

**TÜV RHEINLAND  
ENERGIE UND UMWELT GMBH**

Report on the assessment of the antibacterial  
properties of  
AE DeCont rings with AGXX coating

TÜV report no.: 931/21229709/100  
Cologne, 1 October 2015

## Test report

Contracting party: Feindrahtwerk Adolf Edelhoff GmbH & Co. KG  
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TÜV order number: 931 / 21229709 / 100

TÜV customer ID: 248559

Laboratory number: M5-469

Test object: AE DeCont rings with AGXX coating

Scope of examinations: Parameters set by the customer

Date of receipt at laboratory: 2 July 2015

Test period: 13 July to 7 September 2015

Place of test: Cologne

Type of test: Microbiological examination

Cologne, 1 October 2015

Expert



Dr. rer. nat. Julia Wassermann

Responsible Specialist



Dr. rer. nat. Walter Dormagen

## **Task Definition**

Feindrahtwerk Adolf Edelhoff GmbH & Co. KG has commissioned TÜV Rheinland Energie und Umwelt GmbH with laboratory investigations of the antimicrobial properties in water of AE DeCont rings coated with AGXX technology. The AE DeCont rings are sold by the customer under the trademark AE DeCont.

As requested, the microbiological laboratory of TÜV Rheinland Energie und Umwelt GmbH performed the investigations by contaminating water samples with defined bacterial strains and examining the decay rate of the cultivated bacteria in the presence of AE DeCont rings with AGXX coating for a period of up to 28 days. In addition to efficacy testing, control tests were carried out with water and bacteria only.

The bacterial strains applied as well as the level of contamination were chosen in accordance with the microbiological requirements of the European Directive on the Quality of Water Intended for Human Consumption (Council Directive 98/83/EC) and of the German Drinking Water Regulations 2001 (*Trinkwasserverordnung, TrinkwV*) in their version of 7 August 2013. Furthermore, the investigations were modelled after Standard DIN 10521 "Food Hygiene - Household water filters which are not connected to the water supply - Household water filters using cation exchange resin and activated carbon".

## **Procedure**

For the preparation of the test solutions, water samples in 2 l bottles were inoculated with the respective bacterial strain in a way as to obtain a bacterial concentration of approx. 200 bacteria per 100 ml of test solution and per 1 ml of water intended for total colony count.

In addition, ten 2 l glass bottles were filled with demineralised water. From these, five bottles were each given two AE DeCont rings with AGXX coating and sterilised by means of autoclaving.

After cooling down, the water of two bottles - one with and one without AE DeCont ring with AGXX coating - was injected with the prepared bacterial solutions.

The bacterial strains used were purchased from specialised distributors.

Every bacterial strain was obtained with a proper certification and adjusted concentration.

The following bacterial strains were used for the investigations of antibacterial properties:

*Escherichia coli* (E. coli): ATCC 8739

*Enterococcus faecalis*: ATCC 7080

*Klebsiella pneumoniae* (coliform): ATCC 10031

*Pseudomonas aeruginosa*: ATCC 9027

The incubation of the test solutions was carried out at room temperature under laboratory requirements specified in Standard DIN EN ISO/IEC 17025 for up to 28 days. During the incubation period, the test solutions were shaken horizontally with 60 motions per minute with a shaker of the type GFL 3015.

The microbiological examinations of the water samples were carried out in accordance with the specifications of the German Drinking Water Regulations (*Trinkwasserverordnung*).

