Hygiene safety and resource savings in automated cleaning – A contradiction?

Name: Dennis Eisert
Ulf Klung
Matthias Tschoerner
Bastian Wulff

Affiliation: Chemsiche Fabrik Dr. Weigert
GmbH & Co. KG

wfhss
World Federation for Hospital Sterilisation Sciences

Sustainability

Hannß Carl von Carlowitz, (1645 - 1714)

Sylvicultura Oeconomica, 1713, pp. 105–106

"... like such a conservation and cultivation of wood / that there is a continuous, constant and sustainable use / because it is an indispensable thing / without which the country cannot remain in its being."

https://digital.slub-dresden.de/werkansicht/dlf/85039/9

Print: Leipzig: Braun, 1713, Online-Ed.: Dresden: SLUB, 2013

https://en.wikipedia.org/wiki/Sustainability

Sustainability

… means meeting the needs of the present in a way that does not limit the opportunities of future generations.

Federal Ministry for Economic Cooperation and Development

https://www.bmz.de/de/service/lexikon/nachhaltigkeit-nachhaltige-entwicklung-14700

Energy and CO_2 balances

Examples of energy efficient hospitals

Energy efficiency standard	Consumption characteristics of electrical primary energy arithmetic . Middle [kWh/m²a]	Electrical energy consumption figures GHG emissions arithm . Middle [kg/m²a]
Administration building	**77**	**20**
Primary care hospitals (-250 BE)	171	45
Hospitals standard care (251-450 BE)	**217**	**57**
Hospitals maximum care (from 1000 BE)	134	35

Energy consumption characteristics of energetically highly efficient buildings, final report, KWEFF2015, C. Zeine, S. Gausling , C. Cassebaum , M. Gebhardt, N. Goldau, J. Peters, Society for Energy Planning and System Analysis mbH , Münster, September 2015

Environmental aspects in the SPD/CSSD

Latent questions for more than 10 years (Selection)

Reducing the environmental footprint of gastrointestinal endoscopy: European Society of Gastrointestinal Endoscopy (ESGE) and European Society of Gastroenterology and Endoscopy Nurses and Associates (ESGENA) Position Statement; de Santiago Enrique Rodríguez et al. Reducing the… Endoscopy 2022; 54:797-826

wfhss 2015 Lille: Kristian Hemström , study on the impact from production to disposal on energy consumption and the climate: **The use of single-use instruments releases 600 times as many greenhouse gases (GHG) consumes 17 times as much energy as the use of reusable instruments**; Report: G. Westermann, Central Sterilization, 2015, 388

Eco-Sterilization: A challenge for all of us; Christophe Lambert, 7th Swiss conference SGSV, 2011

Sustainable development in processing , 32nd French National Sterilization Days in Lille, April 28th and 29th, 2010; Report: G. Westermann, Central Sterilization, 2010, 144

