Summary

of the presentations held at the meeting of the SANIRESCH project partners
(February 2012)

Explanation

There is a periodic meeting of all SANIRESCH project partners every 6 months. In February 2012, the 6th meeting was held.

All partners have presented their latest results. Various Powerpoint presentations are available in German. The most important content of these presentations was translated into English and is summarized in this document.

Content

- Presentation 1: Operation and changed parameters of the MAP- precipitation reactor (Johanna Heynemann, THM)

- Presentation 2: Analysis results, microbiology and operating parameters of the brown- and greywater MBR (Franziska Nun, THM)

- Presentation 3: Storage of urine: Behaviour of problematic matter in urine- and brownwater treatment (Bettina Schürmann, RWTH Aachen)

- Presentation 4: Agricultural application of urine (Ute Arnold, University Bonn)

- Presentation 5: International transferability of the installed sewage conceptions (Katharina Löw, Yue Wu, HfWU Nürtingen-Geislingen)

- Presentation 6: RoeVac© No-Mix Toilets - Operating diary and it‘s interpretation

- Presentation 7: Selective results of the second period of surveys (Manfred Romich, RWTH Aachen)

Presentation 1:

Johanna Heynemann
(THM)

Current operation and parameters changed of the MAP-precipitation reactor

MAP-precipitation reactor

TECHNISCHE HOCHSCHULE MITTELHESSEN

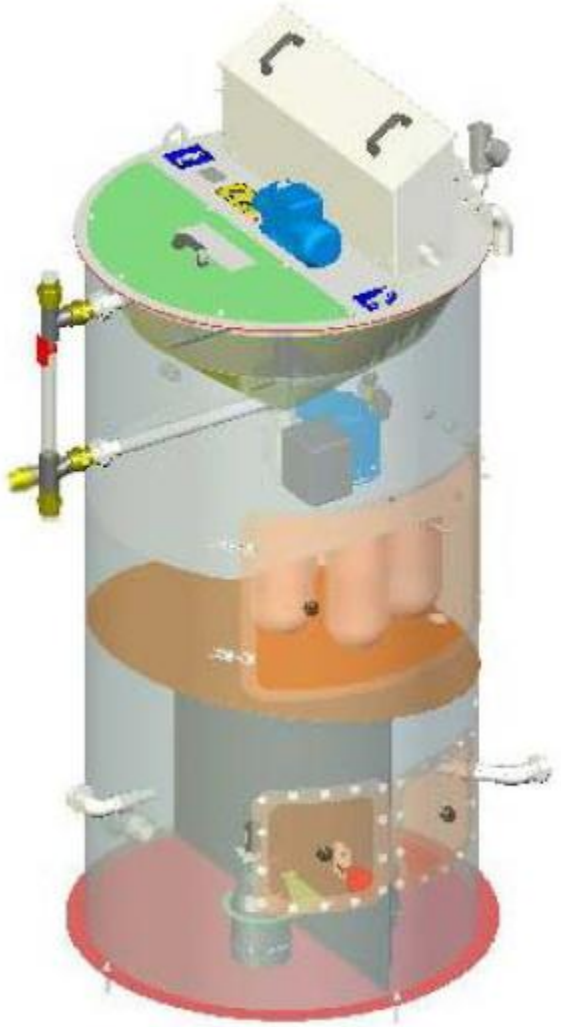
Beginning of operation:	May 2010
Flow Capacity:	≈ 1400 l/week
ß-factor:	1.5
MAP-yield:	0.7 to 1.3 g/l urine
Stirring time:	3 min 30 s stirring/30 s break
Sedimentation duration:	90 min

MAP-precipitation reactor – current operation

TECHNISCHE HOCHSCHULE MITTELHESSEN

MAP production for field experiments in Bonn:

- In the pump sump of the precipitation reactor MAP accumulates, which
  - Could not be hold back by filters
  - Spilt over the filter.
- Therefore about additionally 4 to 5 kg MAP exist
- An analysis of the deposited MAP will be conducted by the RWTH Aachen.



MAP-precipitation reactor – changed parameters

Following results of the diploma thesis from Matthias Hartmann were converted into the reactor operation:

- Sedimentation duration of 90 min (before 180 min)
- Adaption of the urine volume to the maximum possible MgO - amount of 14 g

Improved operation by following changes:

- Installation of a coarser sieve with a mesh size of 0,8 mm into the urine influent pipe
- Only the first 40 litres of an urine tank are discharged without being used in the reactor (before: around 200 litres)
- The major part of contained pollutants are removed
- The cleaning intervals could be extended

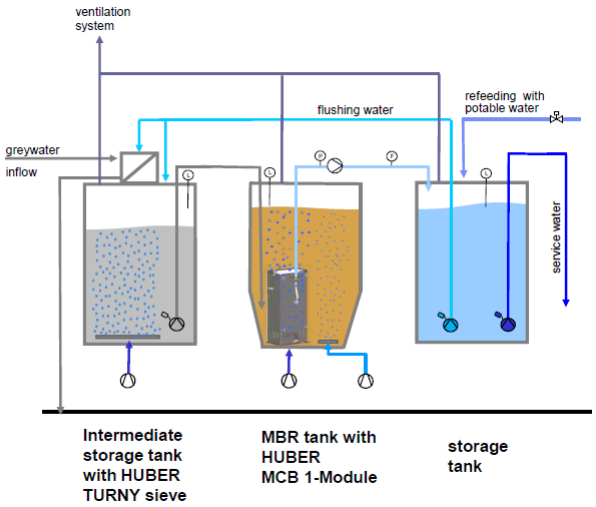
Presentation 2:

Franziska Nun
(THM)

Brown- and Greywater- membrane bioreactor (MBR):

Analysis results, microbiology and
operating parameters

Greywater – membrane bioreactor



Beginning of operation:	13.05.2011
Flow capacity:	≈ 20 till 25 l/h
Flow capacity [l/d]:	≈ 500 till 600 l/d
TS_{MBR}:	5 to 6 g/l
Turny (mesh width): (Pre-treatment – sieve for solids)	3 mm
Break:	10 pm – 7 am
Filtration:	270 s
Break:	60 s
Transmembrane pressure:	60 mbar

Greywater – analysis results

		Inflow	Permeate
COD [mg/l]	Ø	593	30.5
	min	329	17.2
	max	984	72.6
TN_b [mg/l]	Ø	13.6	11.4
	min	5.4	5.4
	max	26.2	21.0
P_{total} [mg/l]	Ø	20.7	14.2
	min	2.8	3.4
	max	44.3	23
TS [mg/l]	Ø	291.7	2.2
	min	146.0	0.3
	max	484.5	3.8

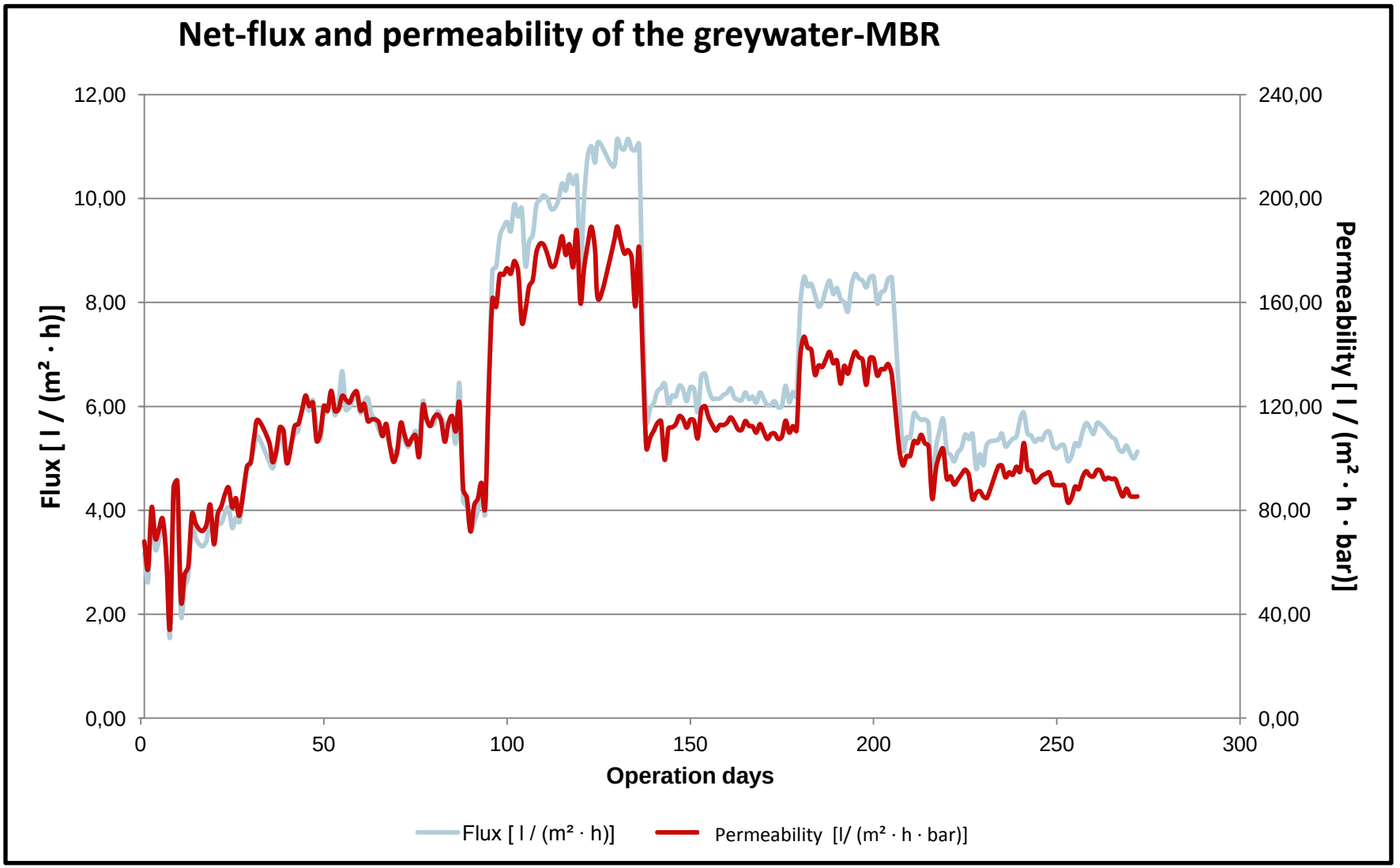
TECHNISCHE HOCHSCHULE MITTELHESSEN

Nutrient ratio:
C : N : P = 100 : 2.3 : 1.2

COD removal efficiency:
95 %

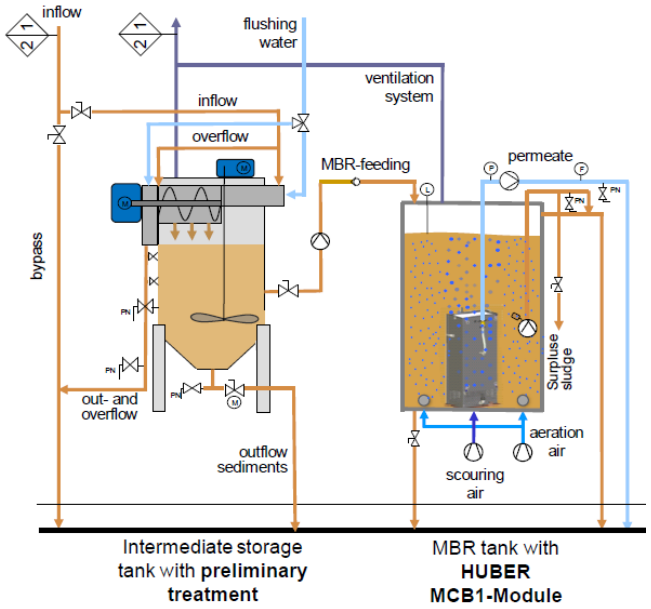
Greywater – Operation parameters

TECHNISCHE HOCHSCHULE MITTELHESSEN



Brownwater - membrane bioreactor

TECHNISCHE HOCHSCHULE MITTELHESSEN



Beginning of operation:	27.06.2011
Flow capacity:	≈ 14 l/h
Flow capacity:	≈ 350 l/d
TS_{MBR}:	5 to 6 g/l
Pre-treatment (mesh size):	3 mm
Break:	11 pm – 4 am
Filtration:	120 s
Break:	60 s
Transmembrane pressure:	50 mbar

Brownwater – analysis result

		Inflow	Permeate
COD [mg/l]	Ø	826	21.7
	min	270	14.9
	max	1439	31.3
TN_b [mg/l]	Ø	66.0	67.3
	min	15.2	34.2
	max	92.0	102
P_{total} [mg/l]	Ø	20.7	14.3
	min	6.5	3.8
	max	34.4	23.8
TS [mg/l]	Ø	321.3	1.64
	min	91.8	0.0
	max	682.0	3.6

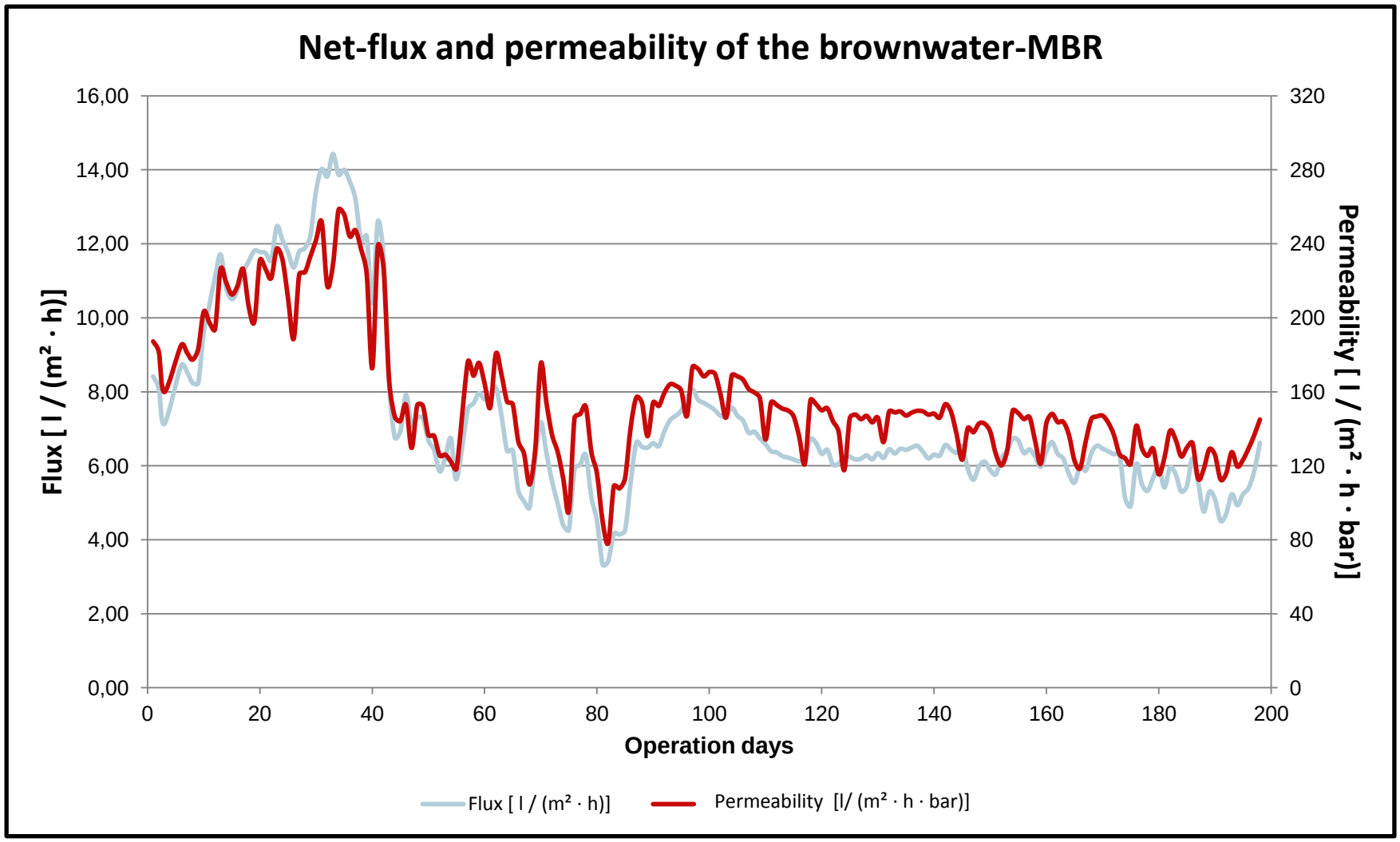
Nutrient ratio:

C : N : P = 100 : 8.2 : 0.8

COD removal efficiency:

98 %

Brownwater – Operation parameters

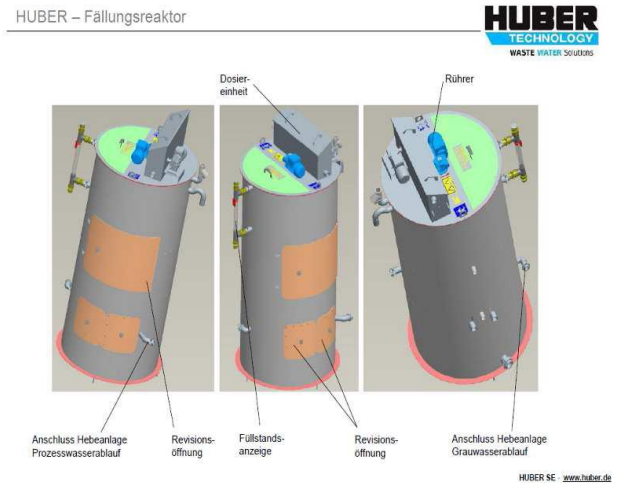


Presentation 3:

Bettina Schürmann
(University RWTH Aachen)

Storage of urine: Behaviour of problematic matter in urine- and brownwater treatment

Urine treatment plant

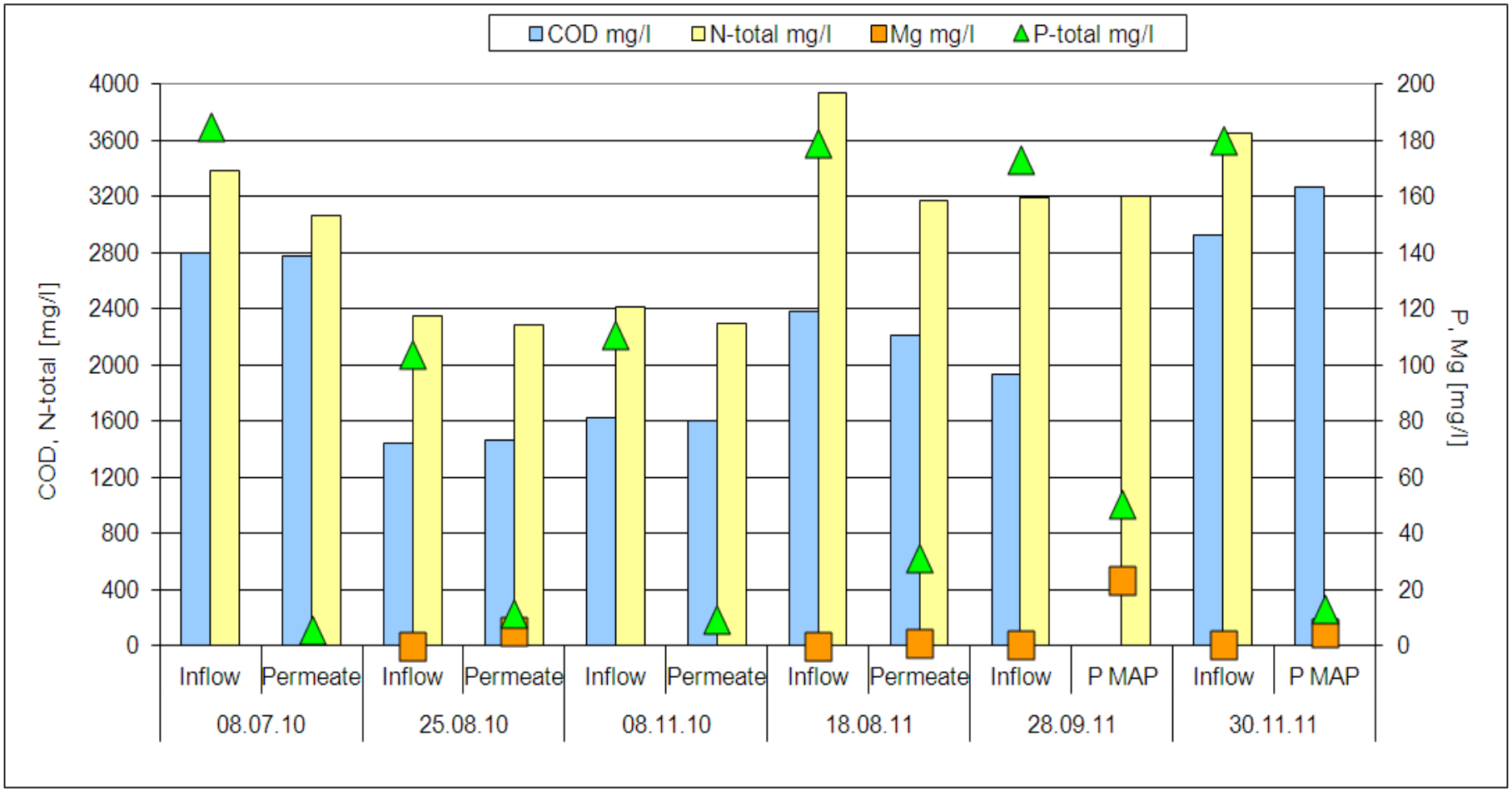


- 1st: Storage
- 2nd: MAP precipitation

- **Studies:**
- Standard parameters (COD, N, P, Mg, …)
- Pharmaceuticals
- Germs

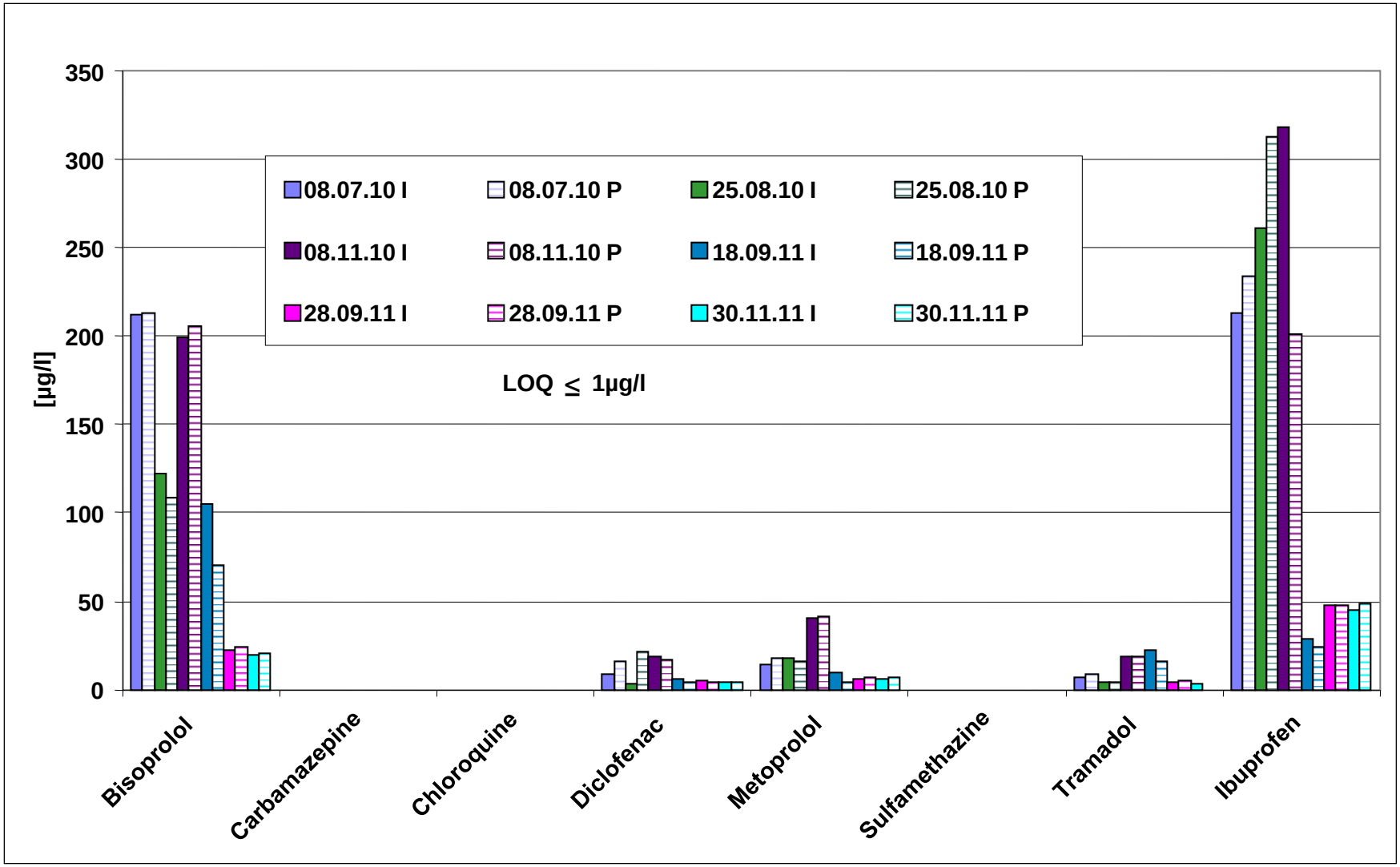
Urine treatment plant

Standard parameters



Urine treatment plant

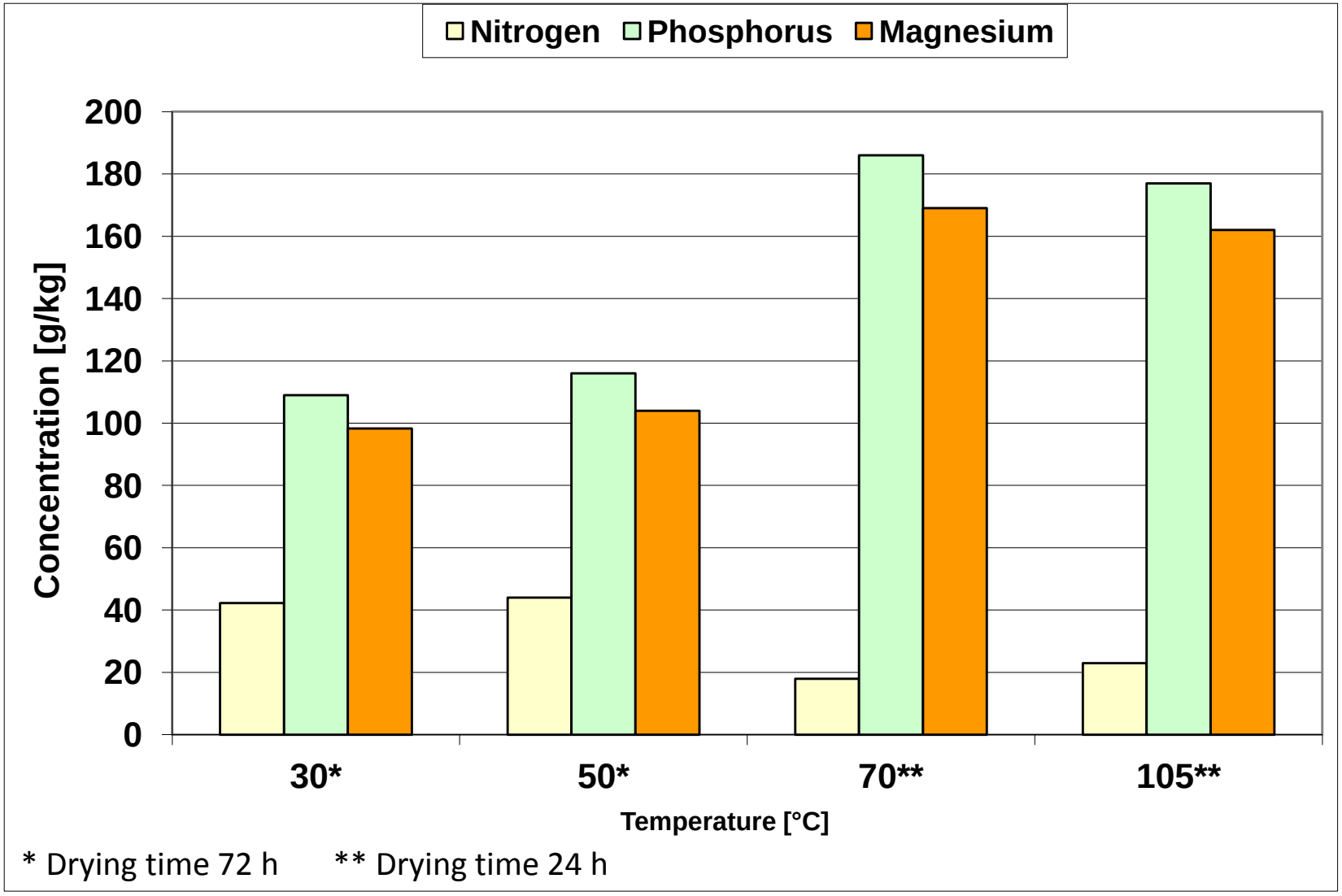
Pharmaceuticals in inflow and permeate



MAP: all pharmaceuticals are under LOQ (Limit of quantification)

