



Report

Cleaning with Less Water

Test of combined cleaning and disinfection product

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Purpose **Introduction**
The meat industry wishes to reduce the water consumption associated with daily cleaning. The purpose of these tests is to investigate if the water consumption can be reduced by using a combined cleaning & disinfection (C&D) product in low soil areas instead of the traditional 2-step procedure. This without impairing the level of hygiene and disinfection efficiency.

Background
The traditional cleaning procedure in the meat industry involves large volumes of water and liquid chemicals. The current cleaning programme can be divided into the following subroutines: 1) Prerinsing with water to remove solid waste, 2) Application of cleaning detergent, 3) Rinsing, 4) Disinfection, 5) Rinsing.

Cleaning and disinfection can be combined into one operation using a product containing both cleaning detergents and a disinfectant (C&D product). These products can in some cases replace the traditional 2-step procedure leading to both time and water savings.

Previous tests (Bildsted and Granly Koch, 2022) have shown that the water consumption can be reduced by 30-45% if combined C&D products are used instead of the conventional 2-step procedure¹ (see Table 1).

Table 1. Water consumption (Litres \pm std.dev., n=3) using combined C&D products versus using the conventional 2-step procedure. Two combined C&D products were tested. Test 1 = Foam 2000 CL, Test 2 = Topaz CL1.

	Test 1	Test 2
Combined C&D	217 \pm 10 L	121 \pm 3 L
2-step procedure	308 \pm 15 L	219 \pm 14 L
Reduction (%)	30%	45%

The effect of the combined C&D product in these tests is evaluated by visual inspection of the surfaces and by sampling surface swabs for microbial analysis. There is no legal standard for accepted microbial levels on clean surfaces, but a range of guidelines have suggested:

- 3 cfu/cm² – Suggested by Swedish Food Agency³
- 5 cfu/cm² – Suggested by USDA³
- 10 cfu/cm² – Suggested by Ministry of food, Agriculture and Fishers of Denmark²
- 10 cfu/cm² – Suggested by European Community³

The disinfection effect of the combined C&D product is evaluated against these guidelines.

Conclusion

- It is possible to reduce the water consumption with approx. 1/3 if a combined C&D product is used instead of the conventional 2-step procedure.
- The results show a high potential for using a combined C&D product on steel surfaces, as the bacterial count is reduced by 3.5-6.5 log CFU/cm², and only a few samples (3/50) exceed the general guidelines for food contact surfaces with levels varying from 43 to 67 cfu/cm².
- It cannot be recommended to use combined C&D products on conveyor belts, as a low disinfection was obtained in these tests. The bacterial reduction varied from almost no effect to a reduction of 3.0 log CFU/cm². The cleaning and disinfection were performed using a spray bar, and it is unknown whether the effect could be improved if a manual procedure was used instead.

Overview of tests

The tests were performed in DMRI's pilot plant using the same cleaning equipment and settings as used in the industry. This included water pressure, water temperature and types of nozzles.

The following routine was performed every workday in 3.5 weeks to measure the long-term effect of a C&D product:

1. Surfaces were soiled with pork breasts ribs inoculated with bacteria.
2. The meat was removed after 18 hours of soiling to simulate a common production day in the meat industry.
3. After 2 hours of drying, the surfaces were cleaned and disinfected using a combined C&D product.
4. Samples for microbiological analysis were taken on selected days to evaluate the disinfection effect. Samples were taken before and after cleaning.

The test plan is shown in Table 2.

Table 2. Test plan. The surfaces were soiled with meat/bacteria on all test days (except in weekends).

Week 1	
Day 1 - Monday	Start-up
Day 2 - Tuesday	Combined C&D
Day 3 - Wednesday	Combined C&D
Day 4 - Thursday	Combined C&D and microbial analysis
Day 5 - Friday	Combined C&D
Day 6 - Saturday	Weekend
Day 7 - Sunday	Weekend

Week 2	
Day 8 - Monday	Start-up
Day 9 - Tuesday	Combined C&D
Day 10 - Wednesday	Combined C&D
Day 11 - Thursday	Combined C&D and microbial analysis
Day 12 - Friday	Combined C&D
Day 13 - Saturday	Weekend
Day 14 - Sunday	Weekend
Week 3	
Day 15 - Monday	Start-up
Day 16 - Tuesday	Combined C&D
Day 17 - Wednesday	Combined C&D
Day 18 - Thursday	Combined C&D and microbial analysis
Day 19 - Friday	Combined C&D
Day 20 - Saturday	Weekend
Day 21 - Sunday	Weekend
Week 4	
Day 22 - Monday	Microbial analysis and start-up
Day 23 - Tuesday	Combined C&D and microbial analysis

