Assessment of „Rinsing Efficiency“
Recap of International Standardization in IEC and related projects
previously on

„Rinsing Efficiency“
(latest) Episodes
• IEC 60456 was first published in 1994.

• IEC 60456 has so far evaluated rinsing based on alkalinity measurement (but reproducibility has always been disappointing ...).

• IEC SC 59D established WG20 „Rinsing“ in it’s meeting in Gaithersburg in 2003-10 (and further developed the alkalinity method in WG18 „Uncertainty“).

• WG20 had its 1st meeting in Istanbul in April 2004.

• WG20 had its last meeting so far in Seattle 12 days ago.
D 6: Participants agreed on the necessity of setting up a new WG20 within SC59D. Secretariat will propose the starting of the new WG on rinsing according to the IEC procedures.

D 7: Scope of the new WG20 is to understand consumer relevant aspects of rinsing as influenced by washing machine and to investigate possible options for measuring rinsing performance. They shall be applicable to all known wash-systems for household wash appliances. Test methods have to be reproducible and repeatable and applicable to today's household washing machines and test institutes' laboratories with reasonable effort; this means equipment, qualification and time.

D 8: Purpose and justification for the new WG 20 is to improve the consumer relevance of IEC 60456 with regard to rinsing efficiency, while ensuring global applicability.

D 9: Participants agreed on nominating Mrs. Anna Duncan (NZ) as project leader (convenor) of the new WG20.

10. State of work of WG 18, Uncertainty in testing washing machines

10.1 Report of the convenor

The convenor presented the activity of WG18 in the last 2 years (doc 59D/237-INF and green paper [SC59D(Gaithersburg/WG18) 4] which updated the former, see Annex G). WG on “Uncertainty assessment of performance and consumption measurement for washing machines and tumble dryers” was created to investigate appropriate methods for assessing the uncertainty of the measurement of performance and consumption values for washing machines and tumble dryers as defined in the standards IEC 60456 and IEC 61121.
(latest) Episodes
• Dr. Ulrich Sommer, BAM, worked on developing and testing rinsing assessment methods for more than 30 years.

• In 2003 BAM conducted a study for CECED. The results were also presented to WG20.

• In 2005 Dr. Sommer compiled a life’s experience with rinsing tests into a comprehensive review that he presented to the AHAM Rinsing Committee and IEC WG20.
• In 2003 BAM conducted a study for CECED. The results were also presented to WG20.
February 2003

Determination of the rinsing performance in household washing machines

Comparison of 4 different methods

Preliminary study CECED - BAM
Introduction

- For the consumer rinsing efficiency is a very important performance criterion of washing machines
- Nevertheless an indication to the rinsing performance is not yet on the Energy Label
- Programmes with very low water consumption are offered and recommended in the market without any performance declaration
- One main reason for this is that until now a reproducible method for the determination of the rinsing efficiency is not available
- In contrary to the washing performance parallel testing in a reference machine and the use of the rinsing index seems not to eliminate the influence of special laboratory conditions
- Comparative testing and evaluation seems to be possible, the repeatability of results of some methods seem to be good, but is not sufficient for labelling purpose
Equipment: pH-Measurement
Equipment: Turbidity Measurement
Summary

4 washing programmes with quite different rinsing programmes with 1 to 4 rinses and different numbers of intermediate spins were tested according EN 60456 prA13. 4 different criteria for rinsing efficiency were measured:
- Alkalinity according to the standard
- pH value on surface of the blind sample of IEC soil strips
- turbidity of samples coming from the conditioning cycle of the load in Wascator by sampling after 15 minutes all 10 minutes up to 65 minutes and measuring the turbidity after cooling to room temperature
- Extraction of washed and rinsed blind samples of the test soil strips

The pH measurements on the surface of the textiles have high standard deviations compared to the differentiation of programmes. Results of extractions of washed and rinsed samples are on a very low level but seem to show similar tendency in differentiation of the different programmes. Nevertheless this method is not recommended.

Alkalinity and turbidity show similarities, but perhaps the increasing number of intermediate spins result in some basic differences between soluble and insoluble residues after rinsing programmes.

The alkalinity method has to be improved by better specifications for the handling and the spin extractors, for turbidity method more experience is needed.

Further work should be done for these both methods.

