



TECHNISCHE UNIVERSITÄT
CHEMNITZ



Raw Wool Scouring – Different Detergents and their scouring results

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Future-Oriented Textile Value Chain



Textil Chain of Chemnitz University for wool



**Scouring machine for manufacturing level is not existing.
New machines and their sustainable scouring processes has to be developed**

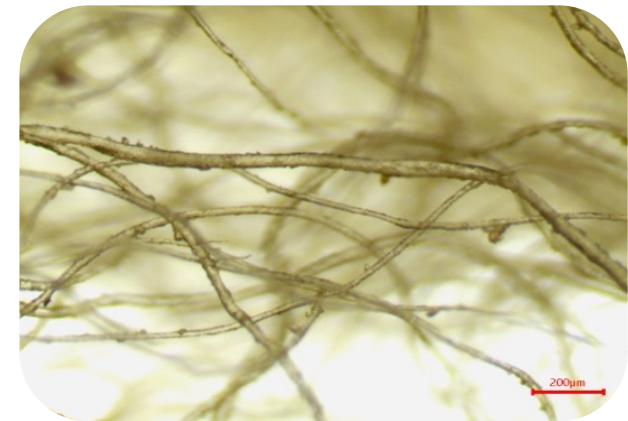
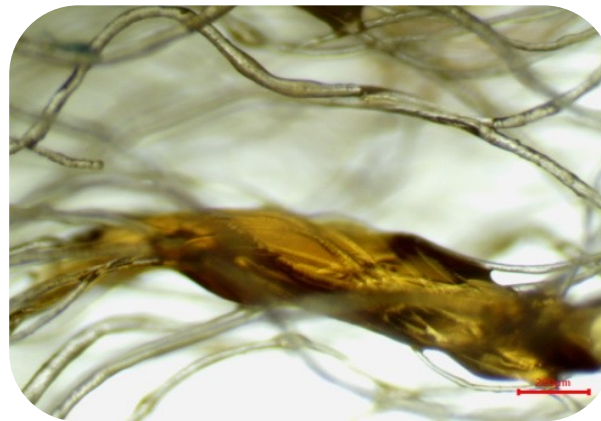
Starting point

- No suitable wool scouring facility in the Germany and Europe
- Regional raw wool can hardly be used or further processed
- Goal: a wool scouring facility at Chemnitz University of Technology

This study

- Consider both detergent formulation and washing procedure
- Compare the wastewater of the different scouring systems
- Parameters: pH, electrical conductivity, turbidity, COD, total solids
- Identify the factors that govern the environmental performance

Raw wool = keratin fibres + a large impurity fraction



Content of impurity Fraction

Wool grease

emulsified by the washing
liquor

Suint fraction

dissolved in the aqueous
phase

Mineral dirt

transferred into suspension

Raw material: Saxon Merino wool from a regional sheep farm in Stangengrün near Zwickau, Germany

