DEVELOPMENT AND LARGE SCALE OPERATION OF WATER REUSE PROCESS TECHNOLOGIES IN WASTE WATER FREE PROPERTIES

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This paper presents the successful use of adapted ultra filtration membrane and upgraded biological process in foldable tanks combined with improved control technology. This advanced treatment of organic matter containing waste water is used for the production of water fit for human consumption according EU drinking water regulations. The reuse of water within households, hotels or food production plants requires save and efficient treatment of waste water to meet up to drinking water quality.

It is known that in official terms, wastewater from hotels, campgrounds and B&BS is defined as equivalent to household wastewater as well as wastewater according to ATV Worksheet A 115. Nevertheless, this wastewater poses difficult problems related to decentralized wastewater purification for the various operators of these types of facilities.

The simple solution of connecting to a sewage system cannot always be implemented. In many cases, it is also much more expensive, especially when the sloppiness of the past shows up surprising well on video during camera inspections of house connection pipes, leading to costly renovations.

In the cases at hand, connection to the sewage system was not economical due to great distances and the operators were prompted to invest in decentralized systems at their own expense. Operators were seeking economical solutions. As a result, it was natural to first conduct a good basic evaluation.

In order to apply the process all around the world it has to be easy to handle whilst meeting the requirements of health and safety regulations. The equipment has therefore also to be installable without heavy machinery.

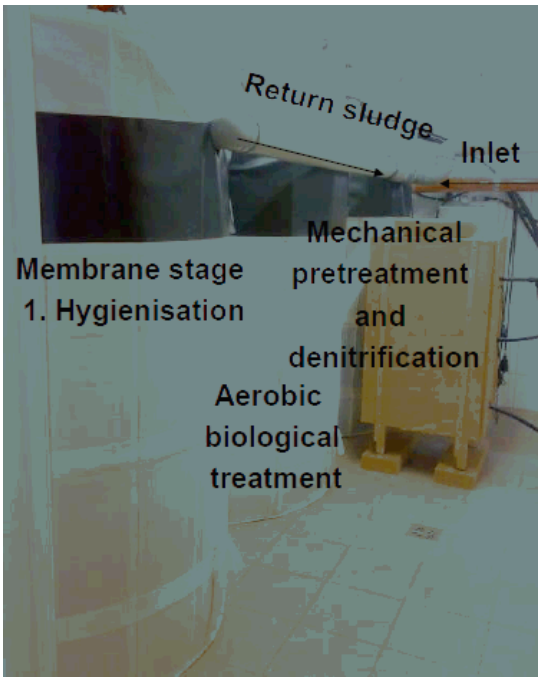

Fig. 1:
Small indoor WWTP with foldable tanks for a treatment capacity of 3 m³ per d

As it is shown in Figure 1 a whole treatment plant can easily be installed within the basement of houses. The waste water inlet enters the first foldable tank. In this tank the mechanically pretreatment as well as denitrification takes place. The separation of non degradable impurities like plastics or sanitary articles is important to avoid any harm to the ultrafiltration membrane.

The waste water is pumped over to the second and third tank and partly back to the first tank. The membrane integrated within the third tank is just separating the biologically cleaned water from the solids.

The whole SCAUT Process is operated by an advanced control system. All important data are transferred either by email or by sms to any control or operating person worldwide.

	SBR plant	Trickling filter plant	Planted bed system	Membrane plant	SCAUT process	Sewer Treatment plant size 4
Waste water parameters						
COD [mg/l]	< 90	< 150	<150	< 90	< 5	< 90 (<40)
BOD [mg/l]	< 25	< 40	< 40	< 25	< 5	< 20 (< 8)
Ammonium [mg/l]	< 10	(< 10)	(< 10)	< 10	< 2	< 10 (2-3)
N_{inorg} [mg/l]	(< 25)			(< 25)	(< 6)	< 18 (< 1)
P_{total} [mg/l]	(< 2)	(< 2)		(< 2)	(< 0,02)	< 2 (< 1)
Faecal coli form germs in 100 ml	> 1 million	> 1 million	> 1 million	< 100	0	> 1 million
Filterable substances	50.0	75.0	75.0	0	0	< 20
Bacteriological potable water parameters						
Coliform bacteria in 100 ml	n. a.	n. a.	n. a.	n. a.	0	n. a.
E. coli in 100 ml	n. a.	n. a.	n. a.	n. a.	0	n. a.
Enterococci in 100 ml	n. a.	n. a.	n. a.	n. a.	0	n. a.
Colony count 20° C in 1 ml	n. a.	n. a.	n. a.	n. a.	< 100	n. a.
Colony count 36° C in 1 ml	n. a.	n. a.	n. a.	n. a.	< 20	n. a.
Clostridium perfrigens (including spores) in 100 ml	n. a.	n. a.	n. a.	n. a.	0	n. a.
Pseudomonas aeruginosa in 100 ml	n. a.	n. a.	n. a.	n. a.	0	n. a.
Salmonella spp.	n. a.	n. a.	n. a.	n. a.	0	n. a.

