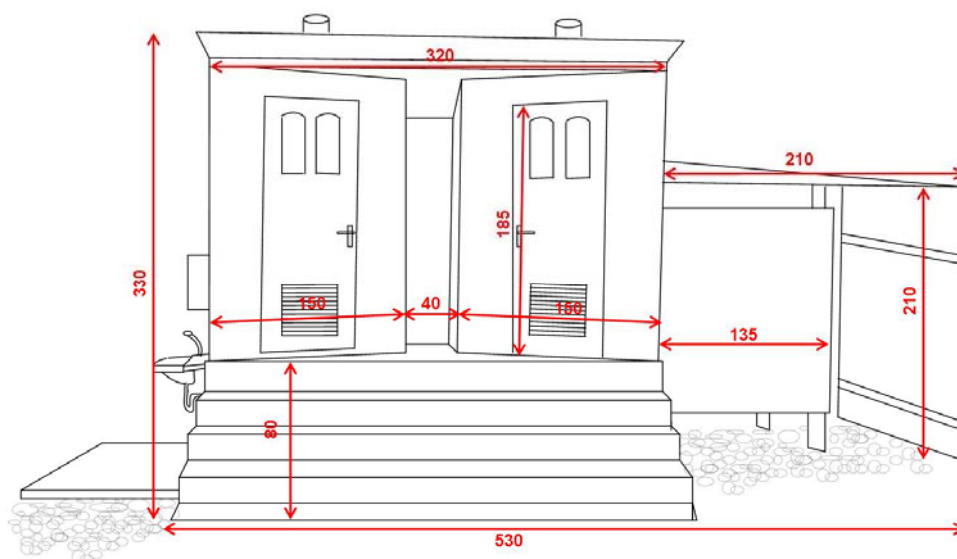


1 KHUVSGUL INN ECOSAN PILOT-PROJECT, KHATGAL

Current practices of wastewater management in the Khatgal area are not sustainable, and there are inherent risks not only for water pollution, but also for the attractiveness of Lake Khuvsgul National Park as such. Deplorably, most lodge owners are not aware of more suitable alternatives. However, the operators of Khuvsgul Inn, a relatively new lodge at the southern end of Lake Khuvsgul, broke new ground this summer and built a UDD toilet based on the ecosan concept. After the author and Mr. Madin had got to know each other, the plan for the toilet was refined and adapted more closely to the ecosan concept during winter and spring 2007. The toilet was built at the beginning of June 2007.

1.1 Design



Source: K. CONRADIN

Fig. 1: Front view of the toilet at Khuvsgul Inn (plan)

The UDD toilet at Khuvsgul Inn was built entirely above ground level; this makes it much easier to remove urine canisters or faeces containers. After the toilet was built, a urinal for men was added on the right side. The sink for hand washing is located on the left side (water brought by bucket). Red figures indicate the measurements in centimetres.

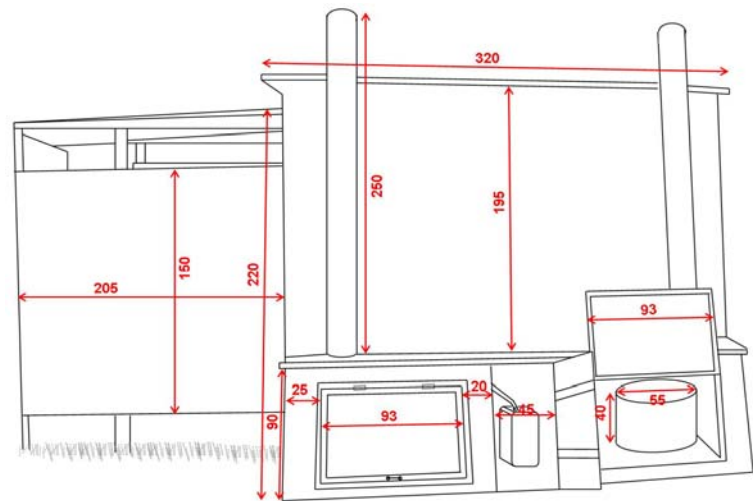
The toilet at Khuvsgul Inn is built entirely above ground; no digging is required. Thus, it is much easier to perform maintenance operations such as emptying the urine containers. To the left of the toilet, a sink with a small water container for washing hands was mounted, to the right, a men's urinal was added. The toilet was built entirely out of wood, which is locally available and inexpensive (for Photos, see page 3f.).