Bacteria	Regulation
E. coli	EN ISO 9308-1
Coliform bacteria	EN ISO 9308-1
Total colony count	<i>TrinkwV</i> 2001, Appendix 5 §15, sections 1, 2 and 4, procedure bb)
<i>Pseudomonas aeruginosa</i>	DIN EN ISO 16266
Enterococci	ISO 7899-2

## Results of the microbiological investigations

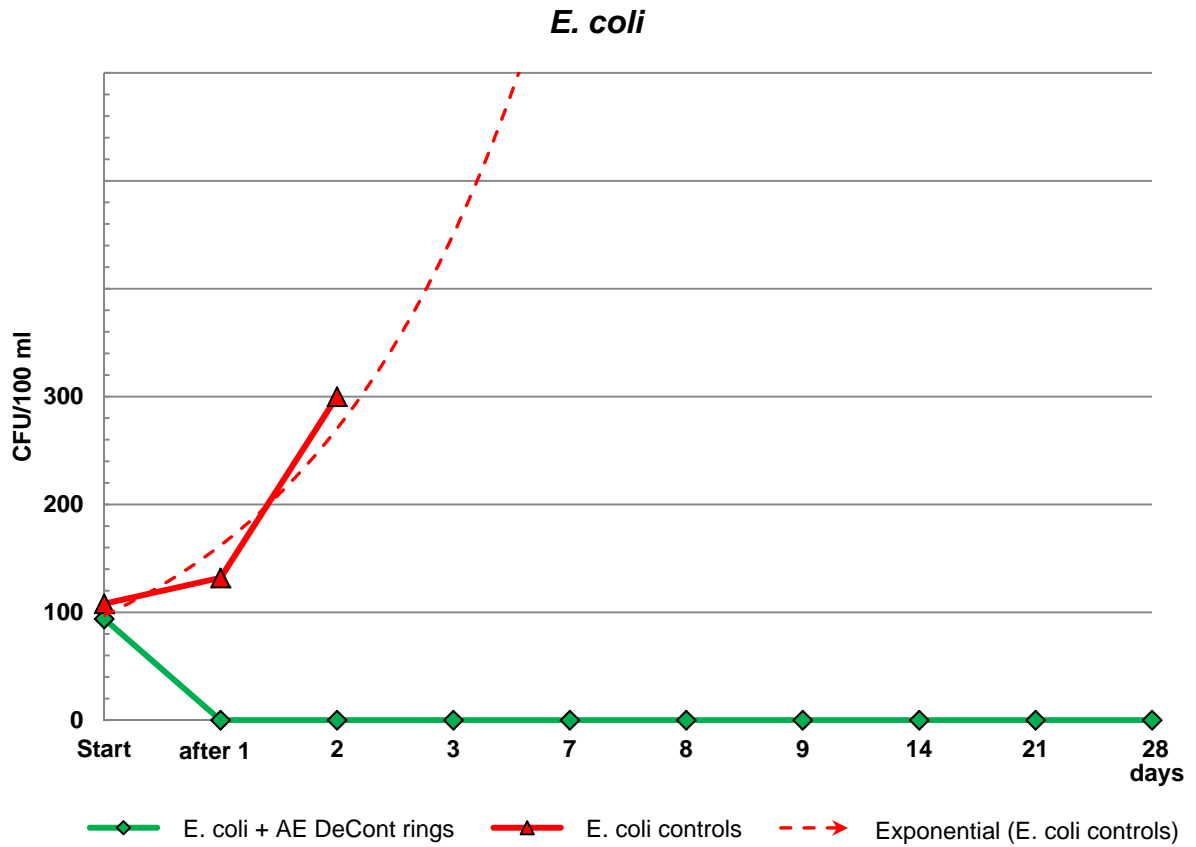
The results of the investigations are presented for each bacterial strain in tabular form and as line charts.

The regulations only allow for presenting a maximum number of 300 grown colonies on the culture medium. The results for all culture media with more than 300 grown colonies are presented in the tables as >300 CFU/100 ml and in the charts as trend line.

