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Marburg, 5.7.2009

**Hygiene survey –
mobile trolley cleaning system *TROLLEY WASH* models M and XL**

According to the assignment we examined whether the Trolley Wash system belonging to Feistmantl Cleanings Systems GmbH in Vomp, Austria fulfils the requirements of hygienic and disinfecting cleaning.

On the assumption that common daily used trolleys not only contain unwanted soiling caused by food scraps, paper scraps, larger loose residues like paper, carton, cans, labels, cups (fruit or vegetables) but also manifold microbiological contamination, a safe system was sought which is able to eliminate this soiling and contamination safely.

The customer should be offered a trolley which doesn't bear the risk of infections or other health risks caused by bacteria.

In order to demonstrate that the trolleys can be safely disinfected in Trolley Wash M/XL examinations according to the regulations "examinations and assessment of chemical disinfection methods" by the German Association for Hygiene and Microbiology have been undertaken. The examinations regarding the test germs were undertaken for disinfection methods in a biological load test under practical conditions according to the guidelines of the German Association for Hygiene and Microbiology.

This test is described in part 1.

Part 2 describes a test under realistic conditions. For this 6 heavily used trolleys from six different supermarket chains were randomly selected from a collection of 10 trolleys of each chain. They were tested on predefined spots that are difficult to disinfect. Two trolleys from each collection of each chain were cleaned in Trolley Wash and then sampled again after this process.

Test object

The mobile trolley cleaning system *TROLLEY WASH* is like a car wash. This mobile system is mounted onto a corresponding trailer truck and is thus ready for a flexible operation. Stationary systems are also available. The technical configuration of the systems is the same. They only vary in the number of trolleys that can be cleaned with one tank load of water. As a consequence the herein described survey results are valid for all systems M and XL. They are conform. The systems are protected by the European Patent EP 139343B1

Depending on the trolley type, construction (metal or plastic), degree of soiling, configuration and pre-selected wash cycle Trolley Wash M and XL can autonomously wash 120 to 180 trolleys per hour.

The system works completely independently and can be operated by one person only thanks to the special and patented loading and unloading system at the rear of the machine.

Technical data and specifications are given in the tables below.

	Tank capacity Liter	Number of cleaned trolleys per tank load	Hourly throughput depending on configuration
Trolley Wash M	approx. 2.500	approx. 1.600	120 - 180
Trolley Wash XL	approx. 6.500	approx. 4.200	120 - 180

		Trolley Wash XL		Trolley Wash M	
Mechanical engineering		standard	optional	standard	optional
Power aggregate	electrical power	40		40	
Continuous-flow heater	Heating power	80		80	
Fuel tank	Liters	2 x 600		approx. 600	
Membrane tank	Liters	6.000		approx. 2.000	
Interim tank	Liters	500		approx. 500	
Filter System		manual	automatic	manual	automatic

configuration	complete system	Trolley Wash XL		Trolley Wash M	
		standard	optional	standard	optional
recycling	X	X		X	
high pressure cleaning	X	X		X	
lance cleaning	X		X		X
brush cleaning on the side	X		X		X
brush cleaning of handle & trolley basket inside	X	X		X	
detergent	X		X		X
Rinse / shine drying	X	X		X	
disinfection	X		X		X
Blow off	X		X		X
warm water	X		X		X
anti-freeze protection			X		X

Part 1

Test set-up and performance:

Standard trolleys were contaminated with the test germs on the relevant and assumedly hard to disinfect areas. For this 0.1 ml test germ suspensions absorbed in blood were applied on each selected area. The germs were absorbed in blood in order to simulate a biological load which would make the cleaning and disinfection more difficult. This was to prove that the system also works under exacerbated conditions.

After the trolleys were completely dry they were loaded into Trolley Wash and cleaned therein. The tests were carried out with two different products. One was a pH-neutral al disinfection cleaner with a rinse component. The product is called *Thermosept® NDR* with a rinse component called *Thermosept® BSK*, produced by *Schülke & Mayr*, Norderstedt, Germany. Hospitals use this particular product combination for thermal disinfection of hospital beds in. These products are listed and approved for use in the German list of The Association for Applied Hygiene.

