Biosolids management

Scarcity of resources and sustainability goals are driving major global changes in the ways that Water Resource Recovery Facilities (WRRFs) are designed and operated. Sustainable biosolids management practices can play a major role in allowing WRRFs to meet the N-E-W (Nutrients – Energy - Water) paradigm due to their potential to provide high quality resource recovery, as well as generation of power and heat to offset the energy requirement of wastewater treatment.

Identifying needs

Biosolids treatment consolidates nutrients into new products for beneficial uses such as soil amendments, compost, fertilizers, artificial soils, fuel, and biochar. WRRFs can also separate phosphorus recovery. Anaerobically digesting biosolids generates gas, a renewable energy with 60 percent methane content for co-generating heat and power (CHP), potentially providing half of a WRRF's energy requirements assuming proper energy conservation. Digester gas can be refined to natural gas quality and even converted to Liquid Natural Gas (LNG).

Importation of Fats/Oils/Grease (FOG) and high strength wastes (such as wastes from dairies, food production, and breweries) into co-digestion can produce the additional methane required to completely power the WRRF. Other sources (such as food wastes), can be gathered efficiently from institutions, universities, schools, cafeterias, or restaurants and provide additional energy production. Tipping fees (a charge for unloading waste at a facility), can also provide revenues to the WRRFs.

As always, energy efficiency and conservation play major roles in making wastewater and biosolids treatment sustainable.

Solutions

We have extensive capabilities in all aspects of biosolids management planning and implementation including:

- Biosolids program planning and development
- Odor, air pollution control assessment, and design
- Greenhouse gas assessment and reporting
- Alternatives analysis, concept/process design
- Detailed design and preparations for bids/tenders
- Evaluation and design of energy recovery systems
- Risk and life cycle assessment
- Owners representative for DB, DBO and other Partnerships
- Construction phase engineering services
- Construction management and inspection
- Startup and commissioning services
- Permitting and regulatory assistance

We’ll work with you from the initial assessment of alternatives to permitting and implementation of solutions to achieve your goals in a cost effective manner.

Benefits

For decades, GHD has worked closely with clients to plan, design, and oversee the construction and startup of facilities that produce high quality biosolids products, produce energy and capture nutrients such as phosphorus and nitrogen for beneficial uses.

We work closely with technical associations, universities, research organizations, and regulatory agencies to stay well-informed and actively engaged in the latest developments in biosolids management. Our team has first-hand experience with state-of-the-art biosolids technologies such as thermal hydrolysis and advanced anaerobic digestion for extremely high levels of biosolids decomposition and digester gas production.

We’ll help you define a strategy to end the perception of biosolids as a problem, shifting the focus to biosolids as a valuable resource.
Experience

GHD has extensive experience in the planning, environmental assessment, design, and implementation of biosolids management, handling, processing, beneficial reuse, residuals management and energy recovery strategies and facilities. Some projects we have recently been involved with include:

**Sydney Biosolids Management Strategy, New South Wales, Australia**

Sydney Water operates 29 sewage treatment plants in the metropolitan Sydney area. Almost all of the captured solids across all plants are beneficially used in agriculture, composting or land rehabilitation. Biosolids production is expected to increase 38% over the next 20 years as the population of Sydney increases. The engineering team of GHD and a subconsultant were appointed to lead a Biosolids Management Strategy for the 20 year planning period. The strategy focused on assessing the likely capacities of marketplaces for high and low value biosolids products and the risks associated with the present practices. A technology assessment was performed as an integral part of the strategy development to assess performance improvement strategies and develop conceptual level cost estimates for identified alternatives. The Biosolids Management Strategy, completed in 2011, allowed Sydney Water to select a path forward that represents a logical technology optimization for the sustainable markets with respect to the strategic goals for pathogen reduction, product odor reduction, volume reduction, energy recovery, nutrient recovery, reduction in greenhouse gas emissions, and carbon sequestration.