**Table 1: E. coli bacteria**

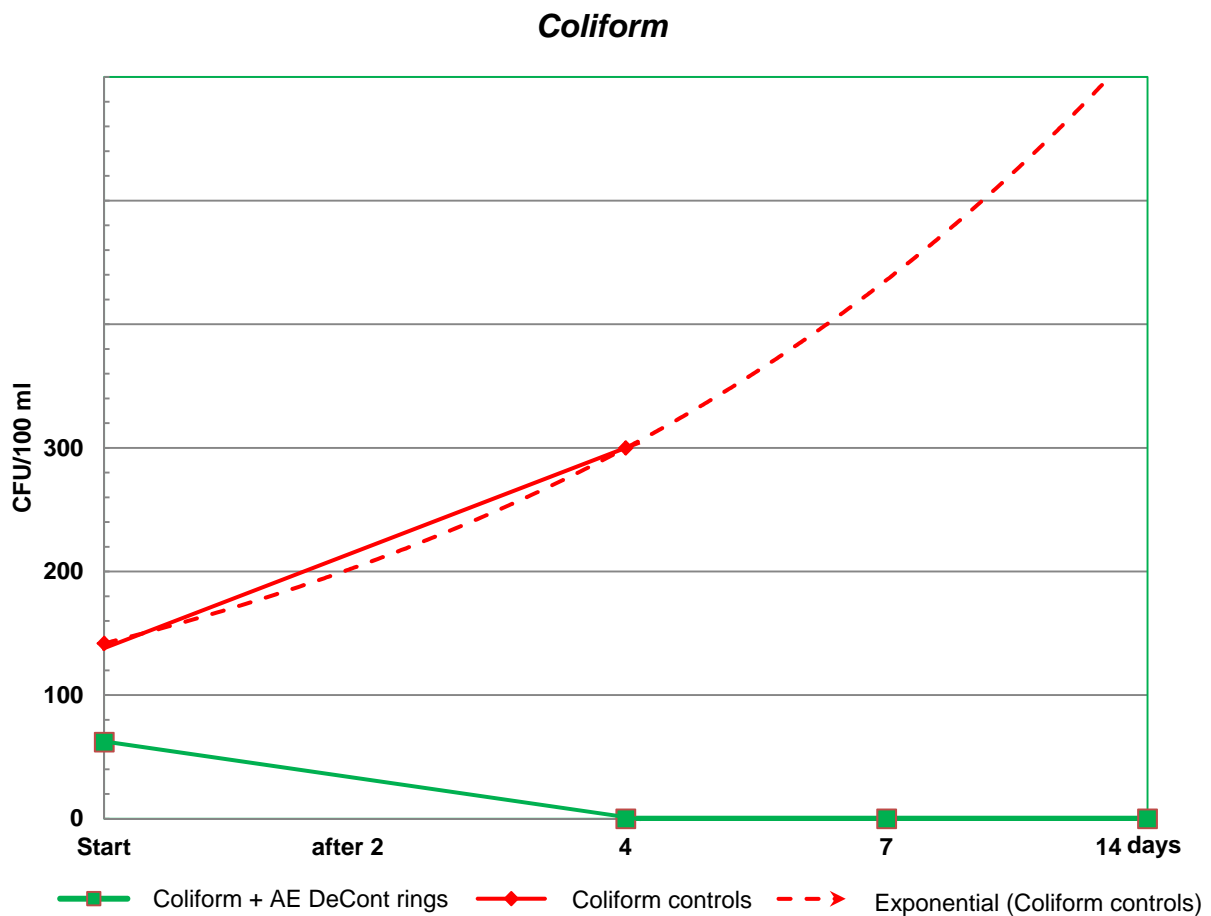
Sampling	AE DeCont rings with AGXX coating	Control samples without AGXX
	<i>E. coli</i>	<i>E. coli</i>
	(CFU/100 ml)	(CFU/100 ml)
Start	94	108
after 1 day	0	132
after 2 days	0	>300
after 3 days	0	>300
after 7 days	0	>300
after 8 days	0	>300
after 9 days	0	>300
after 14 days	0	>300
after 21 days	0	n.e.
after 28 days	0	n.e.

