

# **Sustainability in commercial laundering processes**

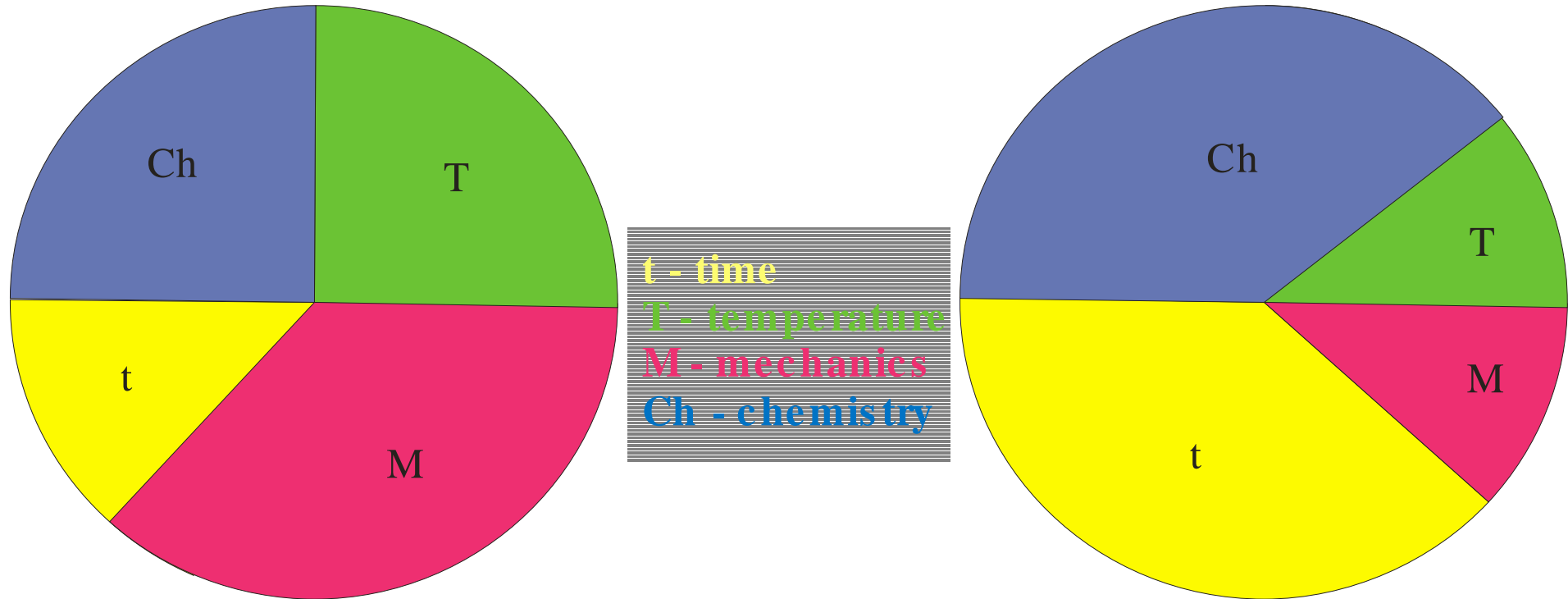
Module 2  
**Machine Technology**

Chapter 1

## **Sinner's circle**

- Sinner's circle
- Mechanics and it`s effects
- Chemistry and it`s effects
- Temperature and it`s effects
- Time and it`s effects

# Sinner's circle



<i>Temperature</i>	-	<i>const.</i>	<i>Temperature</i>	-	<i>low</i>
<i>Chemical dosing</i>	-	<i>const.</i>	<i>Chemical dosing</i>	-	<i>high</i>
<i>Mechanics</i>	-	<i>high</i>	<i>Mechanics</i>	-	<i>weak</i>
<i>Time</i>	-	<i>shortened</i>	<i>Time</i>	-	<i>prolonged</i>

# Mechanical factor and its effect on washing performance

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- The movement of the wash in the washer extractor is caused by revolutions of inner drum
- Its intensity depends on peripheral speed of the drum, i.e. number of revolutions per minute
- Depending on peripheral speed the effect of mechanical action is diversified, from low to significant
- If the peripheral speed is a little lower from the speed equilibrating, the wash weight is falling down under the so called **falling angle,  $\alpha$**

# Mechanical factor and its effect on washing performance

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## The mechanical action is also affected by:

- **load ratio** (the quotient of an inner drum volume in  $\text{dm}^3$  to the wash mass) expressed in  $[\text{dm}^3/\text{kg}]$  or simply 12:1
- **liquor ratio** (water level in drum) in washing and rinsing processes defined as the quotient of total water volume in the washer extractor to the wash mass expressed in  $[\text{dm}^3/\text{kg}]$  or simply 5:1; at the low level of the washing bath due to an increased friction forces the mechanical action is also increased
- **construction of an inner drum**; in sectional drums a decreased mechanical action is observed; an increase in the drum diameter is also associated with an increased mechanical effect

# Chemistry and its effect on washing performance

## DREAM OF THE WASHERWOMAN (*R. Berneiser, K. Ueberschär, Lehrbuch der Textilreinigung, VEB Fachbuchverlag, Leipzig 1980*)



## Water consumption in laundry

### **Water consumption in washer-extractors at the considered load (kg) depends on:**

- applied washing technology
- different kinds of textiles to be washed and their soiling degree cause the changes in water consumption
- the main factor affecting the consumption of water in the technological process considered is the liquor ratio in particular phases of the washing process
- the number of these phases requiring the filling of the washing machine with water

## **Main ingredients of contemporary washing powders:**

- **Surface active agents (soaps, anionic, non-ionic)**
- **Sequestering agents (TPPNa, Zeolith A, NTA, EDTA etc.)**
- **Builders (sodium carbonate, sodium metasilicate, sodium sulphate, sodium perborate etc.)**
- **Enzymes (proteinases, lipases, cellulases, oxido-reductases) TAED system**
- **Phosphonates**
- **Organic copolymers**
- **Foam stabilizers (alkyl amides)**
- **NaCMC (sodium salt of carboxymethyl cellulose)**
- **Fluorescent brightening agents (FBA)**
- **Fragrance**
- **Dyestuff (ultramarine)**

## BLEACHING/DISINFECTING AGENTS

- chlorine - containing bleaching/disinfecting agents (sodium hypochlorite, chloramine, isocyanurates),
- oxygen - containing bleaching/disinfecting agents (hydrogen peroxide, sodium perborate, peracetic acid,



- activated systems (TAED), modified activated systems (**H<sub>2</sub>O<sub>2</sub> /TAED/ACL**)  
– for bleaching in tunnel batch washers (wfk)

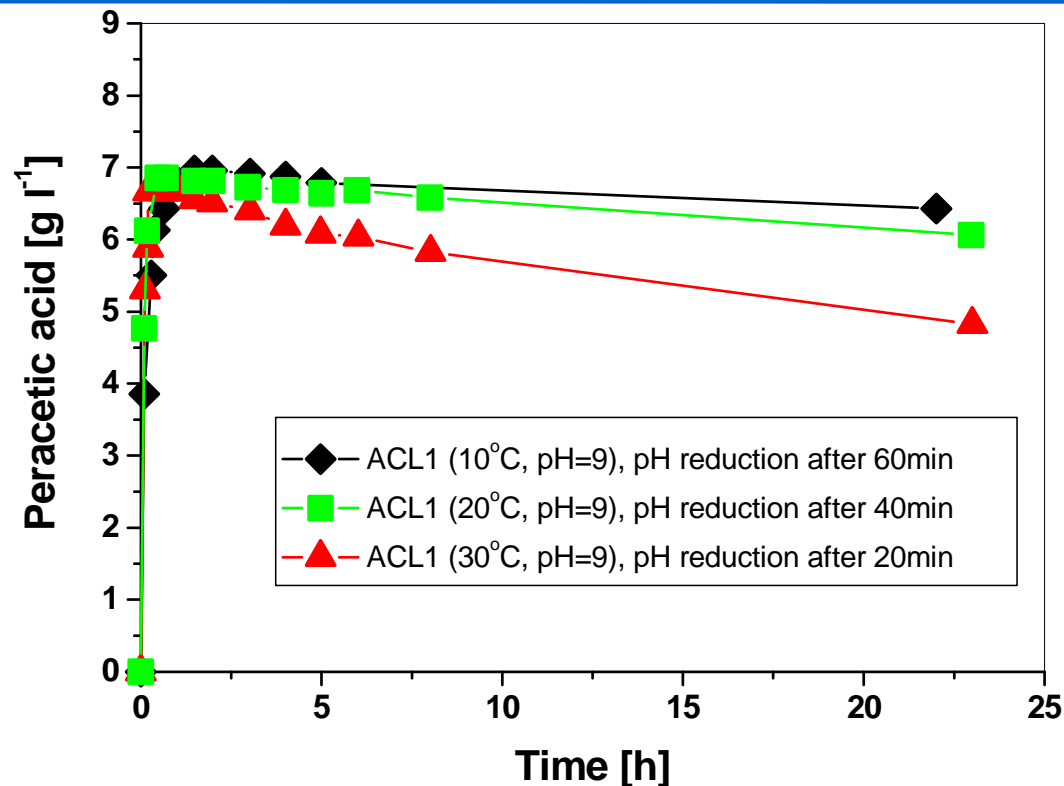
Foellner, B., Bohnen, J., Kruessmann, H., Proceedings of the 40th wfk-International Detergency Conference, April 30th – May 3rd, (2001), Strasbourg, France, pp. 283-291

