Challenges for cost-effectiveness

Possibilities to make struvite production a more cost-effective technology:

- Turn the **effluent** into a source of revenue: a maximum of the remaining nutrients (nitrogen, potassium and others) have to be recovered and made available as a complete fertilizer product with supplementary technologies. Thereby, the costs to treat the effluent, i.e. to eliminate the nutrients, can be reduced.

- Increase the **sourcing efficiency of urine**: The urine volume required per shift of the 4 x 400 L reactor set-up equals the amount produced by 8000 adults per day. In order to minimize the cost of urine sourcing, an efficient urine collection system needs to be established and supported by the authorities.

- Compensate for the **external benefits** generated by struvite production: If urine is released into water bodies, the high nutrient contents cause eutrophication. Hence, nutrient recovery, such as struvite production, reduces water pollution. Authorities could offset this external benefit via effective subsidies. To embed the struvite production in adequate subsidy mechanisms, the external benefits of struvite production will have to be quantified.

Further readings

Visit the STUN website to download the following documents:

- **How to produce fertilizer from urine brochure**
Overview on the chemistry and technology of the struvite production process.

- **Struvite reactor construction manual**
Detailed explanations on how to build a struvite reactor including technical drawings and quantities.

- **Struvite reactor operation manual**
Describes the handling of a struvite production unit and its everday operation procedures.

- **Struvite calculation sheet**
Template to calculate the costs and revenue of struvite according to various settings.

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eawag
aquatic research

Economics
of struvite production in Nepal

This brochure presents the key findings of the **economic analysis**, conducted for **decentralized struvite production** from urine in Kathmandu, Nepal.

Urine contains valuable nutrients; it is an excellent fertilizer if applied to crops.

Struvite is a powder fertilizer produced from urine.

Eawag: Swiss Federal Institute of Aquatic Science and Technology

Basics of Struvite Production

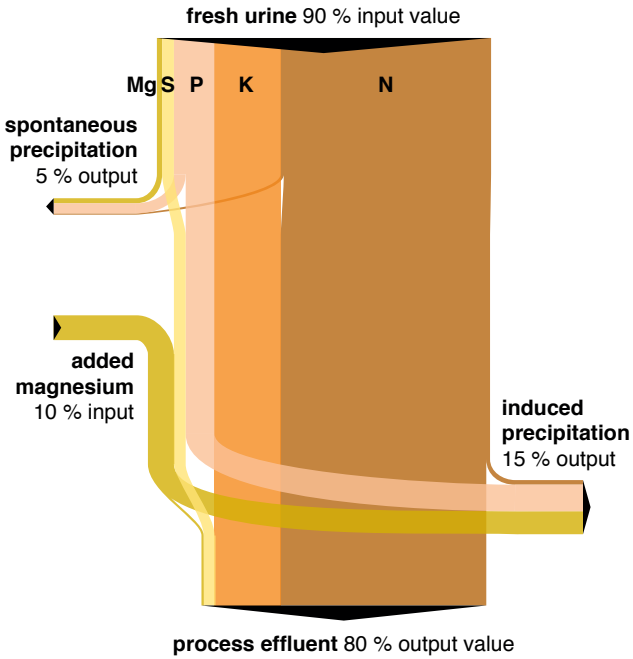
If **magnesium** is added to **urine**, a white odourless powder, called struvite (MAP; $MgNH_4PO_4 \cdot 6H_2O$) precipitates. Through the struvite precipitation process, most of the **phosphate** (PO_4^{3-}) and part of the **ammonium** (NH_4^+) contained in urine can be recovered as a fertilizer product.

Based on the technology piloted by the Struvite from Urine in Nepal (STUN) project, the most efficient struvite production unit was identified as a setup of **four reactors**, with **400 L volume** each.