n.e. = not examined



**Table 2: Coliform bacteria**

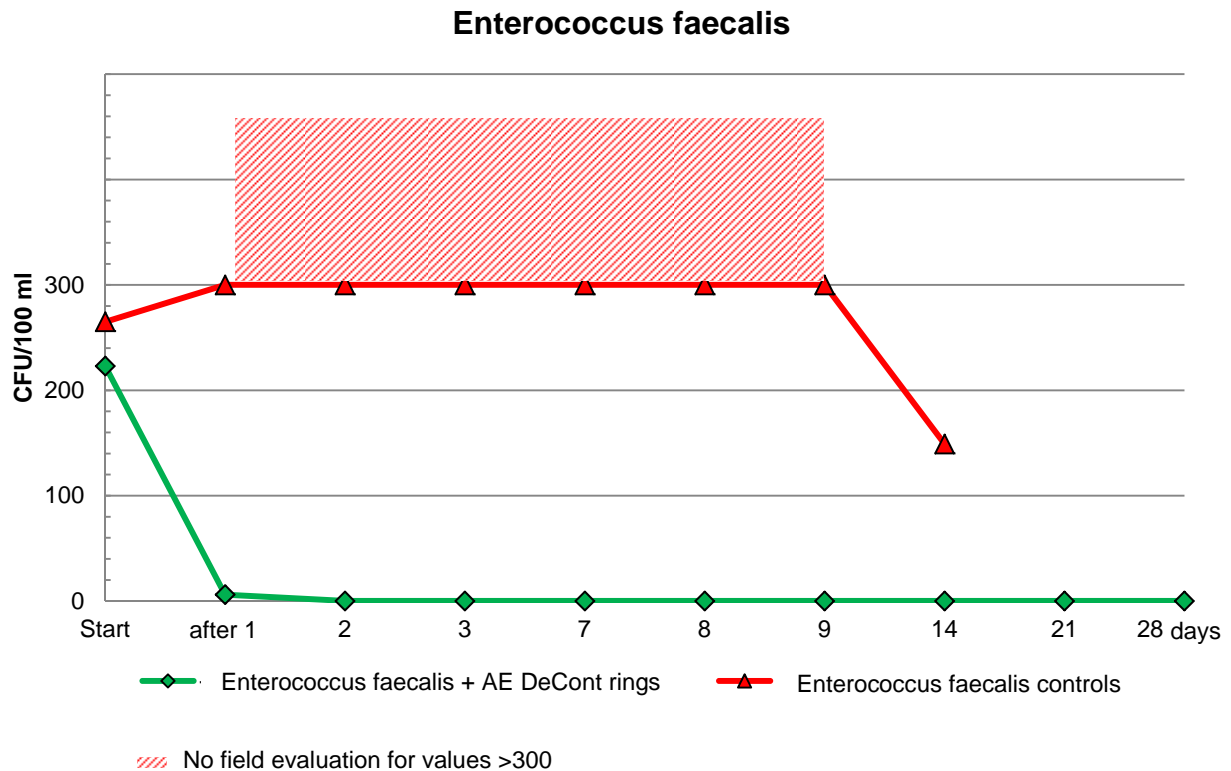
Sampling	AE DeCont rings with AGXX coating	Control samples without AGXX
	<i>Coliform</i>	<i>Coliform</i>
	(CFU/100 ml)	(CFU/100 ml)
Start	62	142
after 4 days	0	>300
after 7 days	0	>300
after 14 days	0	>300



**Table 3: *Enterococcus faecalis* bacteria**

Sampling	AE DeCont rings with AGXX coating	Control samples without AGXX
	<i>Enterococcus faecalis</i>	<i>Enterococcus faecalis</i>
	(CFU/100 ml)	(CFU/100 ml)
Start	223	265
after 1 day	6	>300
after 2 days	0	>300
after 3 days	0	>300
after 7 days	0	>300
after 8 days	0	>300
after 9 days	0	>300
after 14 days	0	149
after 21 days	0	n.e.
after 28 days	0	n.e.