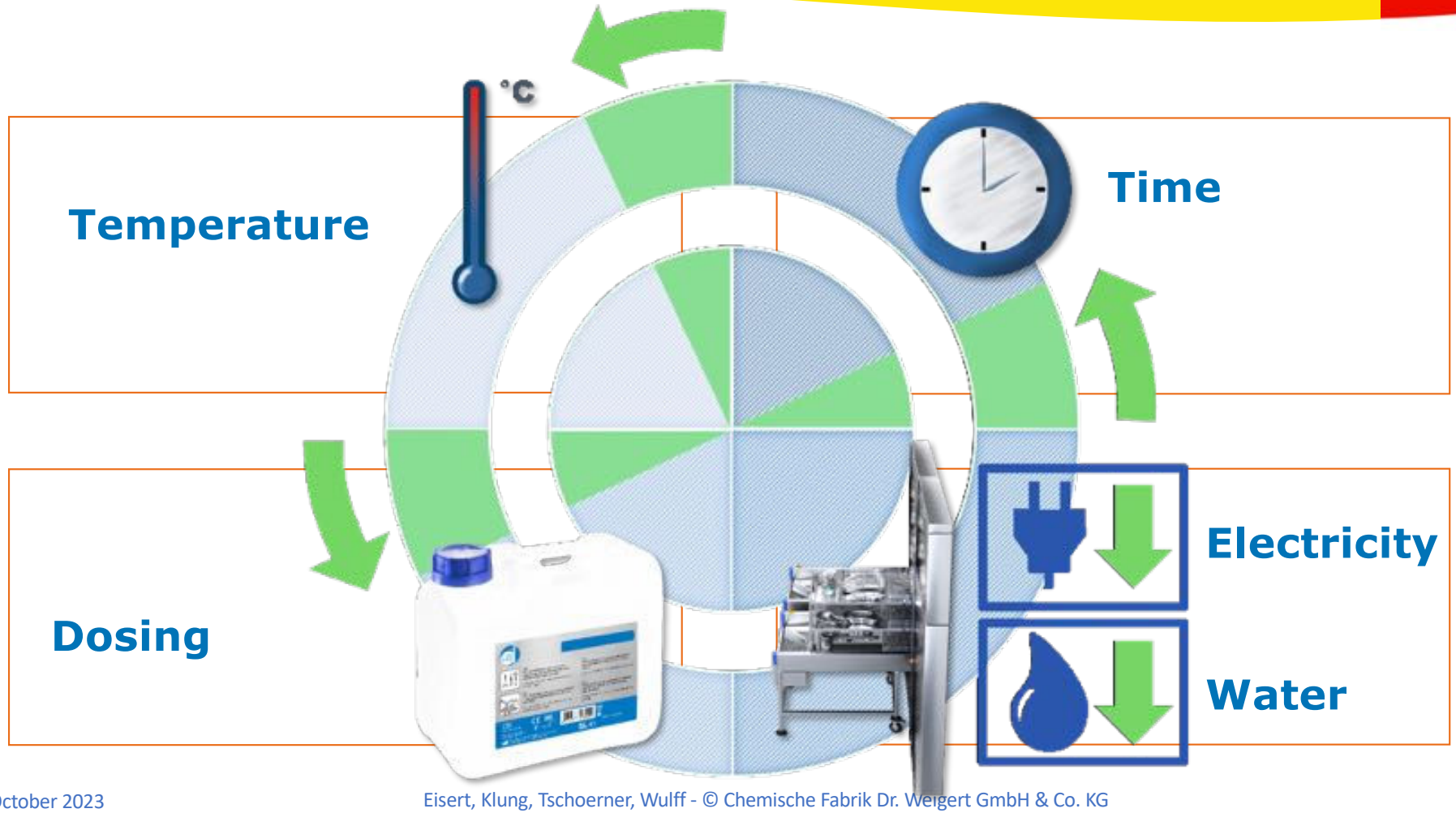
Material and energy balance

Model CSSD – 4 WD, 1 Trolley washer, 225 operating days, 1 shift operation

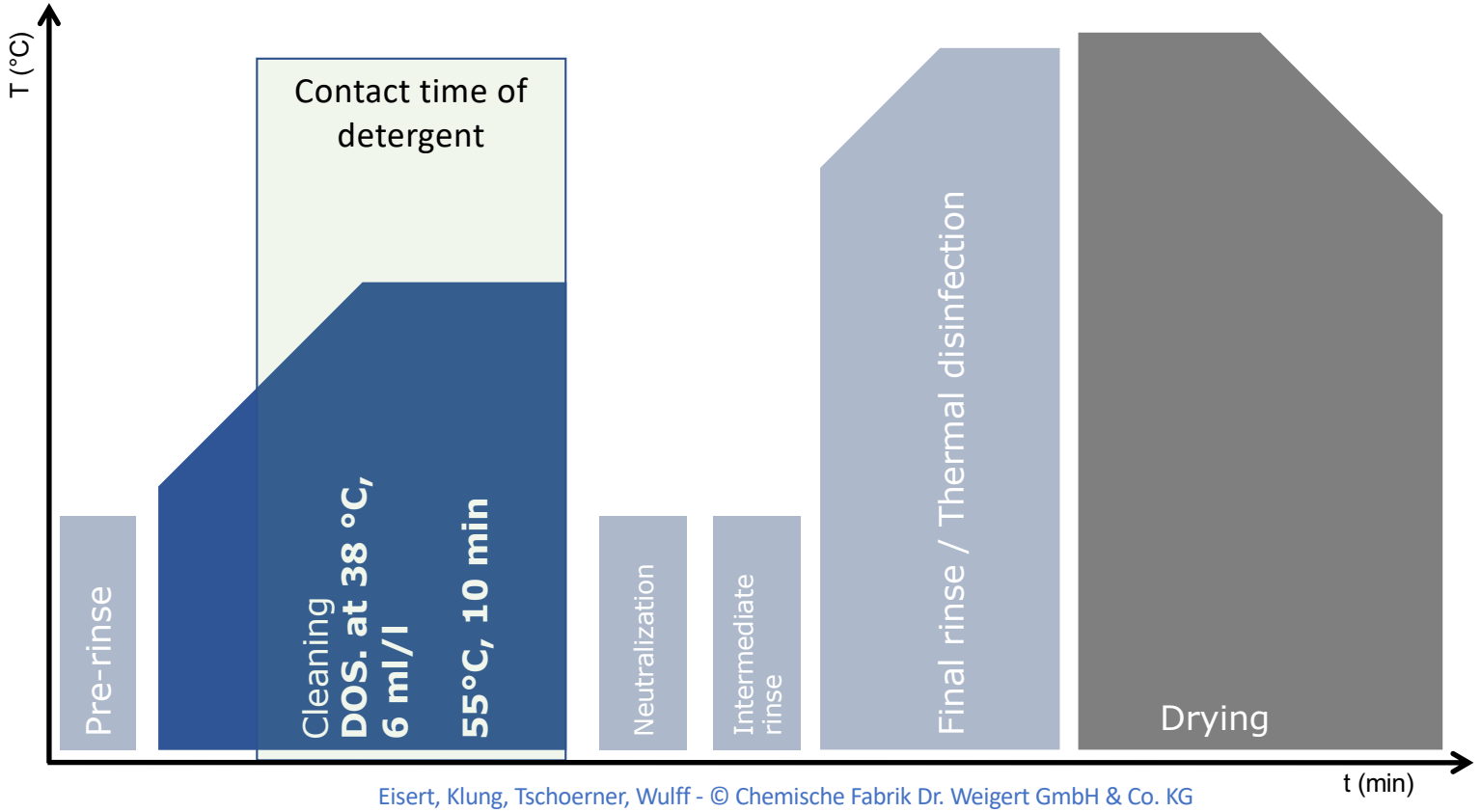
	Chemistry ml/l	Electricity cycle kWh	water cycle L	Cycles Year	Chemistry Year L	Electricity Year kWh	Water Year L
WD	5	10	120	7200	4320	72000	864000
Trolley washer	3	13.3	160	2700	1296	36000	432000
Total consumption					**5616**	**108000**	**1296000**
Costs						**37800 €**	**51840 €**
GHG emissions						**54540 kg CO_2**	

Operating days: 225 p. year, WD: 8 cycles p. day, Trolley washer 12 cycles p. day
Electricity costs € 0.35/kWh, deionized water costs € 0.04/L
Greenhouse gases CO_2 equivalent: 0.505 [kg/kWh], IWU 2020, Institute for Housing and Environment, 26-02-2020

