

EEDAL'06

INTERNATIONAL ENERGY EFFICIENCY IN
DOMESTIC APPLIANCES & LIGHTING CONFERENCE '06

Hygiene properties of low energy European laundering
processes

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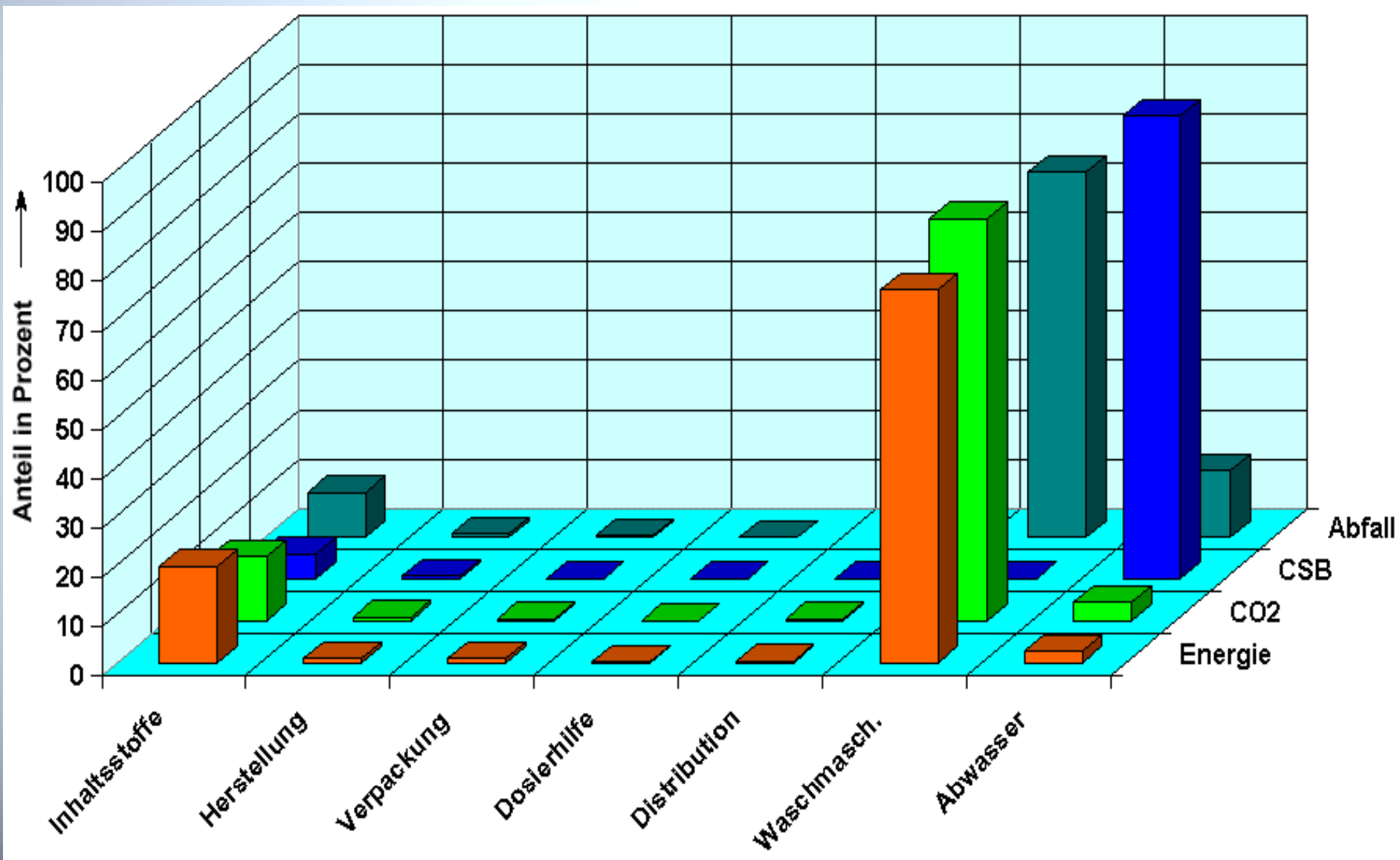
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Content

- Low temperature laundering
- Laundry hygiene
- 3 research projects (I, II and III)
- Overall conclusions
- Implications

Low Temperatures; Why?