Urine treatment plant

MAP – drying test

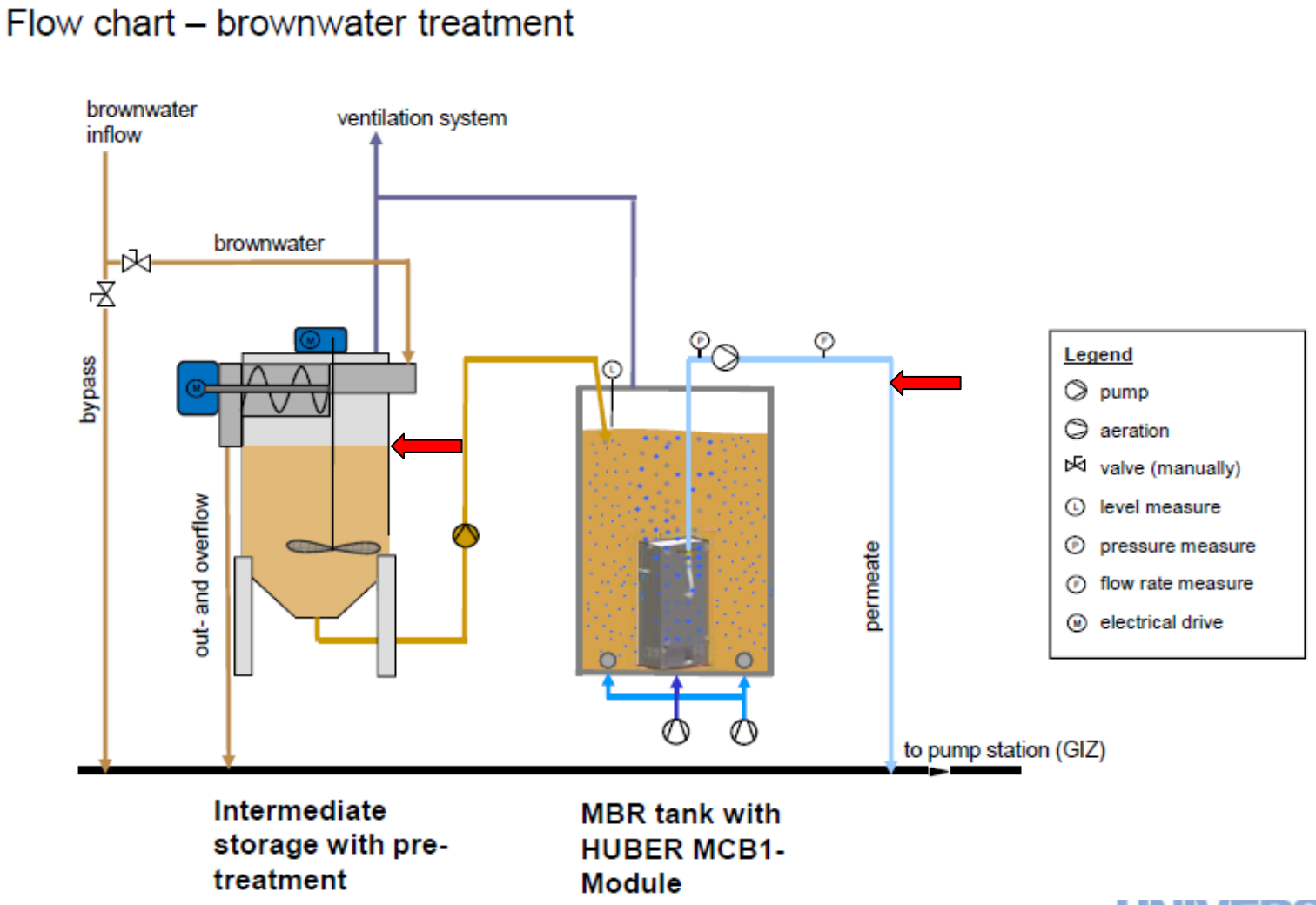


* Drying time 72 h ** Drying time 24 h

Loss of N due to desiccation with high temperatures

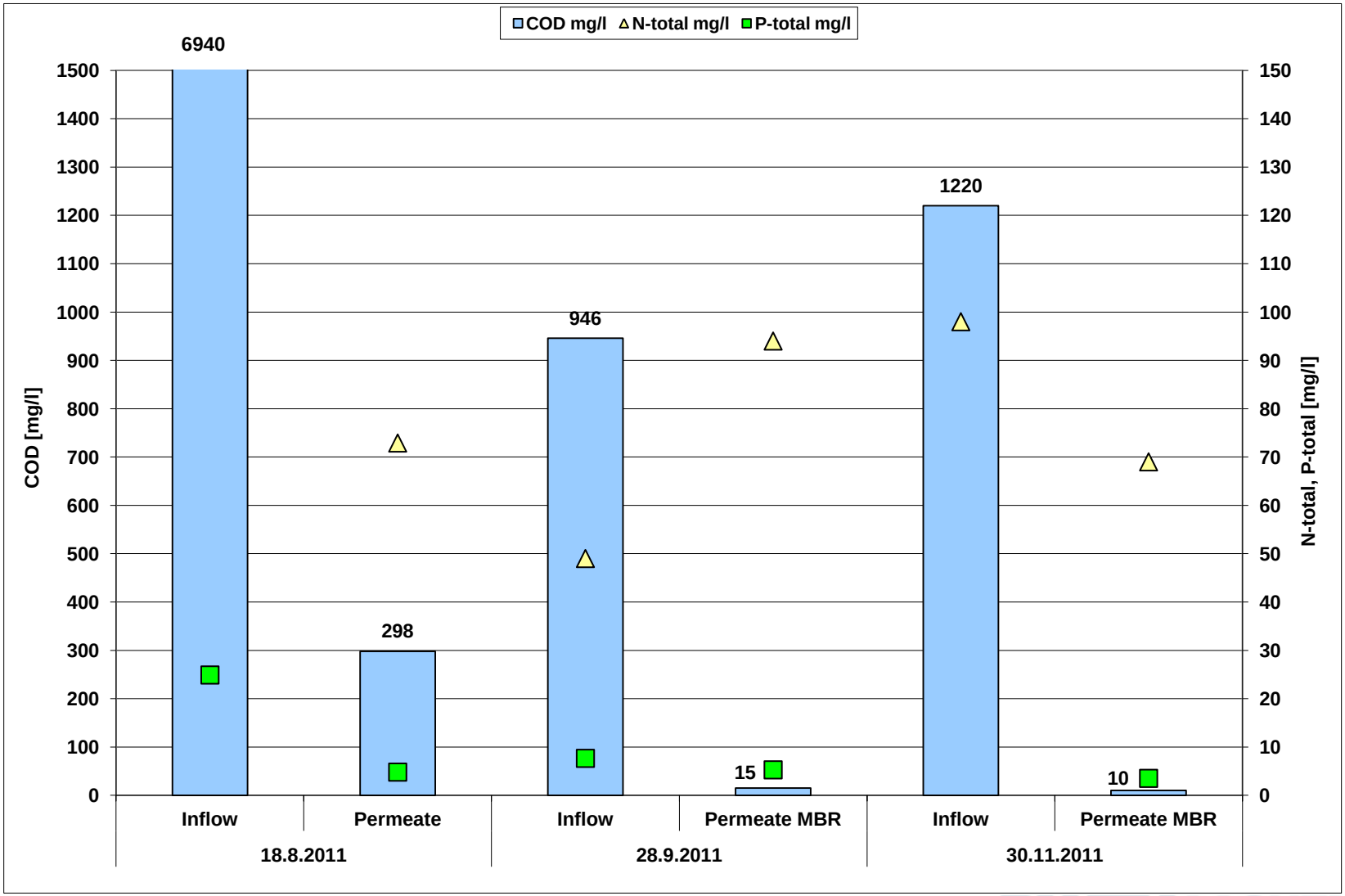
Brownwater treatment plant

Sampling places



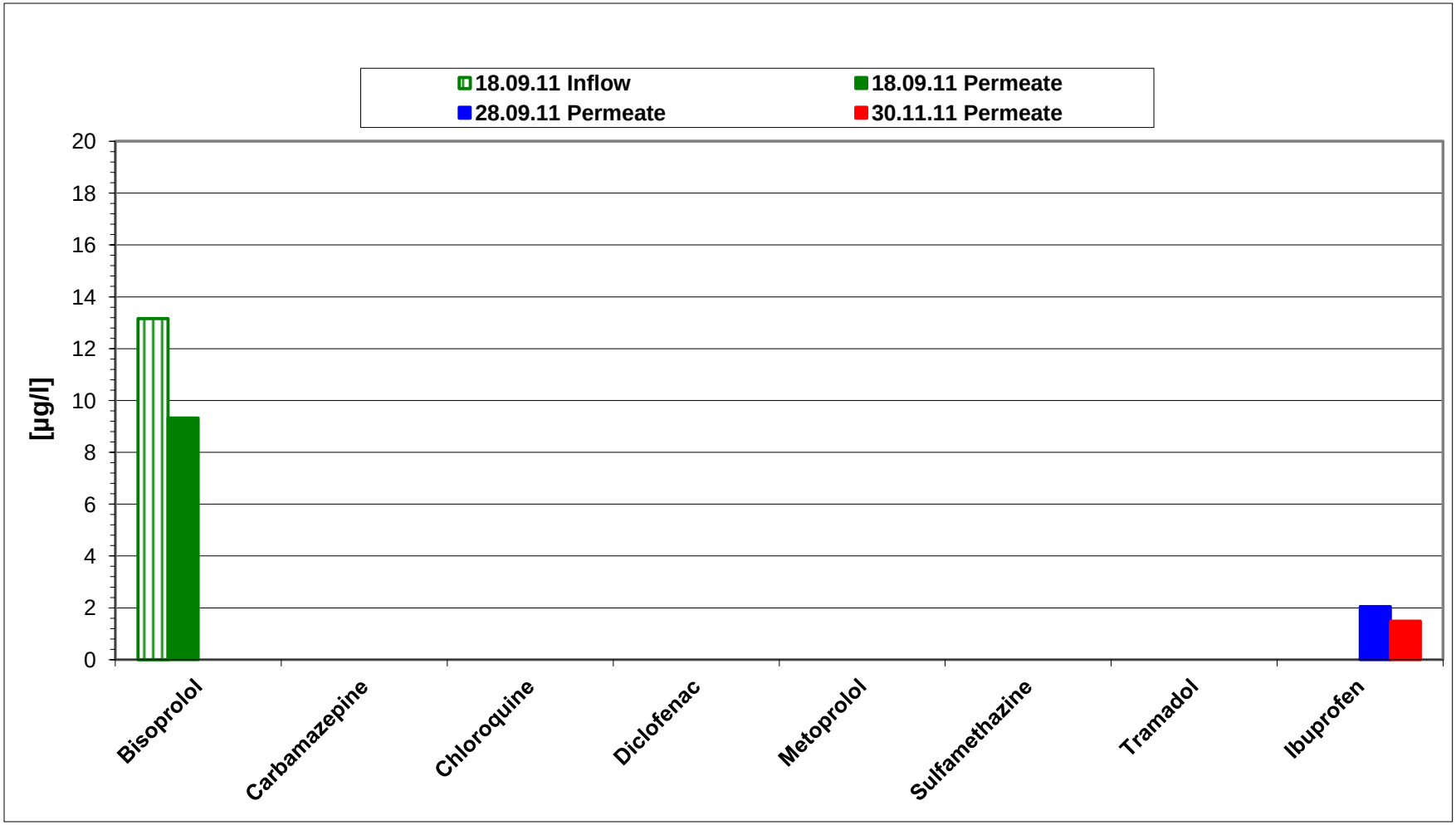
Brownwater treatment plant

Standard parameters



Brownwater treatment plant

Pharmaceuticals



Most of the pharmaceuticals are excreted by urine

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Brownwater treatment plant

Microbiology

Date	Species	E. coli	Coliform bacteria	Intestinal Enterococci
	Sample	n/100ml	n/100ml	n/100ml
18.8.2011	permeate	>24196	>24197	
28.9.2011	permeate	7	980	56
30.11.2011	permeate	68	91	0

Activated sludge with a ciliated protozoon

The highlighted measurements are probably caused by re-contamination and not by a malfunction of the membrane

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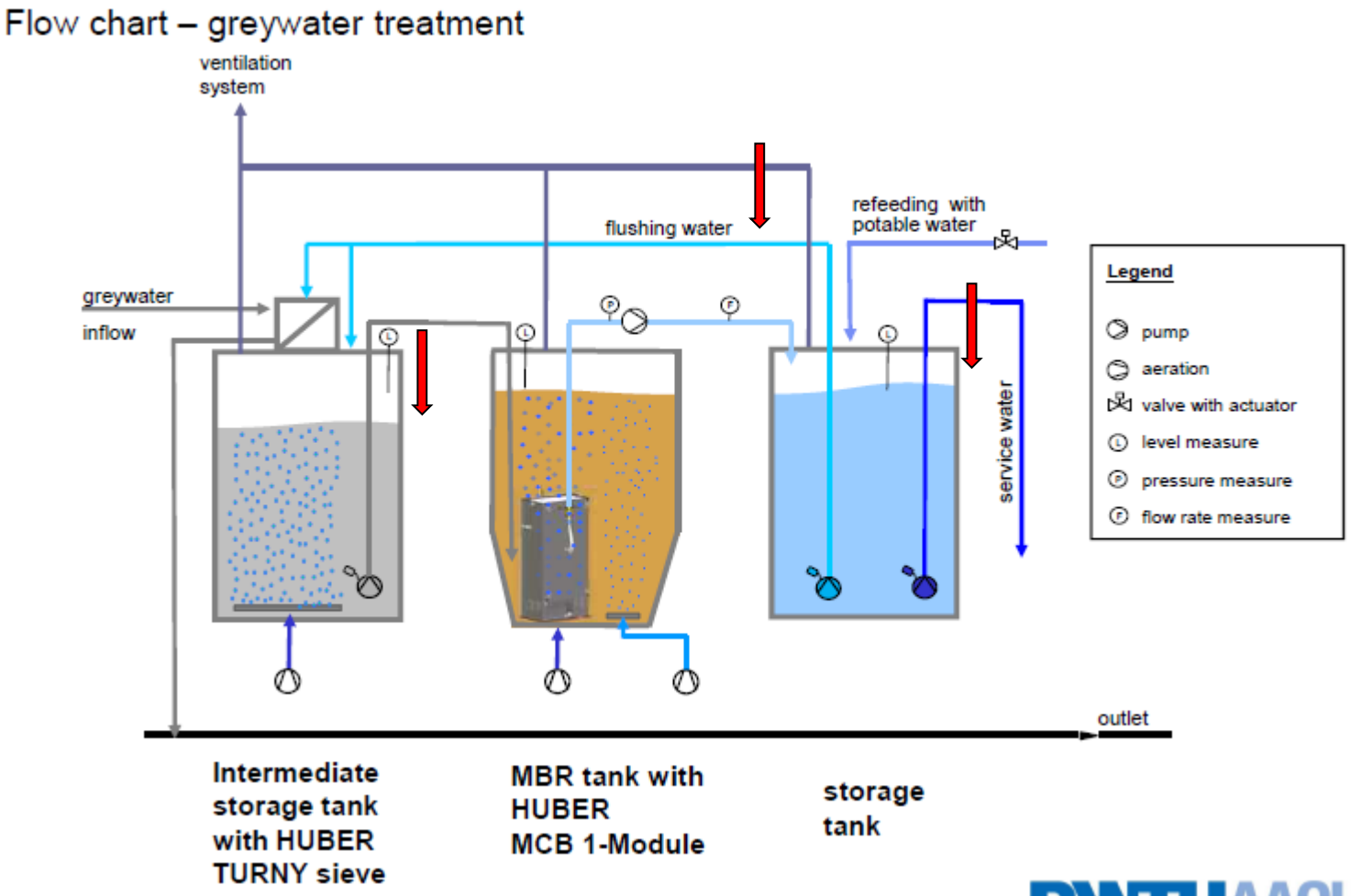
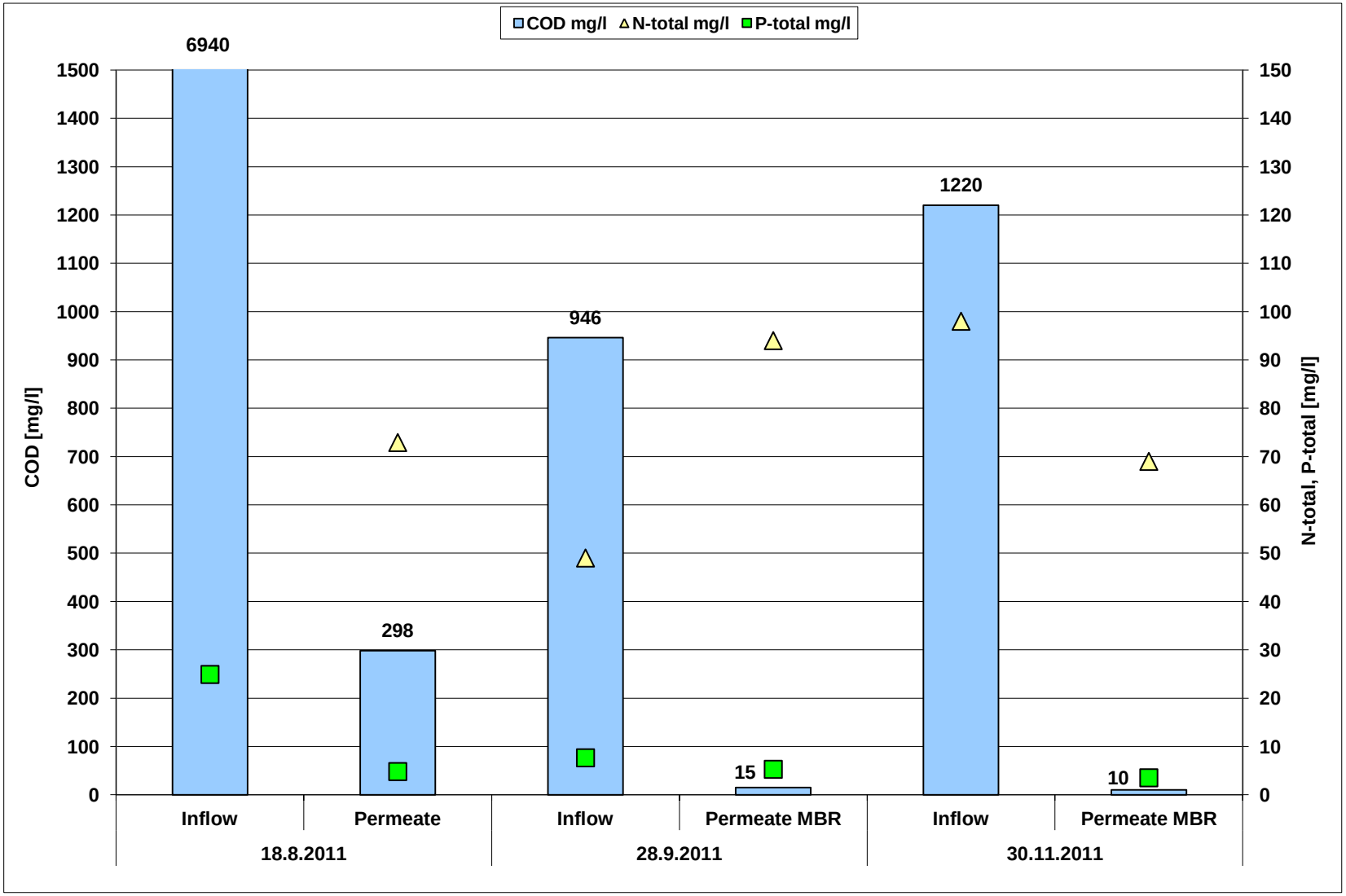
Greywater treatment plant

Sampling places



Greywater treatment plant

Standard parameters



Greywater treatment plant

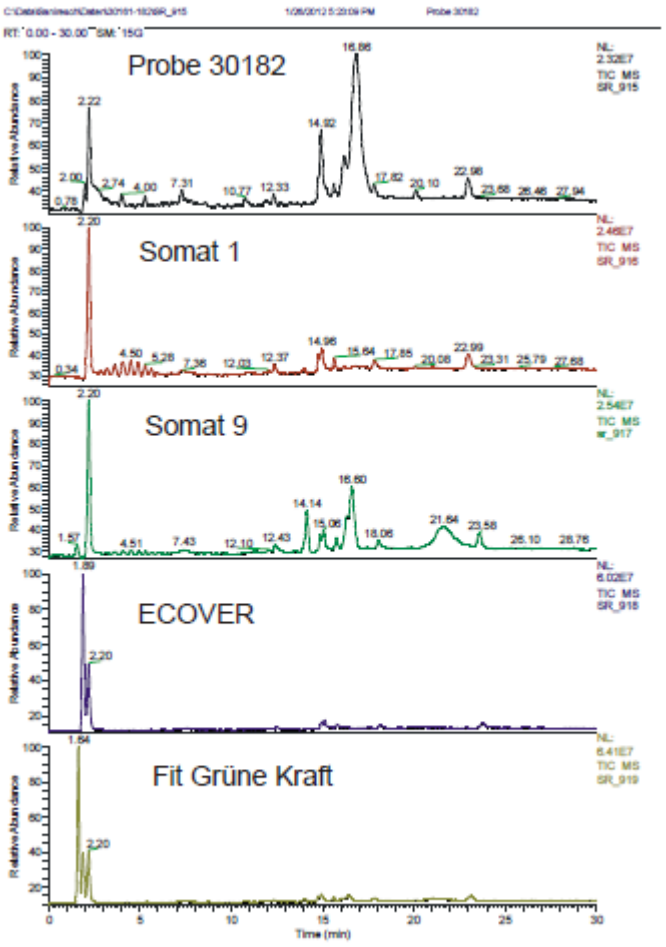
Microbiology

Date	Type	E. coli	Coliform bacteria	intestinal Enterococci
		n/100ml	n/100ml	n/100ml
18.8.2011	Outflow	1	17,1	
28.9.2011	Permeate, stored	0	0	<1
	Permeate, fresh	0	1	<1
30.11.2011	Permeate, stored	0	0	0
	Permeate, fresh	0	0	0