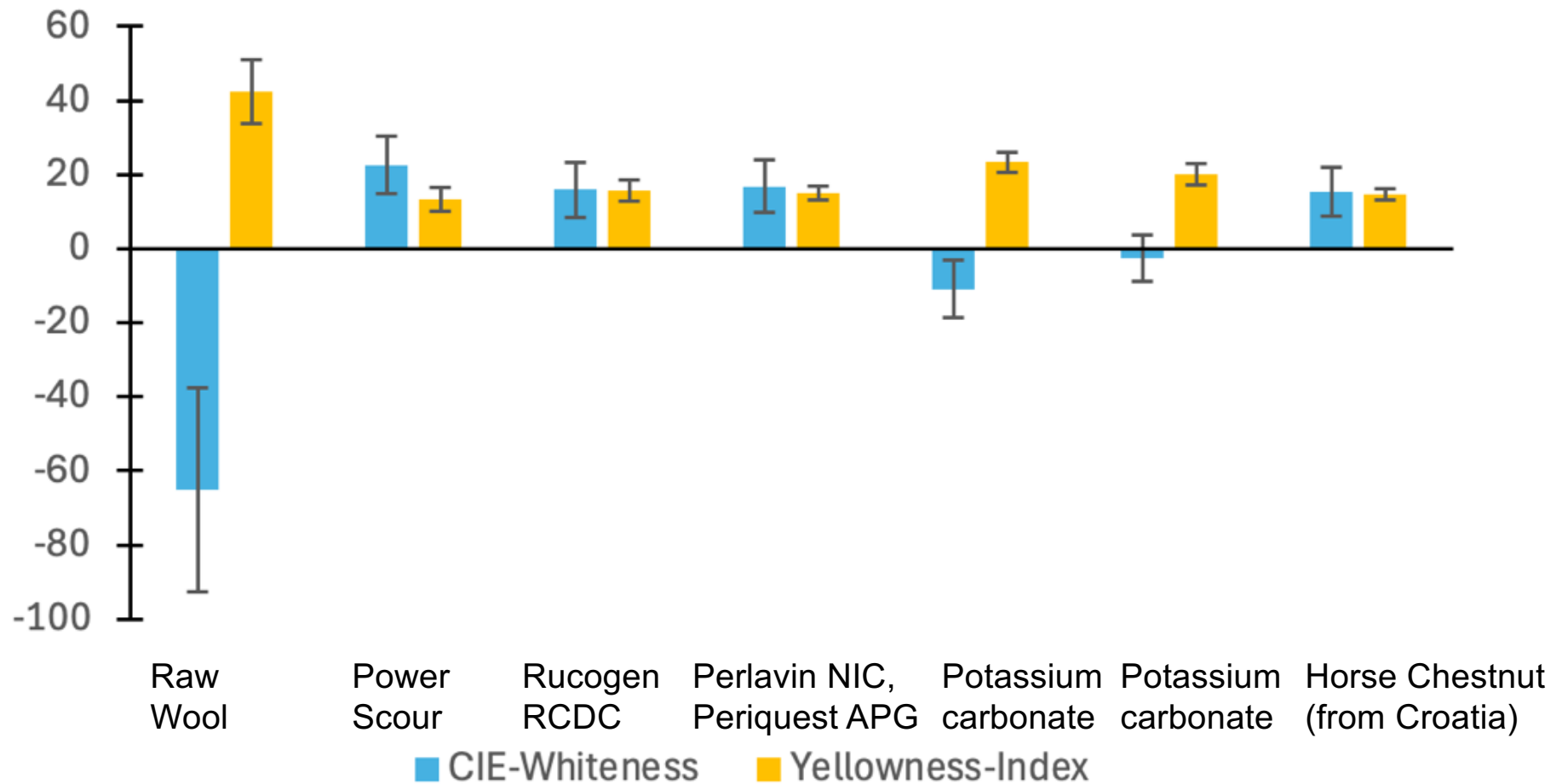
Sample	Scouring agent	Distributor	Basis of cleaning action
PS	Unicorn Power Scour	Unicorn Editions Ltd.	Anionic / non-ionic surfactants
RG	Rucogen RCDC	Rudolf GmbH	Bio-based, non-ionic surfactants
PL	Perlavin NIC + Periquet APG	Textilchemie Dr. Petry GmbH	Non-ionic surfactants + dispersing agent
PA / MPA	Potassium carbonate	Dr. Lohmann Diaclean GmbH	Partial hydrolysis and emulsification of lanolin
CN	Horse chestnut (Croatia)	–	Saponins

Sample	Scouring Agent	Dosage of Detergent	m _{raw wool} (g)	Material to liquor Ratio	Rotation (rpm)
PS	Power Scour	15 mL / 450 g fibre	150	1:20	30
RG	Rucogen RCDC	2 g/L	150	1:20	30
PL	Perlavin NIC + Periquet APG	2 g/L + 2 g/L	150	1:20	30
PA	Potassium Carbonate	30 g/L	200	1:15	5
MPA	Potassium Carbonate	10 g/L	100	1:30	5
CN	Chestnut Suspension	20 mL / 1 g fibre	30	1:20	30

Sample	Scouring Agent	Procedure	Time per step (min)	pH of first scouring bath
PS	Power Scour	scouring (50 °C), scouring (50 °C), rinsing (50 °C), rinsing (50 °C), rinsing (20 °C)	10	6.67
RG	Rucogen RCDC	scouring (50 °C), scouring (50 °C), rinsing (50 °C), rinsing (50 °C), rinsing (20 °C)	10	6.71
PL	Perlavin NIC + Perquest APG	scouring (50 °C), scouring (50 °C), scouring (50 °C), rinsing (40 °C), rinsing (30 °C), rinsing (20 °C)	7	6.40
PA	Potassium Carbonate	scouring (50 °C), rinsing (50 °C), rinsing (50 °C), cooling (30 min), rinsing (30 °C), rinsing (30 °C)	7	11.3
MPA	Potassium Carbonate	scouring (50 °C), rinsing (50 °C), rinsing (50 °C), cooling (30 min), rinsing (30 °C), rinsing (30 °C)	7	10.75
CN	Chestnut Suspension	scouring (50 °C), scouring (50 °C), scouring (50 °C), rinsing (50 °C), rinsing (50 °C), rinsing (20 °C)	10	6.83

Important for the interpretation

The procedures differ between the systems because each one was optimised for its own cleaning performance. The wastewater characteristics therefore reflect the detergent formulation and the applied scouring procedure.

