Total Systems Approach to Wastewater Treatment

Making all the pieces of the puzzle fit for industrial clients

By Chandler Johnson

The total systems approach (TSA) to wastewater treatment is focused on offering industrial clients a fully integrated wastewater solution – one that includes all pieces of the puzzle, rather than simply a set of uncoordinated components and systems. The approach includes a collaborative evaluation process to understand a particular facility's requirements, use of proven designs and materials, and selection of innovative products that have the best life cycle cost while achieving the best water quality.

What is a total systems approach and why is it better than the alternative?

A true TSA begins with an evaluation that identifies options to help achieve a company's production goals. After identifying and evaluating any issues, the next step is the development of a detailed engineering design in collaboration with facility engineers. Components and equipment are selected with an eye on durability and design optimization and the overall system fitted together is focused on long-term reliability and consistent performance. Efficient installation, startup, and training are other important pieces of the TSA. Compliance is ensured with the use of binding performance guarantees. Extended service plans can make the provider almost an adjunct to the company's process engineering team. The final piece of the TSA is the availability of a complete system warrantee.

Components included in a TSA vary depending upon the application. The two main categories include primary and secondary **liquid/solid separation** to remove particulates and organics and **biological treatment** of soluble biochemical oxygen demand (BOD) and ammonia. Related equipment may include pump stations, screening devices, sludge tanks, and a range of other ancillary equipment to handle any byproducts created.

TSA in action

The total system approach is a customized approach, in which solutions are specifically tailored to each industrial customer's wastewater treatment requirements. In the three examples given, the TSA fits the puzzle pieces differently, but in each case an in-depth evaluation sets the stage for a truly integrated and trouble-free solution.

Dairy plant needs to handle wastewater from planned facility expansion

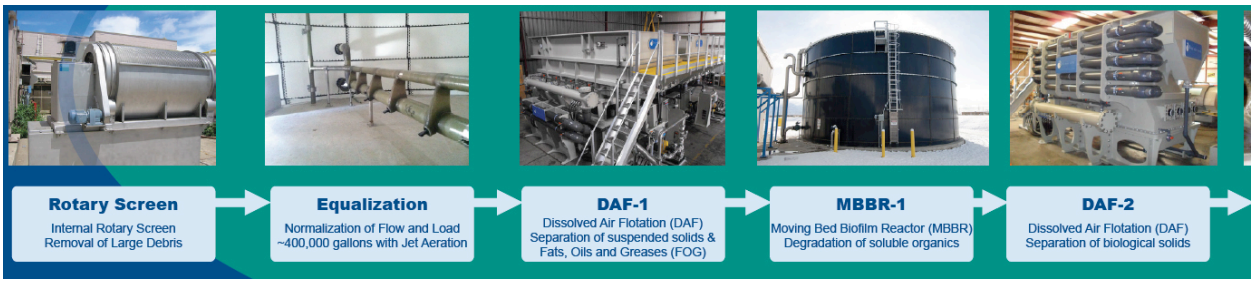
An interesting example of the TSA in action is the upgrading of Dannon's Utah yogurt manufacturing facility's wastewater treatment system. Just two years prior, the company had installed a circular Dissolved Air Flotation (DAF) pretreatment system but had found that it was not well-designed, with high operational costs from chemical consumption, and poor performance.

Dannon recognized that the existing plant would not be able to handle additional wastewater expected from a planned facility expansion and decided to construct a new wastewater treatment system. After evaluating several possible technologies, including both anaerobic and aerobic solutions, they selected a system that uses two rectangular high-rate DAF units, one for separation of suspended solids and fats, oils and greases and one for separation of biological solids. The DAF selected has the added benefit of handling pH swings without corrosion.

In addition, they selected the Moving Bed Biofilm Reactor (MBBR) technology for degradation of soluble organics. MBBR is a biological process used for BOD removal, nitrification and /or denitrification. The system provides significant advantages over other biological processes and has been successfully implemented at several dairies, which have widely variable wastewater loads. Aside from the core DAF and MBBR technologies, the total system also includes rotary screening to remove debris and equalization to normalize the flow and load.

To implement the turnkey project, Dannon selected a partnership between MWH Engineering and World Water Works (WWW). WWW provided the complete TSA for the turnkey solution, including design, engineering, manufacturing and supply of the primary Ideal DAF™ and the Ideal MBBR-DAF™, the slot injector system for the EQ tank through the WWW package, as well as associated chemical feed equipment, start up and commissioning and performance guarantee. The new DAF-MBBR-DAF process is shown on **Figure 1**.

