Summary

of the presentations held at the meeting of the SANIRESCH project partners
(September 2011)

Explanation:

There is a periodic meeting of all SANIRESCH project partners every 6 months. In September 2011, 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.

Contents:

- Presentation 1: Operation, monitoring and optimisation of the MAP- precipitation reactor (Matthias Hartmann, THM)

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

- Presentation 3: Agricultural reuse of urine – Project status 2011 (Ute Arnold, University Bonn)

- Presentation 4: Selective results of the second interview circle (Manfred Romich, RWTH Aachen)

Presentation 1:

Matthias Hartmann
(THM)

Operation and monitoring:

Operation, monitoring and optimisation of the MAP-precipitation reactor

Difficulty in Reactor operation

TECHNISCHE HOCHSCHULE MITTELHESSEN

- Setting the urine volume on a constant level
  - variation in the rage of approx. 5 litre (target-setting 30 litre)

- Larvae of flies + Sedimentation
  - the first litres (approx. 200 litre) of a tank are practically not usable

- Dosing unit
  - most of the MgO-bags with a filling weight of > 14 g are not falling out
  - therefore the reactor operation with volume of 50 litre is problematic
  - *the volume should be adapted to the phosphorus concentration of the urine in the storage tanks*

Results of the reactor experiments

TECHNISCHE HOCHSCHULE MITTELHESSEN

- **Behaviour of the stirrer:**

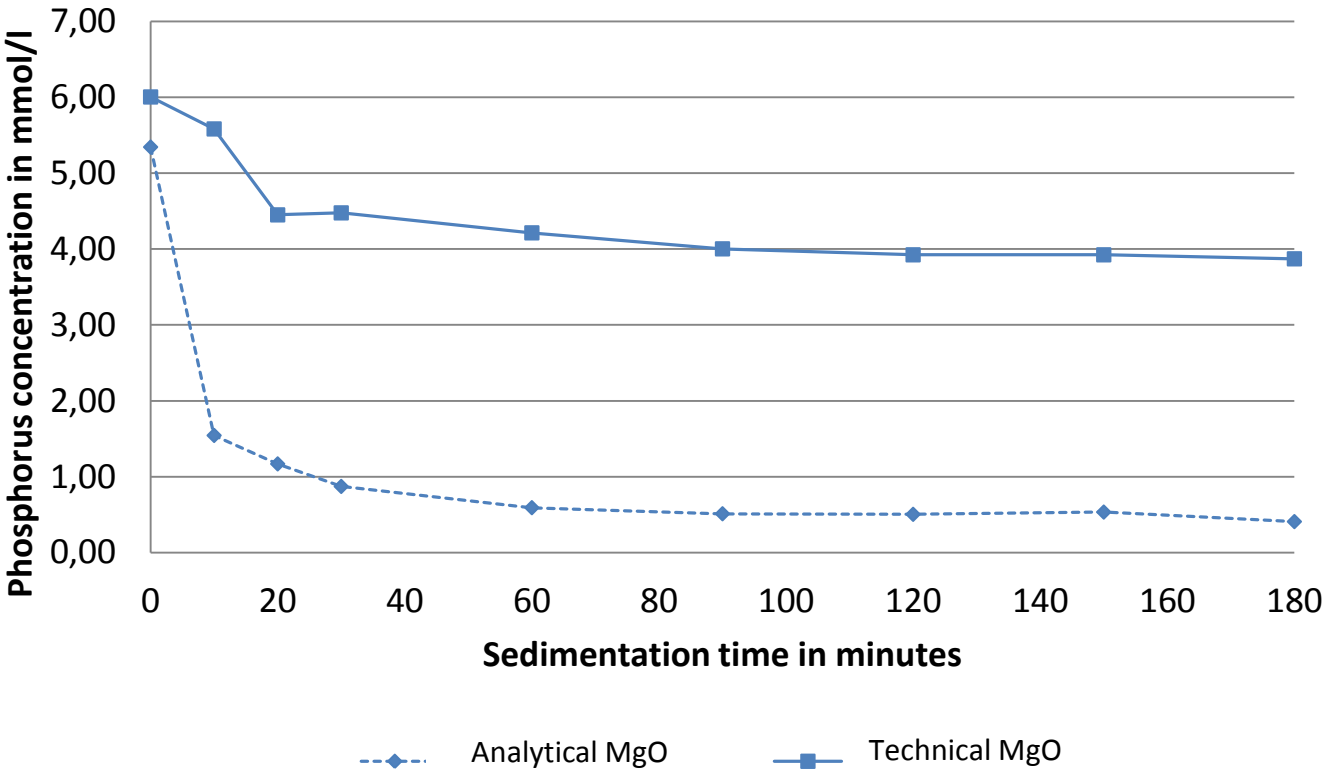
➢ **Experiment realised with 3 x 10 minutes stirring (instead of 3 x 30 seconds).**

→ the phosphorus concentration is still high in the overhang
(after 1. cycles 40 % of the input content)

→ but still lower as the past experiments with a lower stirrer time
(after 1. cycles 55 till 60 % of the input content)

➢ **A higher energy input through the longer stirring is affecting positively the MAP-production (by the use of technical MgO).**

Results of the reactor experiments



	technical MgO	analytical MgO
Cost [€/Kg]	approx. 20,-	approx. 500,-
Grain size	approx. 10 µm	< 10 µm

Comparison for the whole tank

TECHNISCHE HOCHSCHULE MITTELHESSEN

Account:

→ Useable urine volume approx. 2000 l

→ Phosphorus content in the storage tank = 550 mg/l

→14 g MgO * 50 cycles by a ß-factor of 1,5

→ Urine volume in the reactor per cycle = 40 L

MAP-account

(g) = calculated data of a gravimetric determination
(a) = calculated data after the phosphorus determination of the filtrate

- **theoretical MAP-mass 2840 g**

▪ analytical MgO	2628 g *(g)*	= 93 %	
	2600 g *(a)*	= 92 %	
▪ technical MgO („optimised“ stirrer behaviour)	2325 g *(g)*	= 82 %	**1 litre urine results in 0,7 to 1,3 g MAP**
	1766 g *(a)*	= 62 %	
▪ technical MgO (Standard calibration)	1800 g *(g)*	= 63 %	
	1396 g *(a)*	= 49 %	

Comparing for the whole tank

TECHNISCHE HOCHSCHULE MITTELHESSEN

Flow capacity of the plant

- V = 40 Litre

• Dissolving of the bags	6 minutes
• Stirring	3 minutes (31 minutes)
• Sedimentation time	90 minutes
• Outflow of the supernatant	6 minutes
	∑ 105 minutes (133 minutes) per cycle

→ 13 full cycles could be performed per day (or rather 10 cycle)

→ 520 litre urine are treated per day (or rather 400 litre)

→ 364-676 g MAP/day (standard calibration)

→ 353-465 g MAP/day (optimised stirring behaviour)

Summary

TECHNISCHE HOCHSCHULE MITTELHESSEN

- **The ß-factor of 1,5 is fitting well for the operation**

  - the effective ß-factor is lower with technical MgO, because of the practically sedimentation