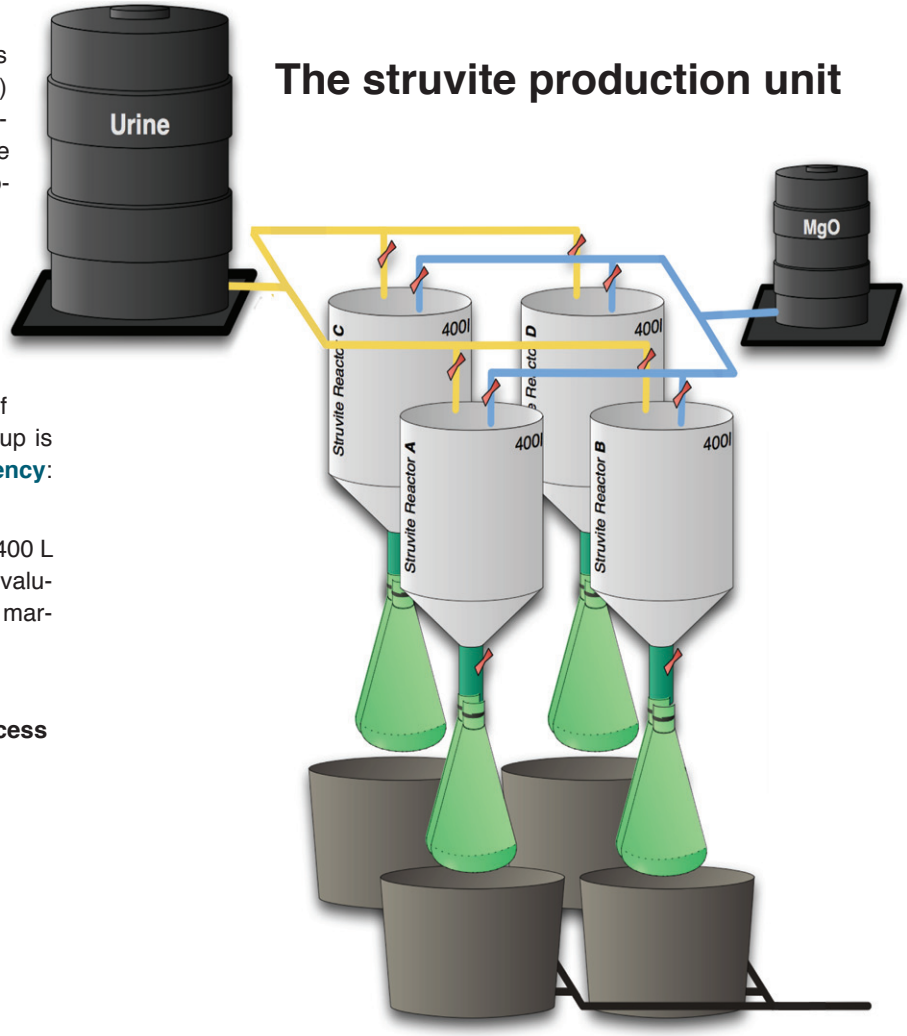
While a struvite production facility could consist of any number of production units, the 4 x 400 L setup is considered most efficient in terms of **labour efficiency**: one operator can run up to four reactors in parallel.

Production costs were estimated based on 50 and 400 L pilot plants operated in Kathmandu. The monetary values of nutrients were calculated based on a fertilizer market survey conducted around Kathmandu.

Monetary values of nutrients in the struvite process



The struvite production unit



Key figures of a 4 x 400 L production unit:
Inputs & outputs of a one-day shift (8 working hours)

Inputs:
- 11 m^3 urine
- 9 kg magnesium oxide (MgO)

Outputs:
- 23 kg struvite
- 11 m^3 effluent

Viability

The charts below illustrate that the theoretical revenue from struvite sales (including possible subsidies) will just cover the production costs except the urine sourcing. The challenge concerning the revenue is to recover the value of the nutrients remaining in the effluent.

Cost

- Only **production costs** were considered in the present analysis; the costs for the treatment of the effluent were not considered.
- The costs for **urine sourcing** are the largest element (90% of total cost) and impossible to cover with the struvite sales revenue.

Revenue

- The **nutrient value** of struvite is based on regression estimates from a market survey.
- The **unique selling proposition** (USP) is the theoretical value above the current market price that would be paid for a „sustainable“ product.
- The current **subsidy** of fertilizer in Nepal (2010).

Estimated cost and revenue of struvite in Nepal