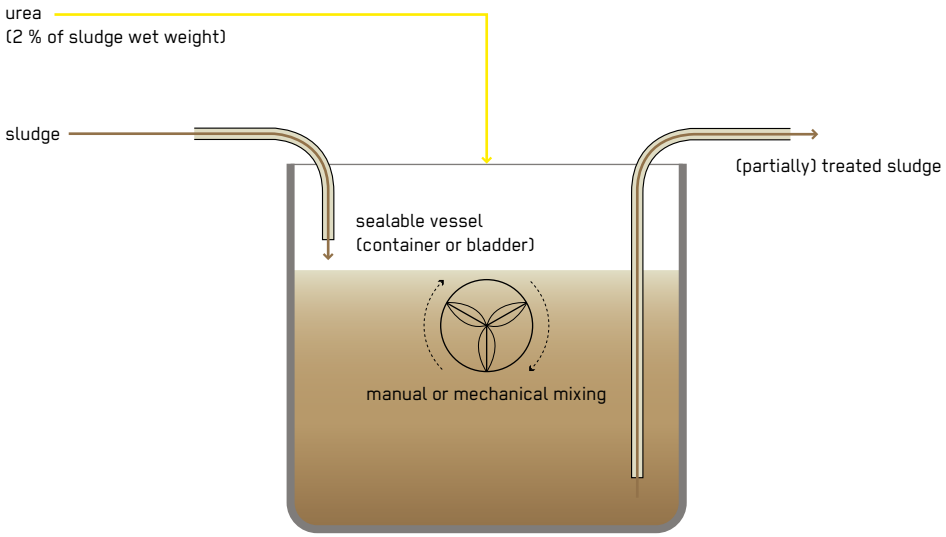
Urea Treatment (Emerging Technology)

Phase of Emergency	Application Level / Scale	Management Level	Objectives / Key Features
** Acute Response Stabilisation Recovery	Household ** Neighbourhood City	Household Shared ** Public	Pathogen removal, Minimising immediate public health risks
Space Required	**Technical Complexity**	**Inputs**	**Outputs**
* Little	** Medium	● Blackwater, ● Faecal Sludge, ● Urine, ● Faeces	● Sludge



Urea Treatment can be used on faecal sludge, blackwater or source separated urine and faeces. Urea, with the chemical formula $CO(NH_2)$, is used as an additive to create an alkaline environment in the sludge storage device and thereby helps sanitise the sludge.

Urea when added to faecal sludge is catalysed by the enzyme urease, which is present in faecal material, to decompose into ammonia and carbonate. The urea decomposition results in an alkaline pH (above 7) affecting the equilibrium between ammonia and ammonium, favouring the formation of ammonia. The un-ionised ammonia (NH_3) acts as the main sanitising agent. Pathogen inactivation by uncharged ammonia has been reported for several types of microorganisms, bacteria, viruses and parasites. Ammonia disinfection has been shown to be effective in urine, sewage sludge, and compost, but applications for faecal sludge are still in the research phase. The process depends on temperature and partial pressures of ammonia gas above the liquid. Hence, ventilation and head space also influences the process conditions. It is recommended that treatment is undertaken in a sealed vessel to minimise the amount of ammonia gas that escapes and to force the equilibrium towards soluble ammonia. The treatment should be done as a batch process to ensure consistent sanitisation in the sludge.

Design Considerations: Urea is usually added at a ratio of 2 % of the overall sludge wet weight. Urea is initially placed in the storage vessel (e.g. bladder/closed tank) and then faecal sludge is pumped into the vessel. The size of the vessel may vary depending on the amount and frequency of the sludge to be treated. A pump is used to circulate the sludge within the storage vessel to ensure adequate contact between the urea and sludge. Urea decomposition requires a minimum of 4 days, hence a retention time in the closed vessel of approximately 1 week is recommended.

Materials: Urea Treatment needs a lockable vessel (e.g. a closed tank or portable bladder) and a recirculation pump to achieve a homogeneous sludge-urea mix. For liquid sludge, a diaphragm pump may be used, whereas thicker sludge may need a screw pump or a vacuum pump. In addition, a steady supply of urea is needed. Urea is a conventional, widely used and affordable chemical fertiliser that should be available in most local contexts. In addition, a water testing kit (particularly for pH and E. coli) is needed to control pH levels in the urea sludge mix and to test the level of treatment efficacy.

Applicability: Urea Treatment is considered an emerging technology that has not been widely used yet in emergency settings. However, first pilot projects and studies are promising and growing evidence suggests that Urea Treatment may be a suitable treatment option for the acute emergency phase due to its short treatment time (around 1 week), a relatively simple process and use of readily available materials.

Operation and Maintenance: Regular maintenance of pumps used for mixing is required. Due to potential health risks when handling urea (see below) the process requires skilled personnel following health and safety protocols and wearing proper personal protective equipment (PPE).

Health and Safety: Urea may be hazardous when it comes on contact with skin or eyes (irritant), ingestion or inhalation and may be combustible at high temperatures. Ammonia gas is toxic and precautions are needed when removing sludge from the tank. PPE (for example masks, gloves, aprons and long-sleeved clothing) must be worn when handling urea to prevent irritation to eyes, skin, and the respiratory system.

Costs: Urea Treatment is a relatively cheap treatment option. Costs may vary depending on the availability and costs of local materials and urea. To treat 1 m^3 of faecal sludge, 20 kg of urea are required and urea is generally available and affordable.

Social Considerations: Appropriate health and safety protocols must be in place and include the provision of PPE and trainings for involved staff.

Strengths and Weaknesses:

⊕ Treatment time ≈ 1 week (4–8 days)
⊕ High level of pathogen removal (6 log removal of E.coli i.e. pathogen count is 1 million times smaller)
⊕ Simple process which uses readily available material: urea
⊕ Produced sludge has a high nitrogen content which is beneficial for an agricultural application

⊖ High chemical input
⊖ Mixing is essential for the process
⊖ Additional post sludge treatment may be required
⊖ Potential health risks if not handled properly

→ **References and further reading material for this technology can be found on page 192**