Thermal hydrolysis in front of anaerobic digesters at Oxley Creek WwTW, Brisbane, Australia

Sludge treatment and dewatering

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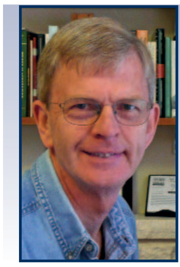


Increasingly wastewater is being seen as an opportunity for resource recovery. We are depleting the planet's phosphate reserves at an unsustainable rate. Phosphate is essential for life, it is part of DNA, and it can never be substituted. At the current rate of extraction, today's phosphate mines will be exhausted by the end of this century. Estimates of future reserves range for 200 to 400 years, which is not long in the history of human kind. Life on a warmer planet will be uncomfortable, but life without phosphate is impossible. The EU27 imports 9% of the world's phosphate, 34% of that ends up in urban wastewater (babies accumulate P in their bones, teeth, etc. but adults excrete 98% of the P in their diets because they are just turning over cells). Currently the EU squanders 80% of the P in wastewater, but that will change. In the not too distant future, wastewater treatment and sludge treatment will be required to recover P. The purposes of sludge treatment (which includes incineration) are currently to:

Egg-shaped anaerobic digesters at Reading WwTW, UK

- reduce sludge volume to minimise handling and transport costs,
- reduce the number of pathogens in the sludge and
- prevent it smelling objectionable.

Dewatering

The effectiveness of sludge dewatering is critical to the efficiency of subsequent processes. The costs of haulage and spreading when cake is recycled are directly related to the effectiveness of dewatering. This is also true of the cost of thermal drying or incineration because dewatering affects the amount of water that has to be evaporated. The better the dewatering, the better the cake will stack, the easier it is to compost or to sanitise with lime and the smaller the energy requirement for drying.

The three principal methods of dewatering are plate and frame filter press, filter-belt press and decanter centrifuge. A variant of the filter press that has been more effective in site trials is emerging; it supports the filter cloths on flexible 'ropes' and is fully automatic. In each case a conditioner is added to the sludge so that the particles 'flocculate' and the water is free to be removed. Selecting the correct conditioner and the optimum dosing rate for the particular sludge are essential.

Automatic in-line dose optimisers are state of the art but they have not been adopted widely and are not applicable to all types of dewatering equipment. The principle is to drive the dosing pump from real-time information, for example the turbidity of the liquor, the stiffness of the cake, the solids content of the feed or its viscosity or particle charge characteristics.

There is no universal answer for dewatering; each works needs to find the best solution for its particular sludge and circumstances and then ensure it is operated optimally.

Liquor treatment

Conventionally dewatering liquor (the water separated by dewatering machines) has been returned for treatment through the works where it can be 25% or more of the nitrogen and phosphate load on a treatment works. Another method is emerging, which is to treat dewatering liquor in a compact side-stream plant to remove most of the nitrogen and

Co-digestion facility at Studsgard, Denmark

phosphate before returning the liquor to the main plant. At its most basic this involves biological processes to remove nitrogen but the more pioneering wastewater treatment works (WwTW) are recovering ammonia solution and/or phosphate by physico-chemical processes. These physico-chemical recovery processes are financially competitive with merely returning the liquor to the head of the WwTW and at least equal to side-stream biological treatment. They have smaller global warming potentials. Magnesium ammonium phosphate (struvite) is easy to recover and it is a good fertiliser. Ammonia solution has industrial uses in addition to its fertiliser use. Recovering phosphate and ammonia is consistent with moving from a disposal to a recycling society.