**Oneida County Biosolids Improvements, New York, USA**

Oneida County retained the services of GHD to design solids handling upgrades at their regional Water Pollution Control Facility (WPCF), which currently treats a maximum month flow of 205 MLD (54 mgd). Much of the solids handling facilities at the WPCF have reached the end of their useful service life and require replacement. A critical component of the project was reviewing the existing two fluidized bed incinerators for compliance with the recently issued EPA Maximum Achievable Control Technology (MACT) standards. Because of the significant capital and operating costs associated with continued sludge incineration, GHD evaluated biosolids handling alternatives for the County and recommended the ultimate retirement of the incinerators and constructed new anaerobic digesters and an energy recovery system. Two 1.2 million gallon egg-shaped primary digesters were designed by the GHD team along with a secondary digester, energy recovery system, sludge thickening, and dewatering improvements. Construction scheduled for completion in 2018.

**Leigh and Burnley WWTP Thermal Hydrolysis Facilities, Manchester, UK**

GHD provided multi-discipline design for Design/Build contractor KMI for two new thermal hydrolysis processes (THP) for United Utilities at their Leigh and Burnley WWTPs near Manchester, UK. The facilities are designed for throughputs of 300,000 m3/pa and 140,000 m3/pa, respectively. The Leigh THP upgrade included sludge storage and blending, centrifuge thickening, thermal hydrolysis, cooling, mesophilic digestion, degassing and final dewatering. The Burnley THP upgrade included sludge thickening centrifuges, polymer storage / dosing kiosk, thickened sludge cake silo, liquor treatment plant and de-gassing tank. Design challenges included maintaining operation of existing equipment, integration of new systems and co-ordination of vendor packages.

**Luggage Point Sewage Treatment Plant, Queensland, Australia**

GHD was commissioned in 2013 by Queensland Urban Utilities (QUU) to develop the optimum biosolids treatment facilities at the Luggage Point STP. Luggage Point is the largest wastewater treatment facility operated by QUU, serving an equivalent population of around 850,000, and is Australia’s largest STP achieving total nitrogen less than 5 mg-N/L with anaerobic biosolids digestion and cogeneration energy recovery. Key drivers for the project were to provide a centralised facility for current and future demands, reduce biosolids volume, and increase biogas production. Designs for three options were developed, including Temperature Phased Anaerobic Digestion (TPAD) and thermal hydrolysis (TH) followed by mesophilic anaerobic digestion. Key achievements included digester modelling using IWA ADM1 and Biotwin steady state models, significant savings for preferred option and reduction in life-cycle costs for QUU identified. Following this work, GHD carried out an assessment of the biosolids dewatering system, including options assessment for replacement dewatering units, and preliminary design of preferred upgrade strategy. Struvite minimisation options were included, with enhanced in-digester struvite precipitation selected as the preferred option. Technical tender specification preparation and costing included. Dewatering centrifuges and in-digester struvite precipitation upgrades are currently in construction.
Biosolids Dewatering and Thermal Dryer Rehabilitation, Maryland, USA
GHD was retained by Synagro for the upgrade of the 40 MLD (10.5 mgd) Hagerstown WWTP Biosolids Dewatering and Thermal Drying Facility. The project included condition assessment and replacement of the following major equipment: sludge pumps and grinder, polymer feed system, belt filter press dewatering, cake pump, 15 dry tons/day rotary drum direct thermal dryer, separator, cyclones, ID fan, screen, crusher, baghouse, silo, and conveyors, and upgrade of the existing 2-stage scrubber odor control system. Construction is scheduled for completion in 2019. The thermal sludge dryer is one of four designed by GHD for Maryland public utilities.

Malabar Biosolids Improvements, New South Wales, Australia
GHD is the design partner in the 4Malabar Alliance, which is delivering the upgrade of the Malabar Wastewater Treatment Plant (WWTP). Malabar is Sydney Water's largest plant, serving an equivalent population of approximately 2.2 million, with an average dry weather flow of about 450 ML/d (120 mgd). The Alliance includes Australian construction firms and the Client, Sydney Water. The project involves the upgrade of nearly all unit processes, with the overall focus being on delivering a significantly improved biosolids product quality that will help reduce the cost and risk exposure of Sydney Water’s biosolids reuse program. The specific works on the biosolids stream include new primary sludge screening, new mixing and heating systems for the digesters, new recuperative thickening to increase digester solids and SRT, new centrifuges for dewatering, replacement of the existing biosolids outloading system, and new biosolids storage silos. The upgrades downstream of the centrifuges are designed to minimize working of the biosolids following dewatering, with the aim of maintaining product quality and managing site odor. Construction is scheduled for completion in 2018.