Surface soiling

Three surfaces were used during the test (see pictures below):

- Modular conveyor belt
- Horizontal steel surface
- Tilted steel surfaces in a 45° angle

Each surface was soiled with pork breasts inoculated with a bacteria cocktail containing the following species:

- *Brochotrix thermosphacta* (DMRICC 4613)
- *Pseudomonas fluorescens* (DMRICC 4760)

The pure cultures were cultivated in BHI bouillon at 25°C/3 days, then the cultures were mixed 1:1, and diluted to 10⁶⁻⁷ cfu/ml. Each pork breast was inoculated with a 25 ml cocktail, corresponding to a microbial level on the meat surfaces of ~ 4.5-5.5 log cfu/cm².

The surfaces were soiled with meat/bacteria in the afternoon, and then the surfaces were covered in plastic to avoid drying of the surface (Figure 1).



Figure 1. The surfaces were soiled with meat/bacteria for approx. 18 hours to simulate a normal production day in the meat industry.

The cleaning process was initiated the following morning. The meat was removed from the surfaces, and the surfaces were cleaned after 2 hours. The surfaces after soiling are shown in Figure 2.

One of the steel tables was raised in an angle of approx. 45° before cleaning, making it more difficult to clean, as some soap and disinfectant will slip off during the contact time of the products.

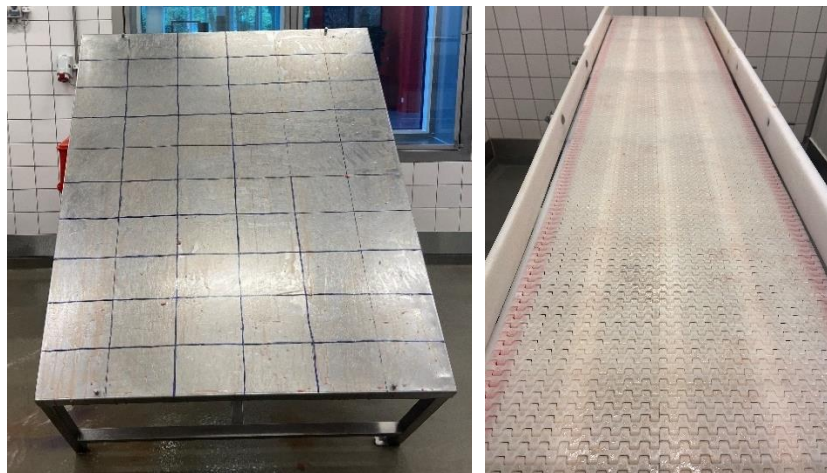


Figure 2. Soiled surfaces.

Product

The following product were used:

- Combined C&D product: Topaz CL1 (3.0%).

Cleaning programme

The surfaces were cleaned every day using the following protocol:

- Pre-rinsing of the conveyor belt with lukewarm water (45-50°C). The belt was rinsed in 1 min.
- Cleaning and disinfection using Topaz CI (contact time = 20 min).
- Rinsing with water.

The conveyor belt was cleaned using a spray bar while the steel surfaces were cleaned manually (Figure 3). The surfaces were inspected (visually/tactile) before and after cleaning and disinfection to document potential day-to-day variations in soil and cleaning levels.

The amount of the combined C&D product on the conveyor belt was increased after day 10, because the preliminary results showed that the disinfection effect was too low. Until day 10, the combined C&D product was applied for 30 seconds (1 round of the belt). After day 10, the product was applied for 1 minute (2 rounds of the belt).



Figure 3. Manual cleaning of steel surfaces and cleaning of conveyor belt using a spray bar.

Bacterial analysis

The bacterial level on all surfaces was analysed before and after cleaning and disinfection on selected days (Table 2).

Samples were taken using sterile gauze swabs. After sampling, 50 ml FKP water were added to each gaze cloth, and the sample was stomached for 1 min.

Areal of swab samples:

- Steel tables = 300 cm²
- Conveyor belt = 315 cm²

Each sample was analysed for the total aerobic plate count at 20°C/5 days on PCA according to SM 108-09.

Results

Combined C&D

The disinfection effect of the combined C&D product on the various surfaces are shown in Figure 4. The results are expressed as bacterial reduction (log CFU/cm²) on tests day 4, 10, 17 and 23.

On the steel surface, the combined C&D product was effective in both cleaning and disinfecting, as the surface was visually clean, and the bacterial count was reduced by 3.5-6.5 log CFU/cm² after the procedure. On the modular conveyor

belt however, the result was less encouraging. Although the surface was visually clean after the procedure, almost no disinfection effect was observed on the belt during the first 10 days of the test. To investigate whether adding more detergent could increase the effect, another layer of detergent foam was added after day 10. Adding the extra detergent resulted in a slight improvement of the effect, as the bacterial count was reduced by 1.7-3.0 log CFU/cm², but it was still far from the effect that would be expected and needed on food contact surfaces.