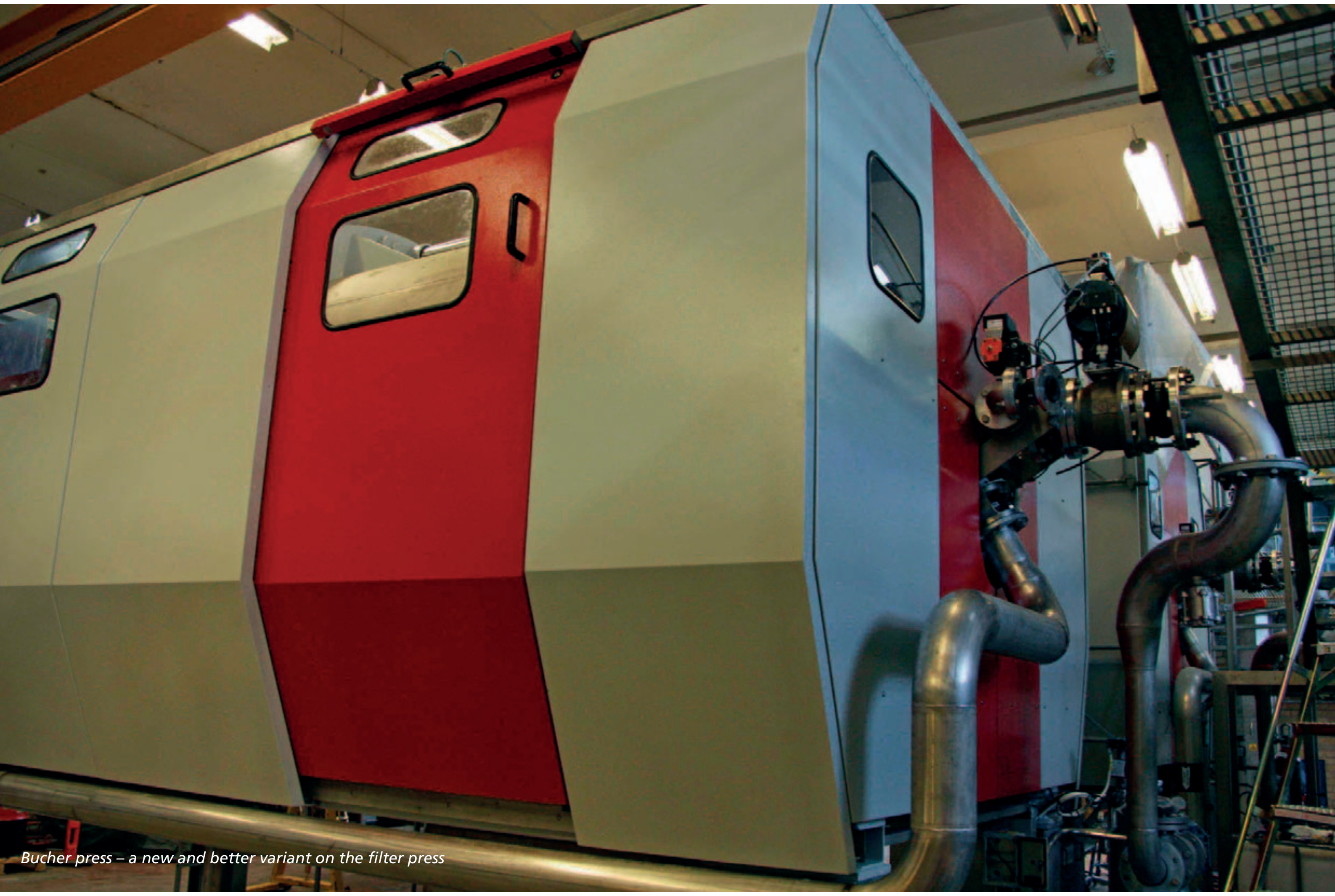
Anaerobic digestion (AD) is the most widely practised treatment. AD stabilises the sludge, reduces pathogen numbers and produces biogas (64% CH_4, 35% CO_2) a clean, continuous and renewable alternative to fossil fuel. In 2005, 65% of sludge in England and Wales was treated by AD; by 2015 it will have increased to 85%. Digestate is a good nutrient rich soil improver that substitutes for all of the phosphate and some of the other mineral fertiliser need for growing crops.

Innovations have focussed on increasing the amount of sludge that can be treated, improving mixing in digesters and making the sludge more digestible (increasing biogas yield and solids destruction). Examples of techniques to increase digestibility are breaking open cells using ultrasound, microwaves or high pressure homogenisers or by hydrolysing them enzymatically or thermally. These pre-treatments can also improve the later dewatering and sanitisation of the sludge and the odour of the digestate. Thermal hydrolysis (pressure cooking at 160 °C) is by far the most effective and whilst the capital cost is high, the whole life cost is often the most competitive of the alternatives.

Sometimes other organic wastes are co-digested with the sludge. Denmark, Germany and the Netherlands have made biogas from anaerobic digestion of biomaterials (organic fraction of municipal solid waste, sludge, manure and organic wastes from industry) part of their national energy strategies. At the time of writing, UK regulators were still having difficulty following this sensible approach.

The Foundation for Water Research has just published a revised edition of its Review of Current Knowledge on Sludge; it can be found at http://www.fwr.org/fwrlib1.html

For further information visit www.fwr.org and www.timevansenvironment.com or contact fwr@timevansenvironment.com



Bucher press – a new and better variant on the filter press