A further product which was used is *Carawash 789* with shine dryer *Carawash S*. *Carawash* is a lightly alkaline carwash based on sodium hydroxide solution, produced by *Halag Chemie Ag* in Aadorf, Switzerland.

Subsequent to the cleaning a quantitative microbiological test was carried out with the recuperation and culture tests.

Test areas

- 1 – handlebar
- 2 – bottom grid
- 3 – sides of trolley (external)
- 4 – sides of trolley (internal)
- 5 – commercial sign at the front
- 6 – Child seat, plastic

Test germs

Representing gram-positive agents *Staphylococcus aureus*, *Enterococcus faecium* and *Enterococcus hirae* were used as test germs.

Staphylococcus aureus is a typical agent for infected wounds, *Enterococcus* as well as *Escherichia coli* are considered to indicate faecal contamination.

Pseudomonas aeruginosa and *Proteus mirabilis* were tested representing hospital-relevant germs. *Candida albicans* was included in the test in order to examine the reduction of yeast fungi, *Aspergillus niger* is a mould fungus which can cause infections in humans. It is a typical representative of mould fungi species. For this test micro organism strains were used that are particularly specified from the DGHM for examining bactericidal and fungicidal effect.

<i>Staphylococcus aureus</i>	ATCC 6538
<i>Enterococcus hirae</i>	ATCC 10541
<i>Enterococcus faecium</i>	ATCC 5037
<i>Escherichia coli</i>	ATCC 11229
<i>Pseudomonas aeruginosa</i>	ATCC 15442
<i>Proteus mirabilis</i>	ATCC 14153
<i>Candida albicans</i>	ATCC 10231
<i>Aspergillus niger</i>	ATCC 16404

Test germ concentration

<i>Staphylococcus aureus</i>	ATCC 6538	1,0 x 10 ⁷ KBE/ml
<i>Enterococcus hirae</i>	ATCC 10541	1,0 x 10 ⁷ KBE/ml
<i>Enterococcus faecium</i>	ATCC 6057	1,0 x 10 ⁷ KBE/ml
<i>Escherichia coli</i>	ATCC 11229	1,0 x 10 ⁷ KBE/ml
<i>Pseudomonas aeruginosa</i>	ATCC 15442	1,0 x 10 ⁷ KBE/ml
<i>Proteus mirabilis</i>	ATCC 14153	1,0 x 10 ⁷ KBE/ml
<i>Candida albicans</i>	ATCC 10231	1,0 x 10 ⁷ KBE/ml
<i>Aspergillus niger</i>	ATCC 16404	1,0 x 10 ⁷ KBE/ml *

* KBE/ml = colony forming unit per ml

Results:

Each germ was applied to six different areas of the tested object so that all possible areas were covered. Each test was repeated.

1. Test with Thermosept® NDR/ Thermosept® BSK***Staphylococcus aureus* ATCC 6538, initial concentration $1,0 \times 10^7$ KBE/ml**

	<i>Result</i>	<i>Reduction rate log-grades</i>
1	germfree	7,00
2	germfree	7,00
3	germfree	7,00
4	germfree	7,00
5	germfree	7,00
6	germfree	7,00
Total reduction rate		7,00

***Enterococcus hirae* ATCC 19541, initial concentration $1,0 \times 10^7$ KBE/ml**

	<i>Result</i>	<i>Reduction rate log-grades</i>
1	germfree	7,00
2	germfree	7,00
3	germfree	7,00
4	germfree	7,00
5	germfree	7,00
6	80	7,00
Total reduction rate		7,00

***Enterococcus faecium* ATCC 6057, initial concentration $1,0 \times 10^7$ KBE/ml**

	<i>Result</i>	<i>Reduction rate log-grades</i>
1	germfree	7,00
2	germfree	7,00
3	germfree	7,00
4	germfree	7,00
5	germfree	7,00
6	22	7,00
Total reduction rate		7,00

