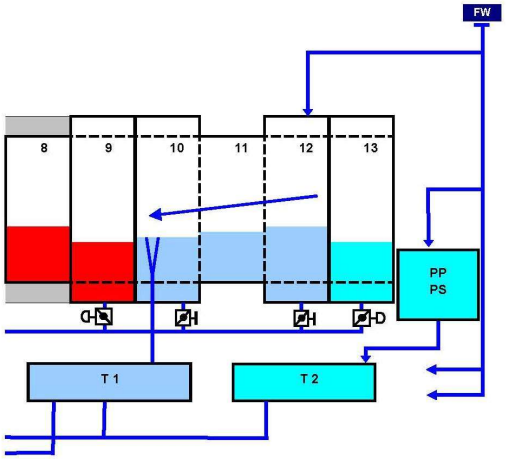


- Comparison: Systems with overflow boxes
- "Rinse flow bypass" through the outer drums

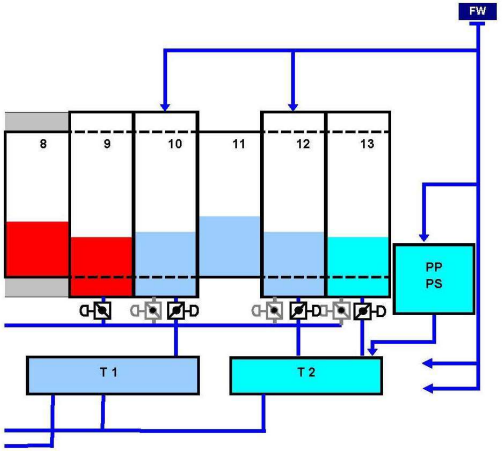
Optimized rinsing

New rinse methods

Traditional: Counterflow rinsing



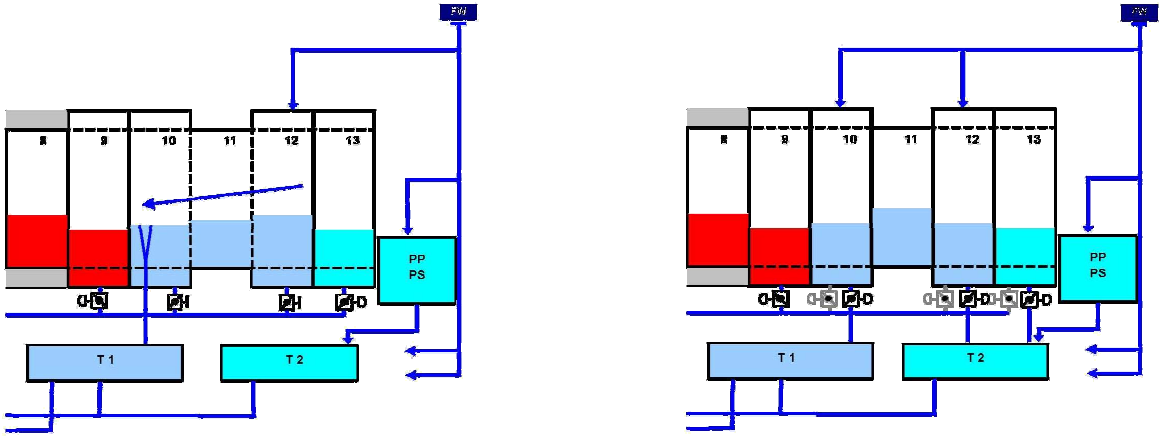
NEW: Multiple bath changes



- Extremly short drain and filling times allow new rinse methods
  ⇒ **Rinse quality as in a washer extractor**
- Considerable better dilution with comparable water usage
- Drastically reduction of empty batches for colour changes
- Rinse process exactly repeatable

Optimized rinsing

Calculation of dilution during rinsing:



Example:

Flow ratio 1:4.5 including 2 ltr/kg bounded water

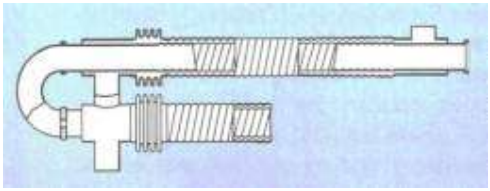
a) **6.0 ltr/kg counterflow rinsing (without DryTransfer)**
Dilution in the rinse section: 4.5 / (4.5 + 6) = **42.8 %**

b) **6.0 ltr/kg counterflow rinsing (with DryTransfer)**
Dilution in the rinse section: 2 / (2 + 6) = **25.0 %**