Greywater treatment plant

Surfactants

- First comparison between the used surfactants in the kitchens and a sample of the permeate.
- Surfactants are traceable.
- Analysis Analyse by means of LC/MS
- More quantified results will follow



Presentation 4:

Ute Arnold
(University Bonn)

Agricultural application of urine

Field trial 2011

Campus Kleinaltendorf

- Investigation of yellowwater (YW) (N-basis)

  Comparison YW - inorganic fertiliser Kalkammonsalpeter (KAS)

  - Spring wheat, maize

- Investigation of Mono-ammonium phosphate (MAP) (P-basis)
  - Comparison MAP – triple phosphate (TP)
  - Spring wheat, field bean

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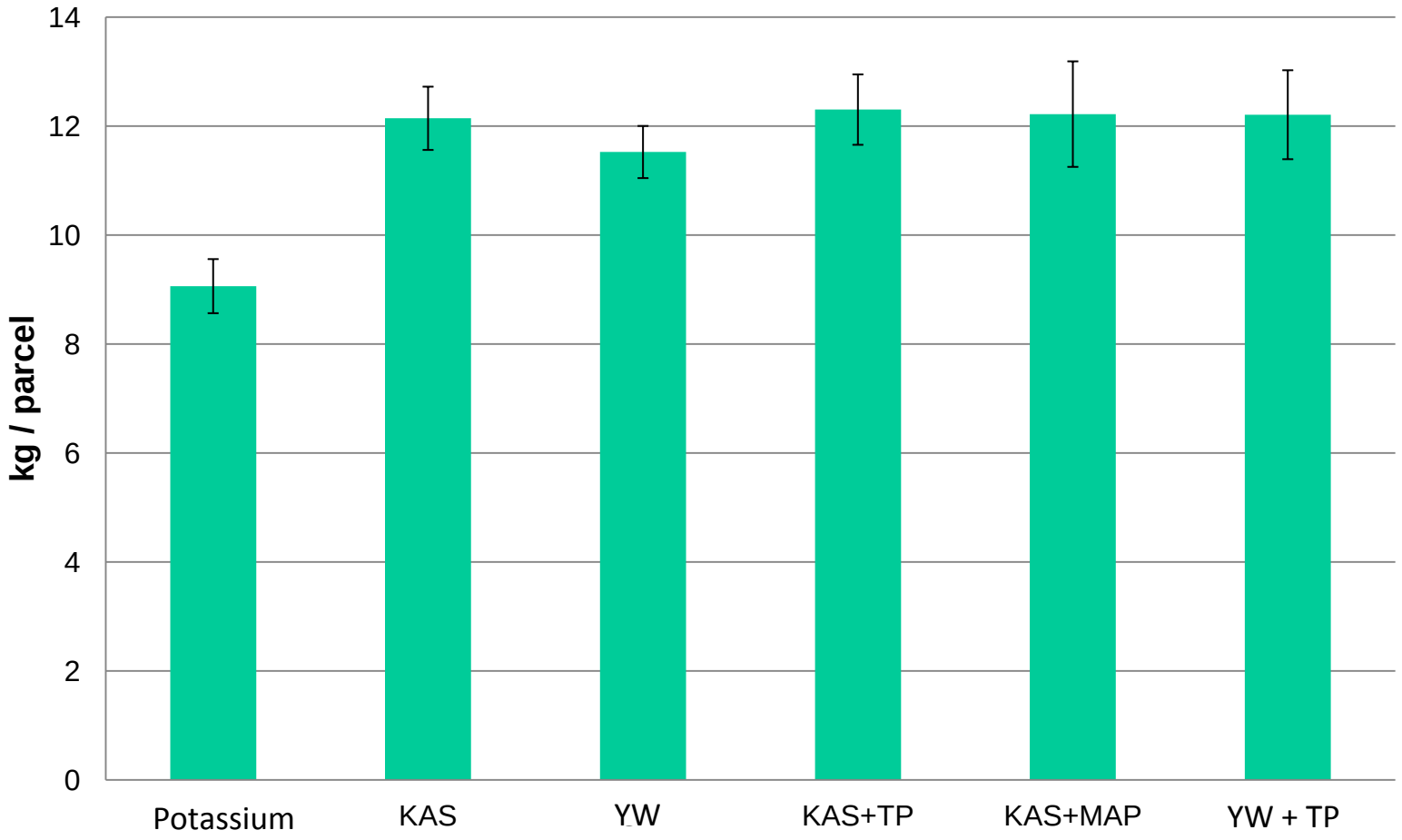
Yield of spring wheat 2011



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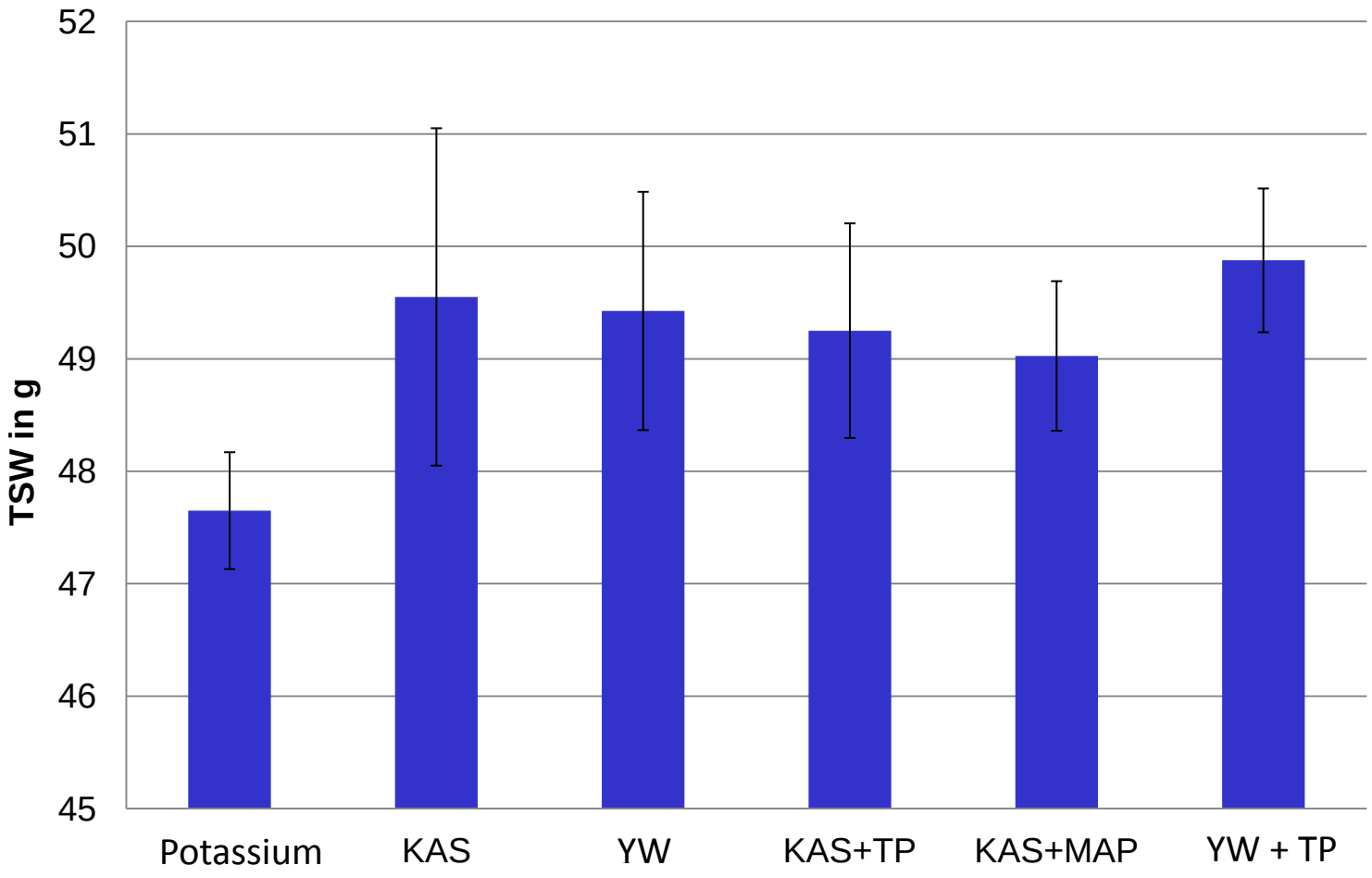
Thousand-seed weight 2011



No significant differences

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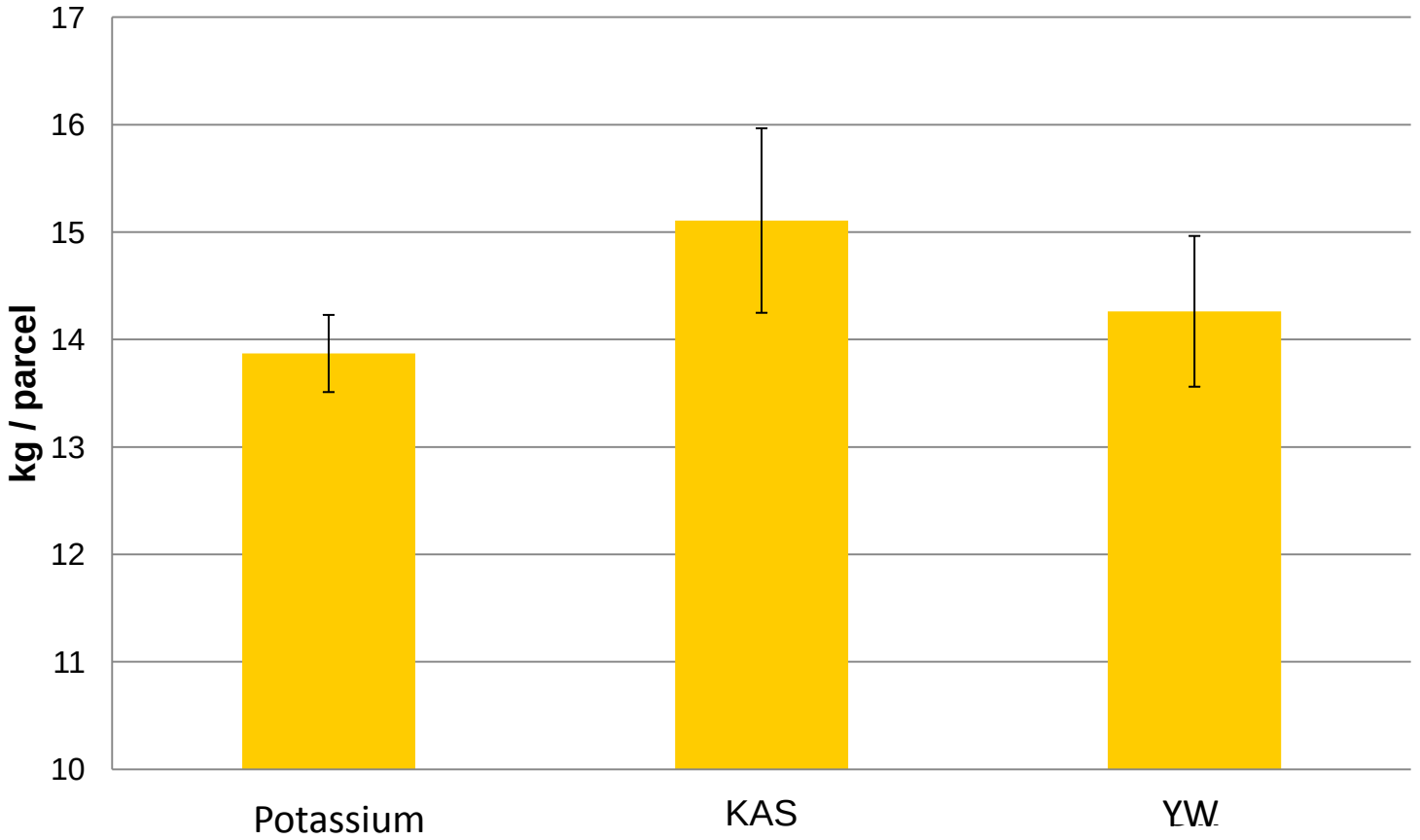
Thousand-seed weight 2011



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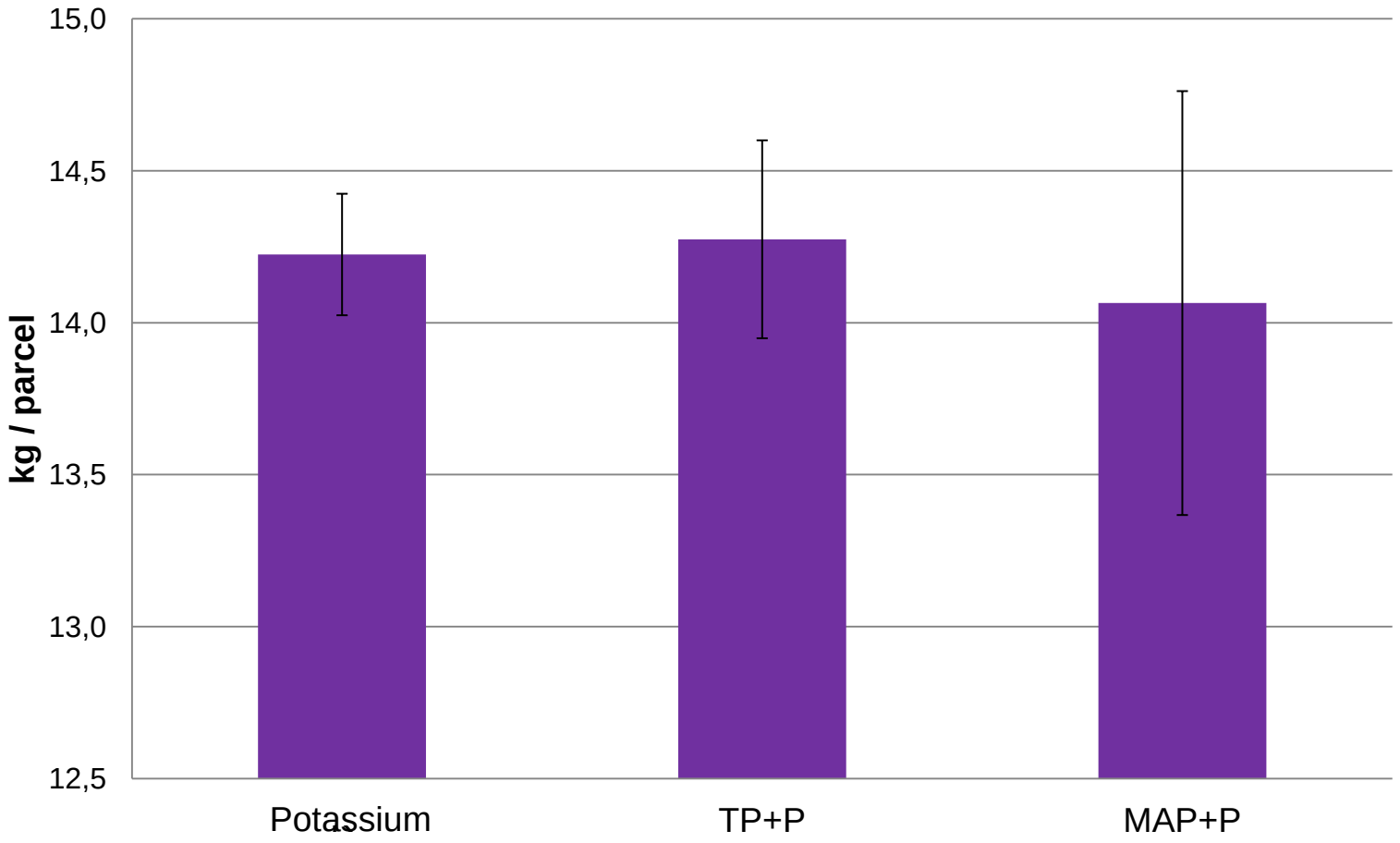
Yield of field beans 2011



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Field trial 2011

Kleinaltendorf

- YW appropriate for fertilisation
- No loss on yield compared to inorganic fertiliser
- MAP_{urine} appropriate for fertilisation
- Same fertilising results of MAP_{giz} compared to phosphate fertiliser triple phosphate
- Further researches regarding the effects on phosphate-poor/phosphate-fixing soils are needed

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Acceptance studies

Overview

- Acceptance of the farmers:
  - 400 written questionnaires sent
  - First returns
- Acceptance of the consumers
  - Sending of the written questionnaires is in planning
- Representative of selected administrative bodies and federations

