Energy and Sludge Cost Savings
with
ECOSYSTEM PLUS™

Neozyme International, Inc. has developed the EcoSystem Plus™ product, which has significant benefits in municipal and industrial biological wastewater treatment including energy savings and savings in sludge disposal costs. EcoSystem Plus™ (ESP) is a concentrated liquid product based upon Neozyme's bio-organic' catalyst technology, which has demonstrated the ability to increase dissolved oxygen (DO) concentrations in aeration tanks/basins through the formation of microbubbles, resulting in increased aeration efficiency. The technology will allow adequate levels of DO (1.5 to 2.5 mg/L) to be maintained while decreasing the energy requirements of the aeration devices.

ESP has also demonstrated the ability to reduce sludge quantities both by solubilising more of the incoming BOD_5 to be used as additional food for the biological process, and by increasing the rate of biological metabolic activity due to the greater availability of oxygen and solubilised food sources. ESP can induce endogenous respiration in the treatment plant biomass (thereby reducing waste activated sludge) even with relatively short Mean Cell Residence Times of 2.5 to 3 days.

The benefits of the ESP technology will vary with each particular treatment plant design and operating conditions. The following paragraphs discuss how to calculate the cost benefits for a given treatment plant based upon accepted engineering factors and actual operating data from some of the users of ESP.

1. Energy Savings

To calculate energy savings, it is necessary to first estimate the power consumption of the plant aeration system per pound of BOD_5 reduced (the Specific Aeration Power Consumption). This can be accomplished by using data from electric power metering on the aeration blowers or mechanical aerators to determine the average kWh consumption per day, and dividing by the pounds of BOD_5 reduced per day (kWh/lb BOD_5) across the aeration/clarifier biological treatment system (excluding BOD_5 reduction from any primary sedimentation or clarification). If no electric power consumption information exists, accepted engineering factors based upon field operating data for other plants could be used to estimate Specific Aeration Power Consumption. The oxygen transfer rate for mechanical aerators under field conditions has been estimated to be between 1.2 and 2.0 lb0^2/hp-hr in certain engineering references[1], and between 0.8 and 2.3 lb0_2/hp-hr in other references[2]. Lacking plant-specific information, a reasonable average oxygen transfer rate for estimating purposes in plants with mechanical surface aerators is 1.6 lb0^2/hp-hr. Using 1.2 lb O_2 per lb BOD_5 reduced, and converting to kWh using a 90% motor efficiency, this oxygen transfer rate would produce a Specific Aeration Power Consumption of 0.62 kWh/lb BOD_5. Diffused air type aeration systems have generally been shown to be 15% to 20% more efficient than mechanical aeration systems. If no plant-specific information exists, a factor of 0.5 kWh/lb BOD_5 can be used for estimating purposes in plants utilizing fine-bubble diffused air systems.

Application of the ESP technology in operating municipal wastewater treatment plants has consistently shown reductions in Specific Aeration Power Consumption of 35% to 40%. These results have been demonstrated in plants using mechanical aeration, and plants using diffused air aeration. Energy savings can be estimated for a given plant by applying this reduction percentage to the existing Specific Aeration Power Consumption, and multiplying by the pounds of BOD_5 reduced by the plant for the period of interest. The resulting kWh savings can then be multiplied by the average unit power cost in $ per kWh to determine the potential budget savings. The average unit power cost used in this calculation should include both energy and demand charges, and can be calculated by dividing the total dollar cost of power purchased by the plant for the given period by the total metered kWh, consumed in the period.

Figure 1 illustrates an example of potential annual energy cost savings for a range of treatment plant flows, utilizing mechanical aerators, over a range of unit power costs. The assumptions used in the calculations are listed. Neozyme International, Inc. will analyze specific plant data, and will determine the proper dosing rate to calculate the cost of treatment. Very often, the aeration cost savings will more than offset the cost of the ESP product, resulting in a net cost savings.