# Temperature and its effect on washing performance

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- At increased temperature the kinetic energy of surfactant ions is elevated and the effective removal of dirt is much easier
- At elevated temperature the sorption velocity of surfactant ions on textiles is increased
- The problem of the washing temperature in laundries should be considered in relation to disinfection
- Taking the washing quality into account, the studies done in British laundries and BLRA proved that no distinct changes in dirt removal at 60°C, 65°C, 82°C and even above 92°C were observed

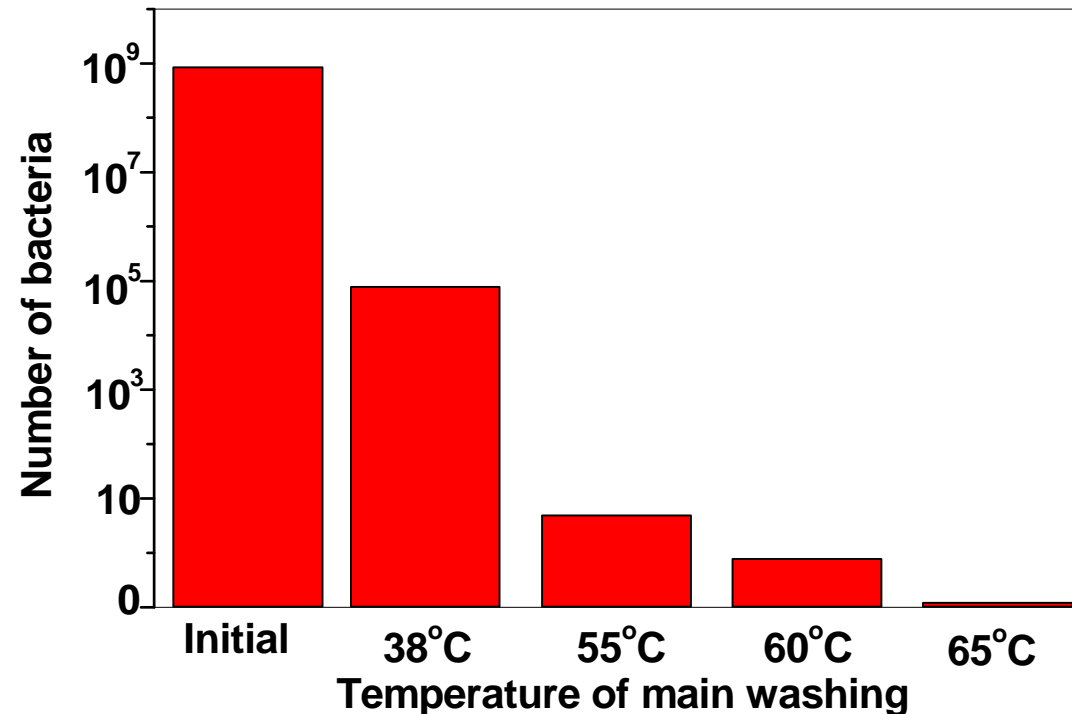
# Temperature and its effect on washing performance



**Influence of the reaction temperature and the timing of the pH value reduction on the concentration of the formed peracetic acid in the system ACL/H<sub>2</sub>O<sub>2</sub>; pH-reduction after 60min (10°C), after 40min (20°C) and after 20min (30°C)**

B. Foellner, J. Bohnen, H. Kruessmann, Proceedings of wfk 40<sup>th</sup> International Detergency Conference, April 30<sup>th</sup> – May 3<sup>rd</sup>, Strasbourg, France, 2001