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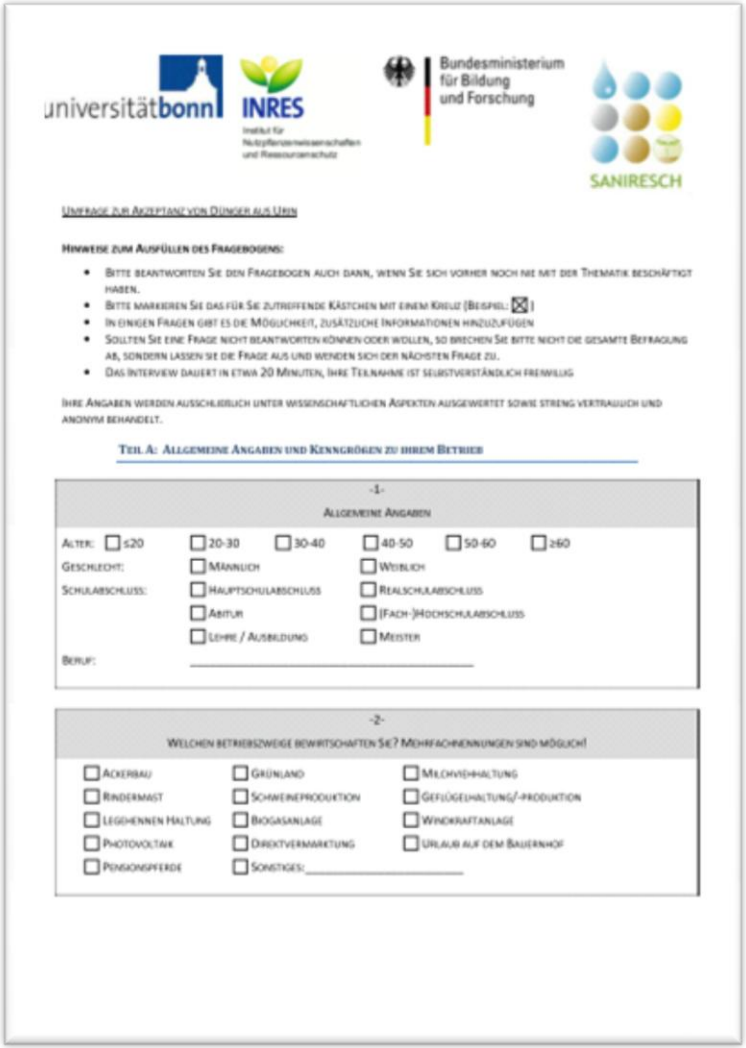
Acceptance studies

State of the farmer survey

- Written questionnaire of farmers and market gardens in North-Rhine-Westphalia (NRW)
- Design of a questionnary with 40 questions
- Recorded are:
  - Business size and type
  - Socio-economic context
  - Ecological background knowledge
  - Stands / opinions regarding an urine-Fertiliser
- Questionnaires were sent out in the beginning of February 2012



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Bundesministerium für Bildung und Forschung

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Umfrage zur Akzeptanz von Dünger aus Urin

Hinweise zum Ausfüllen des Fragebogens:

- Bitte beantworten Sie den Fragebogen auch dann, wenn Sie sich vorher noch nie mit der Thematik beschäftigt haben.
- Bitte markieren Sie das für Sie zutreffende Kästchen mit einem Kreuz (Beispiel: ☒)
- In einigen Fragen gibt es die Möglichkeit, zusätzliche Informationen hinzuzufügen
- Sollten Sie eine Frage nicht beantworten können oder wollen, so brechen Sie bitte nicht die gesamte Befragung ab, sondern lassen sie die Frage aus und wenden sich der nächsten Frage zu.
- Das Interview dauert in etwa 20 Minuten, Ihre Teilnahme ist selbstverständlich freiwillig

Ihre Angaben werden ausschließlich unter wissenschaftlichen Aspekten ausgewertet sowie streng vertraulich und anonym behandelt.

Teil A: Allgemeine Angaben und Kenngrößen zu ihrem Betrieb

-1-

Allgemeine Angaben

Alter: ☐ ≤20 ☐ 20-30 ☐ 30-40 ☐ 40-50 ☐ 50-60 ☐ ≥60

Geschlecht: ☐ Männlich ☐ Weiblich

Schulabschluss: ☐ Hauptschulabschluss ☐ Realschulabschluss ☐ Abitur ☐ (Fach-)Hochschulabschluss ☐ Lehre / Ausbildung ☐ Meister

Beruf: _____

-2-

Welchen Betriebszweige bewirtschaften Sie? Mehrfachnennungen sind möglich!

☐ Ackerbau ☐ Grünland ☐ Milchviehhaltung
☐ Rindermast ☐ Schweineproduktion ☐ Geflügelhaltung/-produktion
☐ Legehennen Haltung ☐ Biogasanlage ☐ Windkraftanlage
☐ Photovoltaik ☐ Direktvermarktung ☐ Urlaub auf dem Bauernhof
☐ Pensionspferde ☐ Sonstiges: _____

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Acceptance studies

State of the consumer survey

- NRW has urban and rural regions
  ⟹ Perspective of population is potentially different

- A written survey is conducted in peri-urbanisations and in rural regions to obtain representative results

- Recorded are
  - Socio-economical context
  - Ecological background knowledge
  - Stand/opinions regarding an urine fertiliser

- Sending is envisaged for March 2012

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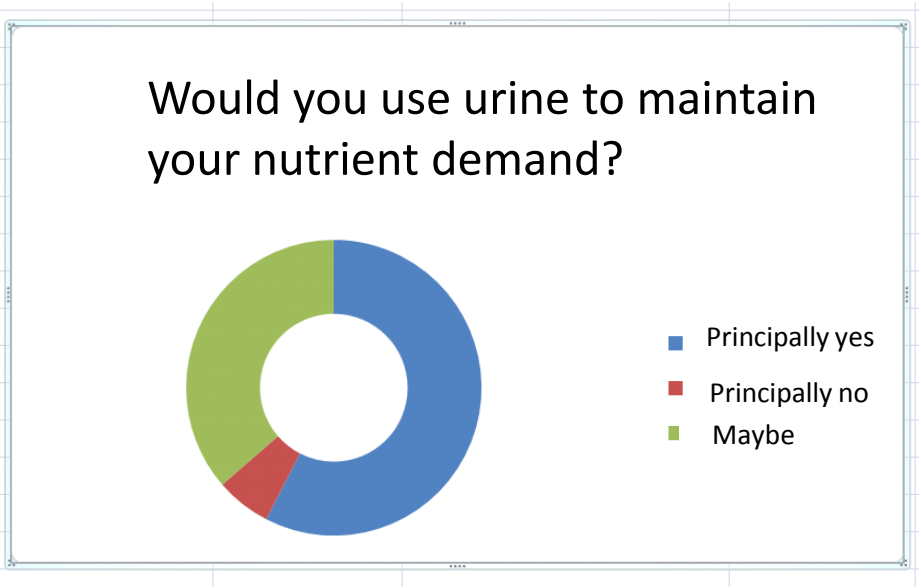
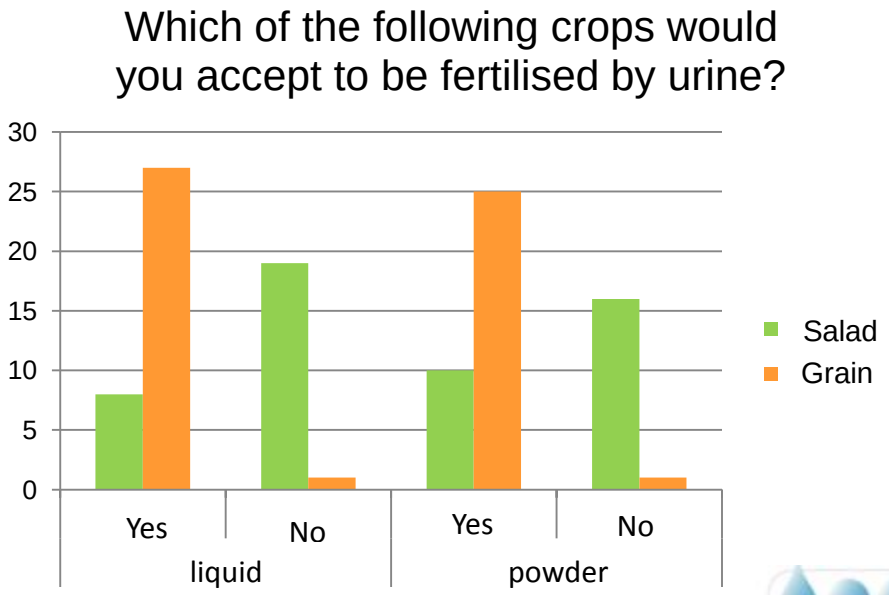
First results and trends

- **Analysis of the first 30 questionnaires of farmers /market gardens**



Most often mentioned concerns: safety, harmlessness



Clear differences within different field crops

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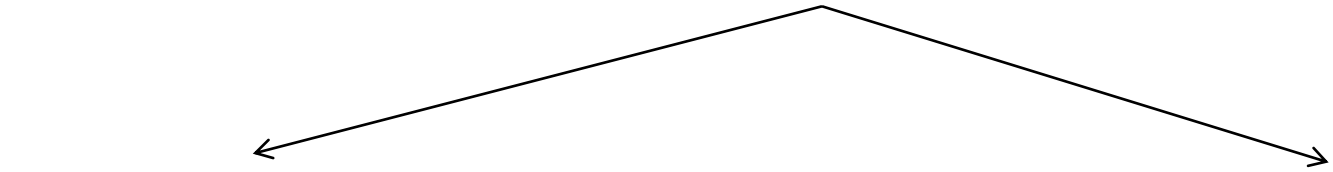
Presentation 5:

Katharina Löw & Yue Wu
(HfWU Nürtingen-Geislingen)

International transferability of the installed wastewater treatment system

Master theses in the winter term 2011/12

International adaptability of the installed sewage conceptions



Greywater treatment

Katharina Löw

Brownwater treatment

Yue Wu

Master degree: Environmental protection

Hochschule für Wirtschaft und Umwelt Nürtingen-Geislingen

Task formulation

Within the master theses:

- The use of the applied techniques is analysed
- The potential transferability of this system is investigated
- The framework and parameters, which are constitutive for an implementation on other markets, are identified.

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Economic aspects of greywater treatment

Imaginary example of the office building GIZ (complete)

- Unfavourable water balance in the office building

3,535 l/d	Greywater production
7,712 l/d	Demand of toilet flush water
- 4,177 l/d	negative result

- High investment costs

8,633 €	Greywater facility
+ 29,750€	In-house installations
= 38,383 €	Investment costs

- No financial incentive

1,979 €/a	Sum of running costs (maintenance + energy costs)
3,391 €/a	Water charges (freshwater + sewage)
1,412 €/a	Cost saving (running costs)

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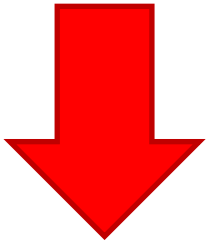
Economic aspects of greywater treatment

Appropriate implementations: hotels, dormitories, apartment buildings, hospitals, …



Calculation example for a four-star-hotel in Berlin,
Financial amortisation time of the facility: 6 years (Paris, 2009).

Hall of residence “Eastside” in Mannheim,
Financial amortisation time of the facility: 6 years (Sellner, 2009).

“Dead Sea Spa” hotel in Jordan,
Financial amortisation time of the facility:
10-12 years (Rothenberger et al., 2011).

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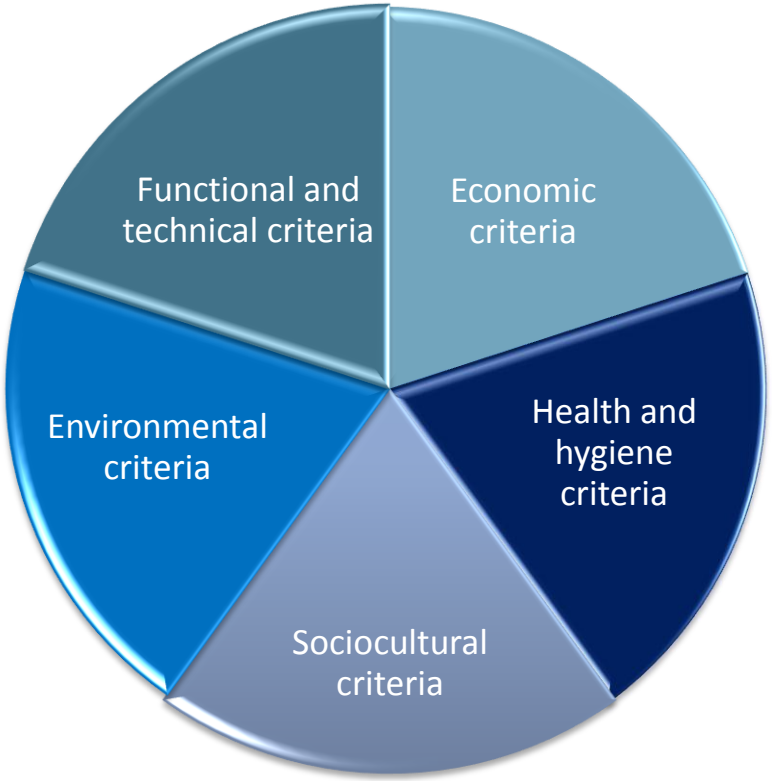
Investigation of the international adaptability of greywater treatment

Identification of the site criteria, which lead to a worthwhile implementation of greywater recycling

Sustainability criteria for sanitation approaches:

- Health and hygiene criteria
- Economic criteria
- Functional and technical criteria
- Environmental criteria
- Sociocultural criteria

(Hellström et al., 2000):



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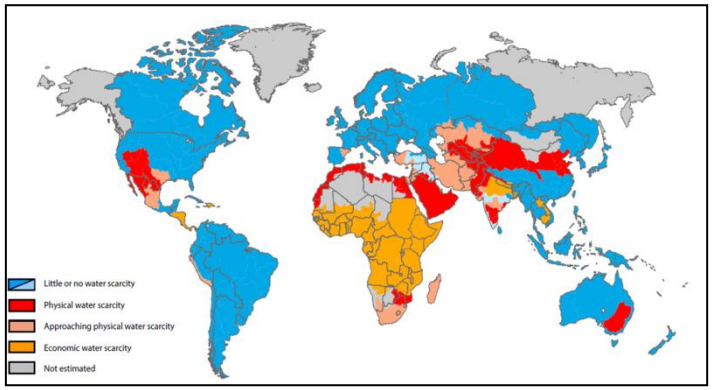
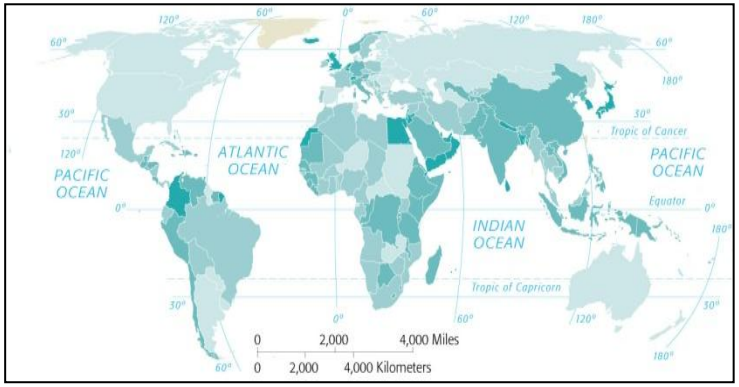
Identification of the global hotspots for greywater treatment based on environmental criteria