2. Sludge Reduction

Another major benefit of the ESP product is the reduction in wasted sludge. Sludge wasting can vary greatly between different plants due to different design and operating practices. It is recommended that plant-specific data be used in the calculation of potential cost savings from sludge reduction with the ESP technology.

The sludge wasting rate can be calculated for a plant by dividing the average pounds of sludge solids pumped from the secondary clarifiers by the average pounds of BOD_5 reduced (primary effluent pounds of BOD_5 per day minus the plant effluent pounds of BOD_5 per day). If these data are not available, accepted engineering factors can be used for estimating purposes. For activated sludge systems, the engineering literature sets theoretical wasting rates at 0.4 to 0.8 lb VSS (bacterial cells) per pound of BOD_5 reduced across the aeration tank or basin.3 In practice, however, actual sludge wasting rates have been shown to be significantly higher: between 1.5 to 2.7 lb sludge solids per lb BOD_5. Actual rates are higher because of the presence of inert solids, and the addition of polymers and other flocculent chemicals.

Applications of the ESP technology in several municipal wastewater treatment plants have demonstrated reductions of 25% to 35% in pounds of wasted sludge per pound of BOD_5 reduced. Potential cost savings can be calculated by applying this reduction percentage to the calculated sludge wasting rate (lb sludge solids/ lb BOD_5), then multiplying by the pounds of BOD_5 reduced for a given period of time. If sludge digesters are included in the plant, then the solids reduction by the digester must also be applied in the calculation (a typical anaerobic digester will reduce total solids by 45% to 50%). The result of this calculation is the potential pounds of sludge reduced by the ESP treatment. The cost per dry ton for treatment (dewatering equipment operation, polymer cost, composting cost, etc.) and disposal (hauling cost, disposal cost) can be multiplied by the pounds (tons) of sludge solids reduced to calculate the cost savings for the given time period.

Figure 2 illustrates an example of potential sludge treatment/disposal cost savings for a range of treatment plant flows, over a range of costs per dry ton (and per wet ton) of sludge. The assumptions used in the calculations are listed. These cost savings are in addition to aeration power cost savings, and very often will create a significant combined net cost savings for the plant after subtracting the cost of the ESP product.

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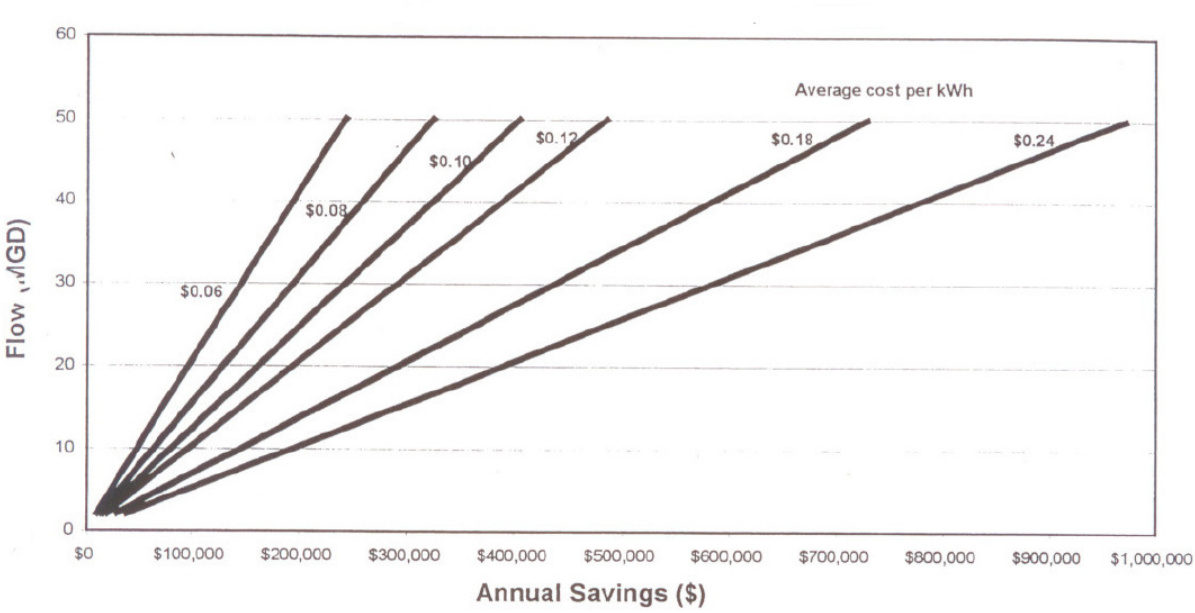
[1] Tchobanoglous, George, Wastewater Engineering: Treatment Disposal and Reuse, Metcalf & Eddy, Inc., 3rd Ed, McGraw-Hill, New York, 1991.
[2] WPCF Manual of Practice FD-13, Water Pollution Control Federation, Alexandria, Virginia, 1988.
[3] Water Pollution Control Federation, Activated Sludge, Manual of Practice OM-9, Alexandria, Virginia, 1987