n. a. = not achievable

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Table 1: Purification quality as a function of the process

With the support of the German Federal Ministry of Education and Research, a sustainable, multi-stage process (Figure 2) that produces various water quality levels from waste water has been developed and is being successfully used for different practical applications. After 5years, the SCAUT Process, an advanced modular decentralized technology, is mature and ready for immediate use to produce potable water and water for domestic use (Table 1) from different types of waste water on an integrated, sustainable basis.

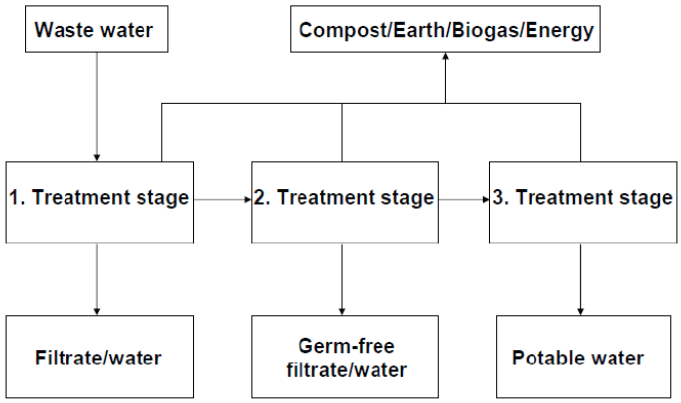

Fig. 2:
3 stage Water Recycle SCAUT Process

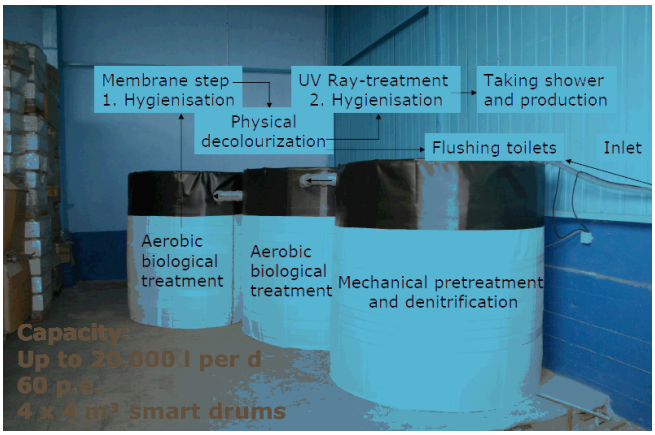

Fig. 3:
Water Recycle Process
with foldable tanks

The worldwide "resource problem water" is currently very obvious right on our doorstep like in Spain. Bottlenecks in the supply of potable water and water for domestic use are on the agenda, and SCAUT Forschungsgesellschaft mbH has the technology to use recovery methods to increase the available quantities of very high quality fresh water.

The ultrafiltration membranes that act as physical barriers for solids greater than 0.02 µm and the fold-up containers (Figure 3) developed as part of this project have made it possible to reduce the sludge content to well under 0.05 kg/kg*d. This was the essential requirement for limiting carbon and for obtaining high-grade stable bacterial colonies. These high-grade bacterial colonies which are adapted to difficult organic compounds also enable complex organic compounds to be broken down into CO_2 and H_2O.

A comprehensive examination of the respective application cases is necessary in order to satisfy the higher-ranking requirements of economical energy and water use. In this case, the nutritive sub-

stances contained in household wastewater and their reuse as a function of the existing land area must be included in the comprehensive consideration.

As already known from agriculture, the nutritive substance of nitrogen represents a limiting factor in the recovery of purified water. As a result, more extensive elimination of nutrient substances is of great importance.

The advantage of membrane biology is that full nitrification can be anticipated as a rule. To achieve the most complete elimination of nitrogen, targeted denitrification in particular is required. This can be accomplished simultaneously, in an alternating manner, when connected upstream, prior to the nitrification or in combination with one or more of these possibilities.

Thus, there are simple solutions for many production facilities as well as for many households in any regions in the world. The latter may also be the case in both permafrost and arid regions. In both cases, there are also considerable energy-related advantages (use of solar power, recycling warm water into excellent quality for human consumption, etc.).

Acknowledgements
The work presented here was performed within the framework of a research project funded by the German Department of Education, Science, Research and Technology (BMBF), contract No. 02 WD 0670 and 02 WD 0671