OTHER TREATMENT OPTIONS – W9

Eco-efficiency resources for the food processing industry

Wastewater technologies to consider

There are many different technologies (both established and emerging) that can assist food manufacturers in designing wastewater treatment or pretreatment systems. A few of these technologies are described below. It is often wise to have on site trials carried out to obtain good performance guarantees from the treatment system supplier.

Pretreatment

Pretreatment, to reduce the amount of contaminants prior to discharge, may enable a site's wastewater to fall into a lower discharge category thereby reducing local authority charges. Whilst this is technically an end-of-pipe solution rather than eco-efficiency, it can also be the first step in a treatment train providing secondary benefits such as water reuse or product or energy capture.

Pretreatment options include physical methods such as filters and screens, chemical treatments such as pH adjustment, the addition of flocculants to remove oils and fats, and biological treatments such as activated sludge removal.

Dissolved air flotation (DAF)

Dissolved air flotation (DAF) removes insoluble material in particular fats, oils and grease (FOG) and can also reduce total suspended solids (TSS), biochemical oxygen demand (BOD) and chemical oxygen demand (COD). High pressure air is pumped into a stream where it forms fine bubbles that entrain FOGs. The air bubbles with the insoluble material rise to the surface of the tank where they are skimmed off, while sludge falls to the bottom and can be easily removed. Flocculants and other chemicals can be added to the DAF to improve removal efficiencies.[1]

DAF is not effective in the removal of dissolved contaminants such as sugars or the BOD associated with the soluble material.

It can be useful as a pretreatment prior to discharge to sewer to reduce trade waste charges and is easy to install and operate, but can have high capital and operating costs. Some systems may have high energy and chemical requirements. A well considered design with the use of balancing tanks and regulation for example, can allow small compact robust DAF systems to deal with high rates of operation and variations in flow quality. [2]

DAF treatment system is useful in removing FOG

1 Envirowise, Dissolved-air flotation (DAF) application and design, www.envirowise.gov.uk/166728
2 Envirowise, DAF.

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Ozone

Ozone can be used as a sanitiser, refer to Cleaning and sanitising options fact sheet (W6).[3] It can also oxidise organic compounds in wastewater into smaller organic compounds allowing tertiary treatment processes such as activated carbon to remove the organics.

Ozone may not be appropriate for all systems, such as those with filtration systems where larger size particles maybe easier to remove.

Sonication

An emerging technology is sonication or ultrasound which uses vibration to remove fats. This technology can be used in wastewater systems to emulsify fats making them easier to remove by methods such as DAF.

Sonication has also been trialled in conjunction with anaerobic treatment as a means of disrupting sludge production to yield a larger quantity of biogas.[4]

Electro coagulation

Electro coagulation can be used to remove suspended and colloidal solids, fats, oils and grease and complex organics. The process involves passing an electrical current through water to initiate a range of electrochemical reactions which destabilise, suspend, emulsify or dissolve contaminants in the wastewater which forces them to precipitate.

Activated carbon

Activated carbon is generally used after biological or physical-chemical treatment to polish wastewater for reuse. The carbon absorbs both organic and inorganic compounds including heavy metals. Activated carbon is formed by heating carbon containing substances such as coal or charcoal in the presence of steam to form highly porous carbon providing a large surface area for contaminants to adsorb onto.[5] Activated carbon can be regenerated on site by heating carbon to a high temperature.

Using activated carbon prior to a disinfection phase can reduce the disinfection requirement. The use of activated carbon as part of the cooling tower or boiler water treatment can lead to better water efficiencies through reduced bleed.

Ultraviolet radiation (UV)

This chemical-free method of disinfecting water inactivates microorganisms such as protozoa, bacteria, moulds and yeasts through the use of ultraviolet radiation. The effectiveness of the system can be increased with the simultaneous use of ozone.[6] However, water quality characteristics such as high turbidity, organic components and flowrate can reduce efficacy. Like ozone, UV radiation does not provide any residual sanitisation compared with chlorine.

3 Pascual, A., Llorca, I. and Canut, A. 2007, "Use of ozone in food industries for reducing the environmental impact of cleaning and disinfection activities." Trends in Food Science and Technology 18, S29-S35.
4 T. I. Onyeche, T. L., Schläfer, O., Bormann, H., Schröder, C., and Sievers M., May 2002, Ultrasonic cell disruption of stabilised sludge with subsequent anaerobic digestion Ultrasonics, Volume 40, Issues 1–8, 31–35
5 The University of Queensland, Naiad Encyclopaedia www.awmc.uq.edu.au/docs/encyclopedia.pdf
6 EHEDG Update, 2005. "Safe and hygienic water treatment in food factories" Trends in Food Science & Technology 16, 568–573

The Golden Circle hydrocavitation system

Golden Circle hydrocavitation filtration system.

Hydrocavitation

Hydrocavitation is a chemical free system of water treatment. Two streams of water are accelerated to high velocities and collide which results in hydrodynamic cavitation and mechanical shear forces, which are believed to kill bacteria and reduce corrosion activity. It removes the need for chemicals and can increase the ability to reuse water.

It is generally applied to cooling tower water (refer to case study below) as it can control corrosion and kill *legionella*. However, new studies are investigating the efficiency of removing heavy metals, phosphorous and trichloroethylene (TCE) from wastewater with additional reductions in BOD.

HYDROCAVITATION SAVES MONEY AND WATER

Golden Circle saves thousands of litres of water and dollars per year through the installation of a hydrocavitation system on cooling tower water. Cycles of concentration in the cooling towers has been increased from three to more than seven, saving approximately 8 ML/year and chemical use has significantly dropped. The reduction in chemical usage had an additional bonus of reducing wastewater treatment requirements. The hydrocavitation system is leased by Golden Circle at a rate considerably less than the savings, providing a cost effect option. (Golden Circle is an ecoBiz participant.)

This series of fact sheets provides examples and suggestions to the modern food processor on how to achieve both economic and environmental benefits from eco-efficiency. Visit the project website www.ecoefficiency.com.au for more ideas and case studies.

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This series of eco-efficiency fact sheets will demonstrate the importance of water in a modern food factory and suggest areas where savings can be made. The project website www.eco-efficiency.com.au has more ideas and case studies on water savings across the food industry.

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