n.e. = not examined



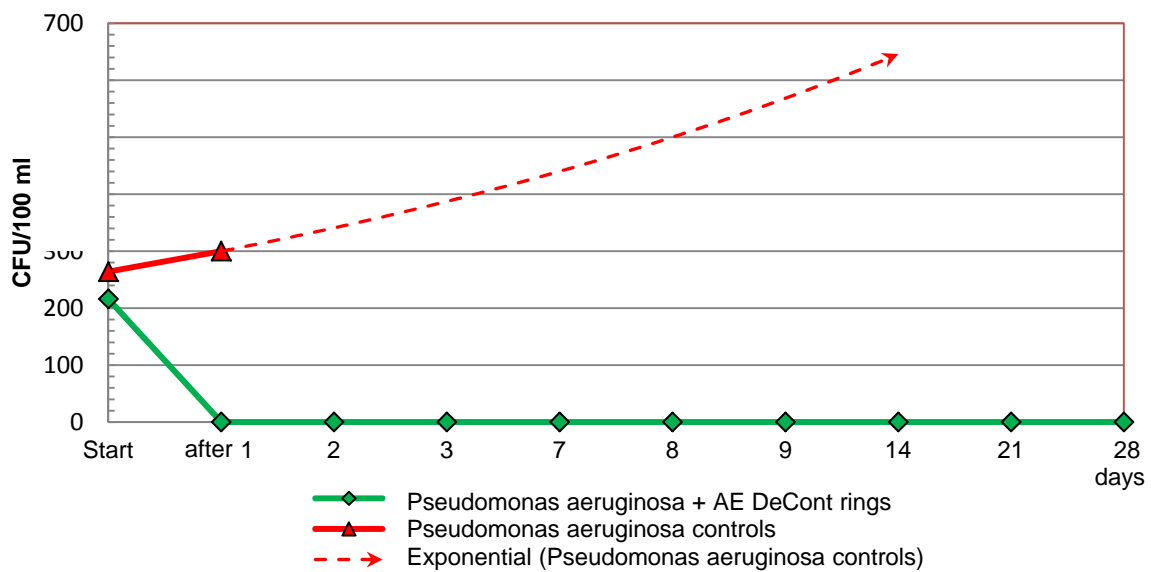


**Table 4: *Pseudomonas aeruginosa* bacteria**

Sampling	AE DeCont rings with AGXX coating	Control sample without AGXX
	(CFU/100 ml)	(CFU/100 ml)
Start	216	264
after 1 day	0	>300
after 2 days	0	>300
after 3 days	0	>300
after 7 days	0	>300
after 8 days	0	>300
after 9 days	0	>300
after 14 days	0	>300
after 21 days	0	n.e.
after 28 days	0	n.e.