- **The sedimentation time could be reduced**

  - 90 minutes are enough

- **The process with technical MgO can be optimised**

  - the balance shows, that “just” approx. 50-65 % of phosphorus fell out

  - further experiments about the influence on stirring and seed crystals are necessary

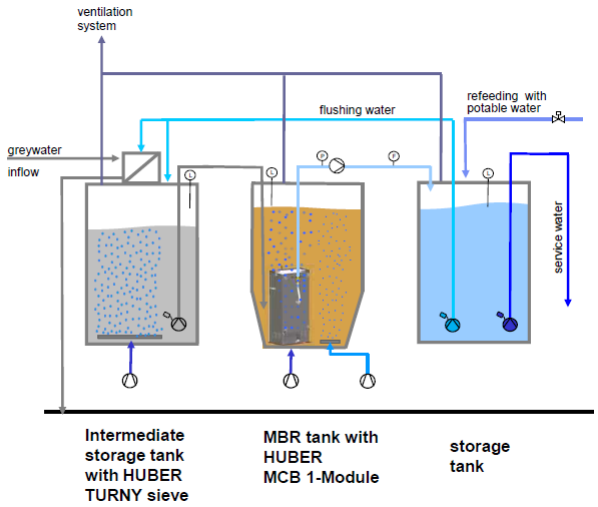
Presentation 2:

Johanna Heynemann
(THM)

Brown- and Greywater- 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 till 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	633	30,2
	min	295	17,2
	max	1025	72,6
TN_b [mg/l]	Ø	13,5	13,2
	min	7,0	7,7
	max	26,2	21,0
P_{total} [mg/l]	Ø	32,9	17,9
	min	9,9	9,5
	max	58,1	30,2
TS [mg/l]	Ø	204	0
	min	142	0
	max	398	0

Nutrient relation:

C : N : P = 100 : 2,1 : 1,7

Degradation of COD:

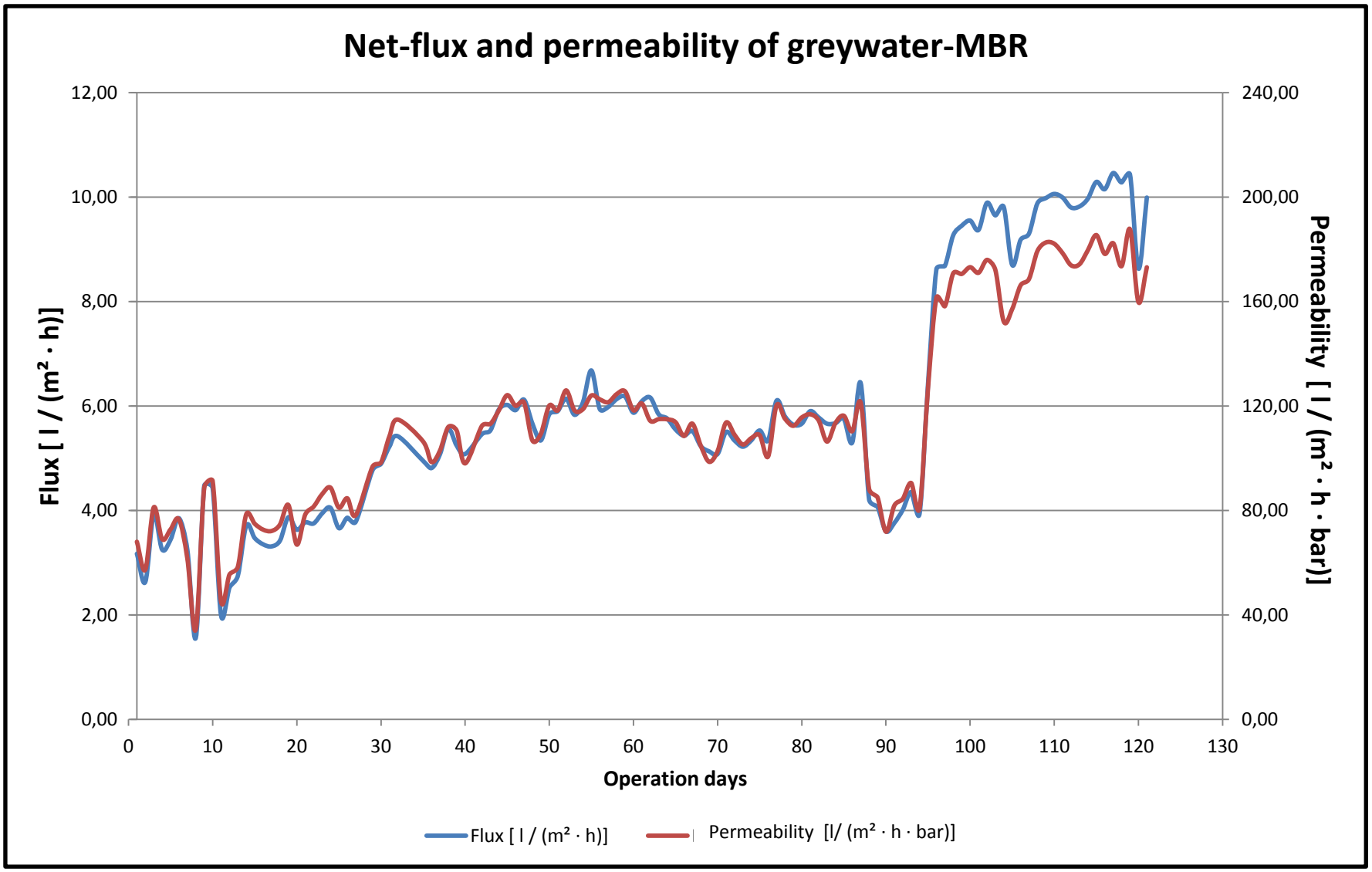
95,2 %

Greywater - Microbiology

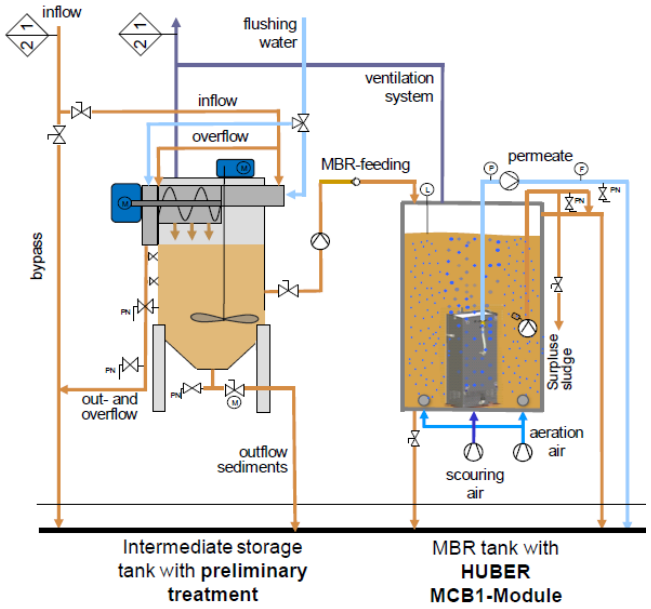
Operation week 1 to 5

Operation week 6 to 19

Greywater – Operation parameters



Brownwater - membrane bioreactor



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	725	21,0
	min	270	13,8
	max	1624	30,5
TN_b [mg/l]	Ø	57,0	62,8
	min	13,4	24,9
	max	82,2	80,6
P_{total} [mg/l]	Ø	21,3	11,6
	min	7,9	5,2
	max	34,4	20,5
TS [mg/l]	Ø	348	0
	min	179	0
	max	560	0