# Temperature and its effect on washing performance



**Number of viable bacteria (*Streptococcus faecalis*) on ½ square inch of textile after rinsing in dependence of main washing temperature**

*Kelsey, J.C., Path, M.C., Wagg, R.E., BLRA Bulletin, 9 (15), 231 – 236 (1969);  
9 (16), 239 –246 (1969)*

# Time and its effect on washing performance

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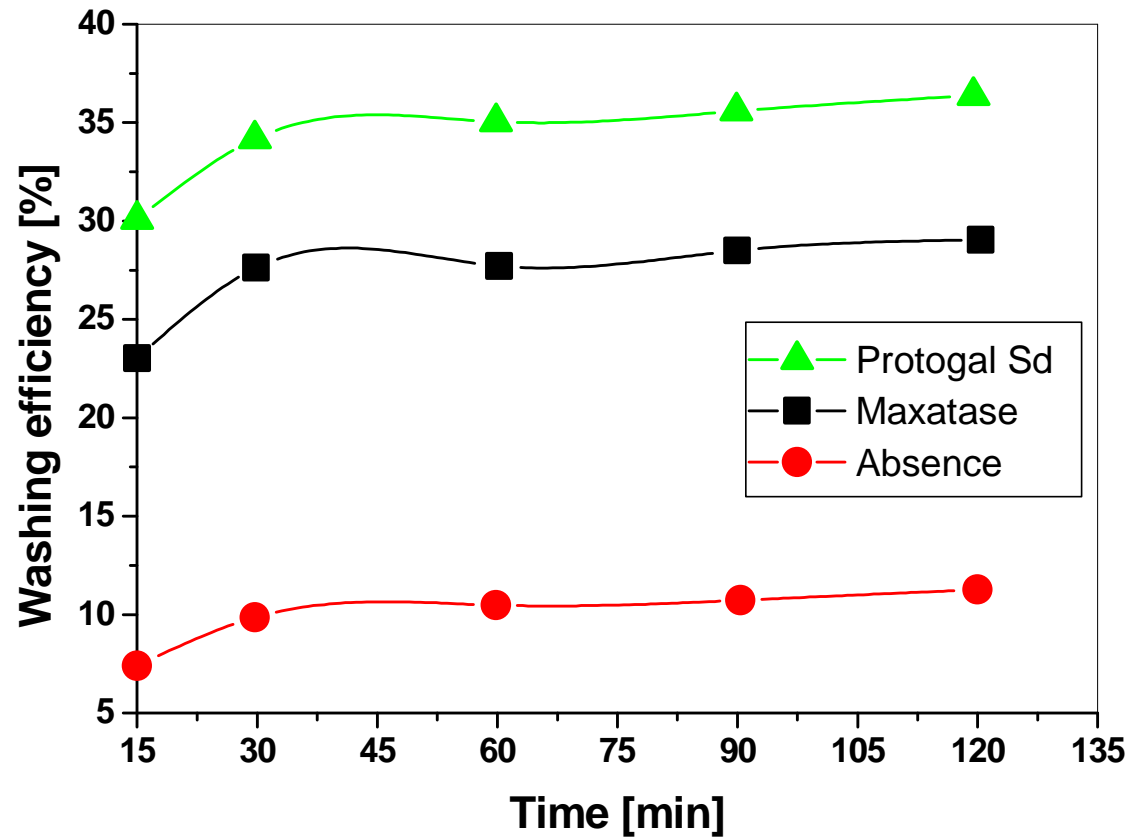
- Washing time is in reverse proportion to washing agent concentration and applied mechanics
- Washing agents require a definite contact time to ensure the proper interactions between fibre, dirt and washing agent
- With an increased time the proper balance between the fibre surface and the washing bath is achieved thus affecting the suspending power of the pigment soil and its redeposition
- The prolonged time of washing contributes to the bigger redeposition of the pigment soil causing bigger greying and the mechanical damage of textiles

# Time and its effect on washing performance

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- Like the temperature, the time in which temperature is kept can be also considered as an important factor for disinfection
- According to the BLRA studies the total time of the main wash should amount to 10 minutes + 4 minutes as “mixing time” at temperature 65°C
- In washer extractors of a big load capacity 8 minutes as “mixing time” should be added (total 18 minutes)
- An increase in temperature up to 71°C is associated with a decrease in basic time of wash up to 3 minutes with a “mixing time” 4 or 8 minutes, respectively

# Time and its effect on washing performance



The influence of time of washing process on washing efficiency of enzymatic washing agents