- Water shortage



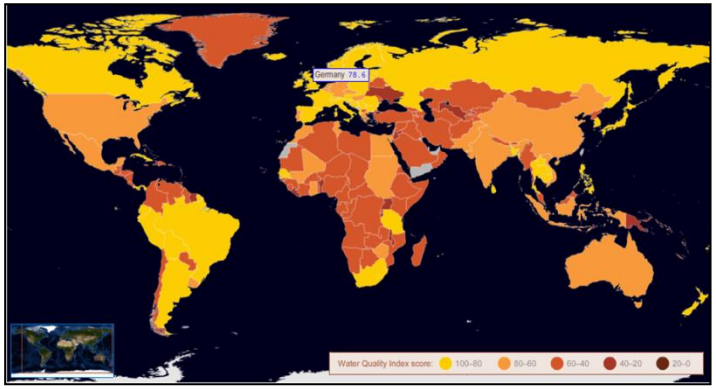
Graphic: IWMI, 2006

- Population density



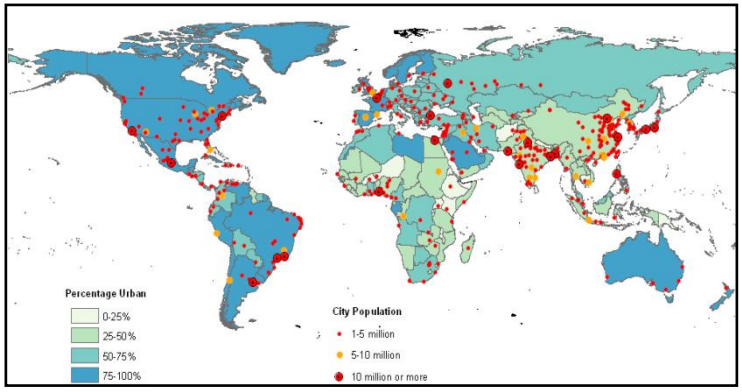
Graphic: Pearson Education Inc. , 2010

- Drinking water quality



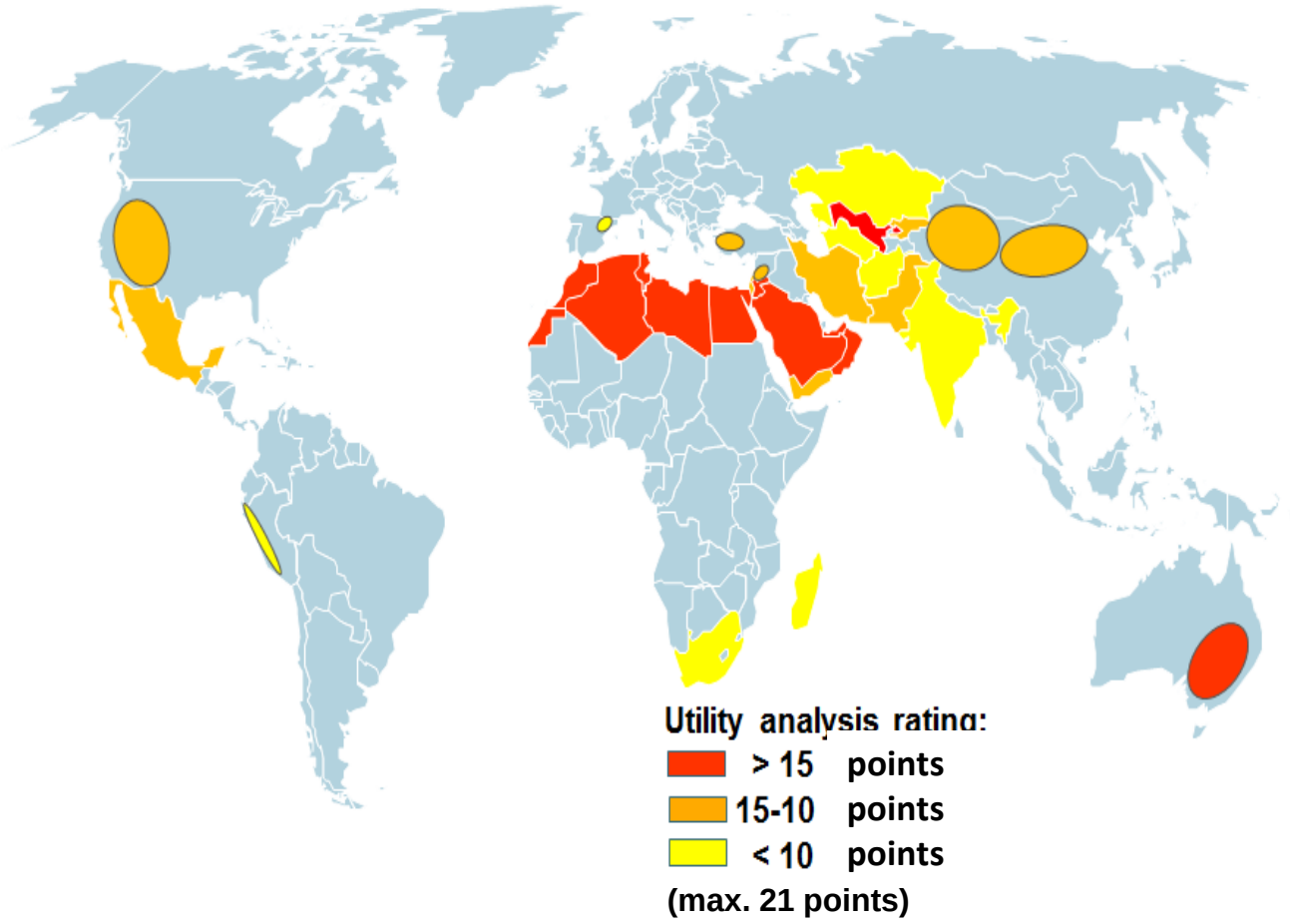
Graphic: Yale University, 2010

- Level of urbanisation



Graphic: United Nations, 2010

Identification of global hotspots for greywater treatment



	Country	Rating
1	Jordan	21
2	Uzbekistan	19
3	Oman	18.5
4	Egypt	17.5
5	Libya	17.5
6	Saudi Arabia	17.5
7	Australia (south)	16.7
8	Morocco	16.5
9	Tunisia	16.5
10	United Arab Emirates	16
11	Western Sahara Territory	16
12	Algeria	15.7
13	USA (south west)	14.7
14	China (north)	14.5
15	Yemen	14.2
16	Israel	12.5
17	Lebanon	12.5
18	Mexico	11.5
19	Pakistan	11.5
20	Turkey (west)	11.5
21	Iran	10.5
22	Kyrgyzstan	10.5
23	Pakistan	10.5
24	Syria (south)	10.5
25	Afghanistan	9.7
26	Kazakhstan	9.7
27	Madagascar	9.7
28	Turkmenistan	9.7
29	Peru(coast)	9.5
30	Spain (north east)	9.5
31	South Africa	8.5
32	India	7.7

Outlook on greywater treatment

- The utility analysis is a sufficient decision support tool
  (Issue becomes measurable and comprehensible)

- Worldwide many fields of application
  - In consideration of all background information
  - Precise project planning

- Distribution of greywater recycling
  - More favourable complete facilities (building set system)
  - Statutory provisions and/or incentives

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Economic aspects of brownwater treatment

Temporary cost evaluation of the facility in the office building

Water balance

-14586 l/d	Brownwater volume (estimation based on measured data)
+15000 l/d	Reuse as toilet flush water by MCB 4 x 4
= + 414 l/d	**100% can be recycled**

Investment costs

+33397.3 €	Brownwater facility (MBR, pretreatment tank)
+25050 €	In-house installations (piping)
= 58447.3 €	**Investment costs**

Running costs

+3274 €/a	Energy costs
+1272.4 €/a	Maintenance costs
+4546.4 €/a	**total running costs**

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Identification of the global hotspots of brownwater treatment

Environmental criteria

- Water shortage (physical)
- Freshwater quality
- Population density
- Urbanisation rate
- Nutrient demand

25 points

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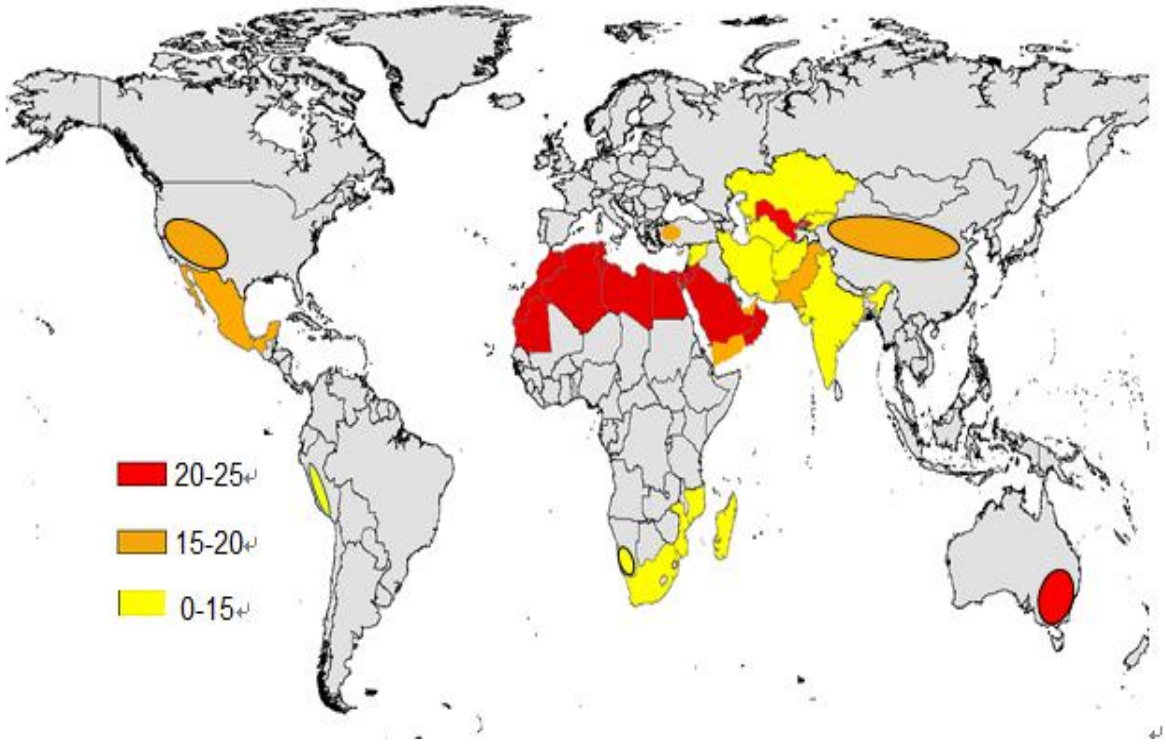
Identification of global hotspots for brownwater treatment



Rate	**Country/region**
23	Jordan
23	Usbekistan
21.5	Ägypten
21.5	Libya
21.5	Tunisia
20.7	Australia (South East))
20.5	Algeria
20.5	Israel
20.5	Morocco
20.5	Mauritania
20.5	Oman
20.5	Saudi Arabia
18	United Arab Emirates
17.9	China (North)
16.2	Yemen
16	Western Sahara
15.5	Mexico
15.5	Pakistan
15.1	USA (South West)
14.5	Kazakhstan
14.5	Lebanon
14.5	Mozambique
14.5	Namibia (South)
13.7	Krygyzstan
13.7	Madagascar
13.5	Iran
13.5	Peru (coasts)
13.5	South Africa
13.5	Turkey (West)
12.7	India
12.5	Syria
12.5	Cyprus
11.7	Afghanistan
9.9	Spain (North East)
9.7	Turkmenistan

Summary and outlook on brownwater treatment

- **MBR- is a very effective process for brownwater recycling**
  - Comparatively high investment and energy costs

- **The utility analysis is a sufficient decision support tool**
  - Good comprehensibility
  - Straightforward model structure
  - Reliability of utility analysis when it comes to the introduction of new alternatives

- **12 countries in North Africa, West Asia and South East Australia have the biggest potential for an implementation of the brownwater treatment by a MBR-facility.**

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Presentation 6:

Manfred Romich
(RWTH Aachen)

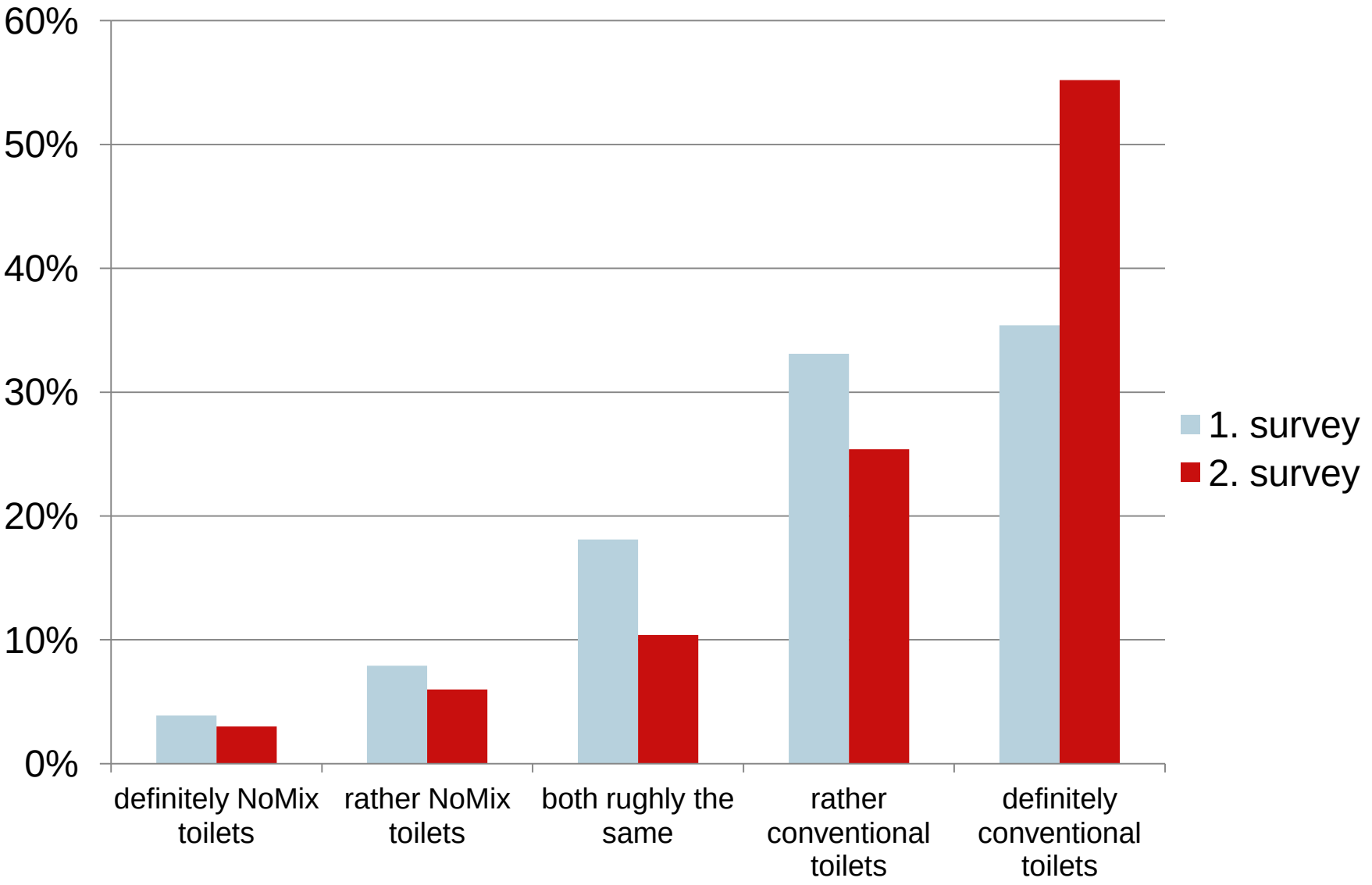
Acceptance study:

Selective results of the first and second period of surveys

Distinctive features of the second round

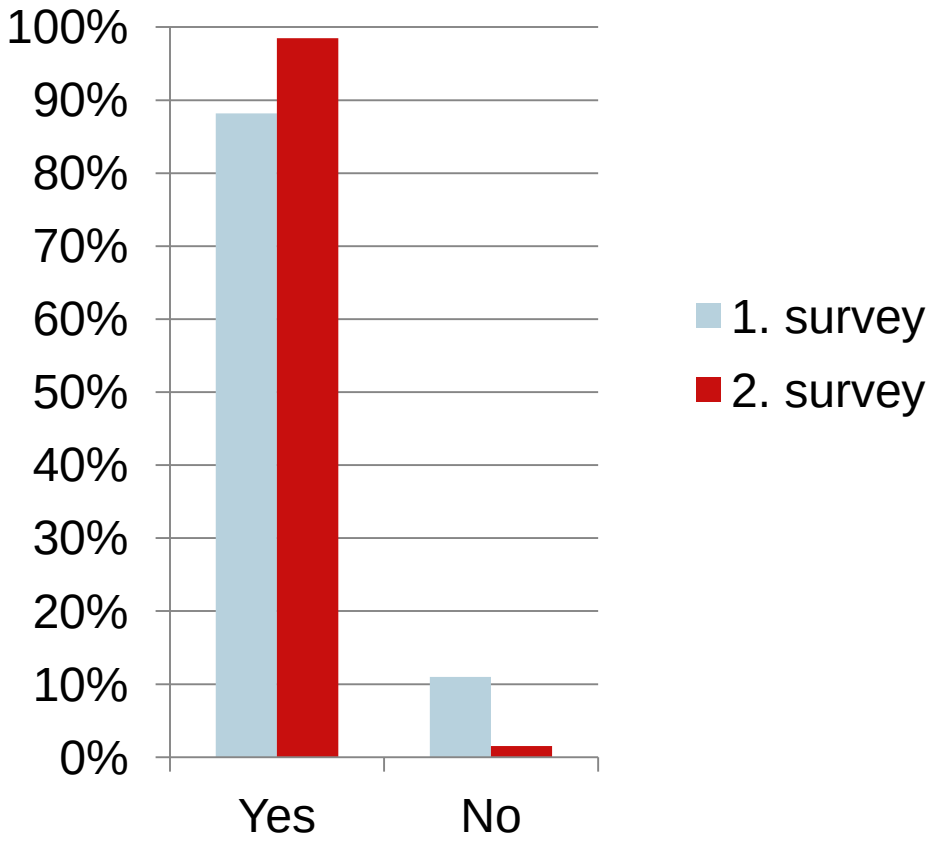
- Less returns (67 in comparison to 127 in round 1)
- More definite views
- Trend to more polarised answers
- Strong increasing of negative statements