Nutrient relation:

C : N : P = 100 : 7,9 : 1,0

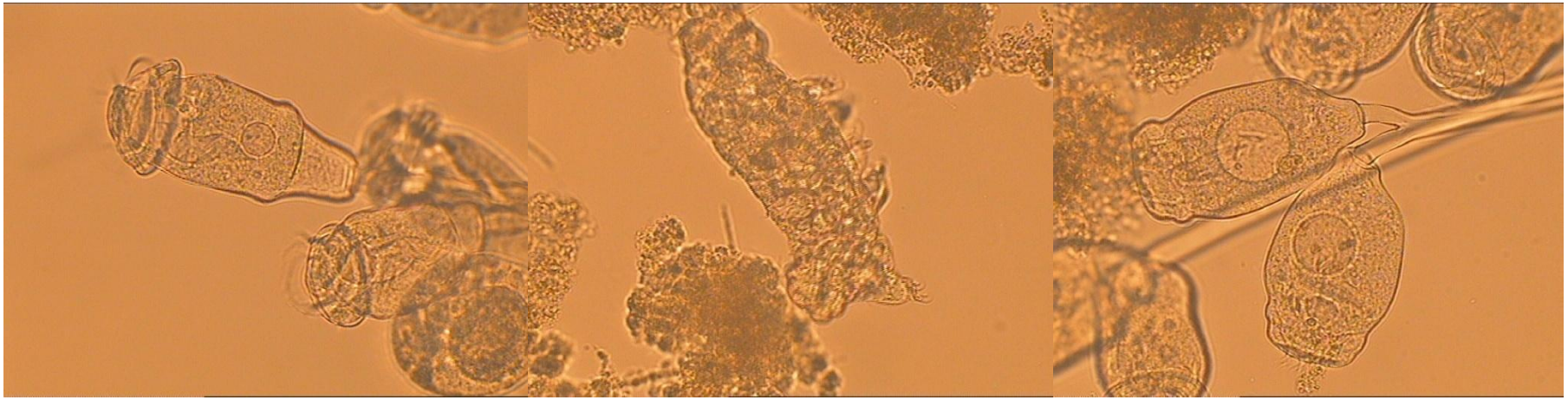
Degradation of COD:

97,1 %

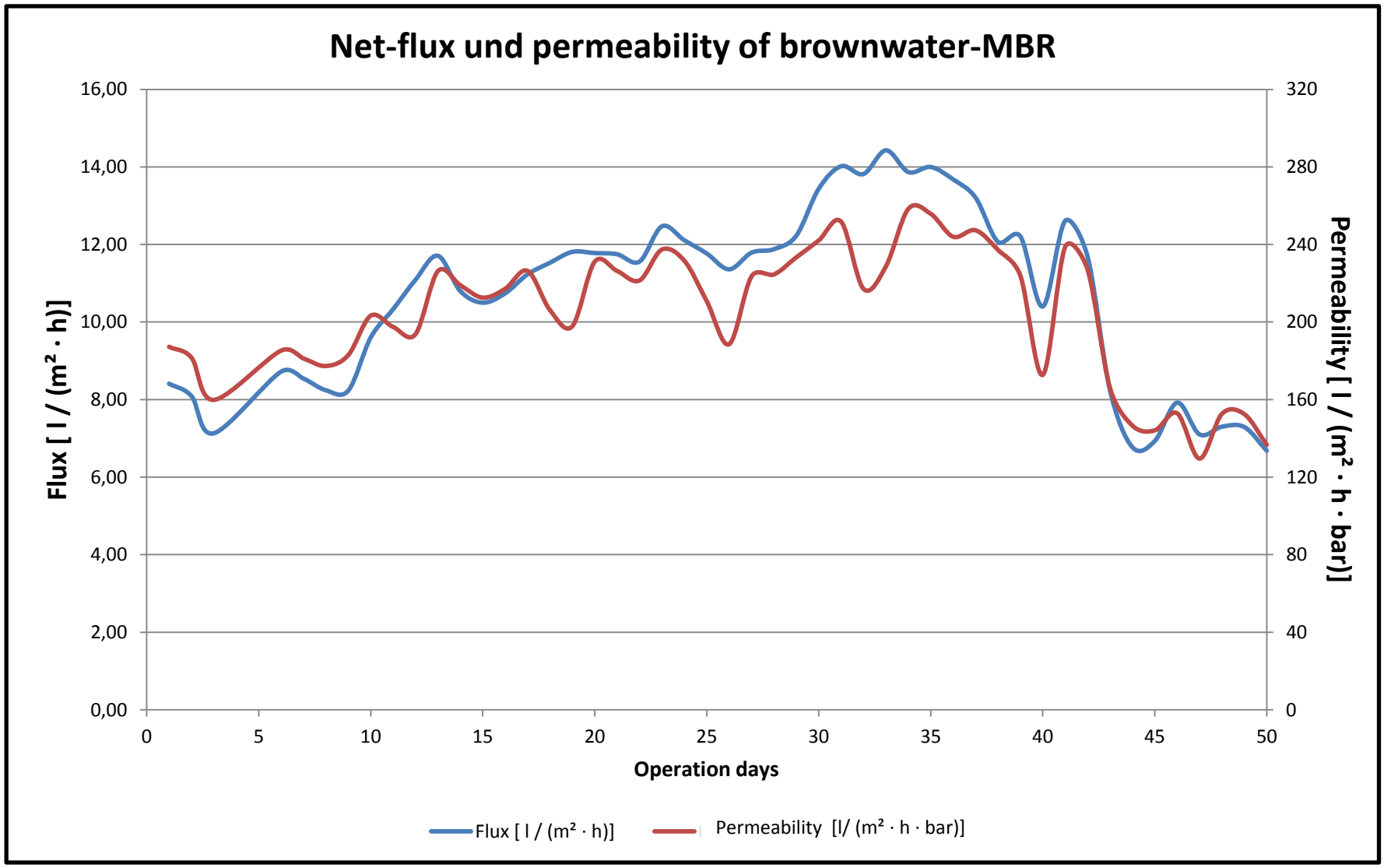
Brownwater - Microbiology

Beginning of operation

Operation week 8



Brownwater – Operation parameters



Presentation 3:

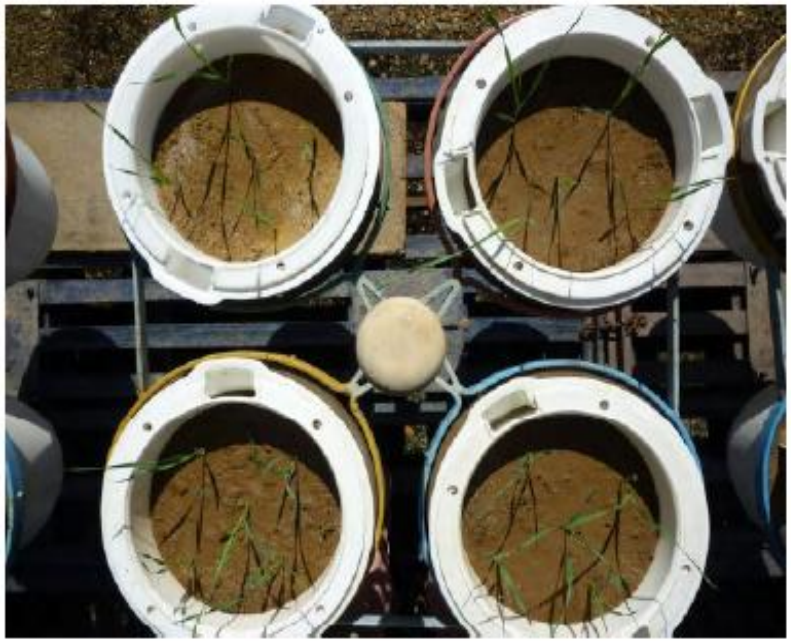
Ute Arnold
(University Bonn)

Agricultural reuse of urine:

Project status 2011

Greenhouse experiment 2010

Realisation



-Summer wheat
- Yellowwater from Eschborn
  Mineral fertiliser
  Null variant
-First addition of active agents:
  Carbamazepin, Diclophenac,
  Atenolol, Verapamil, Estrodiol

In two concentration:
1 mg and 0,1 mg / pot
Four plants per variation

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Greenhouse experiment

No fertiliser application

Verapamil 1 mg

Results

- Pharmaceuticals in the grain
  - HH -> new method: via HPLC/MS

1. Carbamazepin is verifiable in spiked variant, not in “normal” yellowwater
2. Verapamil, Atenolol and Diclophenac unverifiable

  - Carbamazepin concentration is higher at higher doping in all four repetitions
  - Recovery of 3% respectively 5% of the added carbamazepin amount in grain

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Field experiment 2011

Place:

Kleinaltendorf

- Research on fertilising effect of yellowwater (N):
  - Comparison: yellowwater, mineral fertiliser (KAS), null variant
  - Summer wheat, Corn
- Research on MAP (P):
  - Comparison: MAP, mineral fertiliser, null variant
  - Summer wheat, Field bean

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Germ experiments

Questions

- Influence of substrate: Cotton <-> solid
- Influence of urine composition
- Signification of the concentration of urine and pharmaceuticals

Experiments through graduate Judith Schmidt

- Germination of seeds on different substrates: cotton, sand, coco, pearlite
- Comparison of substrates holding yellowwater (GIZ), water or salt solution
- Additional active ingredients: carbamazepin, diclophenac, atenolol, verapamil, EE2
- Identification of germinated plants and their quality

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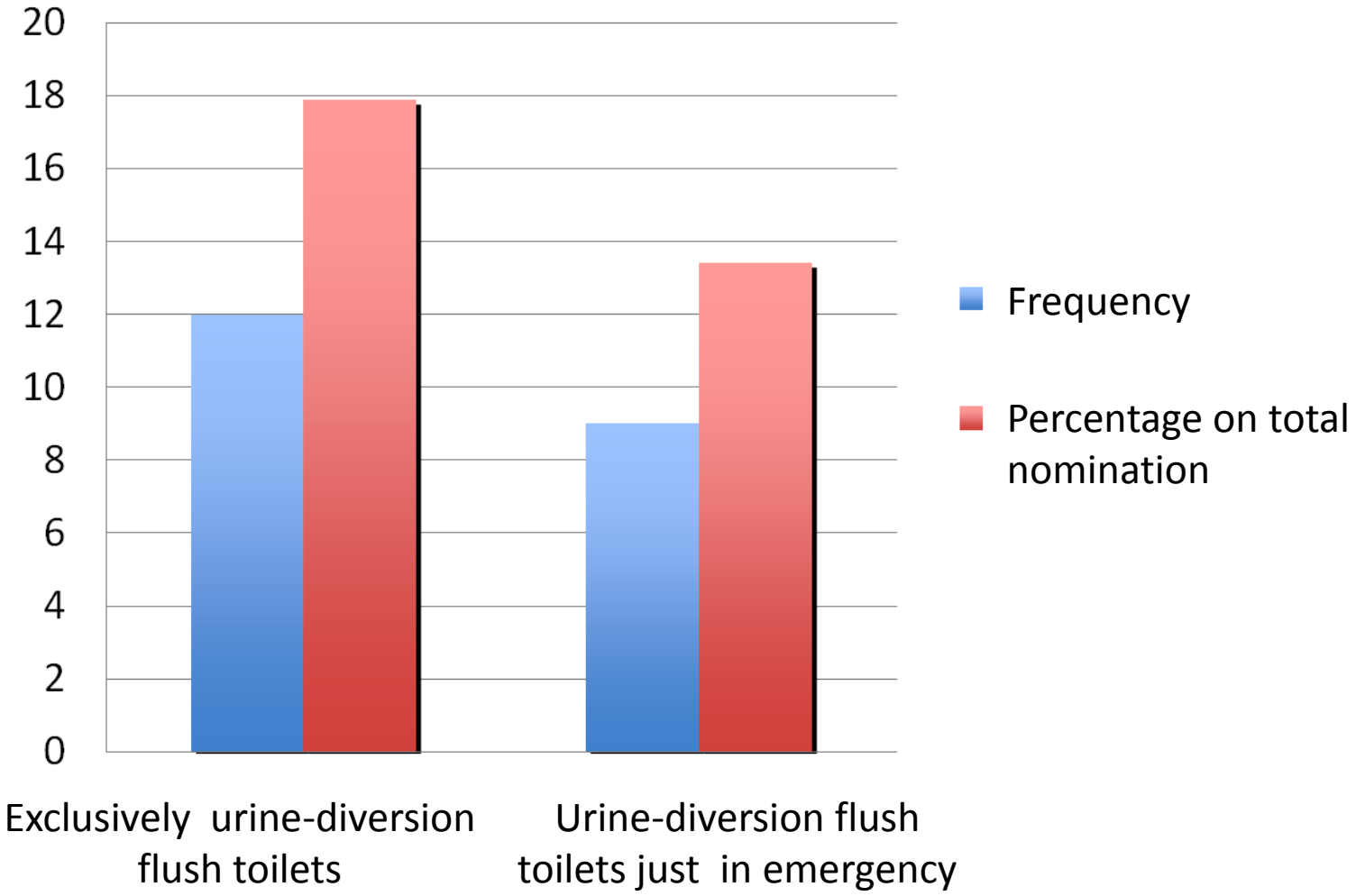
Presentation 4:

Manfred Romisch
(RWTH Aachen - Institute of Sociology)

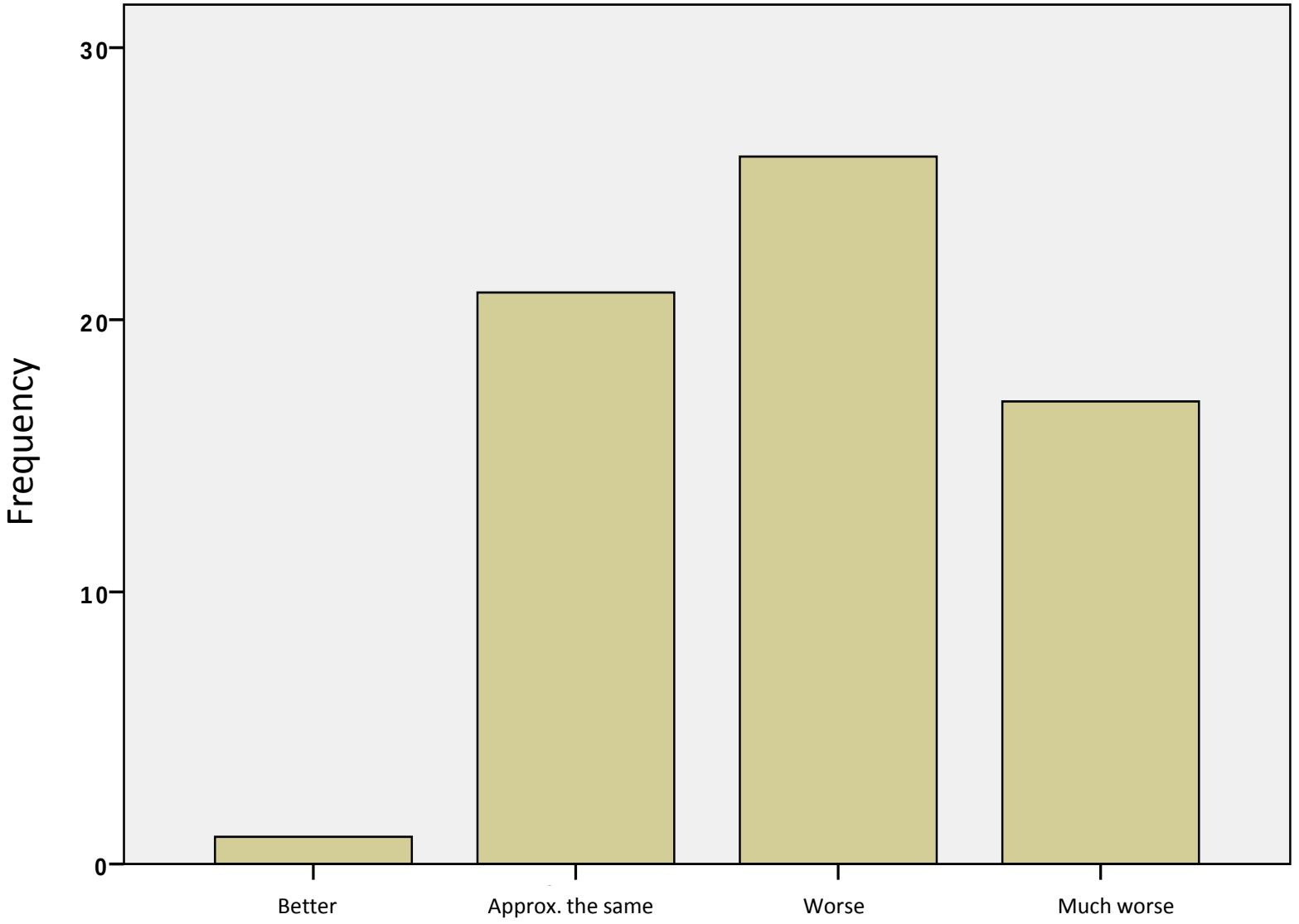
Acceptance test:

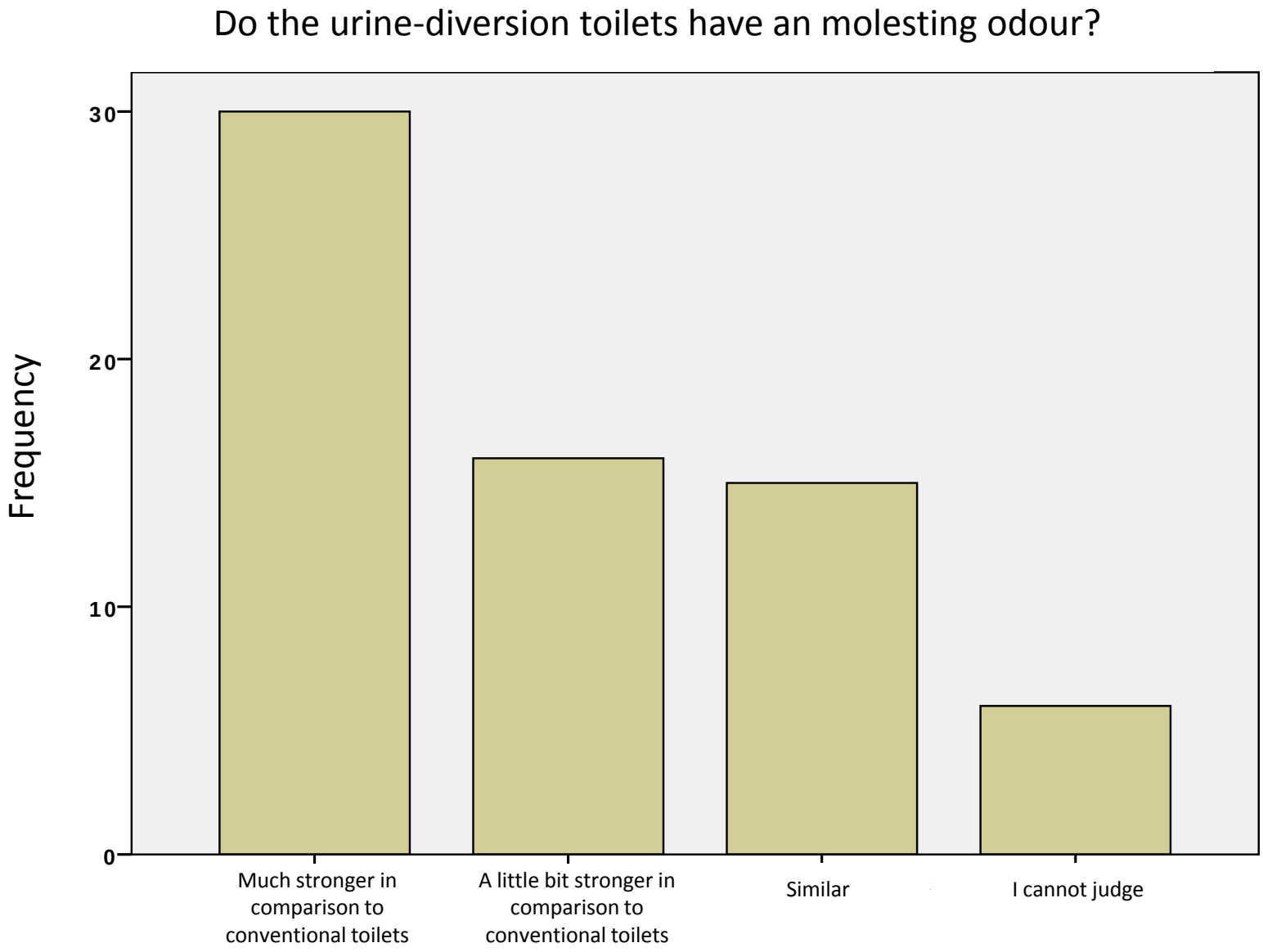
Selective results of the second interview circle