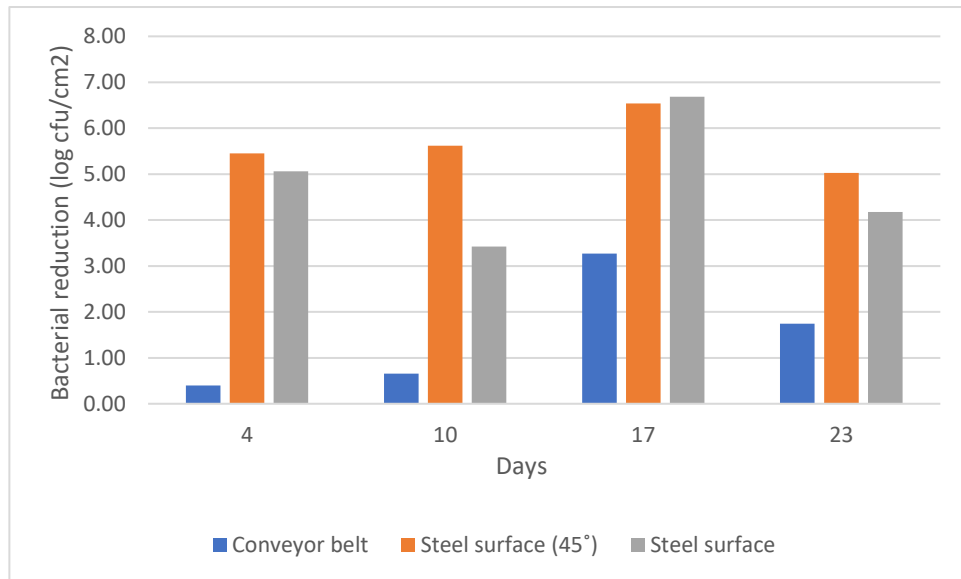


Figure 4. Bacterial reduction (log CFU/cm²) after use of a combined cleaning and disinfection product on a modular conveyor belt and steel surfaces. The effect was tested during 3.5 weeks in which swab samples for microbial analysis were sampled on day 4, 10, 17 and 23.

The bacterial counts (CFU/cm²) in the swab samples taken after use of the combined C&D product are shown in Table 3. Five swab samples were taken from each type of surfaces.

Most of the samples from the steel surfaces after cleaning/disinfection were acceptable, as the total plate count was lower than the maximum recommendation of 3-10 cfu/cm². A few of the samples from the steel surfaces exceeded these guidelines. The levels varying from <1-67 cfu/cm². The increased levels are not associated with bacterial accumulation, as the counts were highest on the first test days. Most of the swab samples from the conveyor belt exceeded the maximum guidelines of food contact surfaces.

Table 3. Results (CFU/cm²) from long term test of combined C&D product.

	Sample nr.	Conveyor belt	Tilted steel surface (45°)	Steel surface
Day 4	1	23810	<1	67
	2	15873	<1	<1
	3	65	<1	<1
	4	23810	<1	<1
	5	2857	<1	<1
Day 10	1	174603	<1	43
	2	2222	<1	45
	3	4444	<1	10
	4	460	<1	<1
	5	190	<1	<1
Day 17*	1	3492	<1	<1
	2	238	<1	<1
	3	206	<1	<1
	4	63	<1	<1
	5	10	<1	<1
Day 23	1	107	<1	<1
	2	55	<1	<1
	3	17	<1	<1
	4	39	1	7
	5	952	<1	<1

*The amount of C&D product on the belt was doubled after day 11, as the effect was too low.

Conclusion

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References

1. Bildsted, E. and Granly, A. (2022). Preliminary tests of combined C&D products. Rengøring med mindre vand, projekt nr. 2009641. Rapport af 3. juni 2022.
2. Ministry of Food, Agriculture and Fisheries of Denmark (FVM) (2003). Vejledning om egenkontrol i fødevarevirksomheder m.v., VEJ nr. 120 af 28/10/2003, kapitel 3, <https://www.retsinformation.dk/eli/mt/2003/120>. (Old reference classified as historical, but no new document)
3. Holah, J., Lelieveld, H. and Gabric, D. (2016). Handbook of Hygiene Control in the Food Industry (Woodhead Publishing Series in Food Science, Technology and Nutrition). 2nd edition. Woodhead Publishing.