n.e. = not examined

***Pseudomonas aeruginosa***

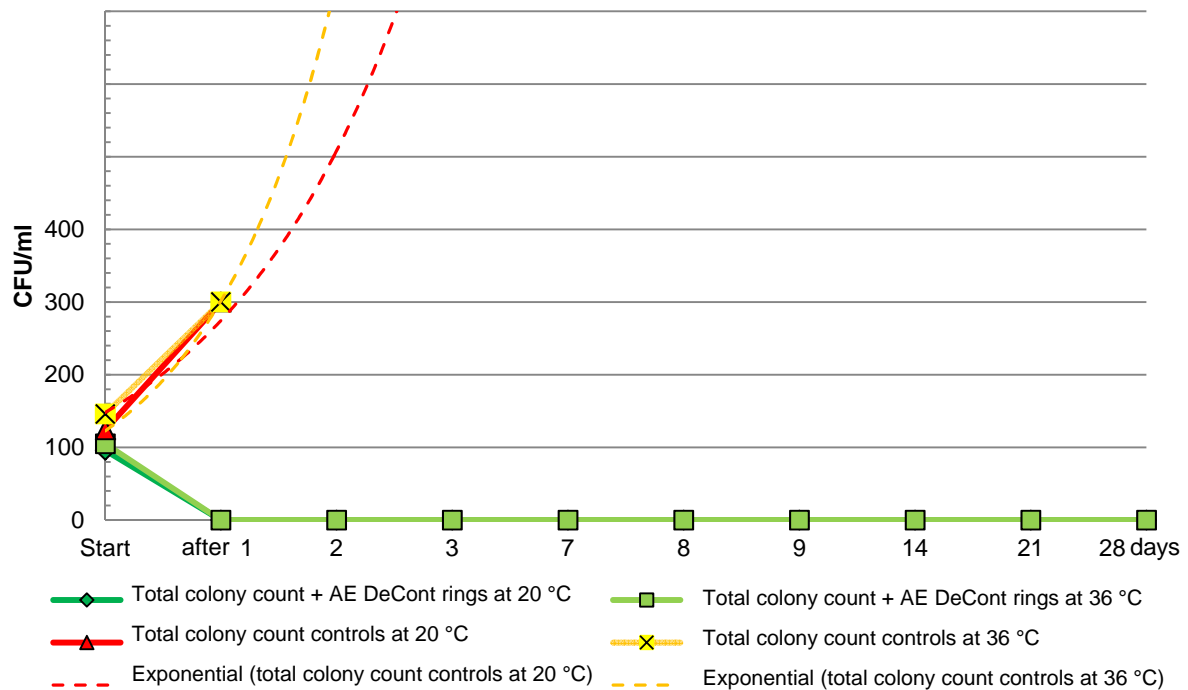


**Table 5: Total colony count**

Sampling	AE DeCont rings with AGXX coating		Control sample without AGXX	
	Total colony count		Total colony count	
	20 °C	36 °C	20 °C	36 °C
	(CFU/ml)		(CFU/ml)	
Start	96	105	124	146
after 1 day	0	0	>300	>300
after 2 days	0	0	>300	>300
after 3 days	0	0	>300	>300
after 7 days	0	0	>300	>300
after 8 days	0	0	>300	>300
after 9 days	0	0	>300	>300
after 14 days	0	0	>300	>300
after 21 days	0	0	n.e.	n.e.
after 28 days	0	0	n.e.	n.e.