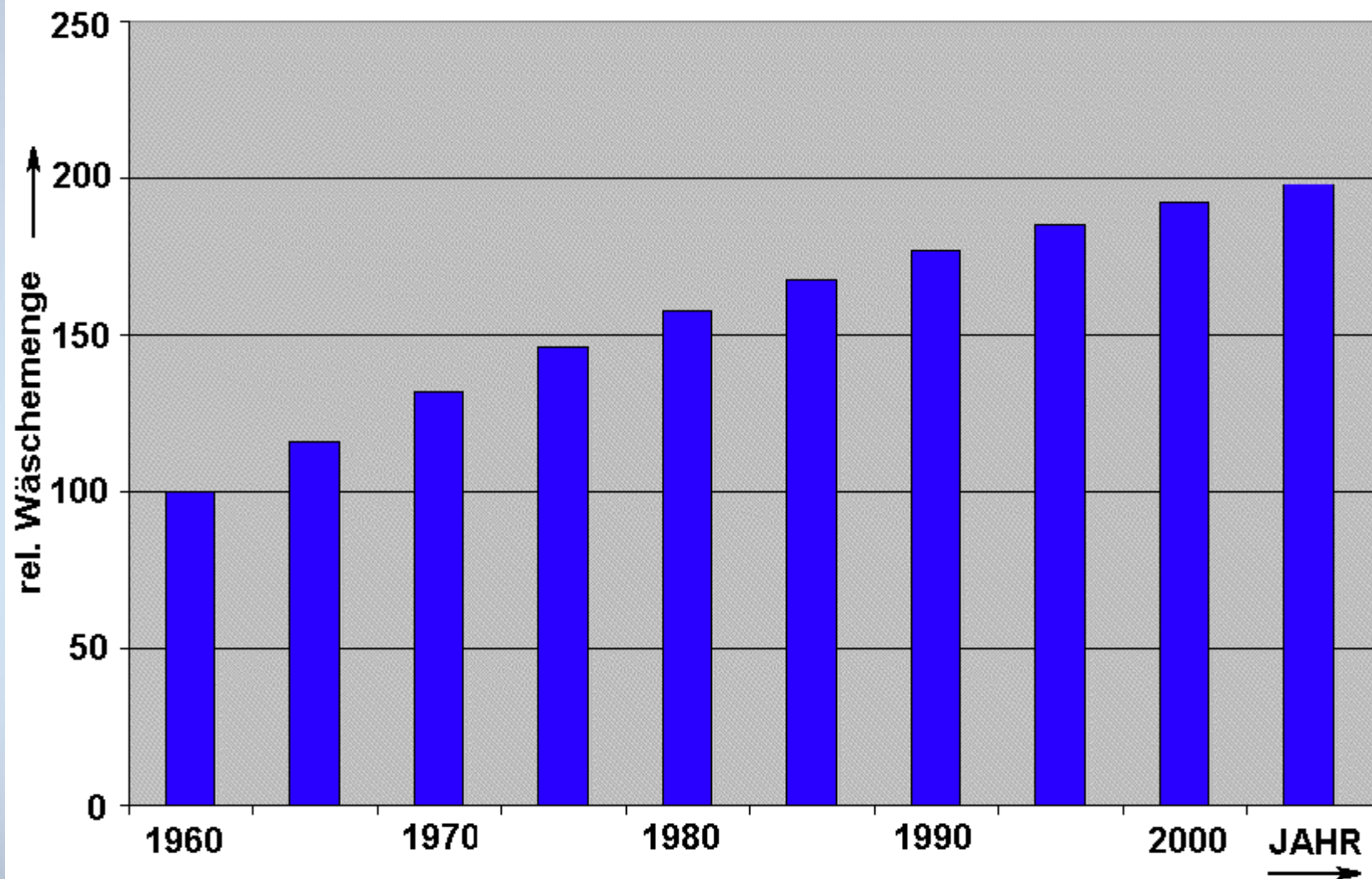
Technology; *Shift of machine classes*

Machines in E-label classes for energy, washing performance and spin drying for '93, '96, '97 and '98

% of machines	Energy consumption				Washing efficiency			Spin Drying		
Per class	1993	1996	1997	1998	1996	1997	1998	1996	1997	1998
A	0,0	0,0	2,7	11,6	11,2	13,3	20,6	0,0	1,3	1,5
B	1,0	41,5	45,7	39,1	26,9	25,1	29,0	14,9	15,3	18,2
C	27,9	38,1	34,5	37,0	19,2	24,6	24,0	25,5	24,0	27,0
D	39,3	19,1	16,3	12,0	24,2	16,9	13,1	21,7	20,0	17,2
E	21,6	1,1	0,7	0,3	5,8	5,3	5,5	15,2	17,6	17,2
F	8,6	0,2	0,2	0,0	8,0	9,7	6,0	14,4	14,3	12,7
G	1,6	0,0	0,0	0,0	4,6	5,2	1,8	8,4	7,5	6,1

Source: SAVE study on the revision of the energy labelling system (NOVEM 2001)

