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Workshop on the relevance of soil in evaluating laundry cleaning performance

Participants

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Introduction

In 'past times' the performance of washing processes (detergents and washing machines) was often assessed with methods that were to a certain extent simulations of the real consumer practices. Examples are the cumulative testing method for testing detergents that was described in DIN, the method with visual judgement that was described in IEC 456 appendix B (early versions), the guidelines for testing detergents of ISO TC91, the Dutch NEN3284 and methods applied by the German, Dutch, Scandinavian consumer associations. In all these methods naturally soiled laundry was applied. The testing methods presently applied by several consumer associations and testing institutes for testing detergents and washing machines, and the standardised methods of IEC and CENELEC have moved away from a soiled wash load in order to improve reproducibility and repeatability. The washing performance in this method is now assessed with artificial tracer stains, the exclusion of ballast soil or consumer relevant soiled load and no evaluation of fabric care. Although this method is designed for testing of washing machines alone it is, however, (mis)used for testing detergents by many consumer organisations and test institutes. There are also indications that the exclusion of a realistic soil load, substantially affects the washing process and the resulting cleaning performance. If the latter is true the validity and consumer relevance of the testing of washing performance without ballast soil can be questioned and should be reconsidered.

Because of the importance of this matter the Wageningen University decided to discuss this subject with experts from different fields in two workshop meetings (the 13th of June and the12th of November 2003). The aims of this informal workshop were
- to identify potential sources of information on this issue
- to compile the relevant data about the impact of a ballast soil on the efficacy of a washing process and
- to discuss if there is a need to adapt the present testing methodology.

The format of the workshop was that the participating experts present their available data and experience on this topic. Thereafter three hypotheses were discussed followed by a discussion on what further actions may be required.

Aims of the workshop

The goal of this workshop is to get a scientific based picture of this issue on the basis of research data and to conclude if there is a need for further actions.
It was proposed to discuss the following three hypotheses after participants presented their research data and experience.
Hypothesis:
1. ballast soil influences the cleaning performance
2. ballast soil may increase the differentiation power
3. ballast soil may effect the ranking in comparative testing

Research data and discussion

The results of the different research projects are compiled in table 1.
In this table hypothesis 3 is split up in two different parts; 3a and 3b. Hypothesis 3 states that the ranking of processes in comparative testing is influenced by the presence of ballast soil. During the discussion of the presented results it appears that there exist two different elements in the hypothesis;
- the impact of ballast soil on the ranking of washing machines and
- the impact of ballast soil on the ranking of different detergents.
When considering the comparative performances of appliances, the main differences are the nature of process time, mechanics, temperature, water level and detergent concentration. When comparing detergents in the same appliance, all these factors are constant and only the chemical composition and physical properties (e.g. solubility and surface tension) differ. This means that if hypothesis 3 is valid for detergents this does not imply validity for washing machines and visa versa. Hypothesis 3a is focussed on washing machines and 3b on detergents in a washing process.
During the discussion it appears that none of the research presented is suitable to test hypothesis 3a. There are tests including washing machines but the designs reported are not suitable for comparative evaluation or ranking.

Table 1: summary of research outcomes

Research data	Hypothesis 1	Hypothesis 2	Hypothesis 3a/3b**
Henkel	Confirmed	Confirmed	*/ Confirmed
EMPA	Confirmed	Confirmed	*/*
Unilever	Confirmed	Confirmed	*/ Confirmed
SOHIT	Confirmed	Confirmed	*/ Confirmed
P&G	Confirmed	Confirmed	*/ Confirmed
WfK	Confirmed	Confirmed	*/*

*   research was not designed for testing the hypothesis
**   3a: evaluation of washing machines
        3b: evaluation of detergents.

Research of Henkel

Henkel has performed a test on detergents with three different ballast load compositions. The details of the experimental set-up are shown in the box below.

Products:	2 different HDD of the German market each with 109g dosage
washing machine:	Miele W918
programme:	cotton
temperature:	40°C
load:	3.5kg
Stains :	(20 pc.): bleachable, cosmetic/pigment, grease, enzyme specific
number of repetitions:	5
measurement:	Y-value, 420nm UV cut-off filter
ballast load:	a) naturally soiled ballast load
	versus
	b) clean ballast load
	versus
	c) clean ballast load + 5 SBL-sheets

Detailed evaluation of individual stains indicates that the number of stains showing significant advantage for product A are similar between clean loads + 5 SBL artificial soil sheets and naturally soiled ballast loads. However, differentiation power is better for bleachable stains in the case of naturally soiled ballast load and better for enzyme specific stains in case of clean load + 5 SBL-sheets. This leads to the conclusion that the composition of the SBL-sheets needs to be adapted in order to accurately replicate the composition found in real naturally soiled loads.