Extreme cases detected for the use of the urine-diversion flush toilets (Question: How often do you use the urine-diversion flush toilets?)

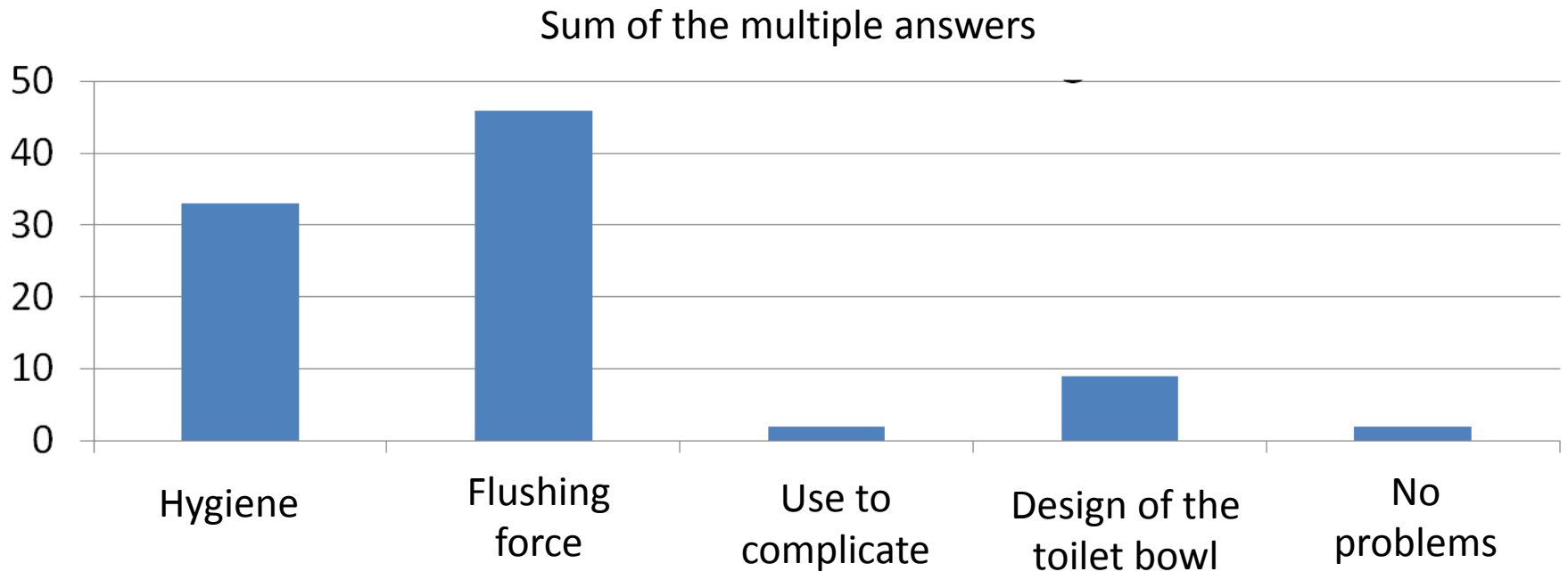


How do you feel about the smell of the urine-diversion toilets in comparison to the conventional toilets?



