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New energy-positive waste-water treatment process uses just 15% of the energy required for current alternative

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Conventional municipal waste-water treatment processes are based on aeration, which is energy intensive. Now, researchers have developed an alternative waste-water treatment process. In addition to avoiding the use of aeration in favour of filtration/biofiltration and encapsulated denitrification (the application of capsules containing nitrifiers, which convert ammonium into nitrate), the process also uses waste biosolids to generate electrical energy. The process has been tested in a pilot facility and found to require just 15% of the energy required for conventional approaches. Moreover, the process is energy positive, as the biosolids are able to generate more than enough energy to power the treatment plant. If this technology could be scaled up to the municipal level, it could significantly reduce the energy use and environmental impacts of waste-water treatment.

Waste-water treatment plants consume a significant amount of electricity[1]. One reason for this is that, conventionally, waste water is treated using an activated sludge process based on aeration, meaning that the plant needs to pump large supplies of air into the biological tank. This is expensive and energy intensive. The implementation of low-energy waste-water treatment processes at the municipal level could, therefore, result in significant cost and energy savings.

To date, efforts to adapt the existing process to make it less energy intensive have only resulted in relatively small reductions. Switching to a completely new process may prove more successful. In a research paper, an environmental engineer has outlined a novel waste-water treatment process that shows potential as a feasible alternative to conventional approaches. The process not only relies on energy-efficient physicochemical (relating to physical and chemical) processes (as opposed to energy-intensive biological ones), but also recovers enough energy from waste-water constituents to power the plant.

First, biosolids and other wastes are removed from raw waste water through the use of microsieving, filtration and encapsulated denitrification. In the second part of the process, the biosolids that have been removed from the waste water are fed into an auger press (a dewatering screw press), dewatered, partially thermally dried, and then gasified to generate thermal and electrical energy. Alternatively, biosolids could also be subjected to anaerobic digestion at this stage if the goal was to generate biogas rather than electrical energy.

Overall, findings from the application of this process in a large-scale pilot facility show this process requires 0.057 kilowatt-hour/cubic meter (kWh/m^3) of energy per volume of inlet raw wastewater — around 85% less electrical energy than is needed using the conventional activated sludge process. In addition, the potential for net electrical energy production per volume of inlet raw waste water is calculated at 0.172 kWh/m^3. This means that the complete process is energy positive (as it can generate more than sufficient energy to cover the requirements of the waste-water treatment plant) as well as carbon neutral.

While further research on the feasibility and cost-benefit of scaling up of this process is needed, the researcher predicts that it would cost two to three times less to construct a treatment plant based on this method rather than conventional processes. In addition, the new type of plant would require a smaller site and use significantly less energy, adding to its financial attractiveness. From a policy perspective, this novel process[1], therefore, shows promise as a means to significantly reduce the costs, energy use and environmental impacts[2] of municipal waste-water treatment plants.

1. For further information on energy performance in EU waste-water treatment plants, visit: http://www.enerwater.eu/enerwater-project-waste-water-treatment-plants/. The ENERWATER project is supported by the European Commission under Horizon 2020.

2. This type of treatment must also be compliant with the requirements of the Urban Waste Water Treatment Directive (UWWTD), i.e. the results obtained from the level of the effluent must be equal to those required in the Directive (biochemical oxygen demand (BOD_5), chemical oxygen demand (COD) for secondary treatment), and eventually nitrogen and/or phosphorus removal, if necessary.