Dr. U. Sommer

Determination of Rinsing Performance

February 2003
• In 2003 BAM conducted a study for CECED. The results were also presented to WG20.
• In 2005 Dr. Sommer compiled a life’s experience with rinsing tests into a comprehensive review that he presented to the AHAM Rinsing Committee and IEC WG20.
Methods to measure the rinsing efficiency in washing machines

Review/Overview

Ulrich Sommer
Presentation to AHAM HLW-1 Rinsing Subcommittee
San Francisco, March 2005
Survey

1. Rinsing: Importance for consumers
2. Criteria for measuring rinsing efficiency
3. Methods for sampling
4. Overview: Applied methods
5. Some results of research and testing of rinsing efficiency
Rinsing efficiency includes several different aspects.

A ‘one criterion method‘ therefore will not cover the requirements for evaluation.

After more than 30 years of work it has not been possible so far to develop reproducible methods to evaluate rinsing efficiency.

A review over that long period of continuous research shows some reasons for this unsatisfactory status.
Methods to measure the rinsing efficiency in washing machines
Ulrich Sommer, March 2005, San Francisco

There is no single method known until now to evaluate rinsing efficiency in a sufficient way with one type of measurement.

Several methods to evaluate rinsing were tested:

- Analysis of alkalinity as monitor for soluble materials
- Analysis of anionic or nonionic surface active agents from detergent
- Turbidity for residues from detergents and soils
- Conductivity for soluble ionised substances
- pH of different samples or on textiles after program
Methods to measure the rinsing efficiency in washing machines
Ulrich Sommer, March 2005, San Francisco

Applied methods

1. Kaolin method (S)
2. SIH method (CH)
3. Dilution method (IEC 456, ECO-Label, AU)
4. Mechanical extraction (Shaking/stirring method; Germany: BAM, WFK; FIH)
5. Alkalinity method (IEC 456, DIN, others, US)
6. Surface active agents (WFK, BAM, US, others)
7. Soxhlet extractions, determination of alkalinity or surface active matter (BAM, BSHG, WFK)
8. Other methods (Foam, ........?)
9. Zeolith method and modification for insoluble residues, (KOV, BAM)
Methods to measure the rinsing efficiency in washing machines
Ulrich Sommer, March 2005, San Francisco

Principle of applied methods

1. Kaolin method (Horrowitz, 1966)
Kaolin is added to wash liquor. After complete program, load is treated in a separate machine with special rinse program, turbidity of a rinse water sample. Evaluation by comparing to a scale good/bad rinse.

2. SIH method
Special pads (4 layers of standard cotton cloth sewn together) were after complete program stirred in boiling water, titration of alkalinity.

3. Dilution method (old IEC 456, ECO-Label EU, AU)
Samples of wash liquor and separately spin extracted water from the load are used to calculate a dilution factor.
Principle of applied methods

4. Mechanical extraction (Germany: BAM, WFK; FIH)

Samples of standard cotton cloth or terry towels are washed, rinsed and spun in the machine under test. The samples then are treated with deionised water (shaked, stirred or without movement), titration of alkalinity or anionic surface active matter. Many variations, poor repeatability, no reproducibility.

5. Alkalinity method (IEC 456, DIN, US, others)

After complete program the load is extracted in a high efficient separate spin extractor to about 40 % rest humidity, alkalinity of the extracted water is analysed.
The alkalinity method is the most common used way to characterise rinsing efficiency. Research in this method started about 1960 and the method was included in IEC 456 in 1974 but is until now a not reproducible method. Last improvements are tested in a RRT in Europe at the moment, this refined method will be presented later.

6. Surface active agents

In parallel to alkalinity or separately surface active agents are often measured from same samples. The results correlate less to real amount on the textiles than in case of alkalinity.
7. Soxhlet extraction, determination of alkalinity or surface active matter (BAM, BSHG, WFK)

This so called total extraction method is well known for testing textiles of all kinds for many substances and with several - in general organic - solvents.

The principle is to extract continuously a sample in 2 with solvent heated in 3 and refluxed in 1. If volume in 2 is filled it automatically flows back to 3.

If you use cotton as sample and water as solvent you will get problems to analyse alkalinity.
Methods to measure the rinsing efficiency in washing machines
Ulrich Sommer, March 2005, San Francisco

9. Zeolith method (KOV) and modification (BAM) for non soluble residues

This is a historical drawing from 1990, when KOV presented the method at IDC in WFK. It shows very simple the principle of the method.

A part of the washed, rinsed and spun special load is treated in a separate rinse device and in a sample of that rinse solution light absorption is measured.
Final conclusion:

There is **no single criterion** to evaluate spinning efficiency in general, a **“one criterion method”** is not reasonable.

**At minimum** soluble (alkalinity, surface active agents) and non soluble materials (e.g. Zeolith method) should be measured to evaluate rinsing efficiency in total.