Consumers



Requirements of low temperature processes

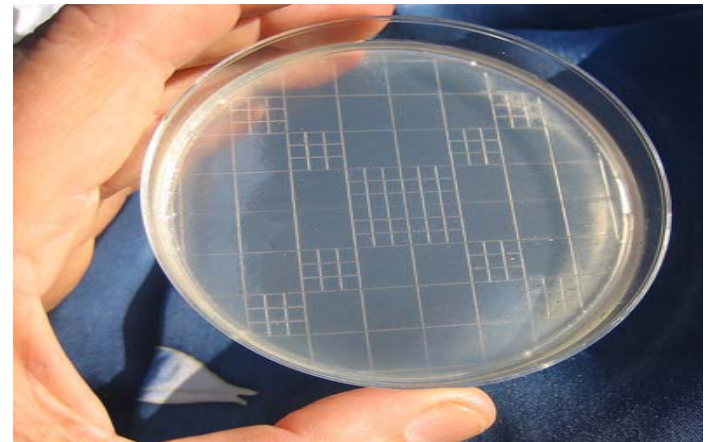
- Visual clean
- Restored wearing properties
- **Appropriate textile hygiene**
- No adverse effects

Laundry contamination

- Underwear: $10^5 - 10^8$ CFU/g
- Socks: $10^5 - 10^9$ CFU/g
- Bett sheets: 10^4 CFU/g
- Kitchentowels: $10^3 - 10^8$ CFU/g
- Handkerchiefs: $10^3 - 10^4$ CFU/g
- Diapers: $10^7 - 10^9$ CFU/g
- Human skin: $10^3 - 10^8$ CFU/cm²
- Germs
 - Enterobacteriaceae
 - Bacilli
 - Staphylococcus aureus
 - Moulds & yeast

Research project I

- Aims:
 - Assessment germ reduction in *relation* to
 - temperature
 - detergent type
 - process type
 - foam (inhibiter)