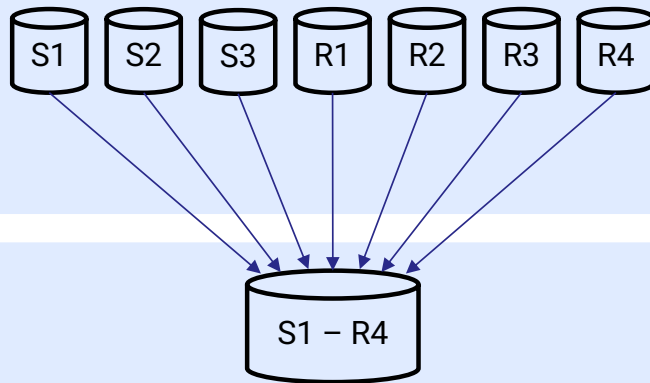


Determination of Grease Content in Wool Samples by Soxhlet Extraction

Sample	Scouring Agent	Grease content %
Raw Wool	-	7,66 (7,77 and 7,55)
PS	Power Scour	1,28 (1,24 and 1,31)
RG	Rucogen RCDC	1,01 (1,03 and 0,98)
PL	Perlavin NIC + Periquet APG	2,56 (2,63 and 2,48)
PA	Potassium Carbonate (Potash)	1,98
MPA	Potassium Carbonate (Potash)	2,45
CN	Chestnut Suspension	3,26
IWTO	IWTO Standard Washing detergent (Na ₂ CO ₃ +))	1,99
MIX	MPA (Potash) / MPA (Potash)	0,99
MIX	PS (Power Scour) / PS (Power Scour)	0,64
MIX	MPA (Potash) / PS (Power Scour)	0,51