Preferred toilet systems

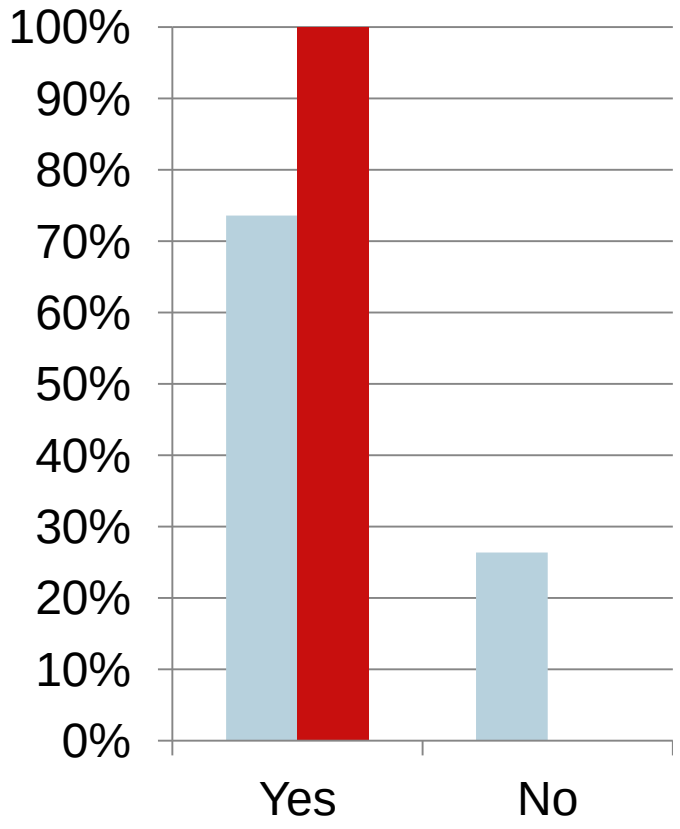


Knowledge improvement

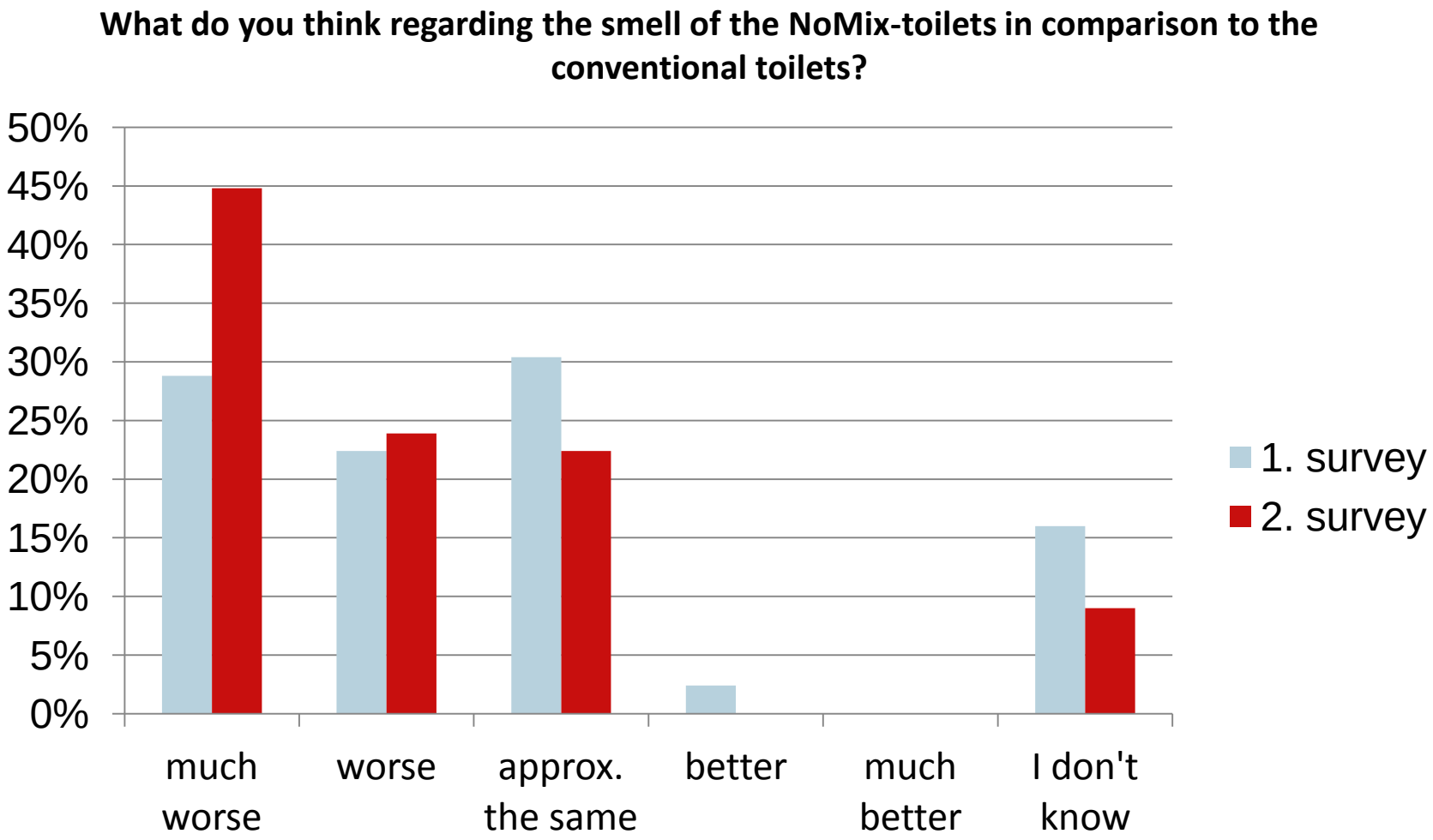
Did you know that by sitting on the toilet seat the urine diversion mechanism is activated?



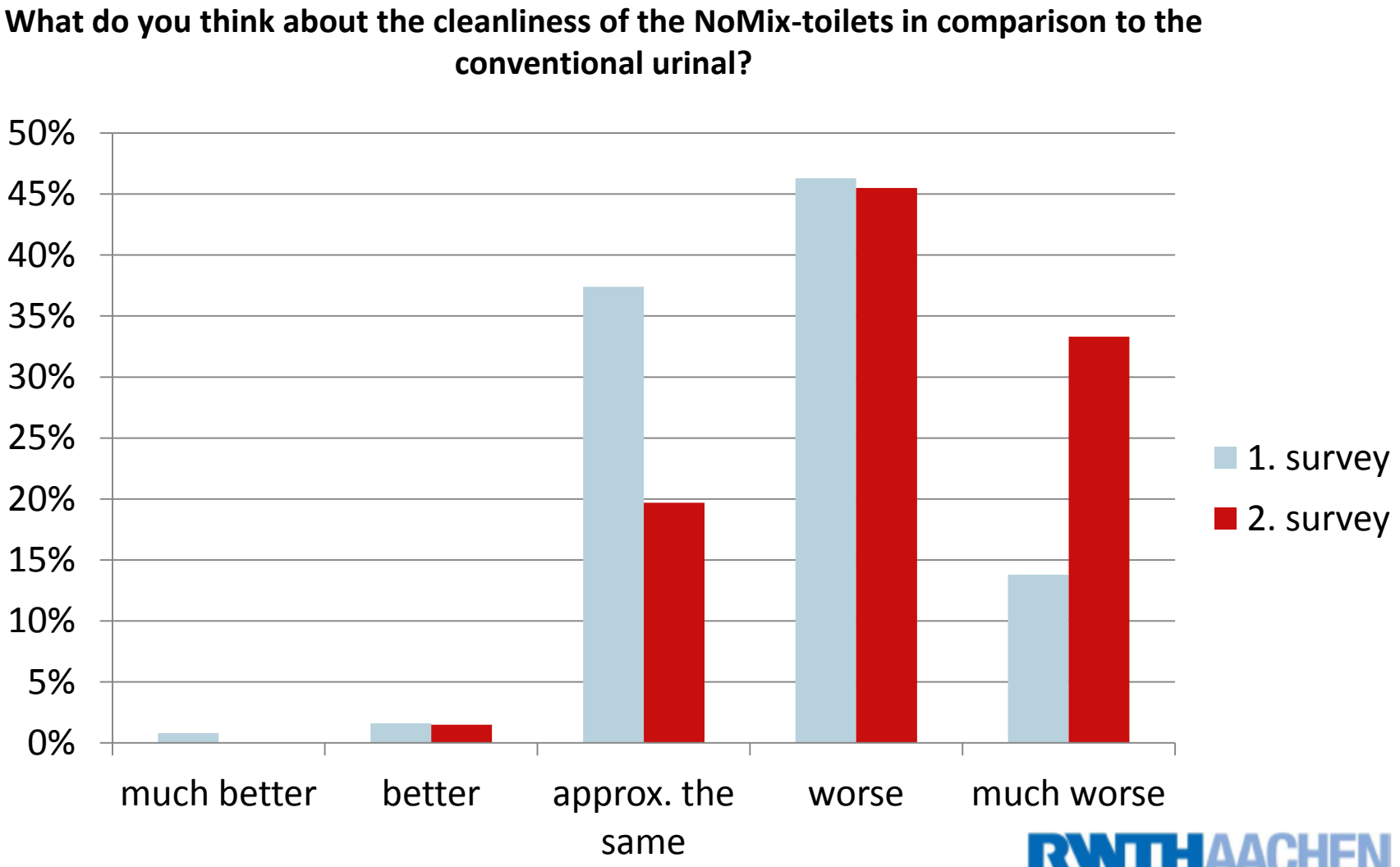
Did you know that the used toilet paper is only allowed to be disposed at the posteriorplughole?



Smell of the toilets



Cleanliness of the urinals



Presentation 7:

Hans-Christian Rüster
(Roediger Vacuum GmbH)

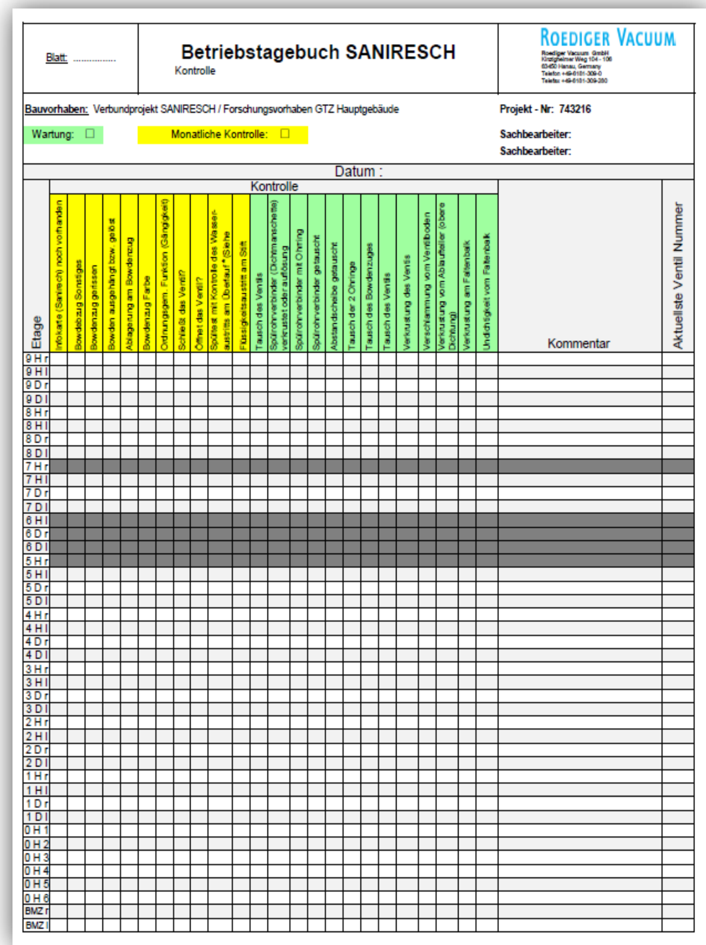
RoeVac© No-Mix Toilets

Operating diary and it‘s interpretation

Operating diary and it‘s interpretation

List for data sampling

- The operation diary was created by the help of the GIZ employees.
- Weekly, monthly and yearly controls can be listed.
- Objective was, to record all relevant data in a single sheet for interpretation.
- The columns list the floors, where the toilets are installed.
- It‘s possible to note down anomalies in a comment column.



Blatt: ....

Betriebstagebuch SANIRESCH
Kontrolle

ROEDIGER VACUUM
Roediger Vacuum GmbH
Kinzigheimer Weg 104 - 106
63450 Hanau, Germany
Telefon +49-6181-309-0
Telefax +49-6181-309-280

Bauvorhaben: Verbundprojekt SANIRESCH / Forschungsvorhaben GTZ Hauptgebäude

Projekt - Nr: 743216

Wartung: ☐ Monatliche Kontrolle: ☐

Sachbearbeiter:
Sachbearbeiter:

Datum :

Etage	Kontrolle: Infokarte (Sanirech) noch vorhanden	Bowdebzug Sonstiges	Bowdenzug gerissen	Bowden ausgehängt bzw. gelöst	Ablagerung am Bowdenzug	Bowdenzug Farbe	Ordnungsgem. Funktion (Gängigkeit)	Schließt das Ventil?	Öffnet das Ventil?	Spültest mit Kontrolle des Wasser-austritts am Überlauf* (Siehe	Flüssigkeitsaustritt am Stift	Tausch des Ventils	Spülrohrverbinder (Dichtmanschette) verkrustet oder auflösung	Spülrohrverbinder mit Ohrring	Spülrohrverbinder getauscht	Abstandscheibe getauscht	Tausch der 2 Ohrringe	Tausch des Bowdenzuges	Tausch des Ventils	Verkrustung des Ventils	Verschlammung vom Ventilboden	Verkrustung vom Ablaufteller (obere Dichtung)	Verkrustung am Faltenbalk	Undichtigkeit vom Faltenbalk	Kommentar	Aktuellste Ventil Nummer
9 H r																										
9 H l																										
9 D r																										
9 D l																										
8 H r																										
8 H l																										
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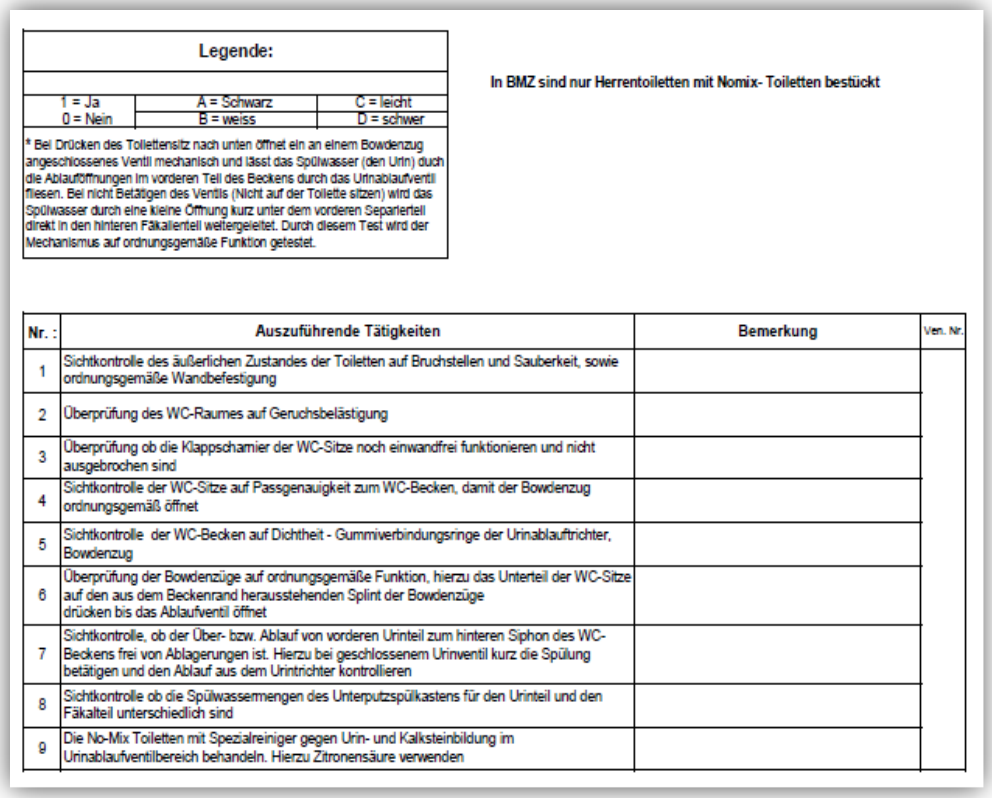
0 H 3																										
0 H 4																										
0 H 5																										
0 H 6																										
BMZ r																										
BMZ l																										

Operating diary and it‘s interpretation

Legend for the list handling

- The necessary control activities are described and are recorded in the list.

- The design of the legend allows for straightforward interpretation.