Delaware County Regional Water Quality Control Authority, (DELCORA), Pennsylvania, USA
DELCORA's Western Regional Treatment Plant is permitted at 151 MLD (40 mgd) and serves the southwestern suburbs of Philadelphia. Biosolids produced by the plant and truck hauled wastes are incinerated using two 48 dry ton per day Multiple Hearth Furnace based systems. DELCOR retained GHD to evaluate continued use of the incineration system in light of pending US EPA 40 CFR, Part 60 emissions standards that reduce the allowed amount of air emissions. Initial findings indicated high auxiliary fuel use, high operating temperatures, and nitrous oxide (NOx) and sulfur oxide (SOx) air emissions above the pending standard. GHD identified and designed a cost effective solution to increase each furnace capacity, reduce particulate emissions by 90 percent, reduce NOx, SOx, metals, and hydrogen chloride emissions, and reduce auxiliary fuel demand by about 50 percent. The payback on investment is 10 to 15 years, dependent on use, with an average annual savings of $1 million USD. Completion of the recommended improvements were completed in 2016.

Charles County Biosolids Master Plan, Maryland, USA
GHD was retained in 2014 by Charles County to assess their current biosolids management practices and assess alternatives for upgrading the Class B lime-stabilization system at the 75 MLD (20 mgd) Mattawoman WRF to a Class A process. GHD assessed local and national trends, evaluated market conditions and opportunities, identified biosolids processing and outlet alternatives, developed mass and energy balances, and provided capital and lifecycle operating costs. Anaerobic digestion and thermal drying were shortlisted as the most appropriate options. The evaluation included innovative processes, including Temperature-Phased Anaerobic Digestion (TPAD), thermal hydrolysis, and combined heat and power. The team also considered a regional biosolids facility at the Mattawoman WRF to serve five nearby wastewater facilities. As a result of this analysis, the County elected to continue their current Class B biosolids process while making future provisions to phase in Class A anaerobic digestion and energy reuse processes at their central wastewater treatment facility.

Biosolids Dewatering and Thermal Dryer Rehabilitation, Maryland, USA
GHD was retained by Synagro for the upgrade of the 40 MLD (10.5 mgd) Hagerstown WWTP Biosolids Dewatering and Thermal Drying Facility. The project included condition assessment and replacement of the following major equipment: sludge pumps and grinder, polymer feed system, belt filter press dewatering, cake pump, 15 dry tons/day rotary drum direct thermal dryer, separator, cyclones, ID fan, screen, crusher, baghouse, silo, and conveyors, and upgrade of the existing 2-stage scrubber odor control system. Construction is scheduled for completion of 2019. The thermal sludge dryer is one of four designed by GHD for Maryland public utilities.

Anaerobic Digestion and Cogeneration Facilities, Victoria, Australia
GHD was engaged to design the upgrade and expansion of the Surbiton Park Recycled Water Plant (RWP) to increase capacity from 8 ML/day (2.1 mgd) to 18 ML/day (4.8 mgd). A key part of the project is the upgrade of the existing anaerobic digester, construction of a new anaerobic digester, and addition of a cogeneration facility using a biogas fueled microturbine that uses biogas produced from the anaerobic digestion process to generate electricity, thereby reducing the plant’s greenhouse gas emissions and reliance on grid power supply. The project also included sludge thickening area including rotary drum thickeners, primary sludge buffer tank, polymer batching/dosing room and control room, a17 m (55 ft) diameter anaerobic digester with sequential gas lancing, upgrade of an existing anaerobic digester with new gas lancing system, and a fully enclosed digester control building. The project was completed in 2014.
Syracuse Biosolids Handling and Digestion Improvements, New York, USA