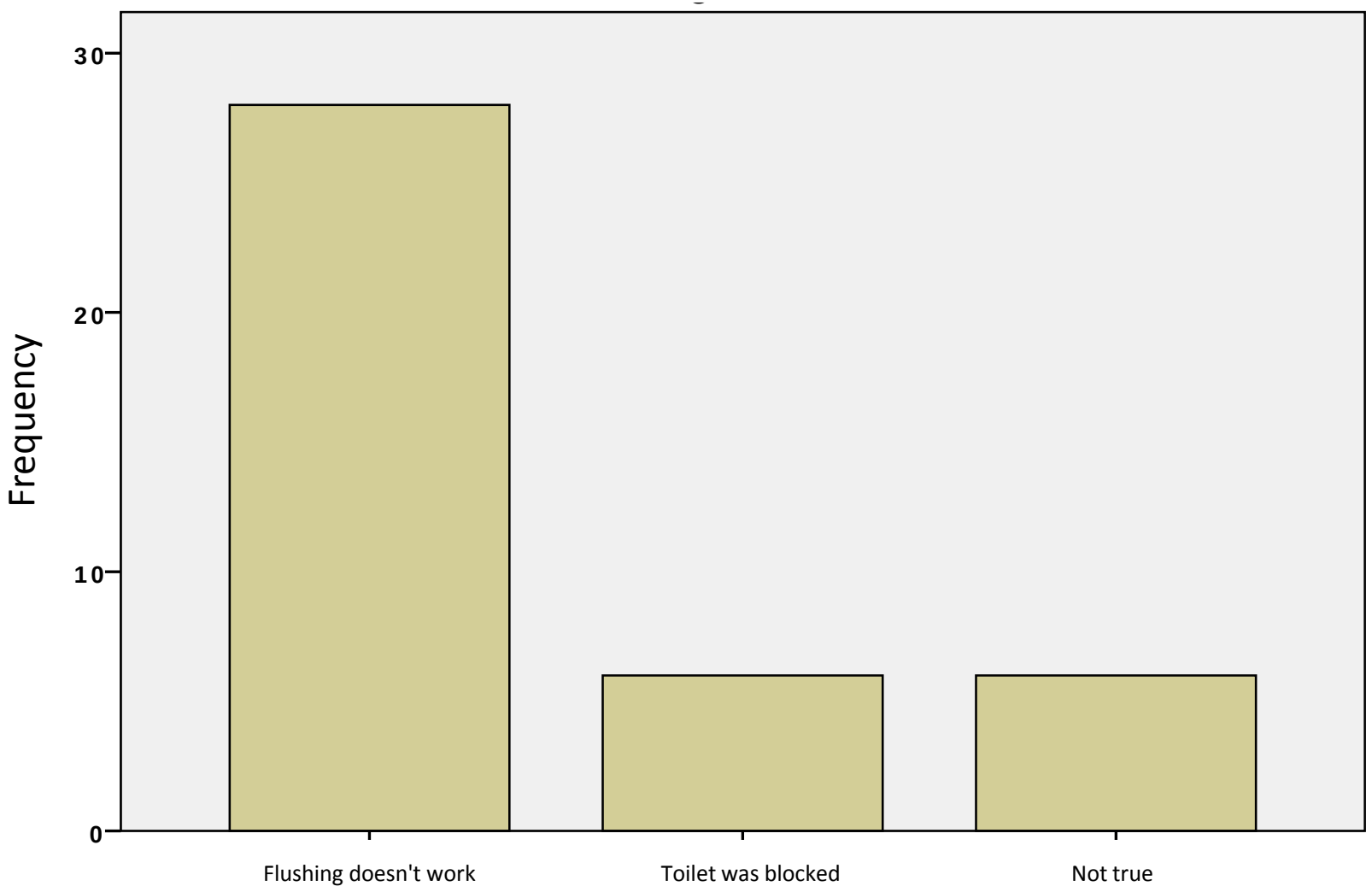

Do the urine-diversion toilets have an molesting odour?
Frequency
30
20
10
0
Much stronger in comparison to conventional toilets
A little bit stronger in comparison to conventional toilets
Similar
I cannot judge

Main problem of the urine-diversion toilets

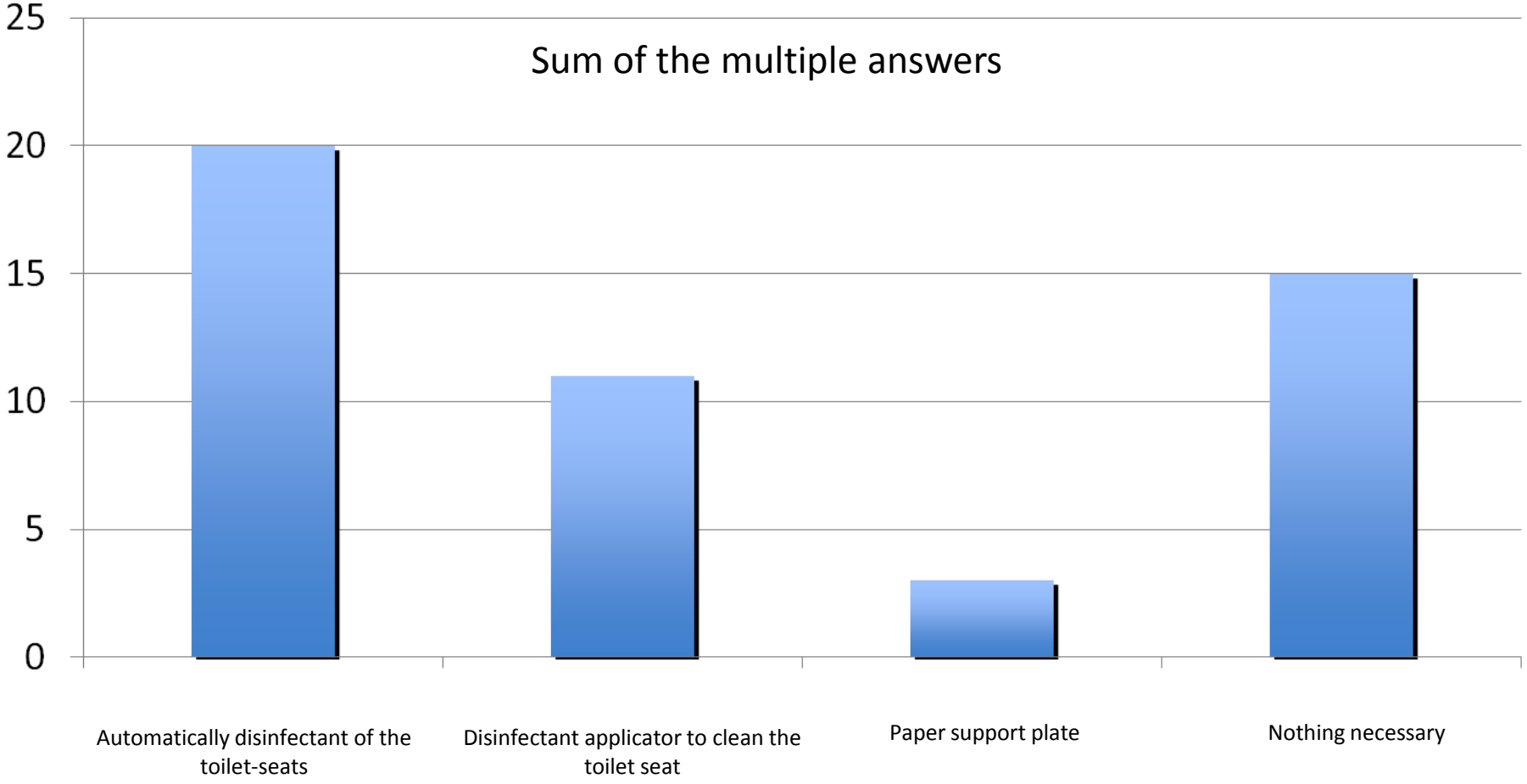


→The frequency table shows, that of the 4 possible main problems of the multiple answer, interviewees mainly choose hygiene and flushing force.
→The combination of the problems hygiene and flushing force occurs collectively by 17 respondents.
→The combination of the problems flushing force and design occurs seven times.
→The combination of the problems hygiene and design occurs twice.
→The combination of the problems hygiene flushing force and design occurs by one respondents.

If you have technical problems, which type of problems occur mainly?