***Escherichia coli* ATCC 11229, initial concentration $1,0 \times 10^7$ KBE/ml**

	<i>Result</i>	<i>Reduction rate log-grades</i>
1	germfree	7,00
2	germfree	7,00
3	germfree	7,00
4	germfree	7,00
5	germfree	7,00
6	germfree	7,00
Total reduction rate		7,00

***Pseudomonas aeruginosa* ATCC 15442, initial concentration $1,0 \times 10^7$ KBE/ml**

	<i>Result</i>	<i>Reduction rate log-grades</i>
1	germfree	7,00
2	germfree	7,00
3	germfree	7,00
4	germfree	7,00
5	germfree	7,00
6	germfree	7,00
Total reduction rate		7,00

***Proteus mirabilis* ATCC 14153, initial concentration $1,0 \times 10^7$ KBE/ml**

	<i>Result</i>	<i>Reduction rate log-grades</i>
1	germfree	7,00
2	germfree	7,00
3	germfree	7,00
4	germfree	7,00
5	germfree	7,00
6	germfree	7,00
Total reduction rate		7,00

***Candida albicans* ATCC 10231, initial concentration $1,0 \times 10^7$ KBE/ml**

	<i>Result</i>	<i>Reduction rate log-grades</i>
1	germfree	7,00
2	germfree	7,00
3	germfree	7,00
4	germfree	7,00
5	germfree	7,00
6	germfree	7,00
Total reduction rate		7,00

***Aspergillus niger* ATCC 16404, initial concentration $1,0 \times 10^7$ KBE/ml**

	<i>Result</i>	<i>Reduction rate log-grades</i>
1	germfree	7,00
2	germfree	7,00
3	germfree	7,00
4	germfree	7,00
5	germfree	7,00
6	germfree	7,00
Total reduction rate		7,00

2. Test with Carawash 789/Carawash S, test contaminations tested only in two areas (handle bar, bottom grate)

***Staphylococcus aureus* ATCC 6538, initial concentration $1,0 \times 10^7$ KBE/ml**

	<i>Result</i>	<i>Reduction rate log-grades</i>
1	germfree	7,00
2	germfree	7,00
Total reduction rate		7,00

***Enterococcus hirae* ATCC 19541, initial concentration $1,0 \times 10^7$ KBE/ml**

	<i>Result</i>	<i>Reduction rate log-grades</i>
1	germfree	7,00
2	germfree	7,00
Total reduction rate		7,00

***Enterococcus faecium* ATCC 6057, initial concentration $1,0 \times 10^7$ KBE/ml**

	<i>Result</i>	<i>Reduction rate log-grades</i>
1	germfree	7,00
2	germfree	7,00
Total reduction rate		7,00

***Escherichia coli* ATCC 11229, initial concentration $1,0 \times 10^7$ KBE/ml**

	<i>Result</i>	<i>Reduction rate log-grades</i>
1	germfree	7,00
2	germfree	7,00
Total reduction rate		7,00

***Pseudomonas aeruginosa* ATCC 15442, initial concentration $1,0 \times 10^7$ KBE/ml**

	<i>Result</i>	<i>Reduction rate log-grades</i>
1	germfree	7,00
2	germfree	7,00
Total reduction rate		7,00

***Proteus mirabilis* ATCC 14153, initial concentration $1,0 \times 10^7$ KBE/ml**

	<i>Result</i>	<i>Reduction rate log-grades</i>
1	germfree	7,00
2	germfree	7,00
Total reduction rate		7,00

***Candida albicans* ATCC 10231, initial concentration $1,0 \times 10^7$ KBE/ml**

	<i>Result</i>	<i>Reduction rate log-grades</i>
1	germfree	7,00
2	germfree	7,00
Total reduction rate		7,00

***Aspergillus niger* ATCC 16404, initial concentration $1,0 \times 10^7$ KBE/ml**

	<i>Result</i>	<i>Reduction rate log-grades</i>
1	germfree	7,00
2	germfree	7,00
Total reduction rate		7,00

Part 2. Practical Test

The trolleys selected for the test have been contaminated with a contact slide culture medium on the bottom as well as the child seat in order to quantify bacteria, yeasts and fungi on surfaces.