As part of a joint venture, GHD was retained by Onondaga County to upgrade the capacity and performance of biosolids handling systems at the 303 ML/d (80 MGD) Metropolitan Syracuse WWTP. Improvements implemented included gravity belt thickeners for waste sludge thickening, two new thickened sludge blend tanks, replacement of belt filter presses with new high-solids sludge dewatering centrifuges, and installation of a 375 kW dual-fuel gas engine-generator cogeneration system. The biosolids handling improvements were completed in 2007. Following the construction project, GHD was responsible for developing and implementing recommendations for cleaning and repairs to the facility’s four 1.8 MG anaerobic digesters. The digester cleaning and repairs were completed in 2015. GHD is currently designing an upgrade of the digestion complex which will include digester heating and mixing replacement, a new dual membrane biogas storage sphere, replacement of the waste gas burners, and upgrades of the Digester SCADA system.

High Performance Anaerobic Digestion, Camden County Municipal Utilities Authority, NJ

GHD served as principal designer and consultant to Anaergia Inc. for a high performance anaerobic digestion system and Combined Heat and Power Cogeneration (CHP) system for CCMUA's 303 MLD (80 mgd) oxygen activated sludge WWTP. The project includes a biogas cleaning system for hydrogen sulfide and siloxane reduction, two 2 Mw Internal Combustion engine based CHP systems, and a urea injection system for NOx control of engine exhaust flue gas. GHD also designed medium voltage (4,160v) tie-in connections, utility grade power metering and safety interlocks to existing switchgear and prepared an interconnect agreement with electrical utility company. The Anaerobic Digester portion of the project consists of sludge thickening, the conversion of four existing, 250,000 gallon capacity, sludge storage tanks to high performance anaerobic digesters, and a separate biogas storage system. Startup of the CHP is planned for 2018 with the digester startup in 2019.

Rialto Bioenergy Facility, Rialto, California, USA

The Rialto Bioenergy Facility (RBF) is a waste-to-energy facility that will convert approximately 1,080 tons per day of organic waste from municipal waste streams to renewable energy. The two waste streams will be food waste and biosolids from external wastewater treatment plants. Food waste will be delivered to the site and pre-processed before loading into two 3.5 million gallon anaerobic digesters. The digesters will generate biogas, which will be used for power generation (5.1 MW via CHP engines) and exported to the local grid (3 MW) or used onsite. The remainder of the biogas (roughly 2000 scfm) will be upgraded for delivery into the local natural gas pipeline. Dewatered cake from external wastewater treatment plants and from the anaerobic digestion process will be dried in two belt dryer units. Wastewater generated from the process will be treated in a new wastewater treatment plant on site that will consist of DAF and MBR. The project is currently under design.

City of Phoenix 91st Ave WWTP Anaerobic Digester Upgrades, Arizona, USA

The Phoenix 91th Ave. WWTP provides wastewater treatment services for the Cities of Glendale, Mesa, Phoenix, Scottsdale, and Tempe and has a permitted design capacity of 230 mgd. GHD was retained to conduct condition assessment and develop cleaning and rehabilitation documents for the City's existing twelve 1.2 MG anaerobic digesters and related ancillary systems. GHD developed repair and rehabilitation alternatives prior to preparing PS&E for the rehabilitation of the concrete structure and replacement of the steel dome for the Digesters. This project included construction administration and inspection services and specialty structural inspections, start-up and commissioning. This project won Arizona Water Association's 2017 Wastewater Treatment Plant of the Year.

Oxley Creek Cambi® THP Mark II Upgrade, Queensland, Australia

GHD completed options assessment and concept design for upgrade of the Cambi® THP process at the Oxley Creek WWTP to augment capacity and improve operational performance and reliability. Assessment included optimization of THP process, ancillary equipment (including steam boiler, cooling HEX, cogeneration and odor control) and capacity assessment of biosolids stream and mainstream process impacts. Recommended option for upgrade of existing THP equipment and control, and boiler optimization to provide up to 40% capacity increase, allowing QUU to treat to stabilization Grade A for the majority of biosolids. Preparation of Technical Specification for Cambi THP equipment upgrade to Mark II standard and capacity increase from 280 to 400 wet-t/d. Detail design of upgrade of THP, ancillaries and downstream processes is currently being undertaken.