Energy saving through optimized program sequences


Temperature
°C
Time
Dosing
Electricity
Water

WD Standard program sequence



WD Standard program sequence

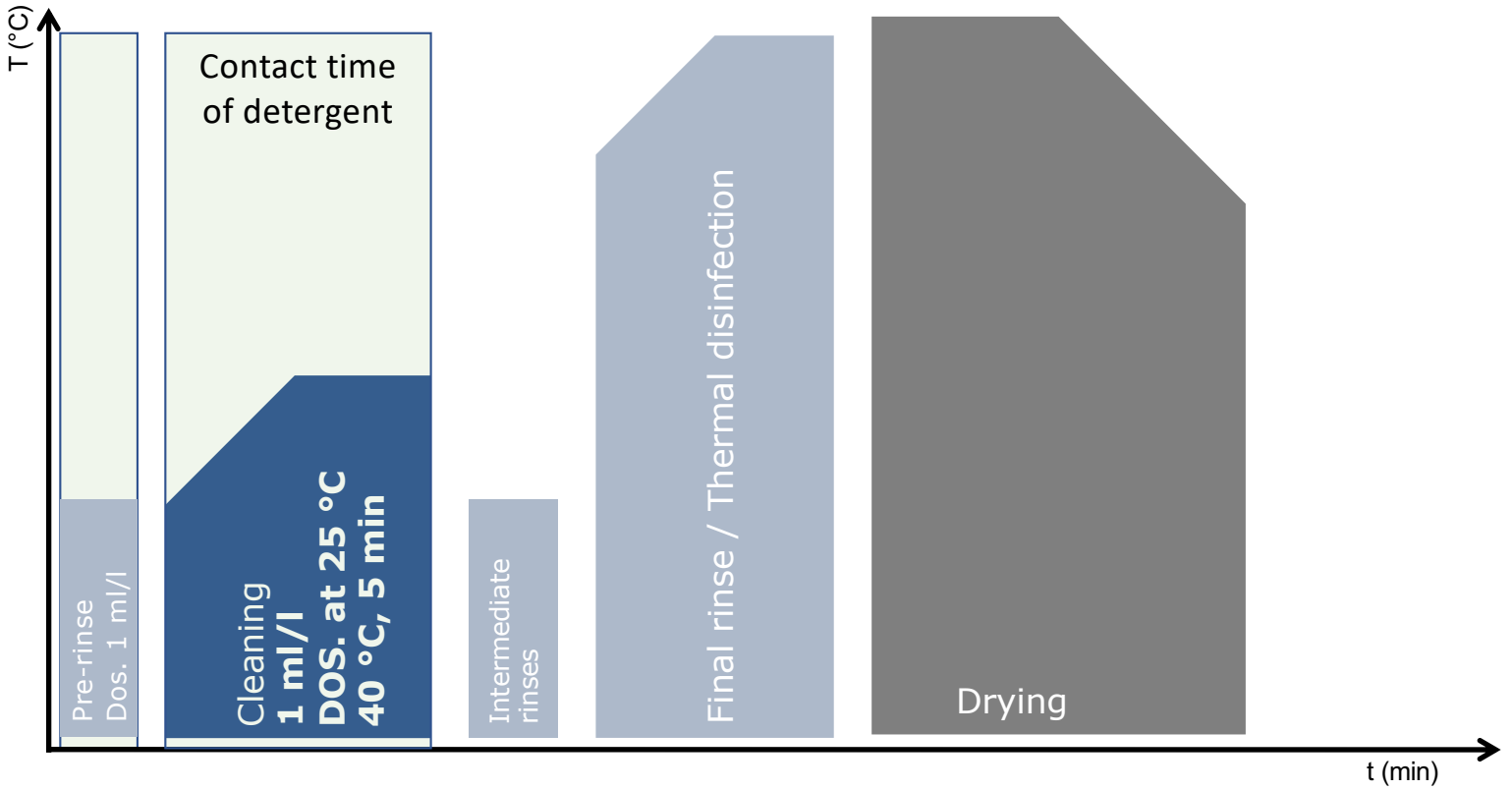
WD: MMM UniClean PL II
Test spicemen: Crile clamp [1]
Test soil: Coagulated blood [1, 2]

Pre-rinse: 2 min, cold
Cleaning: 10 min at 55 °C
6 ml/l mild-alkaline enzymatic cleaner
Neutralization: 2 min, cold
Intermediate rinse, Thermal disinfection, Drying

Parameter	Result per cycle
Water	178 L
Time	49 mins
Electricity	**10 kWh**
Process chemistry	**220 ml**
Cleaning performance (residual protein)	**Ø 14.4 µg ± 5.9 µg**

[1] Guideline compiled by DGKH, DGSV and AKI for the validation and routine monitoring of automated cleaning and thermal disinfection processes for medical devices; 5th Edition. Central Service 2017; 25, Suppl.
[2] ISO 15883-5:2021 Table A.1, 1st Row; [3] AAMI ST98 (2023)

WD energy optimized program sequence



WD energy optimized program sequence

WD:	MMM UniClean PL II, electrical heated
Test specimen:	Crile clamp [1]
Test soil:	Coagulated blood [1, 2]
Pre-rinse:	2 min, cold, 1 ml/l optimized detergent
Cleaning:	10 min at 35 °C
	1 ml/l optimized detergent, dos. 25 °C