Sampling

- Wastewater collected for every single process step per scouring agent



- COD and TS from composite samples of all process steps

pH

HRN EN ISO 10523:2012

SevenCompact Duo S213, Mettler Toledo

Electrical conductivity

HRN EN 27888:2008

SevenCompact Duo S213, Mettler Toledo

Turbidity

HRN EN ISO 7027-1:2016

TU5200 turbidimeter, Hach

Chemical oxygen demand

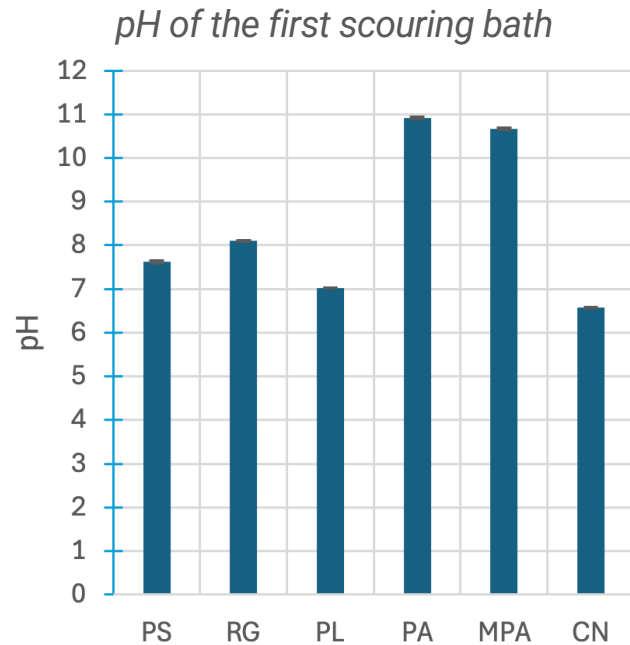
HRN ISO 15705:2003

HT200S thermostat + DR3900 spectrophotometer

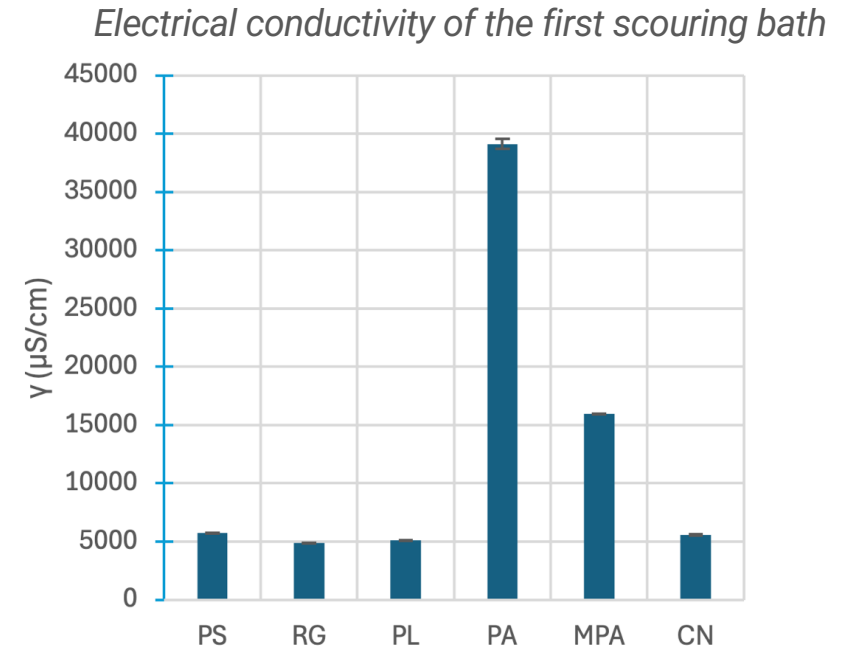
Total solids

Gravimetric determination

100 mL evaporated at 105 °C, dried 1 h at 100 °C



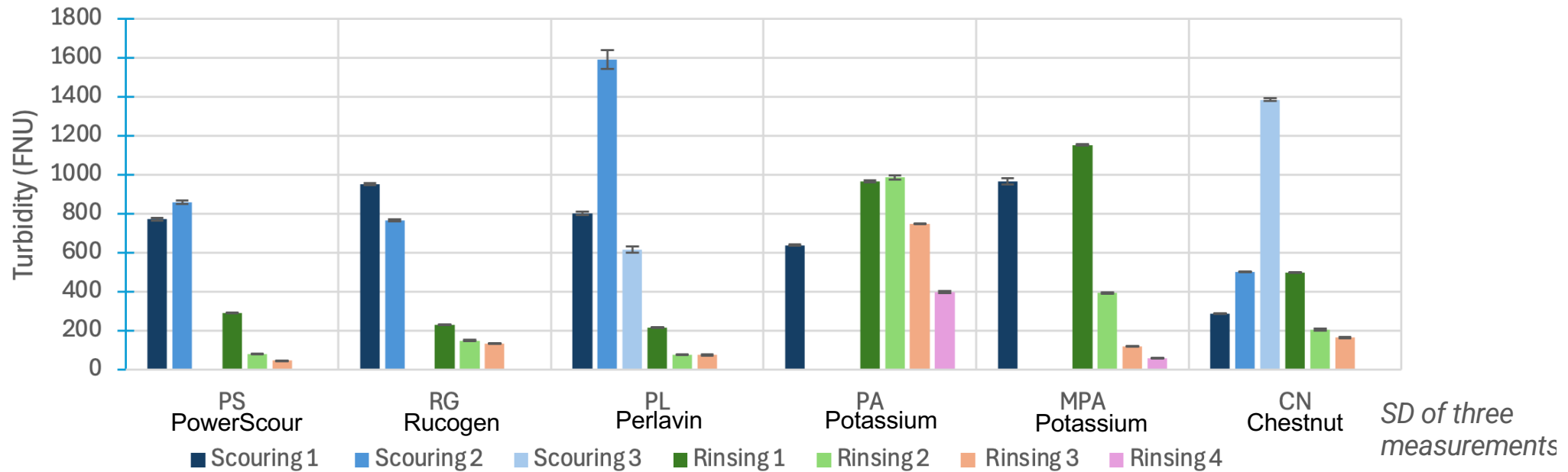
SD of three measurements



- Power Scour PS, Rucogen RG, Perlavin PL: mildly alkaline scouring baths
- Potassium PA, MPA: strongly alkaline
- Chestnut CN: slightly acidic to mildly alkaline
- All systems return towards neutral during rinsing