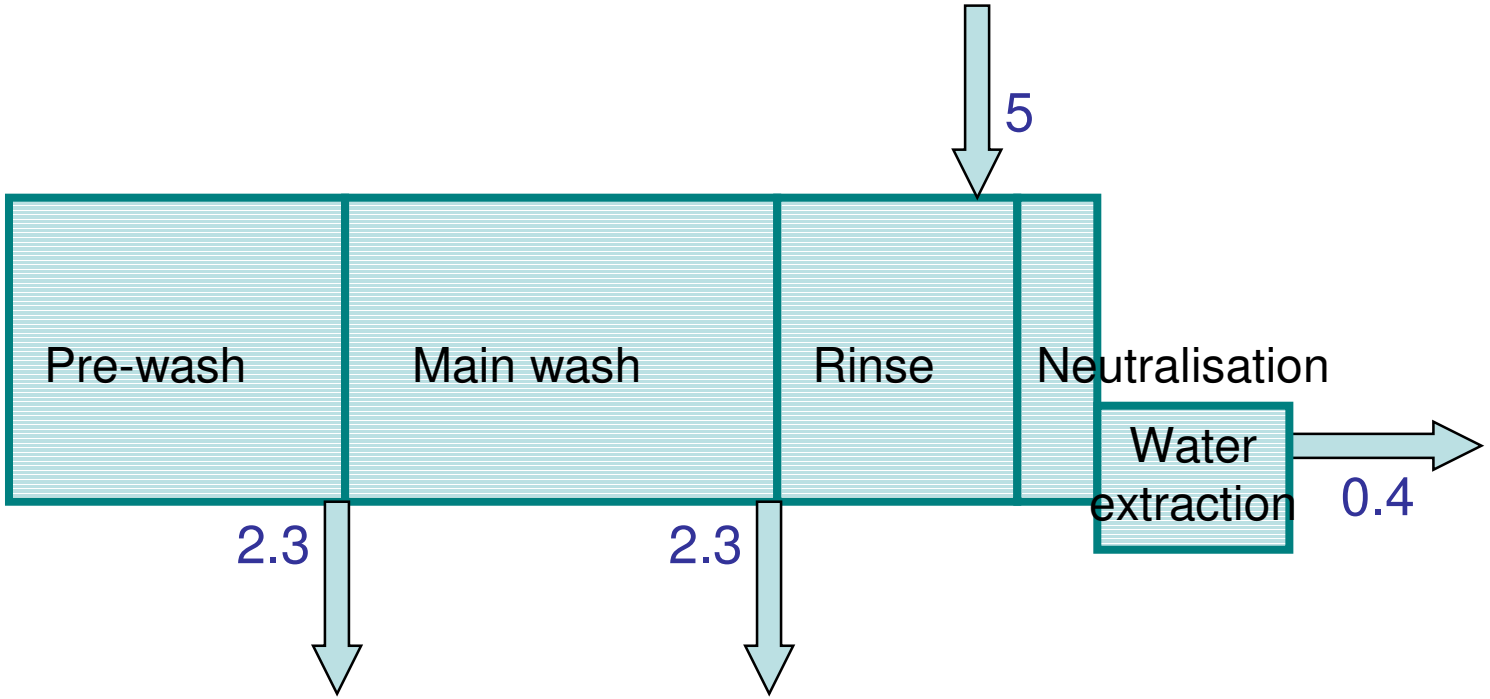
c) **3 x 2.0 ltr/kg multiple bath changes for rinsing**
Dilution 1st bath exchange: 2 / (2 + 2) = 50.0 %
Dilution 2nd bath exchange: 50.0 % x 50.0 % = 25.0 %
Dilution 3rd bath exchange: 25.0 % x 50.0 % = **12.5 %**

Waste Water Heat Exchanger for warm rinsing

- **Better rinse effect** through swelling of fibres
- Better water extraction ⇨ **lower residual moisture**



You find further information in the "Heat Exchanger" presentation in Module 5.



How is a rinsing flow of only approx. 5 l/kg achieved?

A) Optimized wash processes

B) Less soiled liquor transported into the rinsing zone

C) Optimized rinsing

The optimized washing process (Sinner's circle)