Figure 1 – Total systems approach at dairy facility



Note: Pictures are only representative and may not be actual site photos

The plant began treatment and within a few weeks the DAF units were operating at a fraction of the costs of the previous unit. The system has been designed so it can be expanded easily to meet further production needs. It is a flagship site for Dannon, and the plant has won awards at prestigious environmental conferences in the food industry.

Aseptic packager uses total system approach to upgrade overloaded pretreatment system

Using a TSA approach can frequently reduce land, labor, and operational costs compared to such traditional conventional wastewater approaches as activated sludge. In addition, using the TSA approach ensures that the system will actually meet permit effluent requirements.

Take the example of KanPak® LLC, a family-owned company based in Arkansas City, KS, which is a recognized leader in the development of aseptic packaging for beverages and desserts, including smoothies, coffee drinks, creamers, frozen desserts, cocktail mixes, and specialty beverages. The company is known for incorporating the highest degree of technological advancements in aseptic processing and packaging, including stringent quality control measures throughout each step of the production process.

To meet discharge and pretreatment requirements at one of its manufacturing facilities, KanPak had installed a traditional biological wastewater treatment system, including a biological process and a secondary DAF. The system included an interceptor/pump station; equalization tanks; aerobic fixed film bio treatment; secondary solids separation; DAF with flocculation tank; compressor/pressure tank; sludge dewatering; vertical rotary screw press; and a final effluent flow/pH monitoring.

Within a week of startup, the treatment process had failed; solids would not floc and effluent was out of compliance. The plant had been quickly overwhelmed by production discharge, as well as hot water (steam), sanitation products, floor foams, clean-in-place chemicals, and sterilants. The design load was 2,800 pounds/day of BOD_5 but the actual load was 5,600-14,000.

To solve the wastewater challenges, KanPak decided to embark on a TSA, using a partnership between Fuss & O'Neil and WWW. The work began with an evaluation of the treatment systems, which determined that the wastewater equalization tank was not designed properly for dairy wastewater. Dairy wastewater can go septic within hours if not properly handled, and the resultant odors and low pH were affecting downstream processes. They also noted that combined sanitary wastewater was a safety issue for operators, as well as a solids issue. The system was not properly dewatering, which was causing poor sludge quality. Finally, the treatment system lacked primary treatment – the high concentration of milk fat requires long hydraulic retention time for hydrolysis by bacteria, and interferes with oxygen transfer.

The evaluation also considered a major in-plant source reduction initiative undertaken by KanPak, which used an internal audit to identify excessive water usage and the potential for reduction. The audit resulted in recommendations for batching system modifications, directing boiler blow-down to the publically owned treatment works (POTW) instead of the pretreatment system, closed loop recirculation, conversion from retort to aseptic bottle line, and directing sanitary wastewater to the POTW. As a result, the hydraulics to the pretreatment system were reduced from 400,000 gallons per day (gpd) to 100,000 gpd.

Based on the evaluation and source reduction initiatives, WWW developed a TSA for KanPak, with improvements installed in phases over several years. The first phase resulted in odor elimination, reduced sludge production through better dewatering characteristics of the solids and savings on chemicals, as well as better TSS and organics removal. The second phase involved a pilot treatment study, followed by treatment plant design. The new system improved the EQ basin to prevent anaerobic conditions, installed a second DAF, replaced nitric acid for pH control with CO_2, and upgraded the biological treatment with a new aeration system. The third phase improved dewatering (going from 4 percent to 18 percent solids) and significantly reduced sludge disposal costs.

The end result of the TSA was improved sanitation with a marked reduction in water consumption, resulting in savings of more than $100,000 a year, a $4.5 million per year savings in sludge disposal and chemical costs, and a $1 million per year savings in compliance costs.

Turkey processor takes the pressure off municipal wastewater treatment

A final example of the benefit of a TSA is for Sarah Lee/Hillshire Farms, which needed expanded wastewater facilities for its Iowa turkey processing plant.

After conducting an evaluation of the plant's requirements, WWW suggested beginning with a DAF-EQ-DAF system and then conducting a further evaluation to determine if biological treatment was needed at all. The evaluation step gave the company time to review the impacts from the initial system and ask questions about what could be achieved with the effluent if additional treatment was added. The evaluation took place over the course of about nine months.

The company decided to add an MBBR to the treatment line, which reduced its BOD and TSS to single digits. The load reduction means the municipality now has significant additional capacity and will not have to expand its facilities to build any needed capacity.

Focusing on the total system as a whole is important because zoning in on only one specific component may result in missing the bigger part of the picture. Even if a company needs to replace only one piece of its system or add a new component, the project should still include the same elements, with a focus on complete problem evaluation and provision of a solution tailored to the company's individual needs.