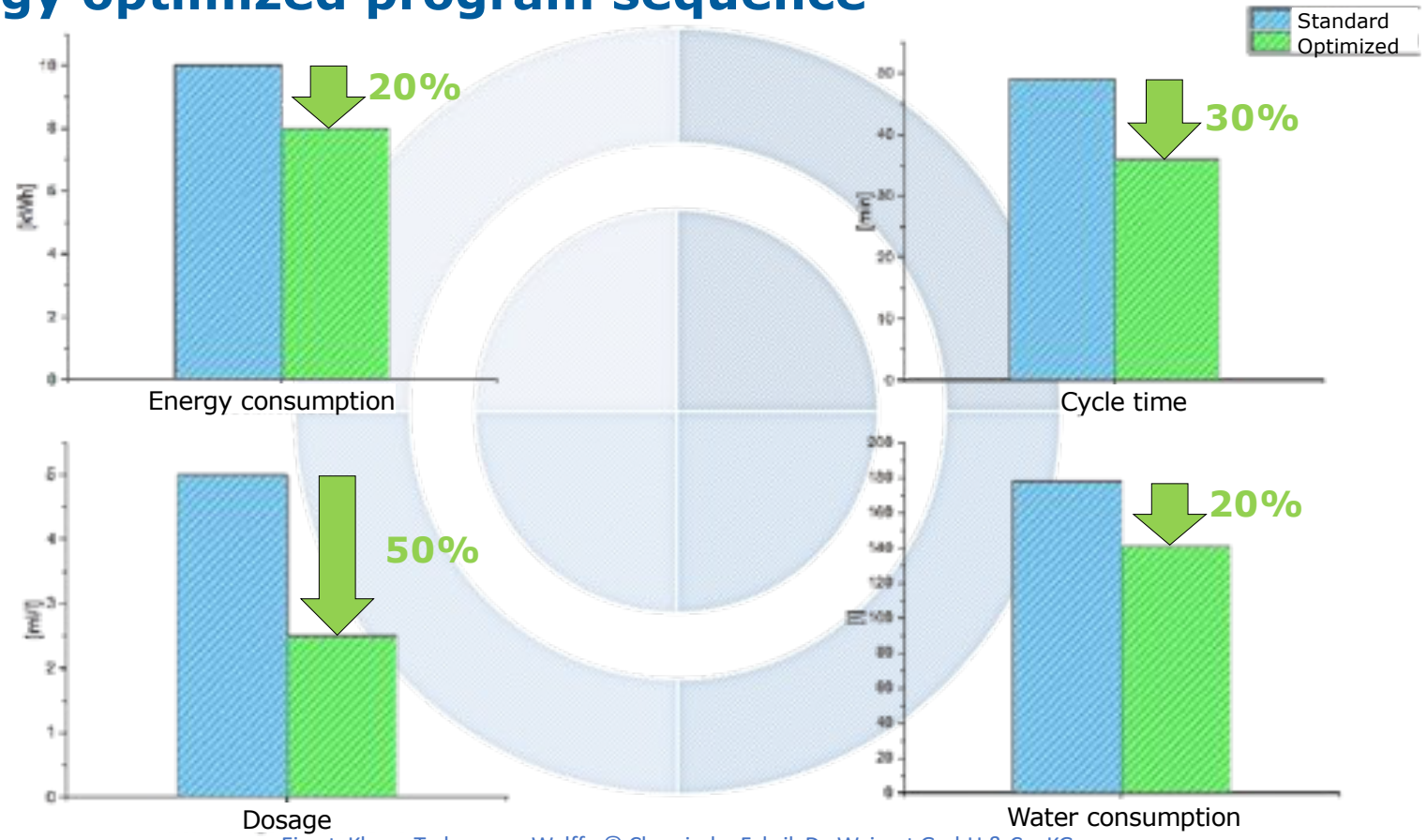
Intermediate rinse, Thermal disinfection, Drying

Parameter	Result per cycle
Water	141 L
Time	36 mins
Electricity	**8 kWh**
Process chemistry	**75 ml**
Cleaning performance (residual protein)	**Ø 15.6 µg ± 11.5 µg ***

