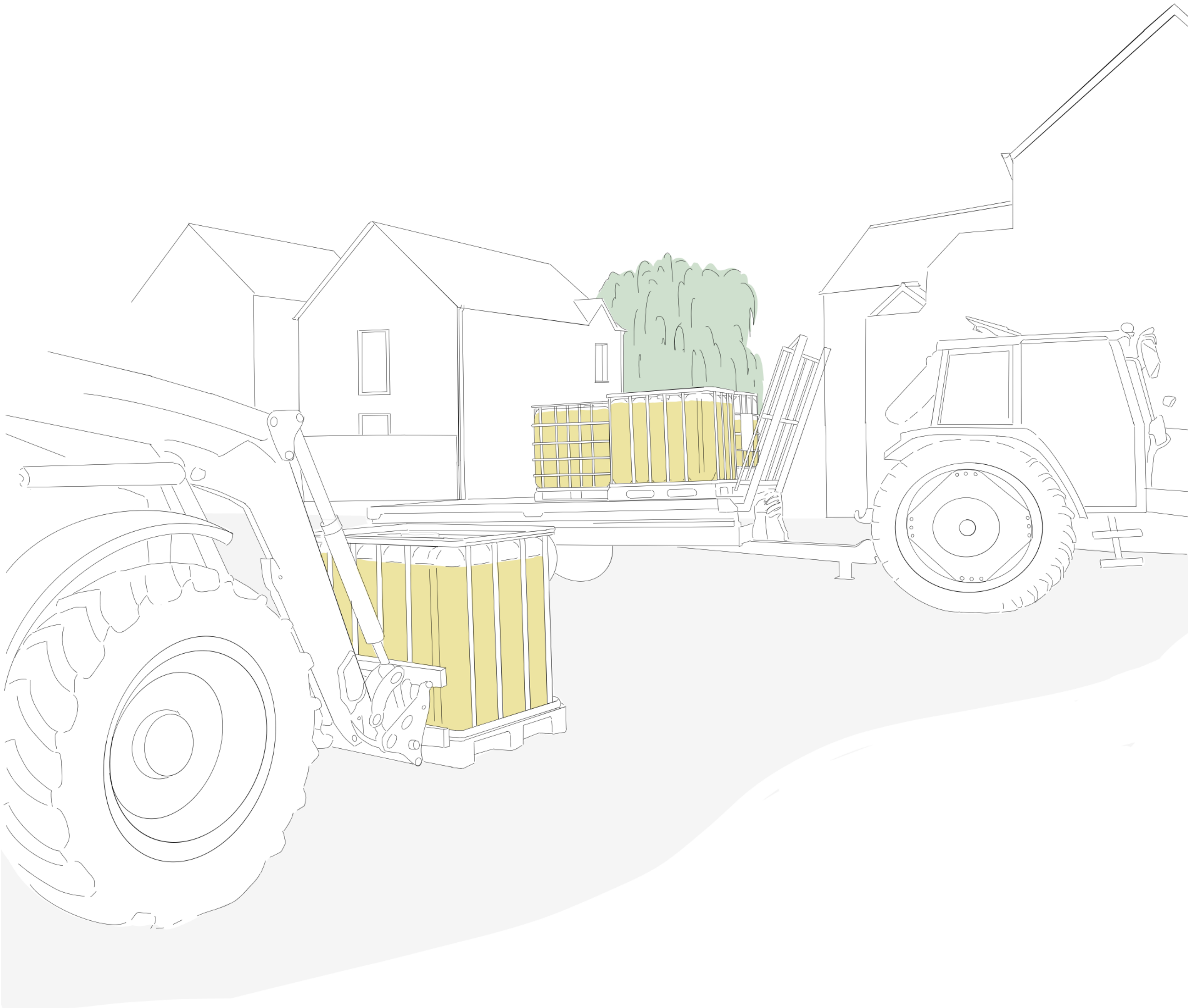
URINE STORAGE | PASTEURIZATION

T.1

TECHNOLOGY



Extended storage of urine is the simplest, cheapest and most common method to hygienize urine. Urine storage achieves pathogen inactivation due to the combination of increased pH, temperature and time. Recommended storage time is at least six months. During storage, urea hydrolyses and decomposes into ammonium and ammonia, changing the organic composition of the urine and causing the pH of the solution to rise. The alkaline urine solution is a hostile environment for bacteria, protozoa, and viruses, which die off over time. Pathogen removal is variable, however. Hormones and organic micropollutants are not removed. To enhance pathogen inactivation and reduce treatment time, the temperature of stored urine can be raised (e.g., at 80 °C for 30 minutes). This process is called pasteurization. Adding a base (e.g., calcium hydroxide) or an acid to stored urine can also help control ammonia emissions, microbial growth and the stability of the urine during storage. Urine storage requires a lot of space.

Stored urine can be applied as a multi-nutrient liquid fertilizer in agriculture. It has a high nitrogen to phosphorus (N:P) ratio. However, pharmaceuticals and some pathogens are not sufficiently removed and can incur risks.

INPUT STREAMS

- U Urine
- YW Yellow water

TARGET OUTPUT(S)

- Liquid Fertilizer

U — COLLECTION TANK — TRANSPORT — T.1 URINE STORAGE

L'ÔÔÔBERGE

Dol de Bretagne, France | 2023

Urine from residential complex collected for offsite treatment

L'Ôôôberge is a participatory social housing complex with 23 apartments equipped with dry sanitation. Urine, collected via a conveyor belt dry toilet, flows by gravity piping into three 5m³ underground cisterns. The pipes and tanks have ventilation and inspection manholes, and are connected to the sewer in case of overflow. Every six months, the urine is pumped into IBC tanks and trucked to a nearby farm for storage. The urine is reused in agriculture.