Urine flows down the toilet and in a short pipe or hose into the closed 20 L collection container. This was emptied regularly and transported into larger barrel, where the urine was stored for some weeks to further hygienise it. Faeces fall down directly into the metal bins that are placed below the toilet. If the faeces container is full, it is pushed to the back and a new container is placed under the toilet. No new faeces are added to the full container, and the contents are allowed to dehydrate completely. By means of this procedure, it is not

necessary to build two vaults for dehydration¹. At this stage, it cannot be said exactly how long the hygienisation will take in this specific project; however, the WHO guideline recommends storage for at least one year to render the product sufficiently safe for further handling. Samples should then be taken to determine the need for further storage or a secondary treatment in order to get a hygienic end product (Fig. 2).

Each storage compartment contains a chimney for aeration.

The back of the toilet faces southwards; both the chimneys and the lids of the storage compartments are painted in black so that they absorb as much solar heat as possible. This accelerates in the drying process. Additionally, when the chimney is warmed up, air rises in



Graphics: K. CONRADIN

Fig. 2: Back view of the toilet at Khuvsgul Inn (plan)

While urine is collected in two canisters in the middle storage compartment (the urine flows into the canister through a short pipe), faeces fall into the metal bins. The backside of the toilet faces south. Red figures indicate the measurements in cm.

it. The toilet cubicle is more or less airtight except for the louvers in the door. If air rises in the chimney, there is a slightly lower pressure in the storage compartment. Consequently, air is sucked through the louvers, down the toilet and up through the chimney. This prevents smells in the toilet, transports humidity out of the collection chamber and hence speeds up the dehydration of the faeces (Fig. 3).



Graphics: BOOJUM EXPEDITIONS

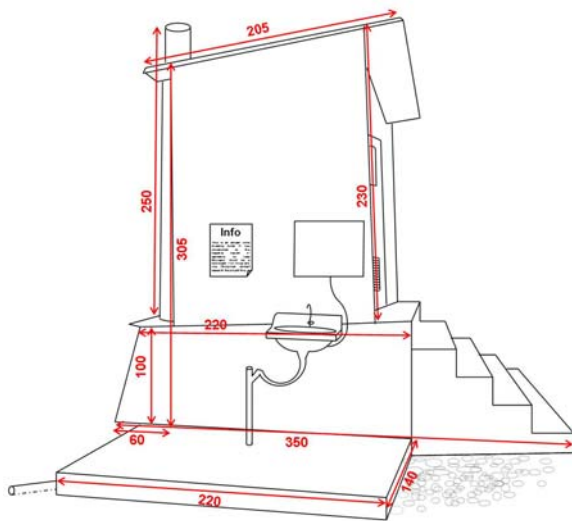
Fig. 3: Cross section of the toilet at Khuvsgul Inn

The back of the toilet faces south. Through solar energy, the storage chamber and the chimney are warmed up. Warm air rises through the chimney, cold air is sucked through the louvers in the door and down the toilet (the cubicle is more or less airtight otherwise). This prevents smell in the toilet and aids the dehydration process.

The floor of the storage compartments is cement-lined. On the one hand, this prevents humidity from

¹ Normally, a UDD Toilet is built with two vaults; if one vault is full, it is locked and left untouched until the faeces are hygienised. Either, there has to be a movable toilet seat, or two cubicles have to be constructed which are used alternately. The solution with a movable container makes this unnecessary.

entering the dehydration chamber from the ground (i.e. when it rains) on the other hand, it makes the infiltration of liquids into the soil impossible.



Graphics: K. CONRADIN

Fig. 4: Side view of the toilet at Khuvsgul Inn (plan)

A sink for hand washing was attached to the left side of the toilet. Water was filled by bucket in the small tank. This greywater was infiltrated the ground with a drainage pipe. Next to the sink, information on the toilet was posted.

Both the roof and the floor of the toilet are sealed to make it waterproof, and the wood is lacquered to make it more weatherproof. To the left of the toilet, a sink for washing hands is attached. The water is provided in a small tank which is refilled by hand. This greywater directly infiltrates the ground with a perforated pipe about 3 m long. The ditch for the drainage pipe was filled with gravel to prevent the clogging of the holes. Next to the sink, information leaflets on the toilet in particular and on ecosan in general were attached.