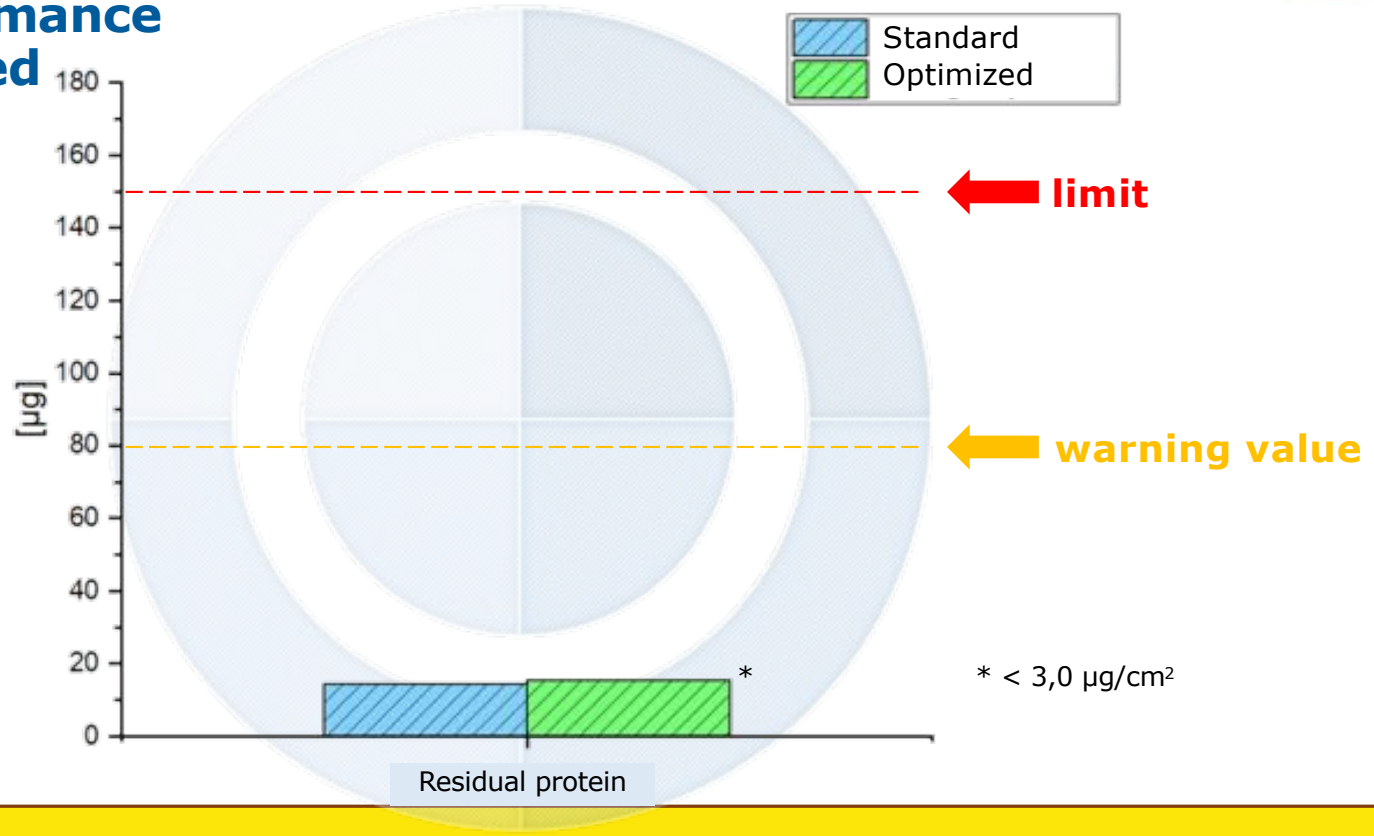
* < 3,0 µg/cm²

[1] Guideline compiled by DGKH, DGSV and AKI for the validation and routine monitoring of automated cleaning and thermal disinfection processes for medical devices; 5th Edition. Central Service 2017; 25, Suppl.
[2] ISO 15883-5:2021 Table A.1, 1st Row; [3] AAMI ST98 (2023)

WD enegy optimized program sequence



Cleaning performance
Energy optimized



* < 3,0 µg/cm²

Consistent cleaning result despite energy savings

Real use - WD Validation France

WD: Belimed WD 290, electrical heated

Load (selection):

- Surgical instruments
- MIS instruments
- Gynecological instruments
- Ophthalmic instruments
- Anesthetic equipment
- Rigid endoscopes / optics
- Container (anodised aluminium)
- DaVinci Optics

Real use - WD Validation France

WD: Belimed WD 290, electrical heated

Contamination from real use (selection):

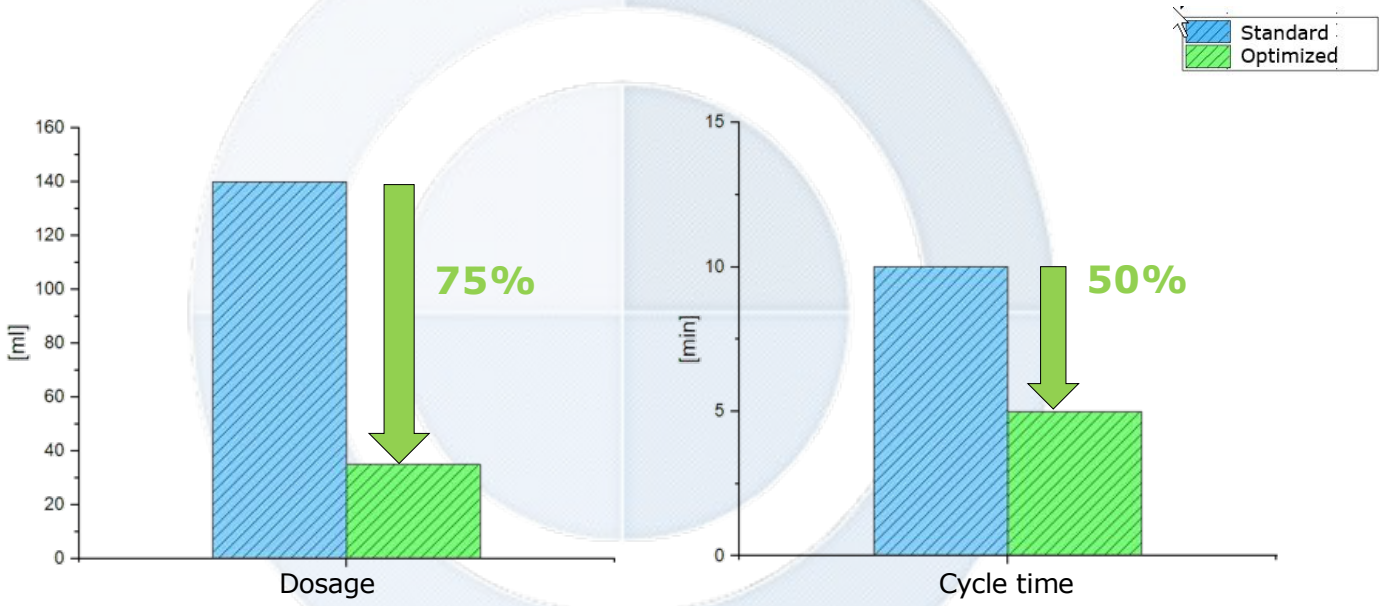
- Blood, Protein
- Denatured blood (e.g. RF-Technology)
- Mucus, blood-mucus mixtures (e.g. gynecology)
- Mucus (ENT)
- Dental dirt, mouth, jaw and palate
- Bone meal, dentin
- Contamination from ophthalmology _
- Antiseptic Residues (containing iodine)

