food for thought

By Glen Lewis

Energy management technologies help food processing operations become more sustainable

Innovations in the integration of energy, weather and wastewater chemistry were recently conducted in food industry operations in conjunction with the California Institute of Food & Agricultural Research at the University of California-Davis. The work established and tested real-time enterprise energy management (EEM) technologies and methodologies used in food and beverage industry operations and sustainability initiatives with applicability to other manufacturing industry segments.

Green Energy Management System

The EEM technologies, called Green Energy Management Systems (GEMS), originated in food industry manufacturing operations' operational extensions into wastewater innovations. One of the paramount objectives is to demonstrate the real-time measurement and interrelationship of time-of-use (TOU) electricity demand, electricity usage and weather factors to measure wastewater quality metrics and the associated CO_2 emissions. GEMS technologies provide the ability to effectively achieve cost savings, sustainability objectives and regulatory compliance.

In summary, for effective food industry wastewater management and analysis, the following are baseline conditions representing current plant operations:

- Demand baseline;
- Demand variability baseline;
- Energy consumption baseline;
- CO_2 emissions baseline;
- Dissolved oxygen (DO) sensor composite baseline;
- DO versus weather for seasonal forecasting of weather-related impacts;
- DO versus kilowatts; and
- Biological oxygen demand (BOD) forecasting within confidence intervals.

In addition to these basic requirements, other food plant production-specific real-time chemical constituency measurements can be accommodated in GEMS, such as salinity and other applicable requirements contingent upon company-specific needs.

Food processing is an energy- and water-intensive operation. For example, fruit and vegetable processors in California consume approximately 30 billion gal of water per year. According to a recent survey of the California food processing industry, 23% of this water was for freshwater supply and 77% was for wastewater disposal. The production process requires water for cleaning, sanitizing, peeling, cooking and cooling, and as a conveyor medium to transport food materials.

Food processing wastewater can contain high levels of organic waste. In addition to the U.S. Environmental Protection Agency, California's food processing industry is regulated by the State of California Environmental Protection Agency, Department of Water Resources/Regional Water Quality Control Board, Air Resources Board and local jurisdictions.

Wastewater from food processing varies in composition and volume depending on the product, scale of operation, weather and season. Upstream efforts to reduce the volume of water used in food processing result in lower wastewater treatment costs, including energy costs.

From an energy perspective, TOU electricity demand management is critical in operations. In addition to TOU, it is important from a wastewater electricity demand cost perspective to determine the minimum kilowatt fixed base-load demand required at the lowest effective cost to meet regulatory requirements. The variable "swing" load can be adjusted on a seasonal basis with technologies such as GEMS where real-time kilowatt and weather data are integrated for reporting at 15-minute intervals at utility invoice-accurate costs.

High Stakes

From a wastewater chemistry standpoint, DO is the primary wastewater operations predictor for regulated BOD levels prior to effluent discharge. Meeting DO levels and subsequent BOD requirements is critical in mitigating both eutrophication and olfactory impacts—directly in wastewater discharges to rivers, or indirectly via municipal wastewater treatment facilities. If untreated, high levels of organic pollutants can severely harm aquatic ecosystems by depleting DO, raising water temperature, reducing growth rates of plant life, and potentially causing the death of fish and other aquatic organisms.

In wastewater operations, there is an inverse relationship between DO, outdoor air temperature and wastewater temperature. Oxygen is only slightly soluble in water. High temperatures on summer days reduce DO saturation capacity in wastewater and increase aeration and aspiration demand requirements.

In food processing wastewater lagoon operations, the paramount objective of aeration and aspiration is achieving the required DO saturation in lagoon wastewater to meet resulting BOD regulatory requirements for microbiological degradation of food production waste. Hence, aeration electricity demand is inversely related to DO levels.

In order to be sustainable, food and beverage companies need to approach the planning, forecasting and management of wastewater operations in an integrated, balanced and holistic context of total operations and supply chain management.

Companies should look at green advanced planning and scheduling technologies to plan energy-intensive production on a TOU basis. This will minimize costs, reduce environmental impact and assist in measuring and achieving corporate sustainability objectives to improve overall company market leadership and competitiveness. WWD

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