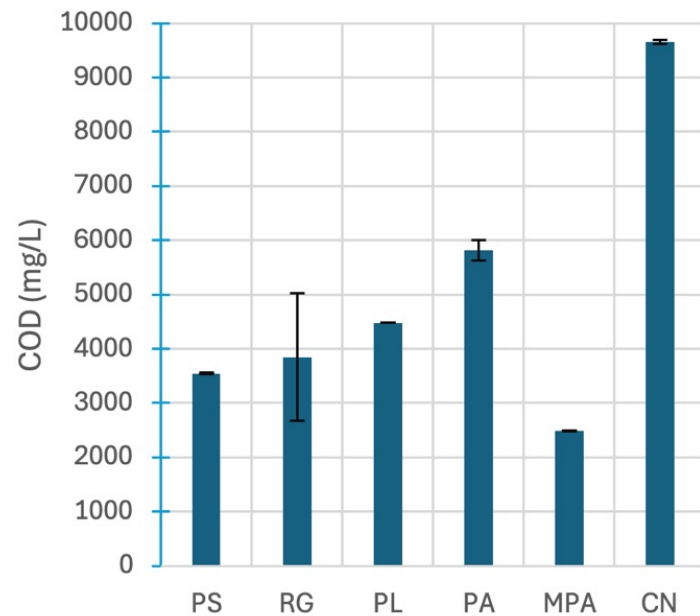
- First bath highest for Potassium PA and MPA → high mineral and ionic load
- Steady decline over the following scouring and rinsing steps

Turbidity of wastewater samples per scouring agent and process step

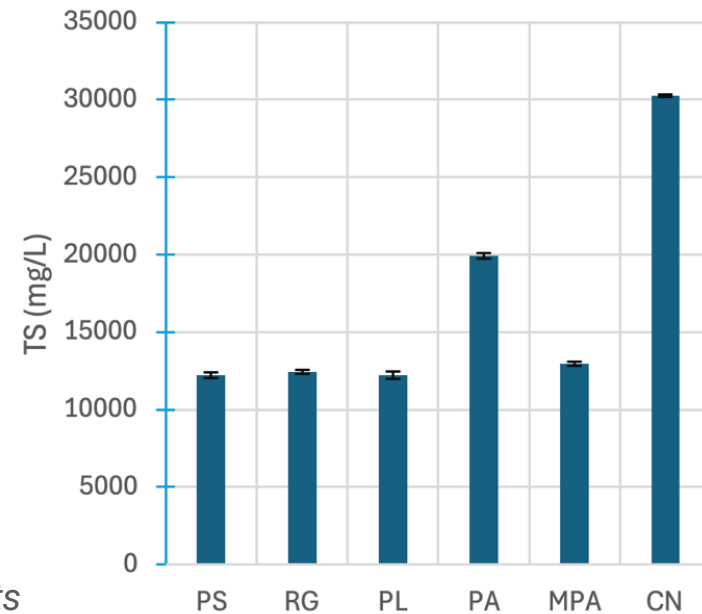


- Power Scour PS, Rucogen RG, Perlavin PL: high turbidity already in the first bath → rapid emulsification
- Perlavin PL highest overall in the second bath (1,591 FNU)
- Chestnut CN rises across the baths to 1,384 FNU – delayed emulsification of the saponin system
- Potassium PA, MPA: elevated turbidity mainly during the rinsing steps
- Turbidity decreases considerably during rinsing for all systems

COD of the composite wastewater samples; error bars



total solids of the composite wastewater samples; error bars



*SD of three
measurements*

- Elevated COD and TS of CN presumed to result in part from the organic load of the saponin extract itself
- High COD means high oxygen consumption in biological treatment and a greater treatment demand before discharge
- Type of non-ionic surfactant has limited influence on the solids load at the tested concentrations

- ➡ PS, RG, PL show the highest CIE_Whitness and the lowest CIE-Yellownesindex
- ➡ PS, RG and potash show the best values of removing the grease
- ➡ Surfactant systems (PS, RG, PL) produced moderate and comparable COD and TS levels with consistent pH and conductivity profiles
- ➡ The horse chestnut system generated substantially higher COD and TS, associated with the organic load of the saponin extract
- ➡ Potassium carbonate systems were strongly alkaline – the modified process (MPA) produced substantially lower pollution loads
- ➡ Environmental performance cannot be inferred from the origin of the detergent – formulation and process design govern the result

Outlook

- Process optimisation, in particular for the bio-based systems
- Targeted wastewater treatment strategies to ensure compliance with the discharge limits

Thank you for attention!



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