Real use - WD Validation France

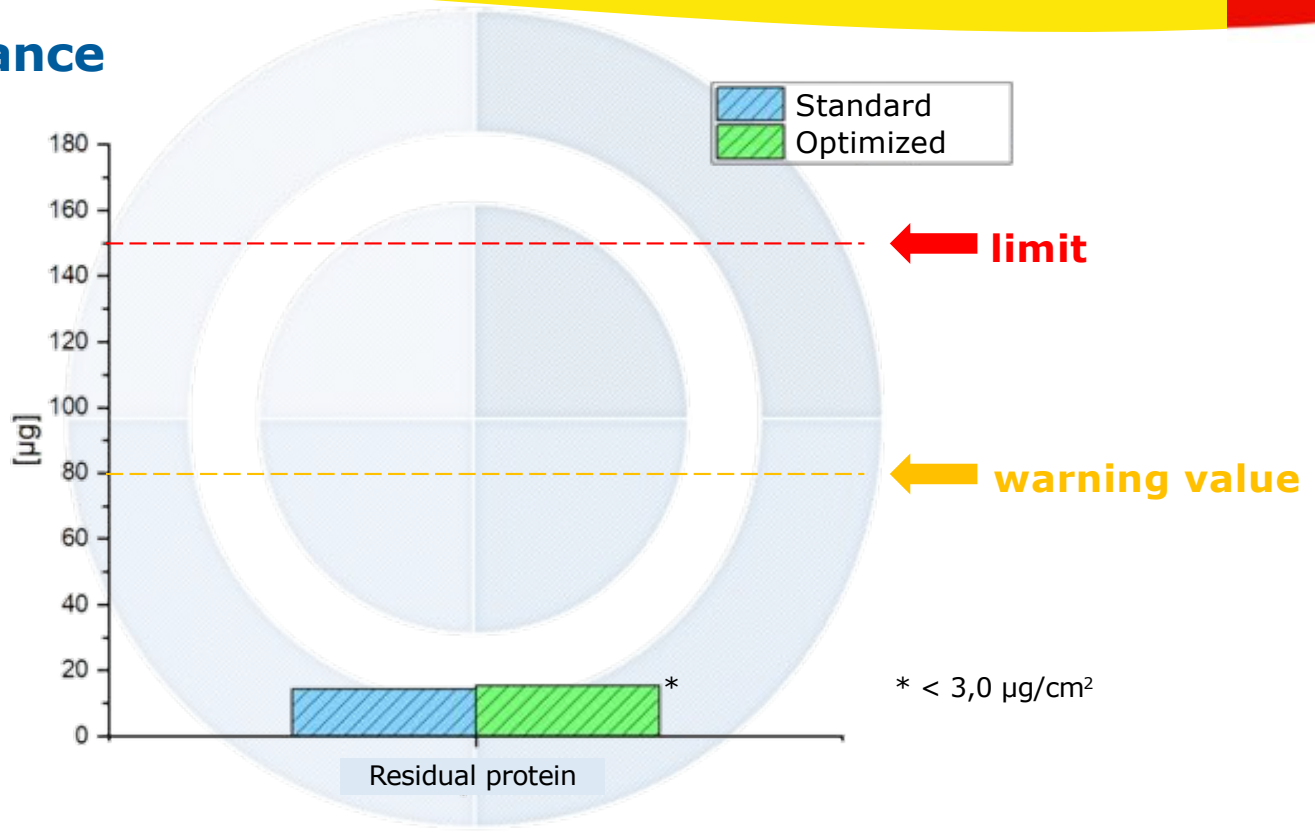
	Commonly used mild-alkaline enzymatic detergent	**Optimized mild-alkaline enzymatic detergent**
Pre-rinse	Unchanged	Unchanged
Cleaning	**4 ml/l, 10 min, 55 °C,** dosing at **38 °C**	**1 ml/l, 5 min, 45 °C,** dosing at **25 °C**
Intermediate rinse	Unchanged	Unchanged
Water	35 l in the cleaning step	35 l in the cleaning step
Process chemistry	**140ml**	**35ml**

Real use - WD Validation France

Real use - WD Validation France



Cleaning performance
Energy optimized



* < 3,0 µg/cm²

Consistent cleaning result despite energy savings

Real use - WD Validation – Service provider Germany

WD: Steelco DS 1000, steam heated

Load (selection):

- Surgical instruments
- MIS instruments
- Gynecological instruments
- Endoprosthetic sets
- Rigid endoscopes / optics
- Container
- Stationware (instruments, utensils)

Real use - WD Validation – Service provider Germany

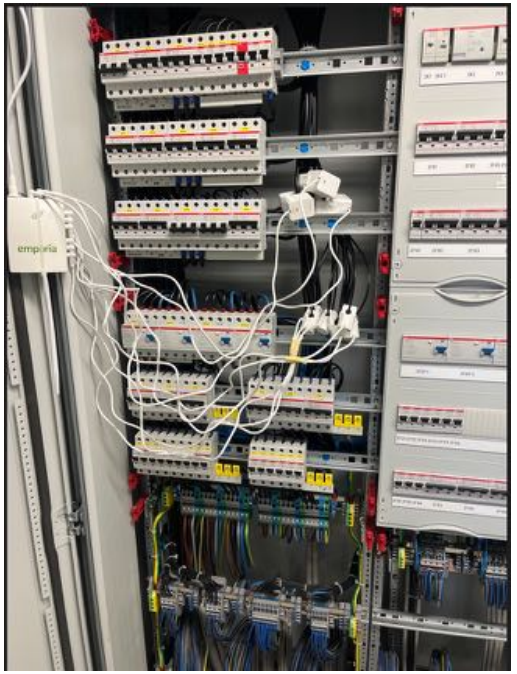
WD: Steelco DS 1000, steam heated

Contamination from real use (selection):