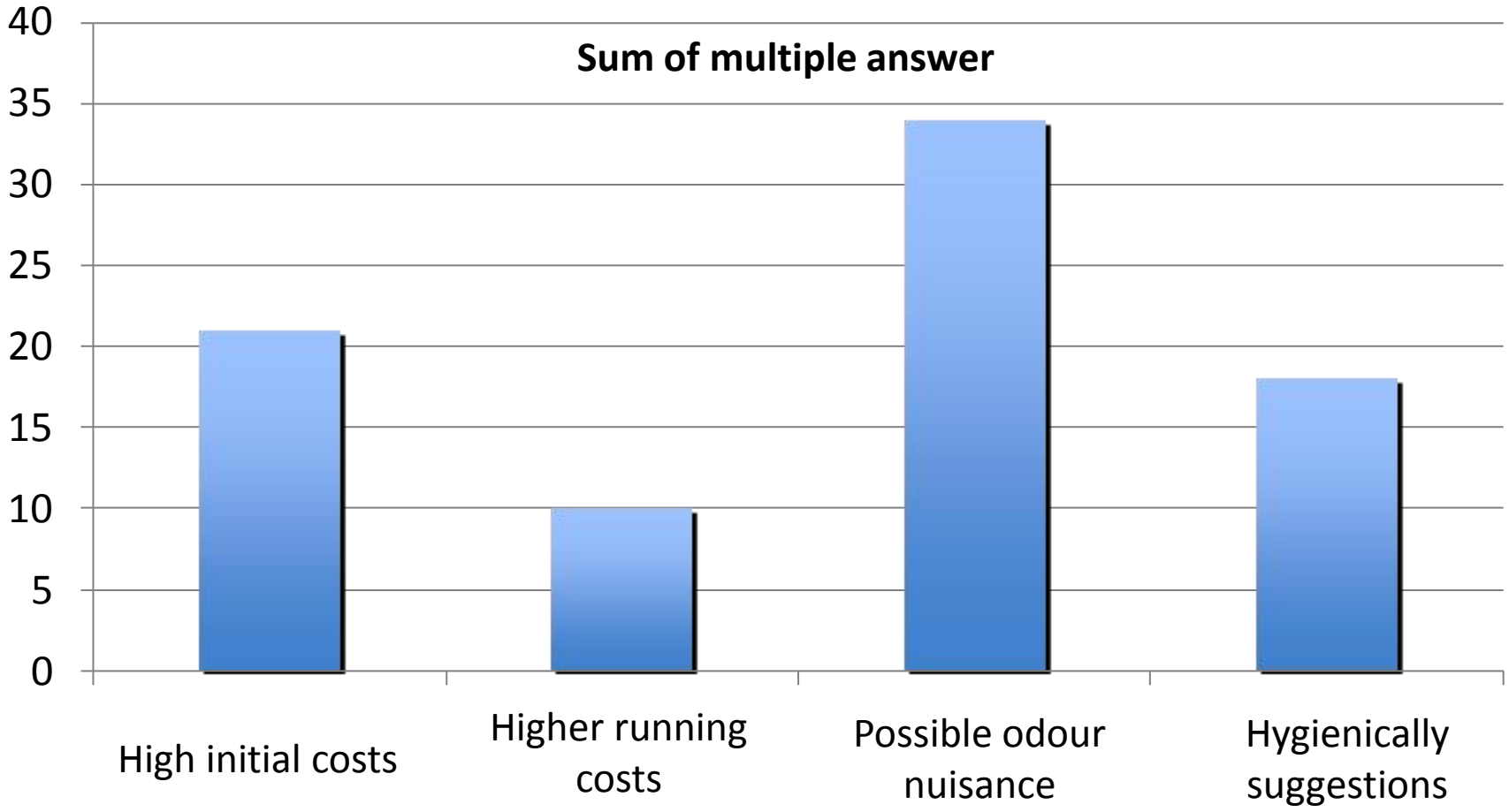


What measure would you personally prefer to use the urine-diversion toilets?



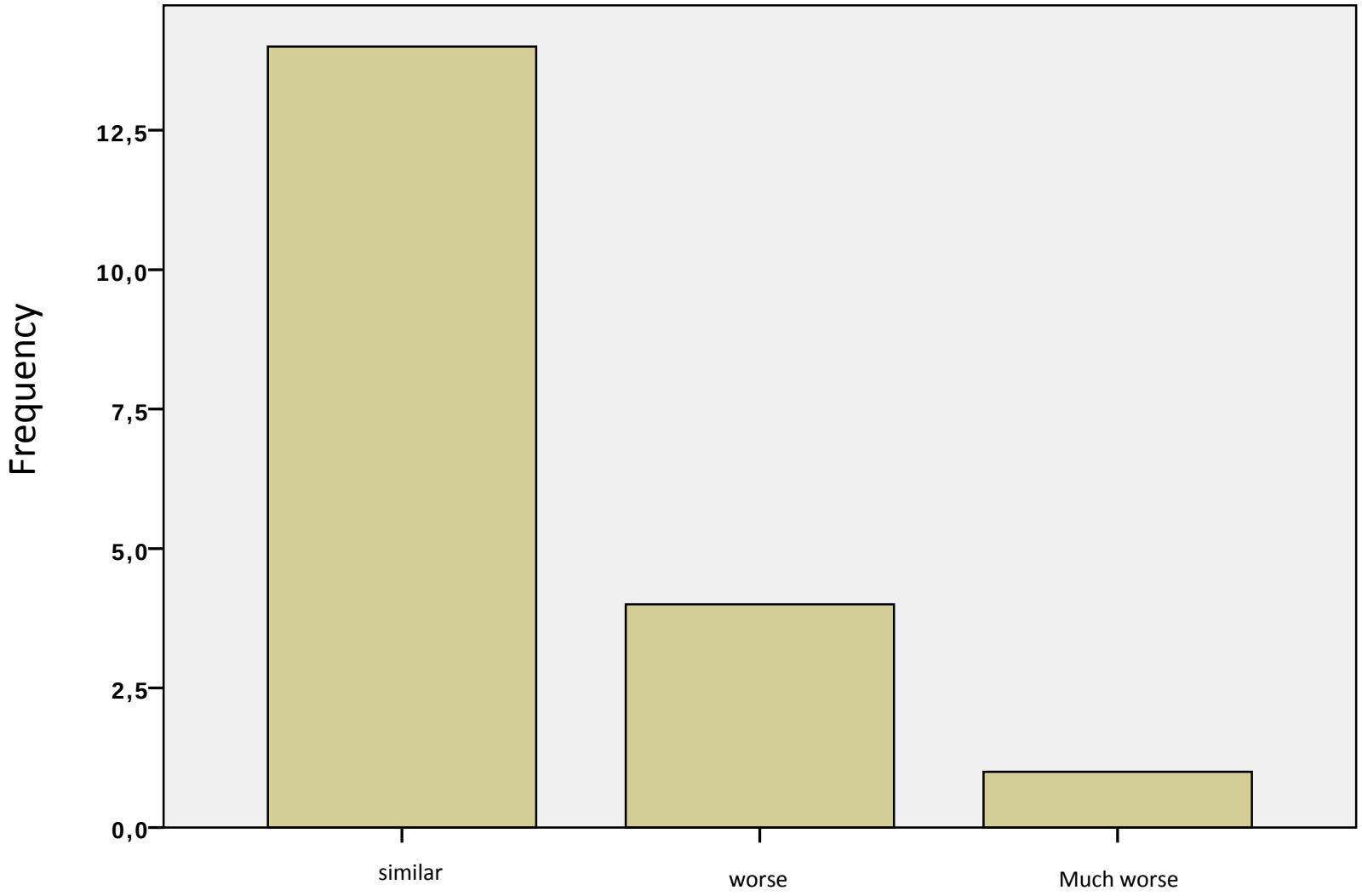
→ User would actively use the measure.

What reason would be crucial for you for not using the urine-diversion toilets in your household?



→ Multiple answers are distributed constantly on the possible answers.
But it still shows that the odour nuisance represents a problem.

How do you feel about the cleanliness of the urinal in comparison to the conventional urinal?



Short summary

- That was criticised:
  - Flushing force and odour nuisance
  - Hygienic problems
    - Question: Produced by the urine-diversion toilets or by heedless users?
- The interviewee is informed about the sanitation concept.
- Women are more affected than men.
- No special significances are found.