



Summary

Workshop

„Hygiene requirements and measurements in dishwashing“

1st and 2nd of April, 2014

University of Bonn

Household and Appliance Technology Section



Schedule / Organisation

1st of April - Day 1 – Afternoon Session (moderation: André Lipski)

13:00-13:20	Stamminger, R.	University of Bonn	Welcome and Introduction
13:20-13:50	Bockmühl, D.	Rhine-Waal University of Applied Sciences	Hygiene in our homes. How relevant is it?
13:50-14.25	Bloomfield, S.F.		Dishwashing as part of a multibarrier approach to domestic hygiene
14:25-15:00	Gunde-Cimerman, N. & Zalar, P.	University of Ljubljana	Dishwashers – a man-made ecological niche accommodating human opportunistic fungal pathogens
15:00-15:30	Coffee break		
15:30-16:00	Bichler, S.	University of Bonn	The microbial load of automatic dishwashers under real life conditions in Germany
16:00-16:30	Ihne S.	Whirlpool Cooperation	Investigation of chemical and microbiological residues on dishes cleaned by hand and machine
16:30-17:00	Berger, S.	University of Bonn	Germ reduction test for manual and automatic dishwashing

Bockmühl, Dirk

Hygiene in our homes. How relevant is it?

- Many food-borne infections are acquired at home.
- The dishwasher provides an excellent mean to clean contaminated food-contact items hygienically adequate.
- Although the dishwasher itself may serve as a reservoir for germs, there's no direct link between the presence of a pathogen and the risk of infection, since other parameters, such as infectious dose, routes of infection, exposition and risk factors have to be considered.
- The methodology of „quantitative microbiological risk assessment“ may be applied to dishwashing as well.
- There are special construction issues such as water reservoirs that may lead to a higher microbial load in domestic dishwashers.
- Although today the antimicrobial efficacy of the domestic dishwashing process must be considered sufficient, there might be future challenges, especially due to decreasing temperatures.

Bloomfield, Sally

Dishwashing as part of a multibarrier approach to domestic hygiene

- Due to increasing risk groups and more healthcare at home there is an increasing risk for infectious diseases in the domestic environment
- Also emerging threats such as new infections / strains and antibiotic resistance have to be taken into account and might cause a need for changing strategies
- The targeted hygiene concept provides a good option to identify critical points and take the right measures
- Breaking the chain of infections mean to apply hygienic cleaning procedures at „critical control points“ (handwash, dishwash, laundry etc.) to render surfaces and goods „fit for purpose“
- There's a need for an evidence-based risk management approach to home hygiene to assess hygiene risks → „no intervention study data“ does not mean „no risk“!

Gunde-Cimerman, Nina; Zalar, Polona

Dishwashers – a man-made ecological niche accomodating human opportunistic pathogens

- Black yeasts are (opportunistic) pathogens that have been found to colonize dishwashers, which might provide an environment to enrich certain microorganisms
- Hot spots for black yeasts in the dishwasher are: interior walls, rubber seals and drains
- There's evidence for water being the source for black yeast
- No epidemiological data on the relevance of black yeasts as a causative agent for infectious diseases are available to date
- Other microorganisms, some of which have only been found inside dishwashers, should be investigated in more detail as well for their possible adverse effects

Bichler, Sandra; Bockmühl, Dirk

The microbial load of automatic dishwashers under real life conditions

- Data of in-home visits of 202 German households on the hygiene of dishwashers were presented ,with sample sites being the sump, the interior walls of the appliances and the kitchen sink.
- Most of the investigated dishwashers showed little or no colonization by microorganisms.
- In cases, where up to 1 colony-forming-unit per cm² was found, it was mostly mould or bacteria, but nor coliforms.
- In machines with higher microbial loads on the walls (ie up to 100 cfu/cm²) predominately bacteria, but nor coliforms were found.
- Very rarely a few yeasts, but no black yeasts were found.
- It was not possible to find any good correlations between impact factors (such as chosen temperature, time after last run etc.); suggesting for further studies

Ihne, Sarah

Investigation of chemical and biological residues on dishes cleaned by hand and machine based on specific examples

- Microbiological reduction on dishes was determined for hand and automatic dishwashing focusing on different parameters, such as mechanical, chemical and thermal action.
- *Enterococcus faecium*, *Geobacillus stearothermophilus* and *Staphylococcus aureus* were used as test organisms.
- Generally, the achieved reduction for automatic dishwashing was higher than for manual dishwashing.
- The highest reduction in automatic dishwashing could be achieved via temperature and chemical action.
- In manual dishwashing, no reducing impact by temperature or chemistry could be observed under the tested conditions.