n.e. = not examined

**Total colony count**



## Summary of results

**Table 6: AE DeCont rings with AGXX coating - 1<sup>st</sup> test series**

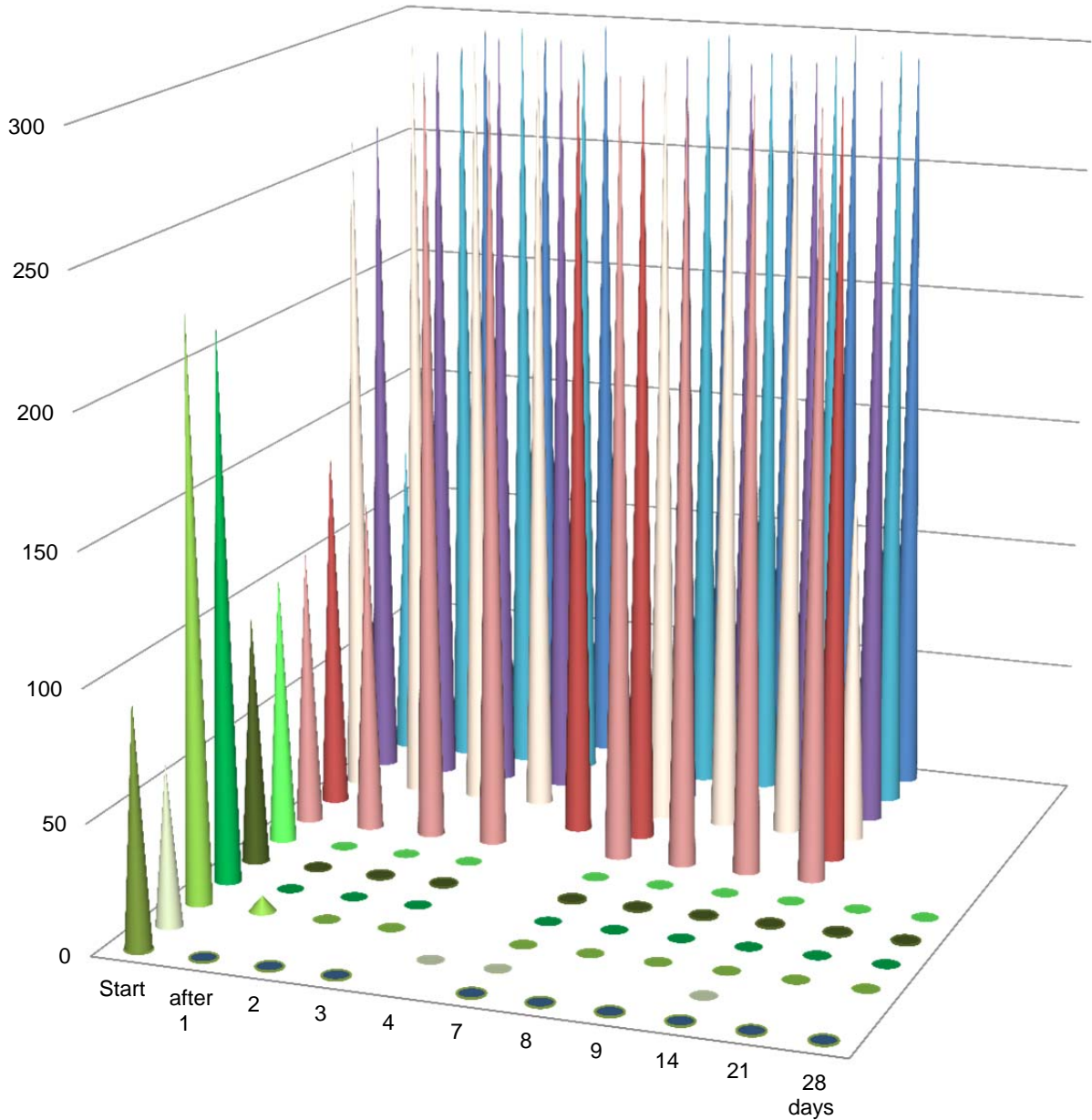
Sampling	<i>E. coli</i>	Coliform	<i>Enterococcus faecalis</i>	<i>Pseudomonas aeruginosa</i>	Total colony count	
					20 °C	36 °C
	CFU/100 ml	CFU/100 ml	CFU/100 ml	CFU/100 ml	CFU/ml	
Start	94	62	223	216	96	105
after 1 day	0	n.e.	6	0	0	0
2	0	n.e.	0	0	0	0
3	0	n.e.	0	0	0	0
4	n.e.	0	n.e.	n.e.	n.e.	n.e.
7	0	0	0	0	0	0
8	0	n.e.	0	0	0	0
9	0	n.e.	0	0	0	0
14	0	0	0	0	0	0
21	0	n.e.	0	0	0	0
28 days	0	n.e.	0	0	0	0