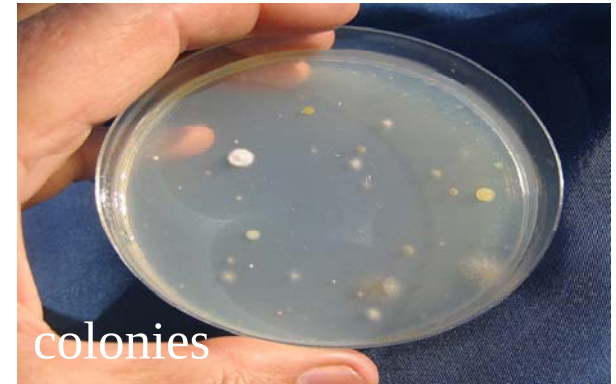
Test parameters

Test details

- Disinfection household machine
- 3,5 kg clean (disinfected) cotton load
- 20 g defibrinated sheep blood
- 1 IEC soil monitor
- when needed foam inhibitor
- Germ assessment > eluation

Contamination

- Germ-loaded rags (3×10^4 CFU/cm²) with :
 - Enterococcus faecium
 - Staphylococcus aureus



Germ reduction (log) & **residual germs** (CFU/cm²)

Detergent	Test organism / Temperature					
	Enterococcus faecium			Staphylococcus aureus		
	30 °C	40 °C	60 °C	30 °C	40 °C	60 °C
All-purpose (P)	> 3/ < 30			> 3/ < 30		
Colour (P)	2,3/ 150	2,2/ 210	> 3/ < 30	2,4/ 180	2,3/ 200	> 3/ < 30
All-purpose (L)			> 3/ < 30			> 3/ < 30
All-purpose (L)		1,3/ 1440			1,3/ 1440	
All-purpose (L)*		> 3/ < 30			> 3/ < 30	
Delicates (L)	0,6/ 7140	2,7/ 300		1,2/ 1980	2,5/ 90	
Delicates (L)*	1,7/ 570	2,7/ 60		2/ 330	> 3/ < 30	

* With foam inhibitor

Conclusions I

1. The germ reduction shows strong variation (range 1,7 (0,6) to 3 log units)
2. Higher wash temperature and bleach favor the reduction
3. Excessive foaming lowers the germ reduction substantially (> 2 log units)
4. Cleaned textiles can contain between < 30 and 7140 CFU/cm²

Research II: effect process parameters

- Aim
 - To evaluate the reduction of germs that survive/ live in the drain of a domestic washing machine
 - to understand the risk of recontamination

Test parameters part II

Test details

- Conditioned test machine
- Cotton load conform EN 60456:1999
- No ballast soil
- Contact samples

Contamination

- Germ-load laundry items: 10^4 CFU/cm² with germs that occur typical in the drain of a washing machine

Total plate count reduction

Detergent	Detergent	Washing Temperature			
		Cold	30°C	40°C	60°C
All-purp. powder	White & colour	2,5	3	2,7	3
All-purp. liquid	White & colour	2,1	2,7	1,7	2,7
Colour powder	Delicates	1,6	1,5	1,7	2,7
Colour liquid	Delicates	3	2,7	2,4	2,7
Delicate I	Wool	2,3	2,7	2,1	
Delicate II	Wool	1,4	2	2,4	

Conclusions II

1. Germ reduction, when using textiles inoculated with drain germs, is in the range 1,4 to 2,7 log units
2. Residual germs 400 CFU/cm² or less

Research project III

- Aims:
 - Assessment germ reduction in daily life conditions in 4 countries
 - Assessment of cross contamination

Wash procedure (NI)

- 💡 Hygiene test are done with laundering conditions that are representative for four different European countries.
(Norway, the Netherlands, Spain and Greece)
- For this purpose
 - used representative detergents,
 - applied a commonly used wash program and
 - used a representative washing machine

Test parameters

Germs

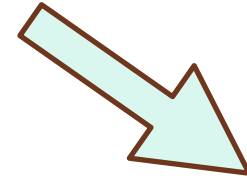
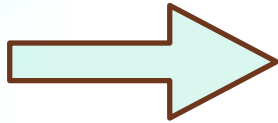
- Total plate count
- Enterobacteriaceae
- Staphylococcus aureus
- Bacilli
- Yeasts & fungi

