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# Valorization of organic biosolids at New York City Water Resource Recovery Facilities

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**Abstract** New York City's 14 Water Resource Recovery Facilities (WRRFs) treat 1.3 billion gallons of wastewater daily, producing 1,400 tons of biosolids. Historically landfilled, these biosolids present an opportunity for resource recovery within a biorefinery framework. This study explores three pathways: (1) fermenting biosolids to produce volatile fatty acids (VFAs) as an internal carbon source for nitrogen removal; (2) implementing thermal hydrolysis to enhance dewaterability and biogas yield; and (3) applying pyrolysis to reduce biosolids volume and destroy PFAS contaminants. Together, these innovations aim to support NYC's goal of 90% landfill diversion by 2030 and improve sustainability across the wastewater treatment system.

**Keywords:** VFAs, Thermal Hydrolysis, Resource Recovery, PFAS

## 1. Introduction

The New York City Department of Environmental Protection (NYC DEP) operates fourteen water resource recovery facilities (WRRFs) that collectively treat 1.3 billion gallons of water per day. Of the fourteen WRRFs, six are dewatering facilities with four equipped for centralized dewatering facilities that receive digested sludge from the other facilities. Figure 1 shows the sludge transshipment routes and means. The combined primary and waste activated sludge is currently thickened using gravity thickeners before being fed in to mesophilic anaerobic digesters (ADs) and the digestate is sent to centrifuges to separate the water and produce a cake which is typically in the range of 25-28% solids. New York City's water resource recovery facilities produce approximately 1,400 tons of biosolids daily. Currently, these biosolids end up primarily in landfills, due to a recent history of lower pricing for disposal. The cost for the City to manage biosolids has risen by over 50% in the past seven years as landfill capacity becomes increasingly scarce amounting to $50 million annually. With a comprehensive plan to reduce waste, improve recycling rates, and divert organics from landfill, New York City aims to reduce the amount of material it sends to landfill by 90% by 2030 as shown in Figure 2. Among the many approaches the city is looking at are 1) Using the volatile fatty acids from the biosolids as an internal carbon source for denitrification purposes, 2) Adopting thermal hydrolysis process to produce high quality biosolids with better dewatering capabilities, 3) to investigate processes such as pyrolysis to handle the issue of PFAS in the biosolids. The following sections will detail efforts being expended for the above mentioned technologies.

## 2.Technologies tested.

### 2.1. Generation of an internal carbon source, volatile fatty acids, (VFAs) :

Acidogenic fermentation is referred to as the first two of four stages in anaerobic digestion: (1) hydrolysis and (2) acidogenesis (Lee, Chua, Yeoh, & Ngoh, 2014). Hydrolysis is the hydrolytic decomposition of complex organic matter into simpler organic matter, such as carbohydrates to sugars, proteins to amino acids and peptides, and lipids to short and long-chained fatty acids.. Acidogenesis is the conversion of these simple organic matter into VFAs. Fermentation is controlled by facilitating the growth of hydrolytic microbes and acidogenic bacteria while inhibiting methanogens (Zhou, Yan, Wong, & Zhang, 2018). Solid retention time (SRT) and pH are manipulated to limit methanogens and allow faster-growing acidogenic bacteria to outcompete methanogens (Lee, Chua, Yeoh, &Ngoh, 2014). In the absence of methanogens, VFAs accumulate and become a recoverable value added product of fermentation.which could be used as an organic carbon source that can replace the externally procured glycerol (at a cost of $9 M for the year 2023) for nitrogen removal at the facilities that practice biological nitrogen removal (BNR). This approach to generate higher value end products will be possible by retrofitting existing anerobic digesters to allow fermentation to take place in a single reactor to produce VFAs, followed by a second reactor where methanogenesis is active and produces methane.

There are preliminary bench scale studies that are being conducted at the City College of New York to verify the use of VFAs as a carbon source for denitrification. Figure 3 shows the comparative results of VFA versus other traditional carbon sources. The next stage for these experiments will be a pilot scale study that is planned to be initiated in early 2026 at one of the treatment facilities to better understand the process and look at the viability of implementing a full-scale system to generate this internal carbon source.


Figure 1. Biosolids transshipment routes in NYC

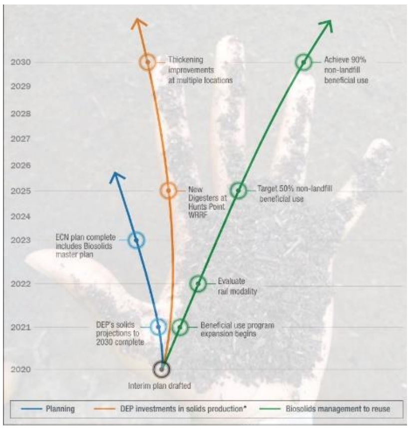


Figure 2. Expected biosolids management timeline

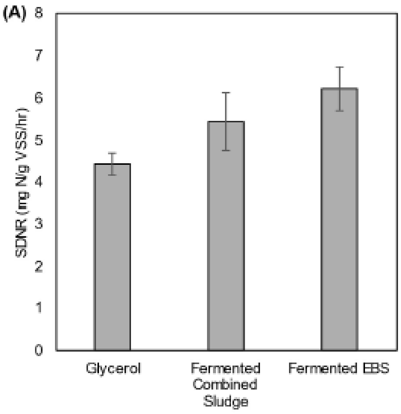


Figure 3. SDNR comparison

**2.2. Thermal Hydrolysis Process (THP)**

THP pre-treats sludge by heating it under pressure (typically 160–180°C) to solubilize complex organic matter, particularly proteins and carbohydrates. This enhances subsequent biogas production and improves sludge dewaterability.( Barber, 2016.). It is a proven environmentally friendly technology for wastewater treatment plants with AD that enables the biochemical utilization of otherwise indigestible material. It is also the preferred pretreatment technology for AD to generate additional biogas and improve dewaterability of the digested sludge compared to others, such as mechanical, chemical, or electrical types of pretreatment for AD (Ariunbaatar et al., 2014.)

CCNY and NYCDEP have conducted bench-scale evaluations using thickened sludge across different temperatures. Results support THP's advantage over other pre-treatment technologies (e.g., chemical, mechanical), making it a strong candidate for integration into existing AD systems.

**2.3. Pyrolysis**

Per- and polyfluoroalkyl substances (PFAS), found in biosolids from domestic and industrial sources, resist conventional treatment due to strong C–F bonds. Pyrolysis heats biosolids to 500–850°C in low-oxygen conditions, breaking these bonds and reducing PFAS presence by >97%.9 Schultes, L. Et al,)

The process also produces biochar, which can be used as a soil amendment, and recovers energy—making it a viable circular economy solution. However, gaseous emissions may require secondary treatment (e.g., thermal oxidation) to ensure complete PFAS destruction. NYC DEP is reviewing pyrolysis literature to assess full-scale viability.

**3. Conclusions**

NYC is actively exploring advanced biosolids treatment technologies that enhance sustainability, reduce environmental impact, and align with citywide goals. VFAs offer cost-saving potential as internal carbon, THP improves digester performance, and pyrolysis addresses PFAS contamination while recovering resources. Further pilot-scale validation will inform future infrastructure upgrades.

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