Dry & WET! Sanitation in Multi-Story Apartment Buildings: The Case of Dongsheng, Erdos, Inner Mongolia, China

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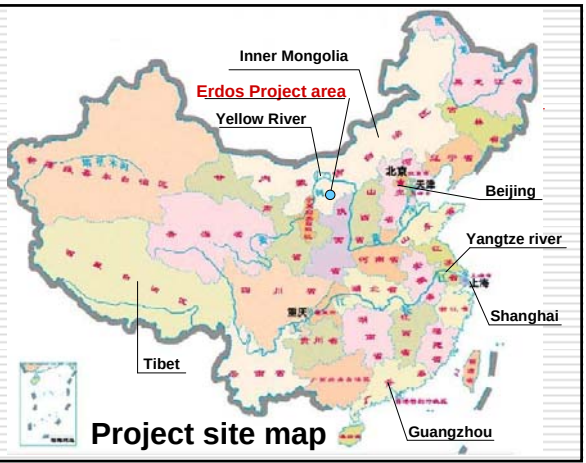


Project site map

Overview of the project site in Dongsheng District, Erdos Municipality (courtesy of Google Earth) plus one of the 42 apartment buildings

Project Description

- R&D project to apply ecological sanitation in an urban environment
- Household residuals in five separate material flows: urine, faeces, greywater, compostable waste and non-compostable waste.
- Faeces and kitchen organics treated onsite at a thermal batch-type composting plant
- Greywater piped to onsite treatment plant and storage pond within the ecostation
- Urine collected in underground tanks until delivered to the endusers
- Urine and compost are returned to local agriculture

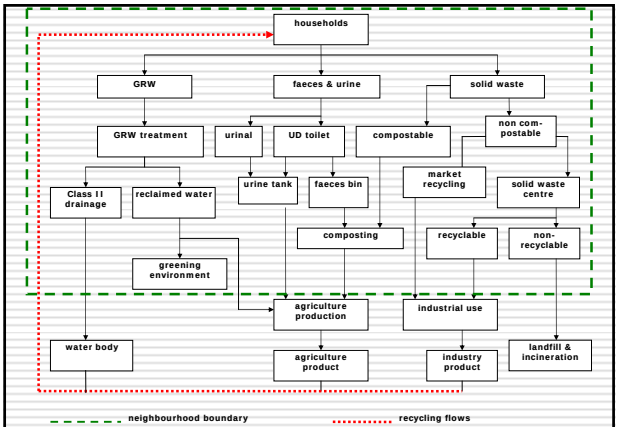
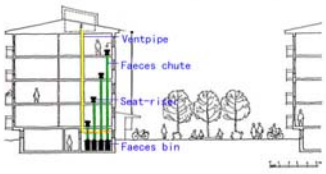


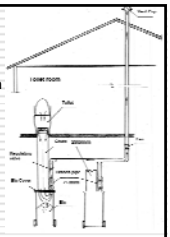
Diagram showing the overall materials flow in the eco-town (diagram by Prof. Zhu Qiang)

Project Technology

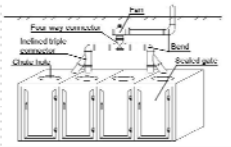
- Buildings completed in 2006, has produced 832 flats in 42 buildings; approx 3000 inhabitants
- Ecosan installations
  - Dry urine-diverting toilets (Swedish-China design; manufactured by Chauzhou Meilong Co. Ltd)
  - 22 underground urine tanks
  - Faecal collection - one 120 L bin for each toilet with sealed basement cabinets vented to the roof
- Onsite ecostation
  - Greywater treatment (250 m^3/d) and storage pond 3700 m^3
  - Thermal composting of the faeces and kitchen organics (1.5 T/d)



Design schematic of the dry faeces ventilation system



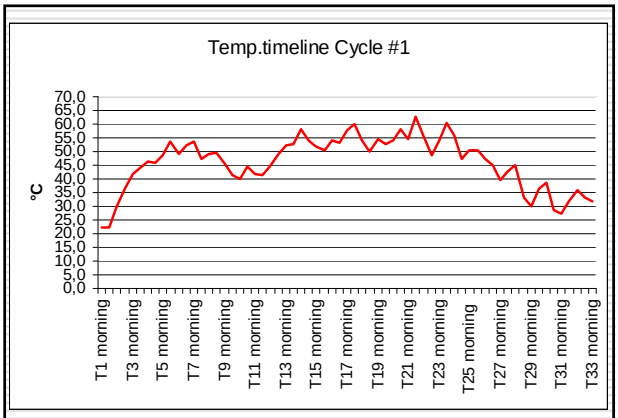
Dry urine-diverting porcelain toilet with oil micro-layer urine odour lock, teflon-coated turning bowl that uses sawdust as carrier and dessicant (Chauzhou Meilong Ceramics Co Ltd)



Basement sealed cabinets containing 120 L wheelie bins with pipe and fan arrangement

Urine collection pump truck with urine tank pipe connection

Thermal compost chambers (each 6 m³) in onsite plant – 35 day cycle that reaches 55-60°C.