Laundry items

- handkerchiefs
- diapers
- socks
- dish cloth
- sterile test cloth



Sampling



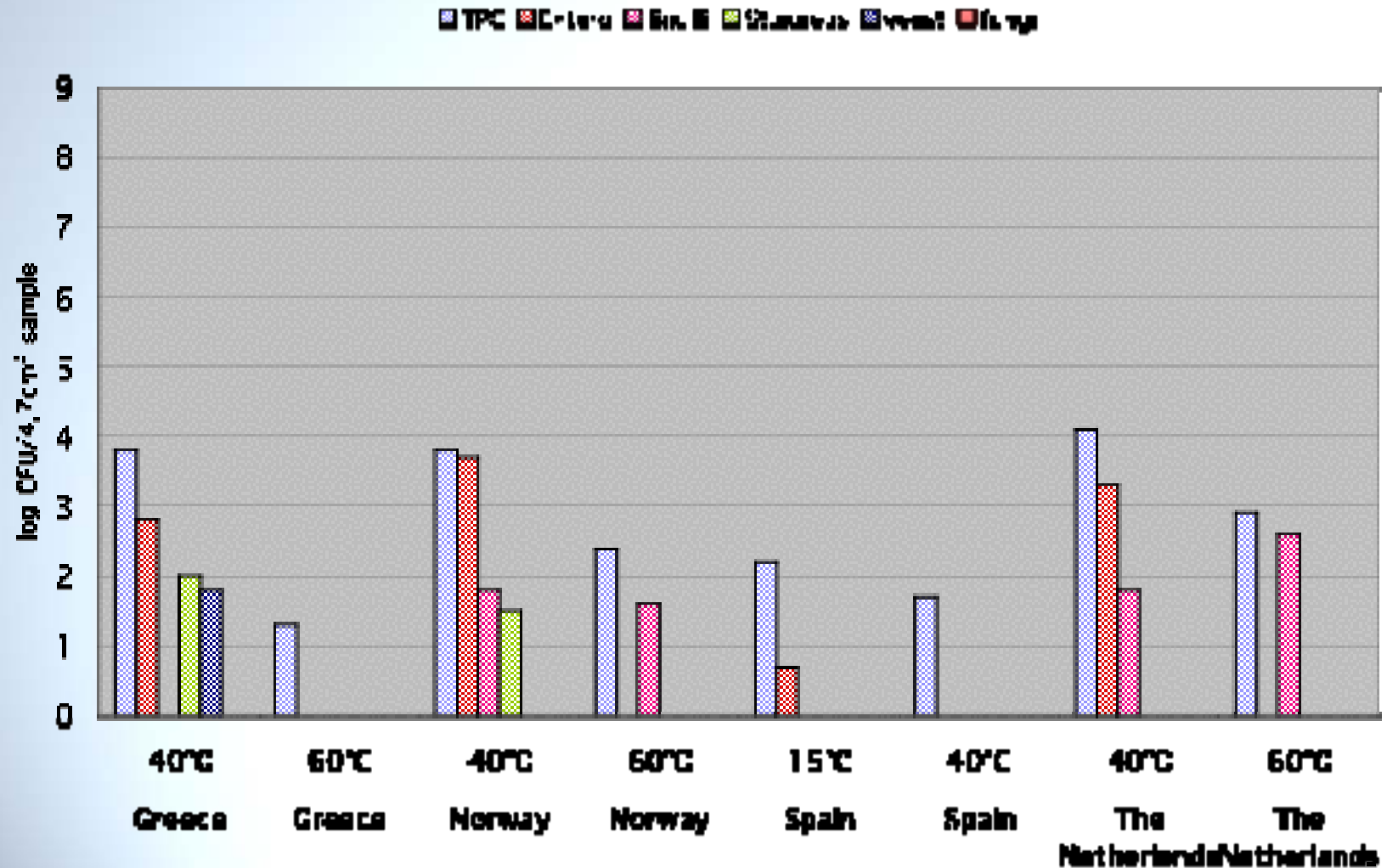
Germ reduction (total plate count)