Berger, Sarah

Development of a method for repeatable measurement of microbiological residues on dishes cleaned by hand and by machine

- The development of an appropriate method that enables measurement of germ reduction after the dishwashing process was presented.
- The work included selection of test strains, identification and proper application of soiling agents, dishwashing and the analysis of the cleaning and antimicrobial performance.
- Obtained reduction factors showed low variations within the groups and could proof automatic dishwashing to be the more effective methods in terms of cleaning performance.
- The matrix of soiling agents has a great influence on the antimicrobial reduction efficacy.
- The developed protocol provides a means to assess the microbiological reduction during manual and automatic dishwashing processes in a repeatable and realistic manner.

Schedule / Organisation

2nd of April - Day 2 – Morning Session (moderation: Rainer Stamminger)

9:00-9:30	Kohler, Mike	NSF International	NSF/ANSI 184 Standard Residential Equipment – Residential dishwashers: Approach and Experience
9:30-10:00	Zwingenberger, Marion	DR. WEIGERT GmbH & Co. KG	DIN 10534:2012-08 `Food Hygiene – Commercial dishwashing – Hygiene requirements, testing`: Motivation and learning from this standard
10:00-10.30	Qingling, Zhang	CHEARI	Eliminating Bacteria Performance Test Method for Household Electrical Dishwasher: Approach and Experience
10:30-11:00	Coffee break		
11:00-11:30	Amberg, Caroline	Swissatest Testmaterials ag	Biofilm washing machines and how they can be measured?
11:30-12:00	Türk, Christoph	VDE	The approach of TC59D (laundry) on measuring germ reduction during washing
12:00-13:00	Buffet Lunch		

Kohler, Mike (NSF International)

NSF/ANSI 184 Standard for Residential Equipment – Residential dishwashers: Approach and Experience

Background:

- NSF / ANSI 184 purpose (cl. 1.1):
 - “This Standard establishes minimum public health and sanitation requirements for the materials, design, construction, and performance of residential dishwashing equipment and their related components”
 - Sanitization is the basis for this standard and is defined as (cl 3.19): “The application of cumulative heat, chemicals, or other approved agents on cleaned surfaces that is sufficient to reduce the population of disease organisms by 99.999% (5 log reduction)”

- Primary NSF / ANSI 184 sections include:
 - Materials (cl. 4):
 - General material requirements, corrosion resistance, smoothness and cleanability, coatings, solder, copper water lines
 - Design and construction (cl. 5):
 - Sanitary design, specific / additional design and construction requirements
 - Soil removal performance (cl. 6.1):
 - A soil removal test using buttermilk coated dish load items, air dried for 17 hours under specified conditions; dish load items must be free of visible soil and detergent after the test cycle
 - Sanitization efficacy (cl. 6.2):
 - Temperatures are measured during a test cycle; the dishwasher must achieve a total of 3600 HUEs (Heat Unit Equivalents) which are accumulated based on time at temperatures
 - Equipment labeling and literature requirements

- Other information:
 - Ernst Grunewald was actively involved in development of NSF / ANSI 184 and its’ predecessor document, beginning in the 1990s
 - NSF / ANSI 184 sanitization is based on science and measurements, resulting in a 5 log reduction in disease organisms at the dish surface
 - Specific dishwasher cycles and / or dishwasher options may be certified according NSF / ANSI 184
 - NSF / ANSI 184 – 2010 for Residential Dishwashers is described (cover page) as an "International Standard"

Summary and recommendation:

- NSF / ANSI 184 describes a proven, practical and safe method for laboratories to evaluate residential dishwashers for sanitization and related considerations
- NSF / ANSI 184 should either be adopted as an IEC standard or an IEC standard should be based on NSF / ANSI 184 content

Zwingenberger, Marion (Dr. WEIGERT GmbH & Co. KG)

DIN 10534:2012-08 `Food hygiene – Commercial dishwashing – Hygiene requirements, testing´: Motivation and learning from this standard

- DIN 10534: Summary of all German standards for Commercial dishwashing concerning hygiene requirements testing (different types of commercial dishwashers)
- Different aspects of inspection: visible cleanliness, possibility of disinfection (5-log-steps reduction, microbial load of detergent solution, rinse water and on the surface of wash ware.
- Particularly the post installation tests and periodic test of the machines are very good methods to ensure the microbiological satisfaction test
- This result is not always conform to the visible cleaning and drying effect in practice
- Despite a good cleaning result of bioindicators the cleaning effect leaves a lot to be desired.
- A combination of a test for the cleaning effect and the microbiological impact or 2 separate tests will be the best.

