Ecological housing estate, Flintenbreite, Lübeck, Germany - draft

Fig. 1: Project location

1 General data

Type of project:
Urban upgrading of an ecological settlement project

Project period:
Start of planning: 1995
Start of construction: 1999
Start of operation: 2002 (except the blackwater reactor, not yet)

Project scale:
117 apartments in twin houses, terraced houses and blocks of flats (appr. 350 - 380 inhabitants)
Total investment: EURO 20 Millions

Address:
Flintenbreite 4
23554 Lübeck

Planning institution:
Otterwasser GmbH
Engelsgrube 81
23552 Lübeck

Executing institution:
Infranova GmbH & Co KG
Flintenbreite 4
23554 Lübeck

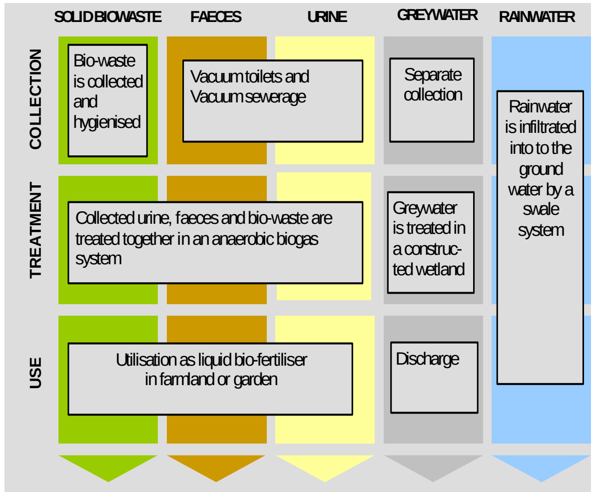

Fig. 2 Applied sanitation components in this project

2 Objective and motivation of the project

- To serve as a demonstration project for the German Federal Ministry of the Environment and as a pilot project for the Hansestadt Lübeck for ecological, social and economical sustainable urban development.
- To ensure the consequent utilisation of ecological building materials, the use of self-sustaining, integrated energy and wastewater concepts, and the implementation of innovative energy saving technologies, with a minimisation of interference in nature, and a responsible, integrative and active cohabitation of the inhabitants.

3 Location and conditions

The settlement served as a global project of the EXPO 2000 Hannover and has attracted many visitors.
The ecological settlement is situated to the West of Lübeck and covers an area of 5.6 ha, of which 2.1 ha are left as natural green space.
It consists of 117 accommodation units in twin and terraced houses and blocks of flats with different sizes for up to 380 inhabitants.

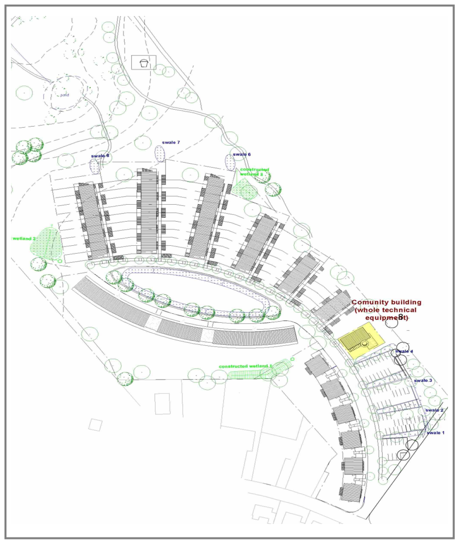

Fig. 3: Location plan (source: otterwasser)

Fig. 4: Twin houses in Flintenbreite (source: Otterwasser GmbH)

It is planned as a nearly car-free settlement with a central parking area.
The special character of the settlement is based on a holistic ecological concept, which includes architecture, landscape planning, social cooperation, energy and sanitation.

4 Technologies applied

The settlement is not connected to the public wastewater system. The wastewater is collected and treated in an internal cycle.
The rainwater of roofs and sealed areas is collected in small gutters and infiltrated to the groundwater in decentralised swales.
In the households vacuum toilets with a very low water consumption (0.7 – 1.2 l per flush) are installed.

Fig. 5: Vacuum toilet *(source: Otterwasser)*

The blackwater (faeces and urine) is transported via a vacuum sewerage system to a central anaerobic digester.
The organic waste from the kitchens is collected into a conditioning plant. There it is crushed separately and mixed together with the blackwater and initially treated by thermic hygienisation.