Garments 	Country							
	Greece		Norway		Spain		The Netherlands	
	40 C	60 C	40 C	60 C	15 C	40 C	40 C	60 C
Handkerchief	0,5	2,5	0,6	1,6	2	2,1	0,3	1,9
Diaper	4,2	5,7	3,3	5,2	6,2	7,6	3,1	4,6
Sock	1,9	4,6	1	1,5	2,6	3,9	1,6	3,6
Dishcloth	3,7	6,4	2,6	5,2	5,3	6	1,6	5,4
 Sterile	-3,8	-1,3	-3,8	-2,4	-2,2	-1,7	-4,1	-2,9

Rest contamination (total plate count)

Garments	Country							
	Greece		Norway		Spain		The Netherlands	
	40 C	60 C	40 C	60 C	15 C	40 C	40 C	60 C
Handkerchief	$2,1 \cdot 10^2$	2,1	$1,3 \cdot 10^2$	13	2,7	2,1	$3,4 \cdot 10^2$	8,5
Diaper	$2,7 \cdot 10^3$	85	$1,7 \cdot 10^4$	$2,1 \cdot 10^2$	$1,1 \cdot 10^2$	4,2	$2,7 \cdot 10^4$	$8,5 \cdot 10^2$
Sock	$5,3 \cdot 10^2$	1,1	$2,1 \cdot 10^2$	67	42	2,1	$2,1 \cdot 10^3$	21
Dishcloth	$2,7 \cdot 10^4$	53	$2,1 \cdot 10^4$	53	$1,3 \cdot 10^2$	27	$6,7 \cdot 10^5$	$1,1 \cdot 10^2$
 Sterile	$1,3 \cdot 10^3$	4,2	$1,3 \cdot 10^3$	53	34	11	$2,7 \cdot 10^3$	$1,7 \cdot 10^2$

Cross contamination



Conclusions III

1. Germ reduction in real life situations: extreme variation !
(range 0,6 to 7,6 log units)
2. Residual germs: strong variation (range from 1 to $6,7 \cdot 10^5$ CFU/CM²)
3. Higher wash temperatures and higher initial contamination lead to higher the germ reduction
4. Residual contamination is related to the initial contamination also

Comparison of both researches

1. The initial contamination levels of I and II are substantially *lower* those of most consumer garments in research III
2. In addition the natural soiled garments of research III have there germs in a *soil matrix*
3. These differences explain the occurrence of both higher reduction levels and higher rest contamination figures in research III

Implications

In general no health implications expected !

But special attention for :