- Blood, Protein
- Denatured blood (e.g. HF-technology)
- Mucus, blood-mucus mixtures (e.g. gynecology)
- Mucus (ENT)
- Bone meal, dentin

Real use - WD Validation – Service provider Germany

	Commonly used mild-alkaline enzymatic detergent	Optimized mild-alkaline enzymatic detergent
Pre-rinse	2 min, cold	2 min, cold, Dos. 0.5 ml/l
Cleaning	**6 ml/l, 10 min, 55 °C,** dosing at **38 °C**	**2 ml/l, 5 min, 35 °C,** dosing at **20 °C**
Intermediate rinse	Unchanged	Unchanged
Water	170 l	170 l
Process chemistry	**270 ml**	**113 ml** (23 ml + 90 ml)



Real use - WD Validation – Service provider Germany

energy demand heated by steam, calculated

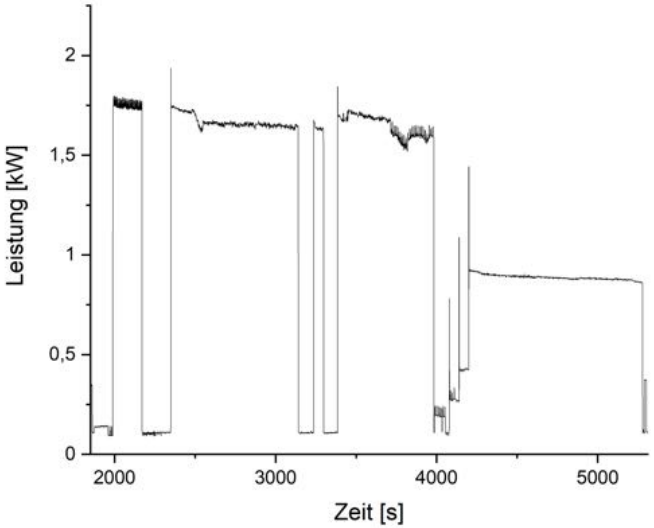
$$\Delta Q = c * m * \Delta T$$

$$\Delta Q = 4{,}19 \frac{kJ}{kg * K} * 40\ kg * 20\ \mathrm{K} = 3352\ \mathrm{kJ}$$

$$\boldsymbol{\Delta Q = 3352\ kJ = 0{,}93\ kWh}$$

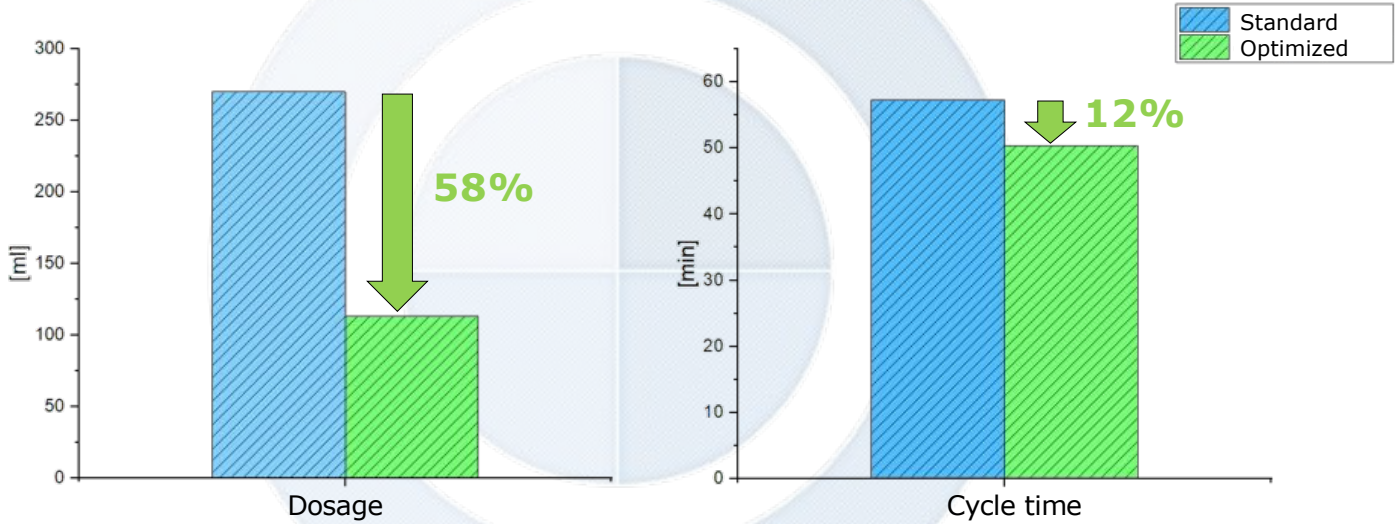
$$m = \frac{\Delta Q}{q_v} \qquad \frac{\mathbf{3352\ kJ}}{\mathbf{2257} \frac{\mathbf{kJ}}{\mathbf{kg}}} = \mathbf{1{,}48\ kg\ Steam}$$