SPECIFICATIONS

INFRASTRUCTURE

After separate collection (via urine diversion toilet, urinal or jerry-can), urine can be piped directly to or manually carried to a storage tank onsite. For offsite treatment, urine can be trucked to a storage facility or farm. Urine storage requires space to accommodate the large volumes of collected urine (~ 0.25 m³/person). Collection of yellow water (urine with flushwater) increases collection volumes, and can reduce treatment performance. For onsite storage, it is recommended to have more than one storage tank to alternate collection and storage between tanks. Some losses of volatile ammonia can occur with ventilation air during collection, causing unpleasant odor. Urine tanks should not be ventilated to prevent nitrogen losses. Since urine is highly corrosive, pipes and storage tanks should be made of resistant materials such as high-quality plastic or concrete; metals should be avoided.

> Urine storage is a simple and cheap on-site treatment solution for off-grid contexts, and lends itself to contexts where urine collection is near to gardens or agricultural lands. In urban contexts, urine is often collected in a basement, however urine storage occurs off site, often in rural areas.

OPERATION & MAINTENANCE

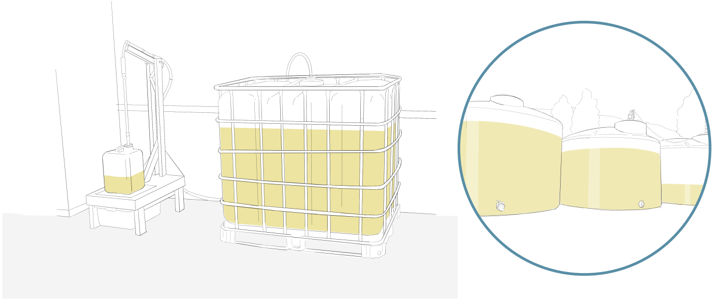
Urine storage is a relatively cheap treatment, though storage space can be costly depending on availability and location. Maintenance requirements primarily concern the prevention or removal of precipitates in the pipes to prevent clogging and blockage. For off-site storage, periodic collection is required. Transport of large volumes can be difficult and costly for large distances. Often arrangements for storage and reuse are made with nearby farms. Use protective gear when handling fresh and stored urine to reduce pathogen risks.