This is followed by anaerobic digestion. The liquid residue is stored for a further stabilisation to produce an organic fertilizer. The treatment plant is still in its start up phase, as the settlement is not yet fully inhabited due to various reasons related to the real estate market.
The greywater (wastewater from the kitchen and bathroom) is transported by gravity pipes to several constructed wetlands. After a preliminary sedimentation the greywater is fed in intervals to the wetlands, constructed as vertical flown filters.

Fig. 6: Constructed wetland (source: Otterwasser)

5 Type of utilisation or reuse

The liquid substrate of the anaerobic digestion of blackwater and biowaste will be collected by farming cooperative and used as an organic fertilizer. The biogas can be used for power and heat generation for the households in a combined heat and power unit. The treated greywater flows toward a nearby receiving water, with a portion infiltrating into the ground en route. The storm water is led back to the natural cycle by infiltration.

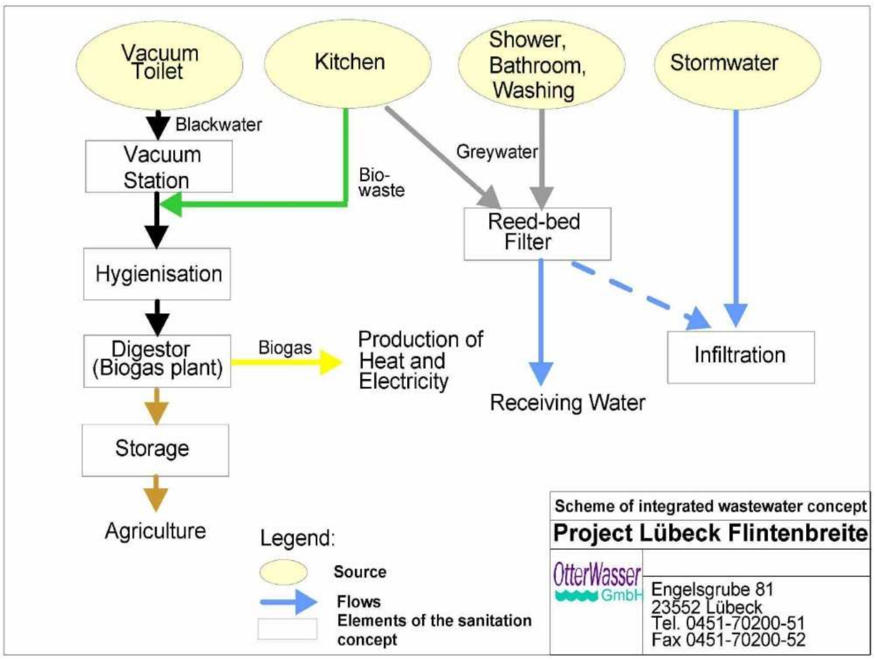

Fig. 7: Flow chart of the system (source: Otterwasser)

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Fig. 8: Gutter and swale system for storm water (source: Otterwasser)

6 Further project

- Houses exceed the low energy consumption standard of the Federal State of Schleswig-Holstein.
- Adapted ventilation systems in the houses.
- Solar panels for water heating. (120m2). Photovoltaic plant on the common parking garage (50m2)
- Combined heat and power unit and gas fired condensing boilers cover a high rate of self-production of heat and electricity.
- Central electronic account system for energy (electricity and heatage) and water consumption.
- Large central community building for all technical systems with rooms for public use and four apartments.
- Scientific supervision of the project by the Technical University Hamburg-Harburg.

7 Project history

Construction began in 1999 after the city of Luebeck approved a development plan for an ecological settlement. Unfortunately the investors for the buildings changed during the construction phase, causing delays and image problems followed by marketing difficulties.

The settlement is therefore still not completely finished and the infrastructure system is not yet be running at full capacity. Construction on the missing units restarted in 2005.

8 Costs & economics

The investment costs of the complete ecological housing settlement project in Lübeck Flintenbreite are approx. EUR 20 Mio.

The investment for the integrated sanitation system is appr. EUR 600.000

Investment costs for the sanitation system are appr. 40% higher than for the common wastewater system, while operation costs are estimated to be 25% less than in conventional settlements. This cannot yet be verified in detail, as the system is not yet fully operational. The additional energy demand through the vacuum system is about 25 KWh a year per inhabitant. But the photovoltaic plant and combined heat and power unit. Is balancing this increasing ongoing cost.