Legende:		
1 = Ja 0 = Nein	A = Schwarz B = weiss	C = leicht D = schwer

* Bei Drücken des Toilettensitz nach unten öffnet ein an einem Bowdenzug angeschlossenes Ventil mechanisch und lässt das Spülwasser (den Urin) duch die Ablauföffnungen im vorderen Teil des Beckens durch das Urinablaufventil fliesen. Bei nicht Betätigen des Ventils (Nicht auf der Toilette sitzen) wird das Spülwasser durch eine kleine Öffnung kurz unter dem vorderen Separierteil direkt in den hinteren Fäkalienteil weitergeleitet. Durch diesem Test wird der Mechanismus auf ordnungsgemäße Funktion getestet.

In BMZ sind nur Herrentoiletten mit Nomix- Toiletten bestückt

Nr. :	Auszuführende Tätigkeiten	Bemerkung	Ven. Nr.
1	Sichtkontrolle des äußerlichen Zustandes der Toiletten auf Bruchstellen und Sauberkeit, sowie ordnungsgemäße Wandbefestigung		
2	Überprüfung des WC-Raumes auf Geruchsbelästigung		
3	Überprüfung ob die Klappscharnier der WC-Sitze noch einwandfrei funktionieren und nicht ausgebrochen sind		
4	Sichtkontrolle der WC-Sitze auf Passgenauigkeit zum WC-Becken, damit der Bowdenzug ordnungsgemäß öffnet		
5	Sichtkontrolle der WC-Becken auf Dichtheit - Gummiverbindungsringe der Urinablauftrichter, Bowdenzug		
6	Überprüfung der Bowdenzüge auf ordnungsgemäße Funktion, hierzu das Unterteil der WC-Sitze auf den aus dem Beckenrand herausstehenden Splint der Bowdenzüge drücken bis das Ablaufventil öffnet		
7	Sichtkontrolle, ob der Über- bzw. Ablauf von vorderen Urinteil zum hinteren Siphon des WC-Beckens frei von Ablagerungen ist. Hierzu bei geschlossenem Urinventil kurz die Spülung betätigen und den Ablauf aus dem Urintrichter kontrollieren		
8	Sichtkontrolle ob die Spülwassermengen des Unterputzspülkastens für den Urinteil und den Fäkalteil unterschiedlich sind		
9	Die No-Mix Toiletten mit Spezialreiniger gegen Urin- und Kalksteinbildung im Urinablaufventilbereich behandeln. Hierzu Zitronensäure verwenden		

Operating diary and it‘s interpretation

Data sampling for the operating diary

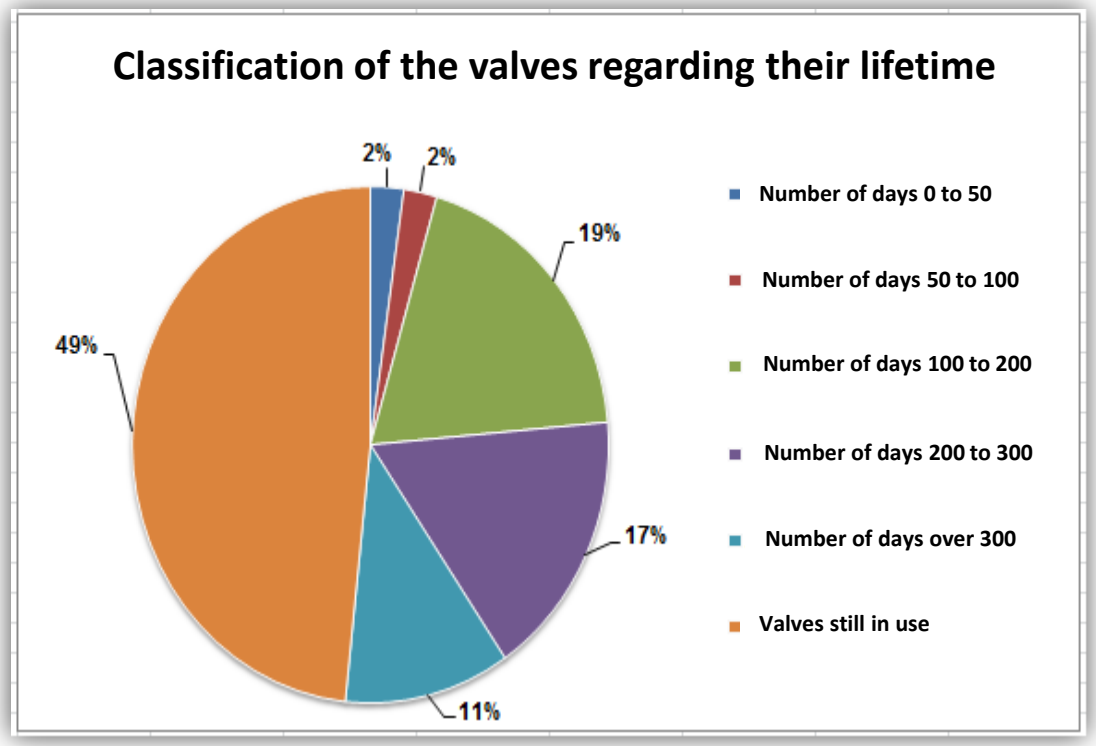
- Data interpretation regarding lifetime of the urine separation valves.
- Detection, which components were removed most frequent ⇨ Conclusions about troubles can be drawn.
- Presentation of the toilet‘s operating condition ⇨ Conclusions about troubles can be drawn.
- Interpretation regarding frequent malfunctions of the No-Mix toilets are possible.

Ventilnummer	Eingebaut	Ausgebaut	Lebensdauer (Tage)
1	defekt		
2	22.04.2010	15.11.2010	203
3	26.04.2010	20.12.2010	234
4	22.04.2010	17.09.2010	145
5	26.04.2010	19.04.2011	353
6	22.04.2010	15.11.2010	203
7	26.04.2010	11.08.2011	465
8	19.04.2011	läuft noch	
9	26.04.2010	14.06.2010	48
10	14.06.2010	läuft noch	
11	09.06.2010	10.02.2011	241
12	14.06.2010	läuft noch	
13	14.06.2010	19.04.2011	305
14	defekt		
15	14.06.2010	19.04.2011	305
16	14.06.2010	15.11.2010	151
17	17.08.2010	19.08.2011	362
18	17.08.2010	läuft noch	
19	17.09.2010	10.02.2011	143
20	21.06.2010	15.11.2010	144
21	21.06.2010	20.12.2010	179
22	21.06.2010	20.12.2010	179
23	21.06.2010	läuft noch	
24	21.06.2010	10.02.2011	229
25	21.06.2010	20.12.2010	179
26	21.06.2010	läuft noch	
27	21.06.2010	01.06.2011	340
28	21.06.2010	20.12.2010	179
29	21.06.2010	19.08.2011	418
30	21.06.2010	17.09.2010	86
31	21.06.2010	10.02.2011	229
32	21.06.2010	20.12.2010	179
33	21.06.2010	01.06.2011	340
34	21.06.2010	01.06.2011	340
35	21.06.2010	22.08.2011	421
36	21.06.2010	19.04.2011	298
37	21.06.2010	10.02.2011	229
38	25.06.2010	10.02.2011	225
39	25.06.2010	19.04.2011	294
40	25.06.2010	läuft noch	

Operating life of the urine flow valves

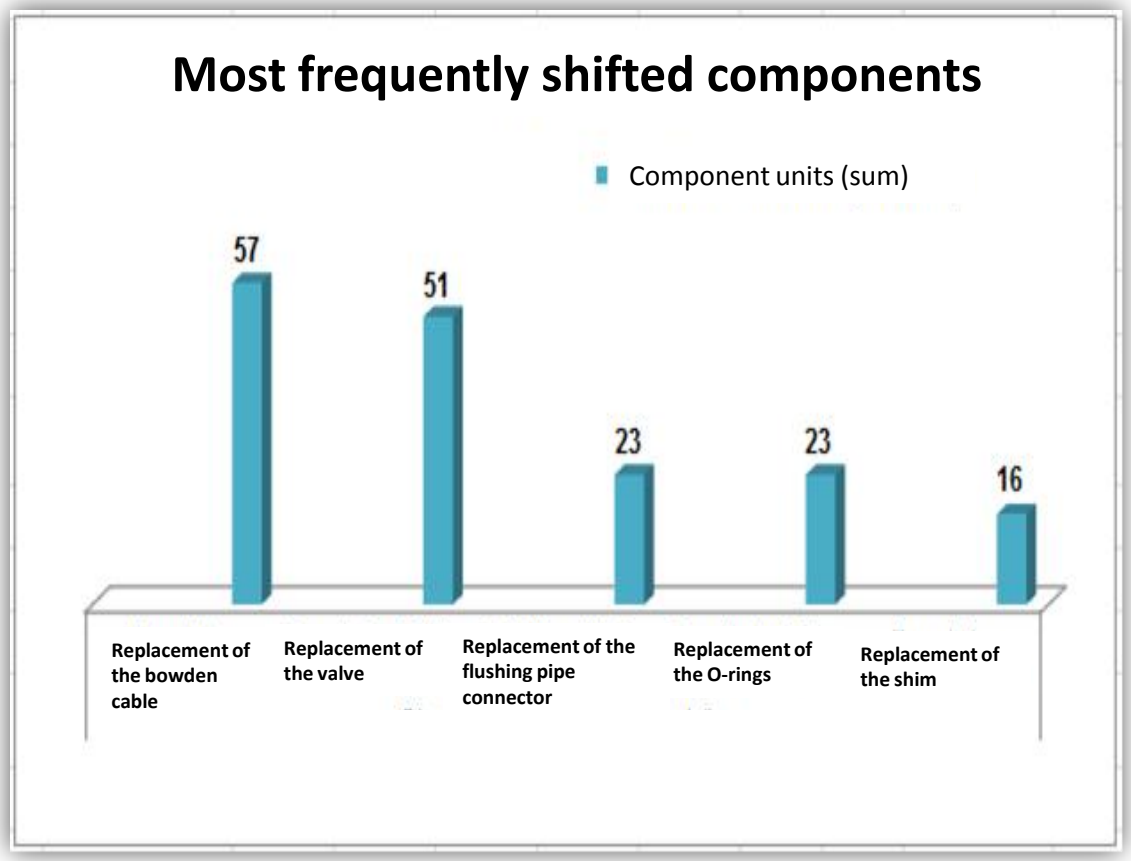
Classification of the valves

- Within the period from 1st January 2010 till 31 December 2011, 89 valves were replaced.
- At the moment the length of the average lifetime of a valve is 221 days.



Components most frequently changed

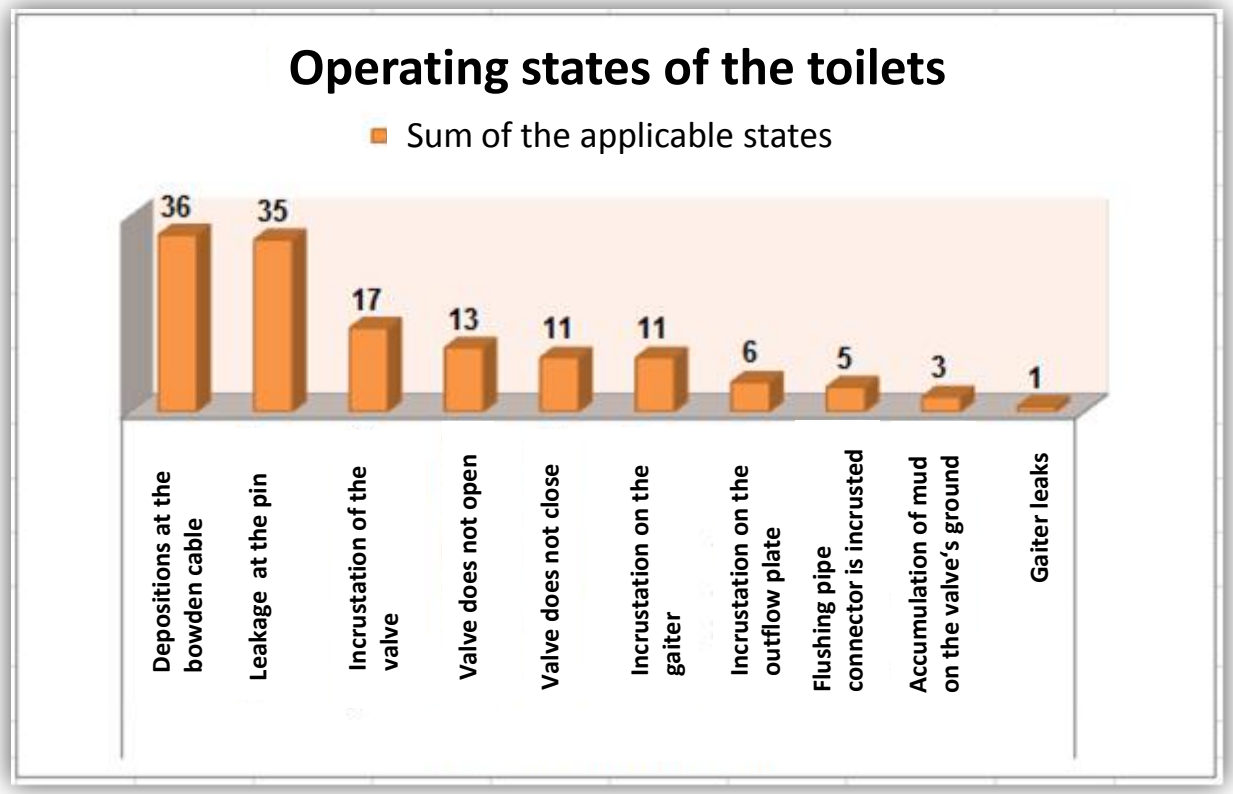
- Within the period from 1st January 2010 till 31 December 2011 170 component units were replaced.
- Bowden cable and complete valve were replaced most often ⇨ they are also the most stressed components.
- Due to time constraints the whole valve was replaced and it was not checked whether only parts of the valve were broken.



Operating states of the No-Mix toilets

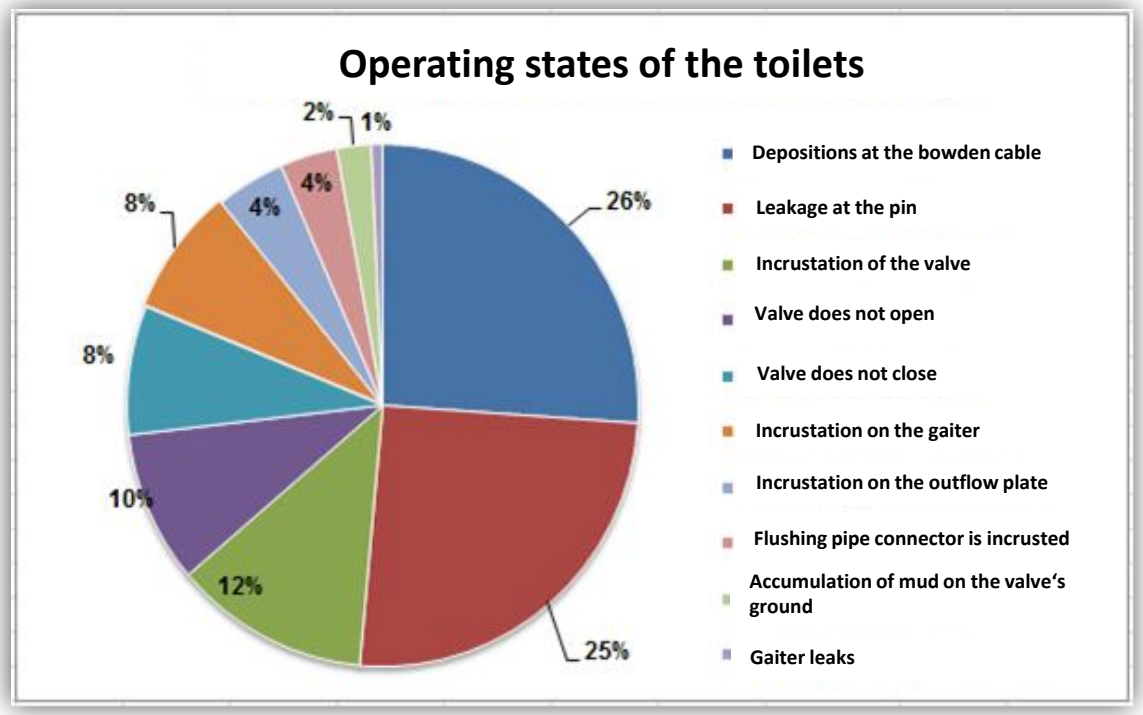
Summary of the interpretation table

- Within the period from 1st January 2010 till 31 December 2011 the most frequent troubles were caused by urine scale deposition and incrustations.
- This problem occurs in general in public urinal facilities ⇨ train stations, service areas, restaurants and airports.



Operating states of the No-Mix toilets

- 56% of all incidents (78 out of 138) show problems caused by urine scale precipitation. These are depositions on the bowden cable (36), incrustations of the valve (17), incrustations on the gaiter (11), incrusted flushing pipe connectors (5), accumulation of mud on the valve‘s ground (3) and incrustations on the outflow plate (6).



Operating states of the No-Mix toilets

- The trend is that the precipitation of urine scale followed by the incrustations and depositions are the most frequent causes for malfunctions of the No-Mix toilets respectively the urine flow valves.

  However, no solutions are known to prevent urine scale precipitation.