Looking to the test with clean ballast load without soil (other than coming from each individual tracer stains), the situation is reversed in favour of product B with significant advantages for some particular stains from every different group. The results of this research show that there is a clear influence of the ballast soil on the cleaning performance (confirmation of hypothesis 1), that the cleaning goes down in general with ballast soil (confirmation of hypothesis 2) and finally that soil can affect the ranking in detergent tests (confirmation of hypothesis 3).

Research of EMPA

EMPA presented results of investigations that were run in relation to ballast soil on the cleaning performance ranking of a household washing machine according to IEC 60456. These research projects were run using IEC tracer stain strips to produce 9/30/60 g of 'soil' plus additional soiling in a 5 kg IEC load with 134/180g IEC A* reference detergent in a Wascator and a Miele 985 machine. Conclusions were that as soil goes up cleaning performance is reduced with the reduction highest in the Miele machine. Standard deviation was also highest in the Miele machine, uncertainty increases about two fold and soil composition can impact the system. Based on the findings of this research it can be concluded that hypothesis 1 is supported and hypothesis 2 and 3a may be supported.

General conditions:	According to IEC 60456 Ed.4
Amount of soil:	9g/30g/60g (EMPA-strips plus additional soilings)
Programme:	cotton 60°C
Load:	5.0 kg
Detergent	IEC A*; 180g (Wascator), 134(Miele)
Washing machines:	Wascator Fom 71 Lab, Miele W 985
Evaluation:	Washing performance; Ratio Miele/Wascator

Research of Unilever

Unilever has performed research in which the performance of 4 detergents was compared using natural soiled ballast load, clean ballast load and different types of soil strips. The details of the experimental set-up are shown in the box below.

The results of this research show that there is a clear influence of the ballast soil on the cleaning performance (confirmation of hypothesis 1). That the cleaning goes down in general with ballast soil (confirmation of hypothesis 2) and finally that soil can affect the ranking in detergent tests (confirmation of hypothesis 3).

In addition the research showed that the soil strips could not replace the use of natural soiled laundry. The researchers assumed that this could be due to the absence of catalase in the soil strips and a pH effect.

4 Detergent products	
Soiling:	- clean load
	- natural soil
	- 3 types of soil strips
Load size	3 kg
Temperature	40 °C & 60 °C
Water hardness	medium & hard
Stains & monitors	Unilever set
Product dosage	half & recommended

Research of the SOHIT institute

The research of SOHIT was focussed on the impact of a naturally soiled household load compared to clean ballast textiles. The research was run with 3 domestic detergents. The details of the experimental set-up are shown in the box below.

3 Bleach containing detergent products	
Soiling:	- clean load
	- naturally soiled household laundry
Load size	3,3 kg (towels, underwear, bed linen, etc.)
Temperature	60 °C
Water hardness	medium
Stains & monitors	fresh stains and artificial soils
Product dosage	recommended

The results of this research showed a general decrease of the washing performance in the presence of soil. So this implies that both hypothesis 1 and 2 are confirmed.

The sensitivity of detergents to the presence of soil appears to differ substantially and the ranking of detergents is likely to change in the presence of soil. The latter confirms hypothesis 3b.

Research of P&G

The research of P&G was focussed on the impact of ballast soil in relation to wash temperature and the level of detergent dosed. The test was run with a combination of IEC standard stains and 16 consumer stains and different types and levels of ballast load.

The results of the research showed an overall decrease of the washing performance in the presence of soil. So this implies that both hypothesis 1 and 2 are confirmed.

The data are such that they support hypothesis 3b.

Other research presented by P&G shows that the actual soil level in the real domestic setting is substantially higher than when applying the IEC test method 60456 and currently no artificial ballast soil exists which can totally replicate the domestic household situation.