Qingling, Zhang (CHEARI)

Eliminating Bacteria Performance Test Method for Household Electrical Dishwasher: Approach and Experience

- Eliminating bacteria → important feature of dishwashers
- New Standard in China: QB/T 1520-2013 Household and similar electrical dishwasher (Annex B)
- Test organisms: *E. coli*, *Staph. aureus*
- Load (IEC 60436)
- No detergent is used in this test
- Bacterial suspension to each dish (half of the load), loading the machine and run through sanitation cycle
- Extracting, shall be pour plated, incubated for 24-48 hours at 37°C and counted
- *Calculating P (= eliminating bacteria rate in %)*
- *Experience: Log reduction is more useful than percent reduction; using more typical Chinese utensils in the future*

Amberg, Caroline (Swissatest Testmaterials AG)

Biofilm in washing machines and how they can be measured?

- Every surface is sooner or later colonized
- Biofilm analyses: Swabbing, material coupons, microscopy, FTIR-Spectrometry → amount of cells, biofilm amount, viability e.g.
- Biofilm in washing machines is not totally avoidable → consequences: odor, microbes on laundry items, biocorrosion, resistance against disinfectants, potential of health risks
- Biofilm must also be expected in dishwashers → nevertheless dishwashing is more efficient against microorganisms than washing (temperature, chemistry), however soil level is higher in the dishwasher → biofilm formation → odor
- Biofilm control strategy is needed including: material/adhesion, combination of chemistry, temperature and mechanical action, monitoring of the strategies efficiency
- Different methods: in situ tests in the dishwasher, lab scale test. Important to define what should be assessed and what the results really say.

Türk Christoph (VDE Prüf- und Zertifizierungsinstitut)

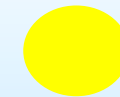
The approach of TC59D (laundry) on measuring germ reduction during washing

- Trends: lower wash temperatures, wash and rinse water volumes; changes in chemistry
- Growing consumer concerns: Low temperature & water, more chemistry, Allergies, dust, pollen, germs
- Standard activities in China, European and North America!
- Presentation of the approach of TC59 D (laundry):
Model should be globally applicable – for all household washing machines, under consumer relevant conditions even under 40°C wash temperature.
- Two methods:
 1. Standard method (reduction with risk class 2 test microorganisms
→ for development purpose in specified labs)
 2. Alternative method (reduction with risk class 1 test microorganisms
→ for pre internal development purpose)

Workshop 1
How relevant is hygiene in dishwashing?



Workshop 2
**Recommendations for measurement standards
for hygiene in commercial dishwashing?**



Workshop 3
**Recommendations for measurement standards
for hygiene in residential dishwashing?**



Summary of the workshop results

Workshop 1

How relevant is hygiene in dishwashing?



- **Possible issues for discussion:**
 - State of knowledge
 - Concerning the microbial load of dishwashers (quantitative)
 - Concerning the kind of germs (qualitative)
 - Assessment of human health risks?
 - In manual and automatic dishwashing
 - In residential and commercial dishwashing
 - Is hygiene relevant for dishwashing?
 - ...in the private context?
 - ...in the commercial sector?
 - Further research needed?

Workshop 1

How relevant is hygiene in dishwashing?



- **Possible issues for discussion:**
 - State of knowledge
 - Concerning the microbial load of dishwashers (quantitative):
 - Including bacteria, yeasts, filamentous fungi, viruses
 - Available data review: food, water, material of dishes
 - Microbial mapping of dishwashers, dishes, waste water, aerosols
 - Microbial growth behaviour, microbial communities, microbial ecology, biofilms
 - odour formation

Workshop 1

How relevant is hygiene in dishwashing?



- **Possible issues for discussion:**
 - State of knowledge
 - Concerning the kind of germs (qualitative)
 - presence of food pathogens,
 - sanitization efficiency, fit for purpose,
 - characterization of microbes resistances (thermo-tolerant, oxidative stress etc.)
 - biofilm forming activity
 - virulence factors, antibiotic resistance genes, horizontal gene transfer, triggering effects
 - epidemiological data, data for laundry available, reference groups (military groups?)

Workshop 1

How relevant is hygiene in dishwashing?



■ Possible issues for discussion:

■ Assessment of human health risks?

■ In manual and automatic dishwashing

- different risk groups (YOPIs), specific instructions,
- resident vs. transient microorganisms
- dose response data
- risk in manual dishwashing?? -> controversy statements
- skin contact, infection pathways, temperature effects, pH, bleaching effects, climate (humidity), sources of microorganisms (sponge)
- enrichment/selection in automatic dishwashing

Workshop 1

How relevant is hygiene in dishwashing?



- **Possible issues for discussion:**
 - Assessment of human health risks?
 - In residential and commercial dishwashing
 - different emissions/presence of microorganism
 - freshly soiled in commercial dishwashing
 - higher turnover rates in commercial dishwashing

Workshop 1

How relevant is hygiene in dishwashing?