other energy savings per cycle, measured

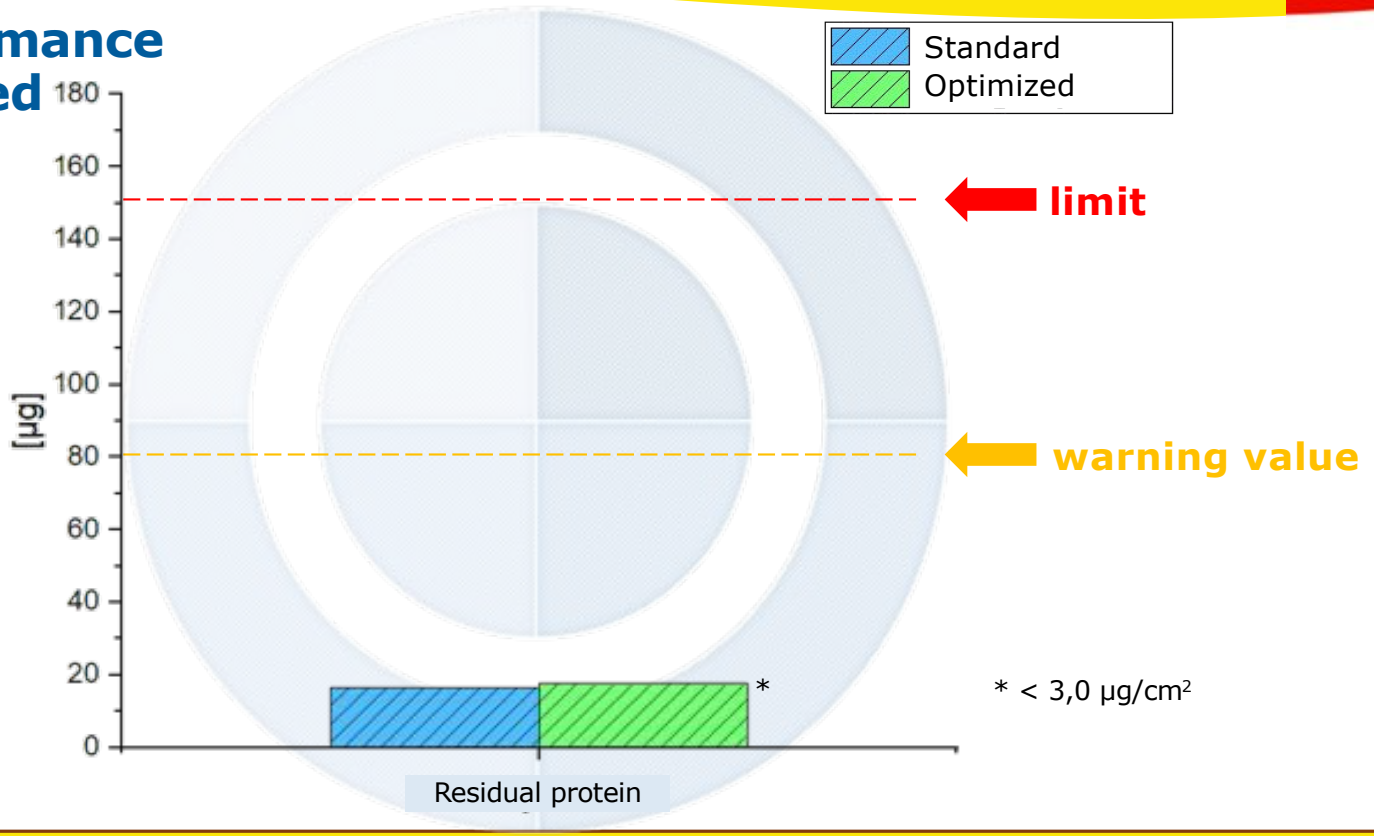


$$\Delta E = 0{,}033\ kWh$$

Real use - WD Validation – Service provider Germany



Cleaning performance
Energy optimized

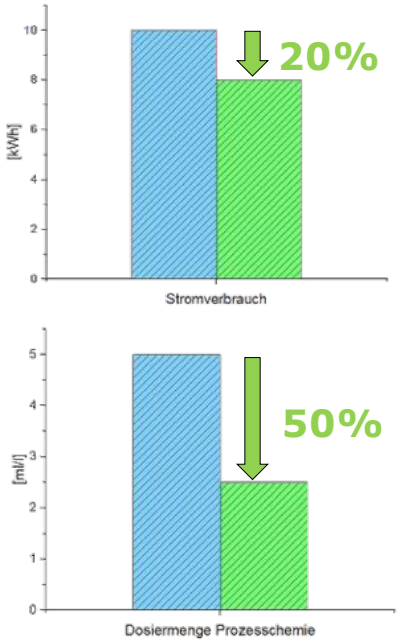


* < 3,0 µg/cm²

Consistent cleaning result despite energy savings

Material and energy balance savings

Model CSSD – 4 WD, 1 Trolley washer, 225 operating days, 1 shift operation



Saving				
	Process chemicals p. cycle ml/l	Electricity p. cycle kWh	Process chemicals Year	Electricity Year
WD	2.5	2	2160 L	14400 kWh
Trolley washer	2	2.7	864 L	7200 kWh
Total savings			***3024 L***	***21600 kWh***
Costs				***€ 7560***
GHG emissions				***10908 kg CO_2***

Operating days: 225 pa, WD: 8 cycles p. day – 3200 pa., Trolley washer: 12 batches pd . – 2700 pa
Electricity costs € 0.35/kWh, deionized water costs € 0.04/L
Greenhouse gases CO_2 equivalent: 0.505 [kg/kWh], IWU 2020, Institute for Housing and Environment, 26-02-2020

Other beneficial effects

- ✓ Less packaging material
- ✓ Lower transport costs and transport emissions
- ✓ Less storage space for replacement containers
- ✓ Fewer container replacement
- ✓ Less waste

Questions?

Thanks!