Similarly, people were informed about the proper usage of the toilet in the toilet cubicles, where a sign with rules was hung. It was explained that it is necessary to sit down to allow for a complete separation of urine and faeces, that paper needs to be thrown in a waste bucket because it would not decompose in a dehydration toilet, that no liquids should be emptied in this toilet, and that some ash should be sprinkled over the faeces to help the hygienisation process.



Photo: K. CONRADIN

Photo 1: Front view of the ecosan toilet

The ecosan pilot project toilet comprises two cubicles and a men's urinal. The sink is located on the left side. The design of the toilet is relatively simple; it was built by one carpenter and several local labourers in about five days. The whole toilet is built entirely above ground and primarily made from locally available material.



Photos: K. CONRADIN

Photo 2: Back view of the ecosan toilet

The back of the toilet faces south. Both the chimneys and the storage compartment lids are painted in black so that they absorb a maximum of the solar heat.



Photo 3: Back view of the ecosan toilet, close-up

Urine is collected in 20 L containers, faeces fall into the black half-barrels, where they are left to dry. The floor of the storage compartment is lined with cement.



Photos: K. CONRADIN

Photo 4: Separating seat

In a separating seat, urine is collected in a funnel in the front and lead away with a hose, while faeces fall down in the back.



Photo 5: Toilet cubicle

The air goes down through the forked seat and is pulled up the chimney by thermal processes. This prevents smell and aids the drying process (see Fig. 3).



Photo 6: "Flushing" with ash

A cup of ash is added to cover the faeces and prevent vectors to land directly on them. Ash raises the pH of the faeces and thus helps in the hygienisation process

1.2 Cost

The costs for the materials of this pilot project toilet were recorded in detail. Naturally, they are higher than the usual costs for a toilet in serial production. The toilet was specifically made look very nice so that the people who used it (both tourists and local people) would get a good first impression of this previously unknown concept. This inevitably made the toilet more expensive. It would without doubt be possible to cut down the costs substantially if only a very basic model of a UDD toilet was built.

Material

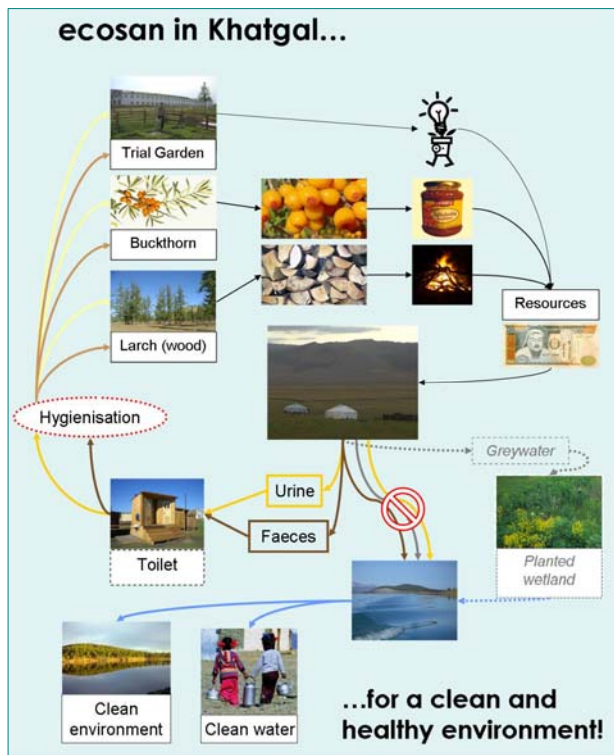
The total cost for the material of the whole toilet with two cubicles was 1'247'700 MNT (roughly 730€). This price comprises all the materials. The seat for the pilot project toilet was imported from South Africa, as no suitable separation seats were available at the time of

planning in Ulaanbaatar. While the heavy materials (such as wood, cement, metal barrels etc.) were bought in Muren, more sophisticated parts (prefabricated doors, tiles, chimneys, sinks etc.) had to be brought from Ulaanbaatar. However, for a simple toilet, all materials, except for a prefabricated seat, would be available on the market in Muren. Presumably, the material for a toilet with one cubicle could be built for about half the price of the double toilet.

Labour

The costs for the labour were insignificant in comparison to the total costs of the toilet. Roughly five people worked on this toilet for about five days. Some of these workers were hired for the whole summer by the lodge; the work they contributed to the toilet was included in their monthly wage. Unskilled labourers who aided in the construction usually earn about 5'000 MNT per day.