Load Size	3 kg
Temperature	40 ºC and 60 ºC
Tracer Stains	IEC (4) and P&G (16) Stain Set (only a few grams of 'soil')
4 Cycles	Average of 8 reps
Detergent Dosage	Recommended and under-dosed (1 scoop and _ scoops)

Research of WfK

WfK has performed research to understand the relevance of ballast soil in evaluating both detergents and washing machines. In the detergent test, a market detergent was used in a domestic washing machine in a 40°C cotton programme at recommended dose. The results using 3.5kg of normally soiled consumer loads were compared with clean ballast loads and three different levels of artificial soil.

In the machine test, two market machines (high and low performance level) were used with two concentrations of IEC A* reference detergent. Tests were run according to IEC-60456 4th edition. The results with a clean ballast load were compared with those of 4 levels of artificially soiled ballast load.

The findings of this research show that ballast soil suppresses the cleaning performance but the effect on different tracer stain types differs and the standard deviation of the cleaning performance is not correlated with the soil load. Artificial soil however makes test results more comparable with the results of real consumer soiled loads. After an in depth discussion of the results it is concluded that the results support hypothesis 1, 2 and 3a.

Detergent tests:	
Load Sizes	3,5 kg
Temperature	40 ºC
Tracer Stains	wfk regular test fabrics
Soil levels	normally soiled consumer load vs.
	clean load with 3 soil levels (0 g, 16 g, 36 g / cycle)
Detergent Dosage	recommended
Machine tests based on and varying IEC 60456:	
Load Sizes	5 kg and 3,75 kg
Temperature	60 ºC
Tracer Stains	wfk IEC strips acc. IEC 60456 4th edition
Soil levels	4 levels (0 to ca. 32 g / cycle)
Detergent Dosage	100 % and 60 % of IEC load based dosage

<u>Supporting research data from Intertek RTC and the Rheinische Friedrich Wilhelms University</u>

Mr. Leach and Mr. Stamminger presented the results at the workshop of research projects that supplied valuable background information. The research of Stamminger was focussed on the impact of load size, detergent dosage and process on the cleaning performance. The results were discussed at the workshop. The research projects as such were not meant and suitable for testing the hypotheses of the workshop.

Summary

The six research projects that were discussed in the workshop all approach the issue from a different perspective. However, they all show a clear influence of ballast soil on the cleaning performance with respect to reducing the level of cleaning and also that the differences may be influenced in magnitude. Therefore the meeting concludes that there is clear evidence that hypotheses 1 and 2 are confirmed. The confirmation of hypothesis 2 also implies that soiled loads may affect the discriminating power of cleaning test methods.

With respect to hypothesis 3 the situation with washing machines (processes) and detergents differ. The data presented confirmed hypothesis 3 for detergents but not for washing machines where data are not yet available or unclear.

The plenary agreed the following concluding statements that were developed during the workshop:

<u>Statement 1 (based on initial Hypothesis 1)</u>
Soil reduces cleaning performance in the wash process (detergents and machines)

<u>Statement 2 (based on initial Hypothesis 2)</u>
Soil can affect the differentiation power of detergent and washing machines in both directions. (*the meaning of this statement is that due to ballast soil the differentiation power can become better or worse*)

<u>Statement 3a (based on initial Hypothesis 3a)</u>
At the workshop no data are presented for a clear statement regarding domestic washing machines.

<u>Statement 3b (based on initial Hypothesis 3b)</u>
Soil does have an impact on performance to the extent that it can have a major influence on the ranking of detergents.

<u>Additional statements</u>
The use of artificial ballast soil versus clean load can significantly improve consumer relevancy in detergent cleaning performance evaluation (further refinement however is required to mimic natural soil).

We (the workshop participants) realise that real life consumer habits and practices remains the only valid reference. We also realise that any single test method can only represent a 'reality snapshot' since consumer habits vary

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within regions and even more between regions and throughout the world. In addition, they are subject to changes with time.

Absence as well as the use of non-suitable ballast soil may create seriously misleading test results in detergent evaluation. Soil level relevance for washing machines however is still unknown and we strongly recommend that further research is done.

Final note

The participants of the workshop agreed that this summary could be issued by the Wageningen University as position paper to inform test institutes and consumer associations on the importance of soil. In addition, it should also be fed into the soils and stains sub team of IEC 60456 SC59D WG 17 (globalisation of IEC 60456). This document together with the presentations compiles current experience and knowledge as a basis for any future discussions. It may be freely distributed to all interested parties.