TARGET OUTPUT

Stored urine can be used as a multi-nutrient liquid fertilizer. Precipitates that settled in the tank can be mixed into the liquid fraction before application, or separated out from the liquid fraction (this increases the N:P ratio and removes essential compounds like magnesium and calcium from the liquid fraction). Urine can be applied directly to the soil or diluted before application. During application, nitrogen losses will occur and unpleasant odor is to be expected. Further inactivation of pathogens are likely to occur in the soil after application. Stored urine still contains hormones and pharmaceutical residues.

SELECTED CASE STUDIES

RICH EARTH INSTITUTE
Brattelboro, VT, USA | 2012

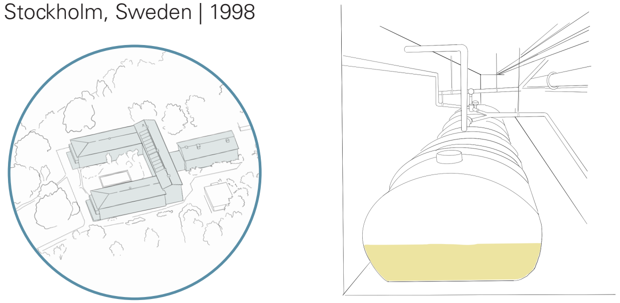


Community-scale urine collection and off-site pasteurization

The Institute's Urine Nutrients Reclamation Program collects 45 m³ of urine each year from home and business installations and via a portable toilet service. Some households bring their urine (in portable jerrycans) to a urine depot, while others have onsite plumbed collection tanks. Urine from both depots and tanks are periodically pumped out by truck and transported to the operations facility for treatment and storage, using an automated pasteurizer. The pasteurizer heats the urine to 80 °C for 1.5 minutes (energy = 20Wh/L). The treated urine is used at local farms to fertilize hay, nursery trees, sweet corn, flowers, and others.

U — COLLECTION TANK — TRANSPORT — T.1 PASTEURIZATION — TRANSPORT

GEBERS
Stockholm, Sweden | 1998

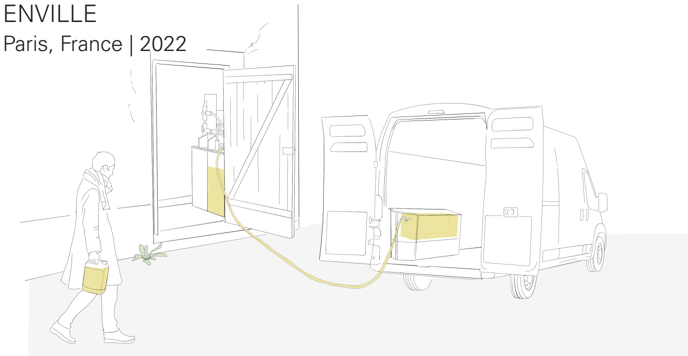


Urine collection and storage for fertilizer use on barley fields

Gebers is a two-story cooperative housing project of 80 inhabitants and 32 apartments located in Stockholm. Urine is collected via urine diverting low-flush toilet (0.1 L per flush) with dry collection of feces. Urine is led to three urine collection tanks (10-15 m³) in the basement via polypropylene pipes. The tanks are emptied by tanker truck with a vacuum system two to three times per year, and stored off-site before use in agriculture.

YW — COLLECTION TANK — TRANSPORT — T.1 URINE STORAGE

ENVILLE
Paris, France | 2022



Citizen urine collection, stored and transported by partner farms

Enville, led by the OCAPI research and action program, is a project that enables community-scale collection of urine in cities, paired with transport, storage and reuse of urine at nearby farms. Individuals collect urine using funnel fixtures on jerrycans and periodically empty them at a urine "decanting" station equipped with two 130L tanks and an electric pump, appropriate ventilation and an overflow pipe to the sewer. The urine is transported by farmers that deliver food to the city, collect and transport urine in their vans equipped with 140L tanks (originally water tanks for camper vans) and bring the urine to the farm for storage and reuse as fertilizer.

U — JERRYCAN COLLECTION — COLLECTION DEPOT — TRANSPORT — T.1 URINE STORAGE