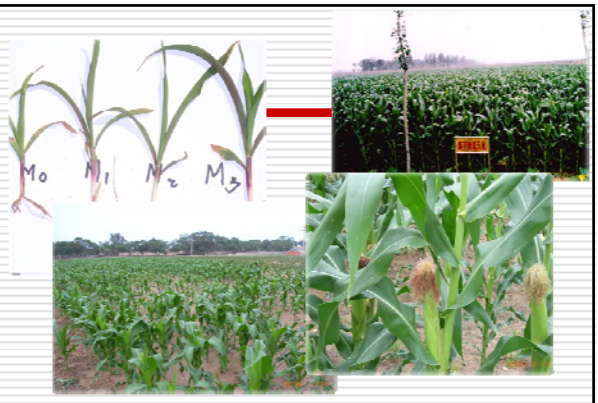


Thermal conditions of the compost over the 35-day cycle

Onsite storage pond for treated greywater (3700 m³)

Demonstration gardens adjacent to the compost plant and greywater storage pond

Potato in Reuse Trials



Maize in Reuse Trials

The Initial Challenges

- Building quality and workmanship was generally poor due to lack of skilled labor and proper building construction inspection
- Improper installations of ecosan equipment causing odor
  - Urine tanks – piping not built according to blueprints causing back flow of air to the toilets
  - Toilets – metal parts of poor quality causing problems in operation and improper placement of urine pipes causing leaky urine connections
- Design limitations of the ventilation system not able to compensate for air pressure changes inside and outside the buildings caused intermittent odour problems

User Reactions

- 20% very positive about the ecosan toilets and system
- 20% were generally dissatisfied equating dry toilets to rural living
- 60% understood the need for dry toilets especially in this water-scarce area of China but still hoped that flush toilets could be installed in the future
- Toilet functions at all times unaffected by water supply cuts
- Elderly, children and visitors found the change to a dry toilet inconvenient
- Faulty operation of the toilet bowl requiring repair
- Use of sawdust as carrier and dessicant caused upwelling of dust
- Toilet cleaning with excessive water (caused additional odour)
- Dumping of solid waste in the toilets became an increasing problem
- Odour caused by shifts in air pressure internal and external to buildings
- Leaking urine pipe connections under some of the toilets due to construction errors
- 20 of the 832 household installed flush toilets

Improvements

- Telephone hotline set up to address user complaints with same-day maintenance service
- Improved urine odour traps in the toilets
- Improved urine pipe connection below the toilets
- Toilet ventilation improvements including sealed cabinets in the basements but the original design could not fully compensate for air pressure variability
- Better maintanence improved mechanical function of the toilet
- Greywater pipes and wells repaired and unblocked following construction phase

Developments After 3 Years of Use

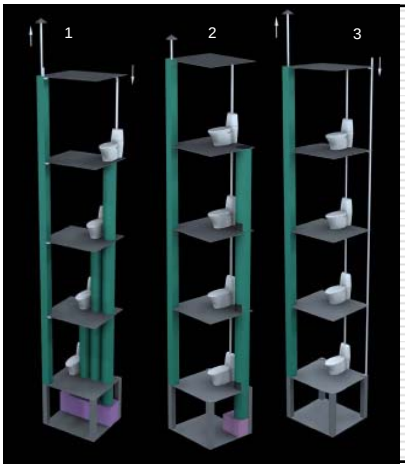
- Increasing negative attitude among users as the standard of living in the city rose (coal prices tripled during this period)
- Winter of 2007/2008 was extremely harsh causing freezing of vent pipes resulting in frequent odour problems
- Households now more vocal and organised than before and no longer would accept the development nature of the project
- A request to install flush toilets was made to the local government in 2009
- Local government not interested in taking over the project for further technology development and has decided to install flush toilets using the onsite treatment capacity

Development of a Decentralised Waterborne System

- Flush toilets to replace the UD dry toilets
- Sedimentation tanks (the present urine tanks) to reduce solids
- Small-bore sewer pipes (the present 110 mm greywater pipes)
- Sewage treatment using the present greywater plant following some hydraulic improvements
- Sludge and kitchen wastes to be composted onsite
- Comparison with the present dry system is of interest in terms of running costs, fertiliser production and quality, and social impacts

Latest Improvements in the Dry Toilet

Inner and outer views of dry urine-diverting toilet connected to the drop chute with small built-in fan unit and replaceable pail for easy maintenance and cleaning (Separett AB, Sweden)



Three options for installing the Separett system in the Dongsheng project. Option 1 is currently being applied. Option 2 involves manual disposal of the faeces bag down the common chute. Option 3 involves carrying the faeces bag down to a collection bin. (Scott Chen, Separett AB)

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