In the water and wastewater industry, the trend is toward smarter wastewater management systems. State-of-the-art technologies with small footprints that offer environmentally sustainable solutions are desirable — all at the lowest possible cost. The technological challenges are complex, but aerobic granular sludge (AGS) may offer some distinct advantages to conventional systems.

AGS technology can be described as an attached growth process where carrier media is not required. The manipulation of selective pressures results in the formation of dense, rapidly settling granules. AGS systems claim up to 50% lower energy and 75% fewer land requirements compared to conventional activated sludge systems.

Requirements
The formation of microorganisms in a tightly aggregated form was accomplished decades ago in anaerobic systems applied for industrial wastewater treatment and more recently, in water reclamation plants that have employed the Anaerobic Ammonium Oxidation (ANAMMOX) process. The challenge has been applying the knowledge gained from these processes to conventional activated sludge, which exists in a flocculated form in many water reclamation plants.

In developing AGS, two major steps are required. In the first step, called “metabolic selection,” the activated sludge is subjected to “feast” (high food/microorganism ratio) and “famine” (complete depletion of food) conditions to induce biopolymer production by the bacteria. Biopolymers are essential components in the structural matrix that promotes aggregation of the microorganisms into a granular form.

In the second step, solids separation is applied to allow the larger, denser solids with high gravity settling rates to separate from lighter flocculated solids with lower settling rates. As a result of separation, the desirable dense solids are retained in the treatment process and the lighter flocculated solids are removed. Mechanical processes such as lamella plate settlers or hydrocyclones, can be used to enhance this step.

When these two steps are applied, an activated sludge with a dense granular structure develops, resulting in a bioreactor sludge concentration that is up to two to three times the concentration in flocculated sludge processes and higher solids loading rates to secondary clarifiers. This means that more wastewater can be treated in fewer tanks.

Achievements and future challenges
The first milestone in achieving granulation of activated sludge was the development of the Nereda® process in The Netherlands. Nereda® requires tank water depths and dimensions that limit the conversion of the shallower, narrower and longer tanks typically used in conventional water reclamation plants to this specific technology. The challenge is to demonstrate that application of the basic concepts of AGS can lead to successful conversion of a flocculated sludge to AGS, regardless of tank geometry.

Proof of concept — Implementation of AGS at the City of Penticton, BC
AECOM has partnered with the City of Penticton, British Columbia, to explore a transition of the flocculated activated sludge to AGS in the City’s conventional treatment process. When the transition is complete, the activated sludge tanks will potentially operate at a higher solids concentration and a higher solids loading rate to their secondary clarifiers. Plant staff will then have the flexibility to remove tanks from service for maintenance at any time of the year. The transition to AGS will also eliminate the near-term need for construction of an additional secondary clarifier.

As part of the transition, the City has installed a lamella plate settler and a hydrocyclone system. Operating conditions were adjusted to create a greater “feast” environment in the anaerobic zone of a bioreactor. As a result, sludge particle sizes and settling rates have increased. Full-scale trials will continue through the winter of 2019-2020.

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From left:
Blue Plains Wastewater Treatment Plant
Washington, D.C., U.S.
Aerobic Granular Sludge
Penticton Advanced Wastewater Treatment Plant (Hydrocyclone System)
Penticton, British Columbia, Canada
Penticton Advanced Wastewater Treatment Plant (Lamella Plate Settler)
Penticton, British Columbia, Canada
Inflow and Infiltration Management

Our experienced professionals combine new, technology-based analytics with our global engineering expertise, using a process known as “optimization” to develop cost-effective multi-objective management plans.

A new approach to inflow and infiltration

At AECOM we understand the importance of infrastructure to our communities. As stewards of these vital systems, we work to help you meet the challenge of efficiently maintaining your infrastructure networks to meet your community’s needs while complying with regulatory requirements.

Most cities operate separate sewer systems for wastewater and rainwater. Wastewater such as sewage, water from the sink, bath and industrial waste drains into a sanitary pipe that transfers it to a wastewater treatment plant. Rainwater drains into a storm water pipe that discharges into local streams, rivers and often directly into the ocean. Inflow and infiltration occur when a wastewater conveyance network becomes susceptible to wet weather inflow and groundwater ingress. The mixture of storm water and wastewater increases the load on the sanitary sewer system connected to wastewater treatment plants.

The results of this overloaded sanitary network can hit your community — and your infrastructure budget hard — causing increased sewer overflows, flooded basements, sinkholes, polluted waterways, public beach closures and higher sewer charges. The American Society of Civil Engineers suggests that the capital investment needed to address wet water overflows across the United States is about $100 billion.

And, while Inflow and infiltration can be expensive to repair, the issue, when left alone, can become even more costly. If your municipality does not comply with regulation, you can be forced to act through a consent decree order. And if consent orders are not met the Environmental Protection Agency can impose daily fines.

The traditional approach … and our innovative solution

Current industry practices tend to be quite reactive and base rehabilitation strategies on flow metering information to identify and prioritize sewer catchment areas. These traditional approaches have their place, although do not consider interrelated factors at the asset level and cannot answer business questions or blend objectives.

We recognize the difficulties and expenses you face in managing inflow and infiltration and have developed an approach that allows you to take a holistic view of your buried sanitary system at asset level. This enables you to identify, plan and execute the right blend of interventions to make the most of your resources and satisfy various performance criteria while meeting your community’s needs.
How we do it

Our experienced professionals combine new, technology-based analytics with our global engineering expertise, using a process known as “optimization” to develop cost-effective multi-objective management plans. Simply put, optimization uses advanced mathematics and genetic algorithms to find the best possible solution from a set of options. In the case of inflow and infiltration, the overarching aim of the optimization model is to identify the most effective blend of repairs, replacement, storage, GSI and lining given a set of performance requirements and cost constraints.

Optimization takes traditional cost benefit analysis further. Cost benefit analysis prioritizes system repairs by adding up and comparing total project benefits to total project costs. Optimization adds constraints to that scenario, so we can answer business questions such as ‘how can I meet my spill frequency performance targets with a set budget at the same time as maximizing asset life’. These sorts of business questions become very complex using traditional prioritization techniques.

Our advanced solution allows us to undertake prescriptive analytics, guiding decision making process through the analysis of various data. Paired with our global expertise, the solution allows our professionals to predict asset performance over time, delivering optimized tailored intervention plans to meet your specific system’s needs. Through our efforts we can determine where and when inflow and infiltration will occur in the future, how it can be prevented as well as its impact on capital and operating expenses and future revenue. The result: Money saving proactive inflow and infiltration management that improves your community’s quality of life.

A track record of success

We have a rapidly expanding track record of success. And we’re only just beginning. As cities continue to have to do more with less we’ll continue to innovate, providing solutions to help you protect the communities that you serve while protecting your valuable resources.