1.3 Concept



Graphics: K. CONRADIN

Fig. 5: The ecosan loop for Khatgal

This locally adapted ecosan reuse cycle was used to inform the toilet visitors about the toilet's benefits for the environment and the possible reuse ways for ecosan fertilizer.

After the urine was collected and hygienised through storage, it was reused in various ways: The trial garden mainly had demonstrative effects but also served to prove the effectiveness of urine fertilizer in this area (see **Fehler! Verweisquelle konnte nicht gefunden werden.**). The fertilization concept for trees was developed during the actual research time, when it was recognized that there was a large need for reforestation, and when it was clear that this reuse option enjoyed a high acceptance among all user groups. Hence a small reforestation project was initiated by J. von Arx and the author (see Appendix 5). The planted trees on an area of 800 m² were too fertilized with urine from the ecosan toilet. Faeces were not used this year, as they first have to dehydrate completely; this will take at least until next year. Presumably, they will be used both for a small sea buckthorn plantation in the

compounds off the Khuvs gul Inn, and for the reforestation project in the future. Sea buckthorn was only fertilized at a very low rate this year. It does generally not react well to nitrogen fertilizer and could be better fertilized with hygienised faeces in the following years.

1.4 Problems and Suggestions for Improvement

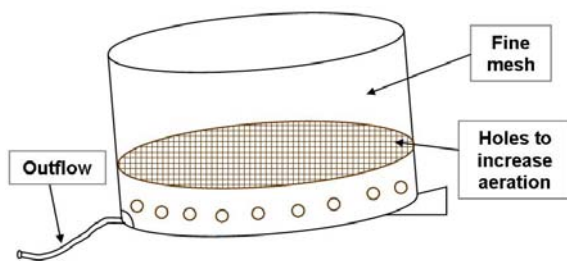
The toilet built in Khuvs gul Inn is the first of this kind in the Khatgal area. Out of the problems during the first season of operation, suggestions for improvement could be deducted.

Watertightness

During the first few weeks in operation, the toilet worked fine, though there was more liquid in the left faeces container. After two or three days with heavy rainfall, there was even more liquid in the toilet, and it was found out that the water entered the storage compartment through cracks in the wooden floor. This problem did not occur in the right storage compartment. It is thus necessary to improve the left compartment by making it completely watertight. Similarly, the chimneys of the storage chamber should be capped off against rain.

Faeces Container

During the operation, it became obvious that the faeces container could be improved in order to create more favourable conditions for drying. Currently, it is a metal barrel cut in half, with a volume of roughly 95 L). Aeration is only possible from above. While the barrel as such is a good idea, as it is a simple and economic adaptation of the two vault concept normally applied for dehydration toilets, it could be improved to facilitate a faster drying process.



Graphics: K. CONRADIN

Fig. 6: Improved faeces storage container

In order to allow for a better and faster dehydration of the collected faeces, some adaptations in the design of the current method are necessary. The container could be retrofitted with a mesh and holes could be drilled in the side. A little hose or drain would allow potential liquid to infiltrate the ground.

In order to increase the airflow, the container should be retrofitted with a small mesh some centimetres above the bottom. In between the bottom and the mesh, holes that measure a few centimetres should be drilled to allow the air to circulate below the mesh. A small hole at the bottom of the container that is slightly raised on one side could be connected to a hose that leads out of the storage compartment into the soil, and potentially emerging liquid could be infiltrated². It is important that the infiltration takes place below the surface of the ground, in order to make it more hygienic. Alternatively, there could be a small drain in the cement lining of the storage chamber, where potentially emerging liquid could be drained away. This system would be similar to the design developed by the GTZ (see Fehler! Verweisquelle konnte nicht gefunden werden.); good results were yielded with this.

Further Adaptations

- The chimneys should be retrofitted with fly screens so that no flies can enter the processing chamber.
- In the first weeks, some problems concerning the cleaning emerged. The staff must clearly understand the functionality of the toilet, and that as little water should be used for cleaning as possible.
- Also the staff should use the ecosan toilet, the pit toilet should be eliminated.
- In a next model, the stairs should have wider steps and should be less steep.
- Biodegradable soap should be preferred for the hand wash.

² As these are only minimal amounts, this is not problematic from a hygienic point of view.