**Table 7: Control tests (without AE DeCont rings)**

Sampling	<i>E. coli</i>	Coliform	<i>Enterococcus faecalis</i>	<i>Pseudomonas aeruginosa</i>	Total colony count	
					20 °C	36 °C
	CFU/100 ml	CFU/100 ml	CFU/100 ml	CFU/100 ml	CFU/ml	
Start	108	142	265	264	124	146
after 1 Tag	132	n.e.	>300	>300	>300	>300
2	>300	n.e.	>300	>300	>300	>300
3	>300	n.e.	>300	>300	>300	>300
4	n.e.	>300	n.e.	n.e.	n.e.	n.e.
7	>300	>300	>300	>300	>300	>300
8	>300	n.e.	>300	>300	>300	>300
9	>300	n.e.	>300	>300	>300	>300
14 days	>300	>300	149	>300	>300	>300

n.e. = not examined

**Overview - 1<sup>st</sup> test series**



- E. coli + AE DeCont rings
- Enterococcus faecalis + AE DeCont rings
- Total colony count + AE DeCont rings at 20 °C
- E.coli controls
- Enterococcus faecalis controls
- Total colony count controls at 20 °C
- Coliform + AE DeCont rings
- Pseudomonas aeruginosa + AE DeCont rings
- Total colony count + AE DeCont rings at 36 °C
- Coliform controls
- Pseudomonas aeruginosa controls
- Total colony count controls at 36 °C

## Assessment – 1<sup>st</sup> test series

The microbiological laboratory of TÜV Rheinland Energie und Umwelt GmbH investigated the antimicrobial properties in water of AE DeCont rings coated with AGXX technology. As requested, the investigations were carried out by contaminating water samples with defined bacterial strains, such as E. coli and coliform bacteria, and examining the decay rate of the cultivated bacteria in the presence of AE DeCont rings with AGXX coating for a period of up to 28 days. In addition to efficacy testing, control tests were carried out with water and bacteria only.

Not one of the water samples examined during this test series, whose contamination levels fall within the scope of the German Drinking Water Regulations (*Trinkwasserverordnung*), exhibited bacterial contamination after 1 or 2 days of treatment with AE DeCont rings with AGXX coating.

Thus, the antibacterial properties of AE DeCont rings with AGXX coating could be demonstrated for test water samples with moderate bacterial contamination.

After 28 days of treatment of the test water samples with AE DeCont rings with AGXX coating, still no bacterial contamination could be observed. Considering the duration and prevailing conditions of testing, this shows that AE DeCont rings with AGXX coating have stabilising long-term effects.

## Further investigations – 2<sup>nd</sup> test series

In order to confirm the antibacterial effects demonstrated on the first test series, the control samples that showed significant bacterial growth (>300 CFU) during the investigations were subjected to treatment with AE DeCont rings with AGXX coating. The control samples of the previous test series thus became test samples for the 2nd test series.

For this test series, the water of the control samples charged with bacteria was each divided into two bottles, one of which was each given 1 DeCont ring with AGXX coating. The samples were incubated and examined at various intervals until the bacteria were eradicated.

## Results – 2<sup>nd</sup> test series

**Table 8: AE DeCont rings with AGXX coating**

Sampling	<i>E. coli</i>	<i>Enterococcus faecalis</i>	<i>Pseudomonas aeruginosa</i>	Total colony count	
				20 °C	36 °C
	CFU/100 ml	CFU/100 ml	CFU/100 ml	CFU/ml	
Start	>300	149	>300	>300	>300
after 1 day	>300	1	>300	6	17
after 3 days	>300	0	>300	0	0
after 7 days	300	0	>300	0	0
after 14 days	60	0	300	0	0
after 21 days	0	n.e.	0	n.e.	n.e.

n.e. = not examined

### **Assessment – 2<sup>nd</sup> test series**

After completion of the 2nd test series, no bacterial contamination could be detected in any of the water samples treated with AE DeCont rings with AGXX coating.

The control solutions that were not given AE DeCont rings with AGXX coating and in which bacteria had proliferated were examined to determine the content of E. coli and Ps. aeruginosa after 14 and 21 days. These untreated water samples still showed high levels of bacterial contamination.

Thus, the antibacterial properties of AE DeCont rings with AGXX coating could also be demonstrated in test waters with high levels of bacteria.

- End -