Optimizing Biological Wastewater **Treatment Processes in the Middle East**

Water scarcity is one of the most pervasive challenges facing communities globally and the Middle East and North Africa is the most water scarce region in the world. With approximately 5 percent of the world's population, but just 1 percent of the world's renewable water resources, the region's water supply challenges are driven by issues including limited naturally available water resources, population growth and aging infrastructure. In this context, identifying initiatives to advance the sustainable management of water resources, has never been more important.

Wastewater treatment in Doha, Qatar

Critical first step

One proven approach to help meet growing water demands, while safeguarding existing water supplies is water reuse. Biological wastewater treatment - a crucial first stage in the treatment of wastewater for reuse - is a process which removes more than 90 percent of the pollutant load, undertaken before polishing treatment and disinfection to meet reuse standards. Using naturally occurring elements, biological treatment is a safe and sustainable method of removing the pollutants from wastewater. Water reuse technologies produce high-quality water at a lower life-cycle cost than developing a new water supply, and deliver a resilient water source with valuable economic and environmental benefits.

The most common form of biological treatment is known as activated sludge whereby air is introduced at the bottom of a tank as an oxygen source. A mixture of untreated wastewater (food) and return-activated sludge containing live biomass enters the tank and the presence of oxygen causes the biomass to consume the 'food.'

Optimizing treatment process

By adjusting the conditions, biomass can be optimized to meet required treatment standards. Parameters which can be adjusted include:
1. the duration for which the biomass is present in the aerated tank (known as sludge age or solids retention time (SRT));
2. dissolved oxygen (DO) concentration;
3. food to microorganism (F/M) ratio.

The sludge age is key as it enables the correct biomass flora. By manipulating a high F/M ratio at the inlet of the aerated tank, a selection of well-settling, floc-forming bacteria over poor-settling filamentous bacteria can be encouraged - critical to ensuring effluent quality.

Tackling complex nutrient removal

Typical biological wastewater treatment is designed to achieve effluent quality standards for Biochemical Oxygen Demand (BOD5), Chemical Oxygen Demand (COD), Total Suspended Solids (TSS) and Ammonia (NH3-N). However, there is frequently a need to remove the nutrients Total Nitrogen (TN) and Total Phosphorus (TP) which, when discharged into the environment, can lead to algal blooms, deoxygenating the water course and causing harm to fish and other water life.

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For an activated sludge plant with positive DO and sufficient sludge age, nitrifying bacteria will convert most of the ammonia (NH3-N) pollutant load into nitrate (NO3-N) by a process of nitrification. However, this does not reduce the TN. By avoiding aeration and providing anoxic conditions, where there is oxygen bound in nitrate rather than DO, denitrifying bacteria will convert nitrate to nitrogen gas (N2) which is then released into the atmosphere, thus reducing TN in the treated effluent.

To enhance TP assimilated in the biomass, anaerobic conditions (where there is no DO or nitrate present) are required to boost formation of phosphate accumulating organisms (PAOs) with phosphorus release, allowing enhanced uptake of phosphorus in the biomass when in aerobic conditions. Chemicals such as ferric chloride can be added to react with phosphorus to create a ferric phosphate precipitate which is bound in a chemical sludge for removal with the surplus activated sludge.

Configuring activated sludge process

The activated sludge process is a generic treatment process which can be configured depending on the treatment challenge and site requirements. The main activated sludge types are:

1. aeration tanks or lanes with final settlement tanks (FSTs);
2. oxidation ditches with FSTs;
3. sequencing batch reactors (SBRs).

SBRs differ from other activated sludge processes in that they are temporal, whereas others are spatial. With SBRs, all activated sludge treatment stages occur in a single tank in a timed sequence, while other processes require separate aeration tanks, FSTs and RAS lines to undertake these stages. Because the entire SBR area is used for settlement, a larger settlement area than that of FSTs is available, enhancing SBR effluent. SBRs

"SBRs differ from other activated sludge processes in that they are temporal"

lend themselves to sites where there is limited land available as FSTs are not required and modular wall construction makes the SBR configuration suitable for expansion.

The ICEAS SBR can be configured to achieve treated effluent standards of 10/10/1/5/1 mg/l BOD/TSS/NH3-N/TN/TP respectively, which covers the tightest of Middle East effluent standards while a customized design approach enables customers to overcome complex challenges. ■

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تعدُّ مسألة ندرة المياه واحدة من أكثر التحديات التي تواجه المجتمعات على مستوى العالم. أمّا منطقة الشرق الأوسط وشمال أفريقيا فهي أكثر المناطق التي تعاني شحًا في المياه في العالم. وتضمُّ المنطقة حوالى ٥ في المئة من سكان العالم، ولكنها تمتلك ١ في المئة فحسب من الموارد المائية المتجددة في العالم. وتقود مسائل مثل الموارد المائية المحدودة طبيعيًا، والنمو السكاني، والبنية التحتية القديمة تحدّيات إمدادات المياه في المنطقة. إنّ تحديد مبادرات في هذا السياق للنهوض بالإدارة المستدامة للموارد المائية هو أمر في غاية الأهمية. إن إعادة استخدام المياه هو نهج أثبت قدرته في المساعدة على تلبية تزايد الطلب على المياه، مع الحفاظ على امدادات المياه المتوفّرة. وتعدُّ المعالجة الحيوية للمياه العادمة، أي المرحلة الأولى الضرورية لمعالجة مياه الصرف الصحي بهدف إعادة استخدامها، عمليّة تزيل أكثر من ٩٠ في المئة من تركيز الملوثات وتتمُّ قبل التنقية والتطهير للوفاء بمعايير إعادة استخدامها. بالإضافة إلى ذلك، تنتج تقنيات إعادة استخدام المياه مياه ذات جودة عالية بكلفة منخفضة على مدى الدورة العمرية عن كلفة تطوير إمدادات مياه جديدة، وتوفّر مصدر مياه مرنٍ ذات فوائد اقتصادية وبيئية قيِّمة.

ECD Fluoride Monitoring System Helps Treat Hydrofluoric Acid

Plant engineers and technicians in manufacturing plants with corrosive processes that rely on hydrofluoric (HF) acid will find the S80-T80 Fluoride

ECD's fluoride analyzer

Monitoring System from Electro-Chemical Devices supports efficient wastewater treatment processes to reduce consumable costs and ensure discharge effluent fluoride levels are compliant with local, state and federal regulations. HF acid is a water based compound that is commonly used in a variety of industrial applications that include: semiconductor chip fabrication, electronics assemblies, chemical refining as a catalyst, metal plating, glass etching and various cleaning processes. While HF acid is technically considered a weak acid, it is a hazardous material with the potential to harm employees and the environment when improperly used or treated prior to plant discharge. Typical HF acid wastewater treatment systems inject a milk of lime solution Ca(OH)2 into the process water, which precipitates the fluorides out as calcium fluoride (CAF) salt. In order to ensure correct dosing with the milk of lime solution, the incoming and outgoing fluoride levels must be accurately monitored and compared in order to prevent either wasteful over-dosing or insufficient treatment of the effluent prior to discharge. The **ECD** S80-T80 Fluoride Monitoring System provides these comparative incoming and outgoing measurements. ECD's monitoring system features an S80 plon Fluoride Sensor, an S80 pH Sensor and a dual-channel T80 Transmitter. This ECD solution helps plants achieve a more cost-effective fluoride removal water treatment system, which doesn't over use consumable chemicals while also ensuring the wastewater is treated sufficiently to meet regulatory requirements prior to effluent discharge.■