Results from a partly extracted load (separate spin extractor) for alkalinity will be more close to the total amount in the load than for surface active agents.
• In 2005 Dr. Sommer compiled a life’s experience with rinsing tests into a comprehensive review that he presented to the AHAM Rinsing Committee and IEC WG20.
(latest) Episodes
• AS/NZS 2040.1 did not have any rinsing efficiency test protocol until 2005.

• While considering the alkalinity based method as well as LAS detection, AU/NZ finally developed a new, separate method tracing a marker (PBIS) that is added at a fixed quantity before the wash.

• Main reason for using PBIS was that AS/NZS 2040.1 specifies 2 detergents with different LAS content and alkalinity.
New Australian/New Zealand Rinse Effectiveness Test

by

Energy Efficient Strategies

Presentation to IEC SC59D WG20

April 2005
How Can we Measure Detergent in the clothes load?

- Direct measure of detergent on the load is very expensive and potentially destructive.
- All of the practical methods proposed attempt to estimate the detergent retained in the clothes load by taking a measurement of the water that is extracted from the load at the end of the program.
- The assumption is that the concentration in extracted water is indicative of detergent retained on the load. (debatable)
Measures investigated for Rinse Performance

- Indirect measurement: detergent contained in water retained in the load (ICP, UV other)
- Indirect measurement: alkalinity of water retained in the load (eg IEC)
- Indirect measurement: conductivity of water retained in the load
- Indirect measurement: marker in the load and contained in water retained in the load
Why did Australia and New Zealand decide to use a marker?

The following special circumstances exist in ANZ:

- AS/NZS uses 2 different detergent types for front and top loading machines
- Mandatory water labelling commences in mid 2006 - rinse requirement was urgent
- ANZ detergents are phosphate based so soluble components are of main interest - marker appears to be a good guide
• The AU/NZ project started off to eliminate the influence of two detergents by introducing a separate marker.

• Today we know that this did not work. (sorry, Lloyd …)
(latest) Episodes
• AHAM considered tracing alkalinity, PBIS, LAS ...
Rinse Test Development by AHAM HLW-1 Rinsing Subcommittee

Presentation to IEC TC 59D/WG 20
Jeju, South Korea
October, 2006

Jennifer Moyer
Association of Home Appliance Manufacturers
Brief background...

- Fall 2004: AHAM members agree on need for improved rinse test:
  - Desire a less skill-intensive test.
  - Desire improvements in repeatability, reproducibility and discernment.
  - Increasing pressure from private and gov’t agencies for water and energy reduction, ultimately affecting rinsing.
  - Australia/New Zealand rinse committee agree to share their development efforts. The UV approach, using a spectrophotometer, was adopted by the AHAM committee as the most attractive option.
Brief background… (continued)

- Winter/spring 2005: Series of meetings to learn about the Australian method and discuss modifications:
  - Decided on LAS vs. PBIS as marker.
  - Use of AHAM-2005 detergent.
  - Run currently with wash/wear test. Three (3) consecutive runs followed by load normalization.

- Summer 2005: Screening test funded by AHAM and conducted at the Textiles Lab at the University of Kentucky.
Brief background... (continued)

- Fall 2005: AHAM members agree to proceed to round robin testing.
- Spring 2006: AHAM Rinsing Subcommittee (SC) decided on round robin tests – Spin extraction method and water extraction swatch method.
  - Spin extraction = wash load, use spin extractor to remove remaining water, test water for UV absorbency
  - Water extraction swatch = wash load with four (4) soil and stain strips attached to towels, extract remaining detergent in distilled water using a shaker, test water for UV absorbency
- Spring/Summer 2006: Round robin testing undertaken by 6 labs: BSH, Electrolux, Maytag/Whirlpool, P&G, Whirlpool and GE/UK
• Method is now published as supplement to AHAM HLW-1
• In its last meeting in Seattle in October 2010 WG20 decided to compare
  • alkalinity (IEC),
  • Chinese alkalinity modification
  • LAS (AHAM)
  • PBIS
• The only realistic candidate (IMHO) is the LAS method, as also IEC will introduce a liquid standard detergent and that just doesn’t have alkalinity ...

• Remaining question is if the LAS method is reproducible - AHAM has not yet performed the planned round robin test.
(latest) Episodes
• The CECED Workshop on Rinsing Assessment in October 2010 was a starting point for yet another (final?) 'Episode'.

• Now it’s time to make a step forward - many options were discussed over and over again before and - rejected.

• There are not too many options left, alkalinity may or may not be one of them …

• Repeatability is not an issue, poor reproducibility has always remained to be the unsolved problem.
Thank you!