Figure 1

Aeration Power Cost Savings
EcoSystem Plus™ Treatment
Activated Sludge Treatment: Diffused Air Aeration

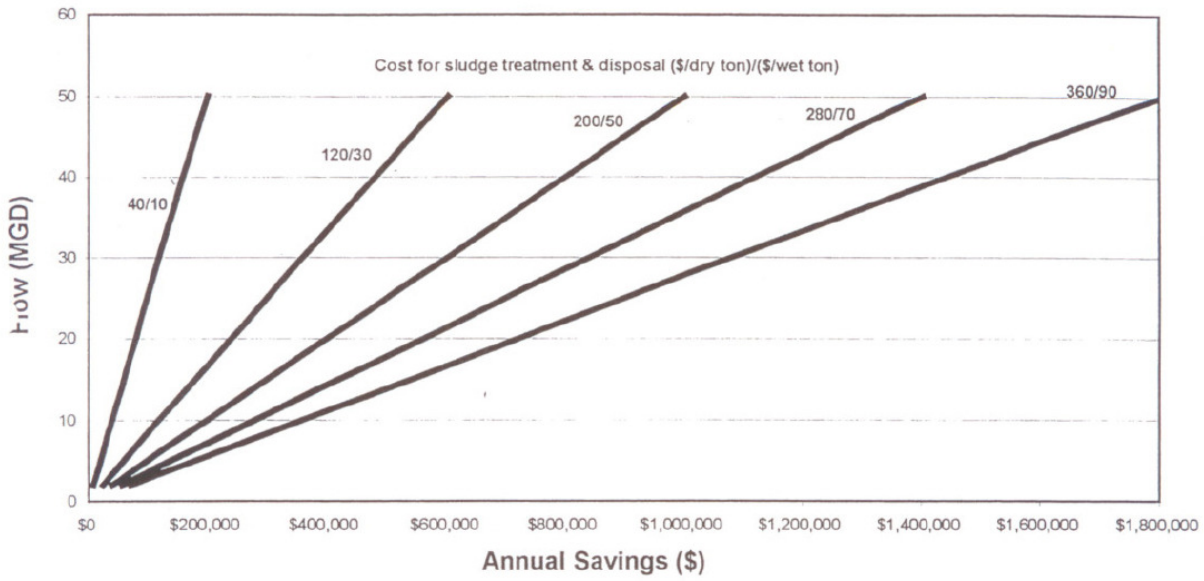


Assumptions:

Primary Effluent BOO_5 (mg/L):	140
Plant Effluent BOO_5 (mg/L)	7
Aeration Power Consumption (kWh/lb BOD_5):	0.62
Neozyme Treatment Reduction:	40%

Figure 2

Sludge Treatment/Disposal Cost Savings
EcoSystem Plus™ Treatment
Injection into Primary Clarifier



Neozyme Treatment Reduction:	30
Total Solids Reduction (anaerobic digester)	45

Assumptions:

Primary Effluent BOO_5 (mg/L):	14
Plant Effluent BOO_5 (mg/L)	
Aeration Power Consumption (kWh/lb BOD_5):	2