The medium was applied to a 40 x 40 cm area on the bottom grate of a trolley. Considering the grate gaps and thickness this gave a 50 cm² area. The same medium was applied to the child seat (25 cm² area). The total test area was 75 cm².

The following table shows the results of the test with the two cleaning products.

1. Trolley - dirty

Trolley No.	Bacteria count KBE/m ²	Type of germ
4	200	<i>Micrococcus luteus</i> <i>Bacillus sp.</i>
7	213	<i>Bacillus sp.</i> <i>Bacillus cereus</i>
8	266	<i>Bacillus sp.</i>
11	106	<i>Bacillus sp.</i>
15	213	<i>Bacillus sp.</i> <i>Micrococcus luteus</i>
19	266	<i>Bacillus sp.</i>
M	210,6	

2. After cleaning in the TROLLEY WASH system with Thermosept® NDR/Thermosept® BSK

Trolley No.	Bacteria count KBE/m ²	Type of germ
1	3	<i>Bacillus sp.</i>
2	24	<i>Bacillus sp.</i>
8	20	<i>Bacillus sp.</i> <i>Micrococcus luteus</i>
9	21	<i>Bacillus sp.</i>
10	7	<i>Bacillus sp.</i>
12	20	<i>Bacillus sp.</i>
15	4	<i>Bacillus sp.</i>
19	12	<i>Bacillus sp.</i>
20	12	<i>Bacillus sp.</i>
M	13,6	

3. After cleaning in the **TROLLEY WASH** system with Carawash 789/Carawash S

Trolley No.	Bacteria count KBE/m ²	Type of germ
3	16	<i>Bacillus sp.</i>
4	26	<i>Bacillus sp.</i>
6	5	<i>Bacillus sp.</i> <i>Aspergillus sp.</i>
7	26	<i>Bacillus sp.</i>
11	37	<i>Bacillus sp.</i> <i>Staphylococcus epidermidis</i>
13	10	<i>Bacillus sp.</i> <i>Aspergillus sp.</i>
14	18	<i>Bacillus sp.</i>
16	4	<i>Bacillus sp.</i>
17	26	<i>Bacillus sp.</i>
M	20,4	

Assessment:

All trolleys gave a positive impression after cleaning in the microbiological test as well as after cleaning in the practical test. This certainly varied depending on the age, the intensive use respectively and the maintenance condition of each trolley. However all trolleys appeared significantly cleaner and newer than before the wash.

In the practical test >90% of the germs found on the trolleys were eliminated, no matter which product was used. As the trolleys obviously had been standing in a dry area for a while initially only gram-positive dry germs without infectiological meaning (i.e. bacillus and micrococcus) were found; on some trolleys also the mould fungus aspergillus was found.

In the tests with test germ contaminations under a biological load the demonstrated microbiological values show that **TROLLEY WASH M/XL** warrants a very good hygienic treatment.

For all tested types of germs a reduction of 7 log-grades could be achieved. This reduction of bacteria count exceeds the required reduction of at least 5 log-grades for a disinfecting treatment.

The thermal disinfecting combination Thermosept® NDR/Thermosept® BSK (approved for medical sector) as well as the car wash combination Carawash 789/Carawash S achieved very good results.

The **TROLLEY WASH** system is to be recommended for a disinfecting cleaning of shopping trolleys as it guarantees the safety and microbiological innocuousness of the transported goods.

Considering that the HACCP concept reaches the consumer to be able to guarantee harmless groceries, the regular use of the **TROLLEY WASH** system implies the elimination of a critical control aspect in this concept.

Marburg, 5.7.2009

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