Elderly & Children



Immunocompromised persons

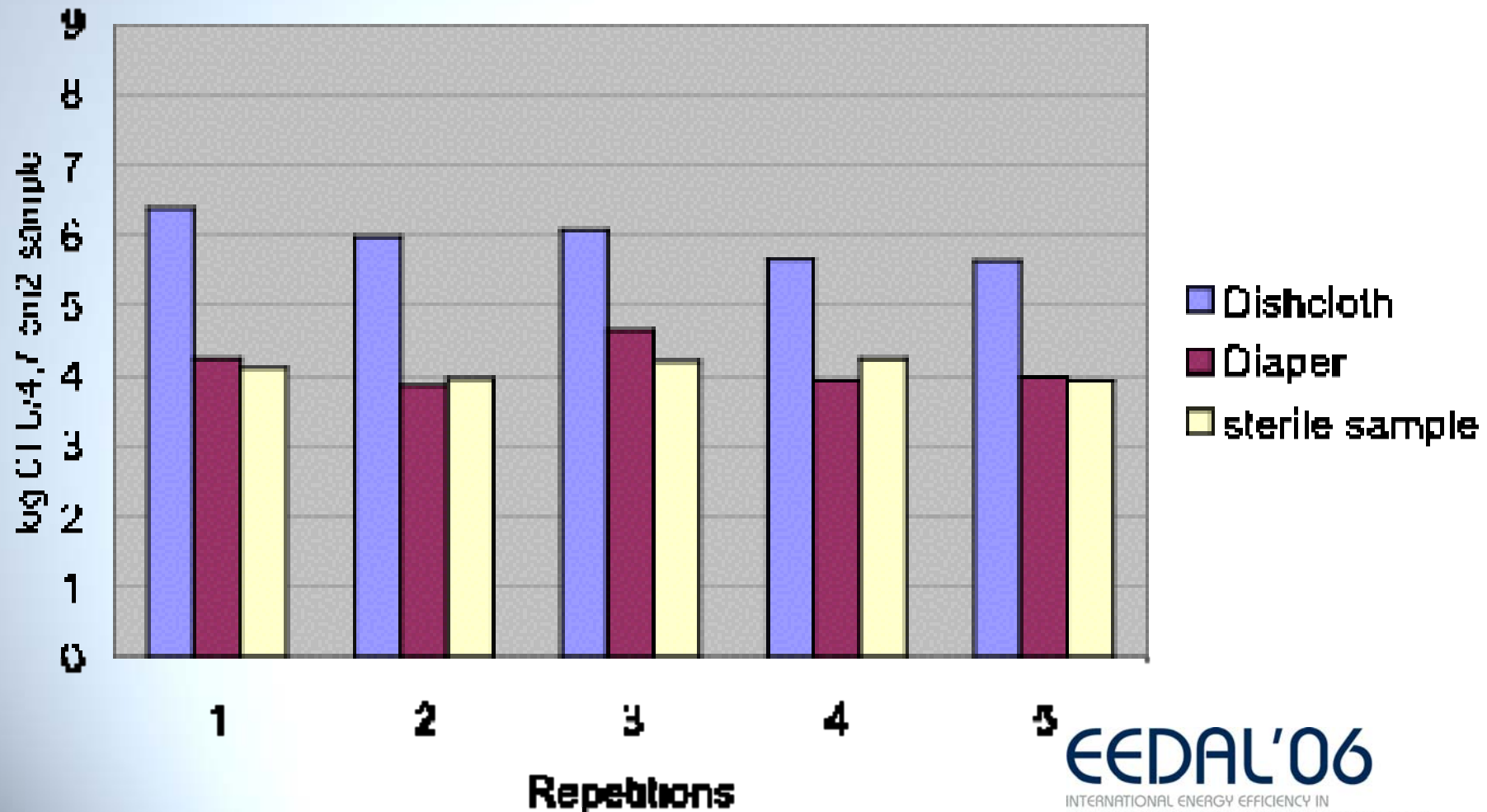


illness in the home

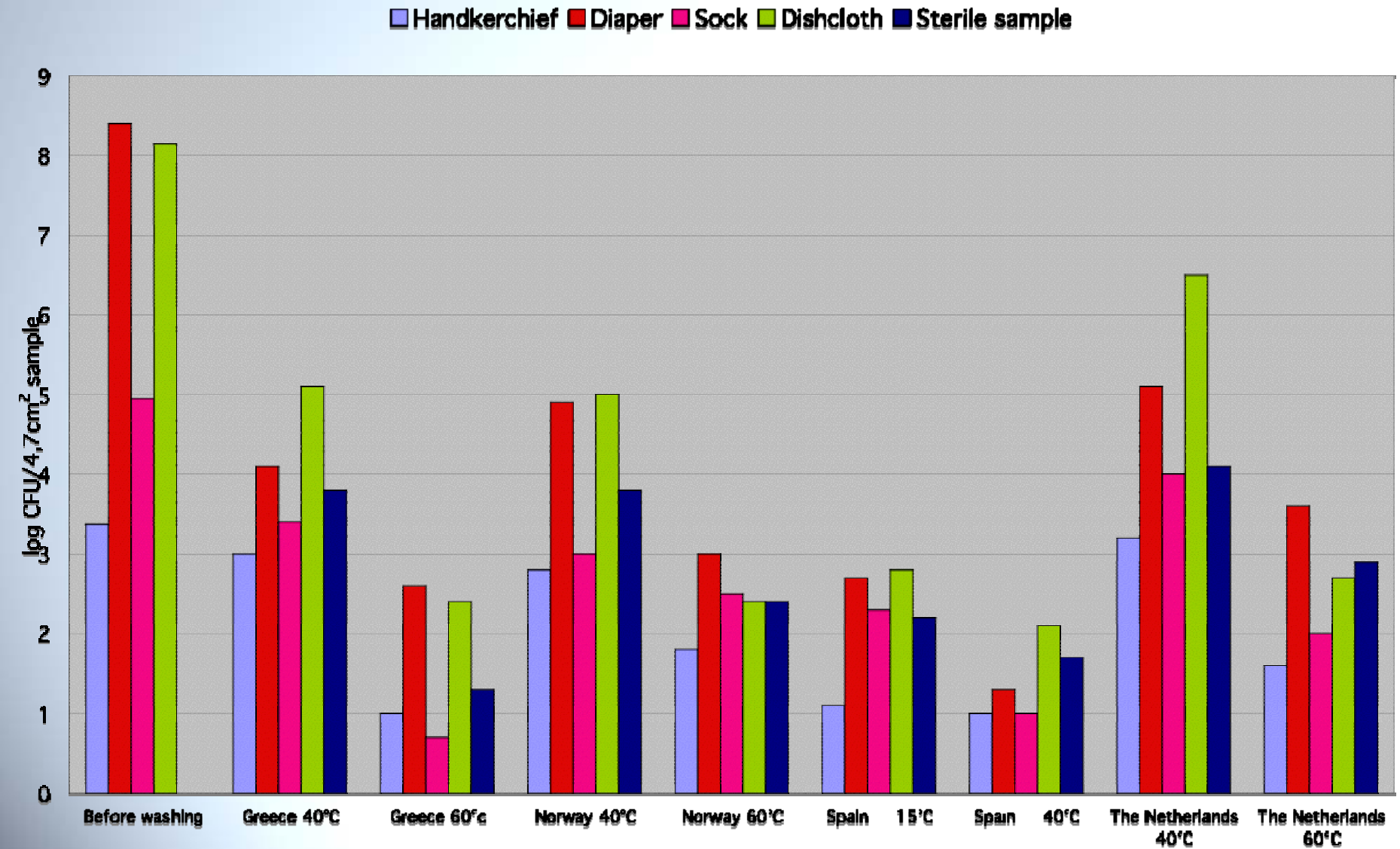
- Inform consumers to prevent habit changes !

Repeatability

Total plate count



Germ reduction



Wash processes Greece and Norway

	Greece		Norway	
Temperature (°C)	40	60	40	60
Program	cotton	cotton	cotton	cotton
Type of detergent	tablets	traditional powder	tablets	tablets
Bleaching agents	yes	yes	no	yes
Dosage (g)	2 tabs	100	1 tab	1 tab
Load (kg)	5	5	3.5	3.5
Water hardness (°Dh)	15.4	15.4	3.5	3.5

Wash processes Spain and the Netherlands

	Spain		the Netherlands	
Temperature (°C)	15	40	40	60
Program	delicates	cotton	cotton	cotton
Type of detergent	traditional powder	traditional powder	compact powder	compact powder
Bleaching agents	yes	yes	no	yes
Dosage (g)	120	120	65	65
Load (kg)	3	3	3.3	3.3
Water hardness (°Dh)	9	9	9	9