The project was partly funded by a demonstration program of the Federal German Ministry of Environment, Nature Conservation and Nuclear Safety, The Deutsche Bundesstiftung Umwelt, has funded a program of technical and scientific monitoring of the infrastructure system.

The economic benefits need to be updated.

9 Operation & maintenance

Most of the technical infrastructure systems are located in the central community building.
The operation is run by the infranova GmbH & Co. KG, which employs one person as technical staff. Yearly billing procedures with the house owners are based on the consumption of electricity, water, energy etc. The house owners are limited partners of the operating company.

10 Design information & technical specifications

Vacuum toilets (system Roevac by Roediger)
Vacuum canalisation of 50-65 mm diameter, laid in a sawtooth profile in the same line with other supply media (cost saving).

Fig. 9: Mixing and hygienisation unit, (source: Otterwasser)

Biogas plant in mesophile operation (37℃) with preliminary hygienisation (1 hour at 70℃). The remaining time in the reactor betrays 21 Days.
Distribution of volume and nutrients of grey and blackwater in Flintenbreite:

Blackwater: (amount: 4.8 l/cap/d)
N: 8g/cap.d
P: 0.8 g/cap.d
K: 0.7 g/cap.d

Greywater: (amount: 56 l/cap/d)
N: 0.8g/cap.d
P: 0.5g/cap.d
K: 0.2g/cap.d

Concentration of greywater before and after treatment in constructed wetland (in mg/l):

Load		before	after
COD	:	502	59
BOD	:	194	14
Total N	:	12	2.7
NH_4-N	:	4.5	0.9
Total P	:	8	5.7
PO_4-P	:	7.6	4.8

11 Practical experience and lessons learnt

The separation of different wastewater flows is possible for a high standard housing area of approx. 350 inhabitants with no operating problems.
A relatively high load of phosphorous in the greywater is caused by washing-up liquids. Washing powder tablets in particular contain up to 30% phosphorous. The inhabitants could be convinced to use different brands, which reduce the P-load in the greywater by 15%.

The technical installations are well accepted by the inhabitants. The vacuum system causes no loss of comfort, but a significant reduction of water consumption. The risk of clocking can be minimize into posing the pips 0.8 meter under the earth level (frost protected) and remembering the user not to dispose any objects through the toilets.

The quantities of water and air had to be adjusted during operating by the caretaker to optimise the system. Technicians had to get used to the new technologies. The experience gained with the first units caused a significantly higher efficiency in the further realisation.

12 Sustainability of the system

The sustainability of the project concerns in the first instance the environment. As only the treated greywater is led into the receiving water body, the nutrient emission is significantly reduced by source separation compared to conventional systems (see table 1).
The total investment costs are higher than a conventional system in this case. But operating costs are estimated to be about 25% lower compared with the cost of a conventional system.
Life cycle assessment shows clear cost benefits for the new system.

Table 1: Qualitative indication of sustainability of system. A cross in the respective column shows assessment of the relative sustainability of project (+ means: strong point of project; o means: average strength for this aspect and – means: no emphasis on this aspect for this project).

	collection and transport			treatment			transport and reuse		
Sustainability criteria:	+	o	-	+	o	-	+	o	-
• health and hygiene	X			X			X		
• environmental and natural resources	X			X			X		
• technology and operation	X			X			X		
• finance and economics		X			X		X		
• socio-cultural and institutional	X			X			X		

Sustainability criteria for sanitation:
Health and hygiene include the risk of exposure to pathogens and hazardous substances and improvement of livelihood achieved by the application of a certain sanitation system.
Environment and natural resources involve the resources needed in the project as well as the degree of recycling and reuse practiced and the effects of these.
Technology and operation relate to the functionality and ease of constructing, operating and monitoring the entire system as well as its robustness and adaptability to existing systems.
Financial and economic issues include the capacity of households and communities to cover the costs for sanitation as well as the benefit, e.g. from fertilizer and the external impact on the economy.
Socio-cultural and institutional aspects refer to the socio-cultural acceptance and appropriateness of the system, perceptions, gender issues and compliance with legal and institutional frameworks.
For details on these criteria, please see the SuSanA Vision document "Towards more sustainable solutions" (www.susana.org).

13 Available documents & references

Official website: www.flintenbreite.de
www.oekosiedlungen.de/flintenbreite/
www.otterwasser.de/german/konzepte/flintg.htm

Additional information can be obtained by contacting at info@otterwasser.de

14 Institutions, organisations and contact persons

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Case study of SuSanA projects

Ecological housing estate

SuSanA 2009

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