- Possible issues for discussion:
 - Is hygiene relevant for dishwashing?
 - ...in the private context?
 - recommendations for consumers (f.e. chopping boards)
 - customer „education“
 - recommendations for regulations (energy saving vs. hygiene)
 - 5-log reduction with other strategies
 - ...in the commercial sector?
 - better control,

Workshop 2

Recommendations for measurement standards for hygiene in commercial dishwashing



- Possible issues for discussion:
 - Actual standards/ test procedures for hygiene in commercial dishwashing
 - Comparison of the different standards:
 - Advantages/Disadvantages:
 - ...concerning the applied test procedure
 - ...concerning the applied test germs
 - Need for action in the future to optimise test standards in commercial dishwashing

Workshop 2 – Where and how to measure what hygiene effects in commercial dishwashing?

Actual standards/ test procedures for hygiene in commercial dishwashing:

- NSF 3 :
 - high temperature sanitising/ chemical sanitising
 - different requirements for different machines

- DIN norms and European norm based on DIN SPEC 10534
 - different requirements for different machines
 - recommendation for temperatures
 - method for type tests and additional tests in practise

- Austrian guideline for commercial dishwashing
- House standards for measuring temperature on dishes

→ **different standards/guidelines in Europe and world wide**

NSF 3

Advantages

- A method for cleaning effect is included
- Different methods for the separate kind of machines (glass washing machine, pot and pan machine)
- Test with temperature measure method (heat units) is possible in each lab
- Test parameters are written down as a manual for the user
- Sanitising product is listed and the formulae will not change (fixed amount f.i. of active chlorine)

Disadvantages

- Method to measure the cleaning effect is only an “indicator” test
- A comparison of the cleaning performance between the machines is not possible
- Cleaning test can be influenced by the recommended detergent
- No tests in real life on machines
- Microbiological test in lab for sanitising machines is with *E.coli*

DIN SPEC 10534

Advantages

- combination of tests (bio-indicator, tank water and dishes)
- test reflects the deviation of settings
- Use of standard detergent or rinse aid with the possibility of use of special recommended products

Disadvantages

- not really a method for measuring the cleaning performance is included
- no easy method included to measure physical parameters (f.i. temperature)

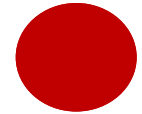
Workshop 2 - Recommendations

Action:

- work intensive in Europe on the DIN SPEC 10534 to have only one standard
- the future European standard has to combine test method to measure the cleaning performance in the machine and the germ reduction
- proof, if some test methods of NSF could be used in the European standard
- the future European standard has to consider environmental aspects

Workshop 3

Recommendations for measurement standards for hygiene in residential dishwashing



- Issues for discussion:
 - Follow NSF-184 as requested by Wayne Klug
 - **Where** and **how** to measure **what** hygiene effects in residential dishwashing?
 - **How** to launch work?

NSF / ANSI 184 – Residential Dishwashers

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NSF 184

Discussion (pro's and con's)

- Easy to apply, reliable...
- Limit influence of mechanical action and chemistry.
- Works only above 60 °C → no hygiene below 60 °C???
- Just looking on dishes and not on dishwasher as a whole
- Advantage: Lowest test burden
- Possible alternative solution: be run in parallel with 60436 load in two steps: 1. screening by temperature (HUE like) + 2. microbiological assessment

Workshop 3 – Where and how to measure what hygiene effects in residential dishwashing?

Discussion:

- Clash between requirements of low energy and low water programmes and hygiene programme
- Hygiene may be communicated as a separate cycle to the customer
- We should look for a measurement standard and not for a specific programme.
- Should be suitable for different temperatures
- No evidence about any risk associated with dishes cleaned by an automatic dishwasher!

Where to measure: load (1st prio) and dishwasher (or water) (2nd prio.)

What to measure (stepwise approach as in laundry):

a: 1. step: temperature+time+(mechanics) + 2. step: accepted reference strains

b: 1. non-pathogen + 2. accepted reference strains (preferred)

c: accepted reference strains

Workshop 3 – Where and how to measure what hygiene effects in residential dishwashing? (2)

Do we need a measurement standard + pass/fail criteria?

- Look at requirement from air conditioners (VDI 6022)
- What source are used to define requirements
- Scientist (hygienic) should determine what is the risk! Risk assessment needed!

Decision: First develop test method which can be used for all programmes! Risk assessment to follow later.

How to measure?

- Bacteria + fungi
- Soil + soil matrix for germs
- Requirement for cleanliness
- Detergent YES, if reference detergent. Amount depending on cleaning result and differentiation potential.

How to launch work?

- Is a measurement standard necessary? → At least we should work on it!
- Report results back to IEC59A (next meeting in Tokyo in Oct 2014)
- Official Questionnaire needed to launch a new Working Group
- Involvement of all people interested important.
- Responsible: Anna Brückner – Chairwoman of IEC59A

- **Use the momentum of the Workshop:
Start with preliminary work using the expertise of the people attending the workshop**
- List of people collected willing to participate.
- Responsible: Rainer Stamminger

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