Aeration Efficiency Guide

EDI specializes in the research, development, and application of advanced technology aeration and biological treatment solutions for municipal and industrial wastewater treatment. EDI's focus on partnerships and value solutions supports new plant construction, existing facility upgrades and infrastructure maintenance. The qualified professionals and engineers at EDI provide the highest level of value added service, technology transfer, process application and system design support. EDI is a full service organization and provides field contract services for equipment installation, start-up and maintenance with demonstrated success with over 6,000 installations in 100 countries worldwide.

INTRODUCTION

“As energy costs continue to rise, knowledge of energy efficient technologies and best practices is becoming more valuable. While these practices have slowly gained acceptance within the wastewater industry, increasingly strained budgets coupled with aging infrastructure make energy efficiency a feasible option to save money.

Energy efficiency projects can vary in complexity from very simple – such as operating process equipment on a different schedule, to complex – changing the type of treatment system or replacing critical process equipment. Regardless of complexity, the benefits are numerous and typically include cost savings, improved treatment and increased system reliability.”

- excerpt from Water & Wastewater Industry Energy Best Practice Guidebook, Wisconsin Focus on Energy

EDI’s Aeration Efficiency Guide is designed to be a simple tool to help you spot energy conservation measure (ECM) opportunities related to aeration systems within wastewater treatment plants. The following pages contain items to look for when conducting initial WWTP plant evaluations. Additional data should be collected by using EDI’s “ECM Design Form”. Don’t be afraid to ask questions and be sure to take a lot of photos.

ENERGY AND WASTEWATER FACTS

- There are approximately **20,000 municipal wastewater treatment plants** currently in operation in the United States
- Nearly **4% of every kilowatt** generated in the U.S. goes to the movement and treatment of water and wastewater
- In a typical mid-sized city, **30% - 40% of energy use** results from water & wastewater treatment operations
- Up to **25% of a cities total energy use** is related to aeration
- WWTP's are rarely operated at design - on average plants run at only **1/3 of capacity**


Activated Sludge
"Plug Flow Design"


Oxidation Ditch
"Race Track Design"


Aerated Lagoon

COMPARATIVE ENERGY USE BY SYSTEM TYPE

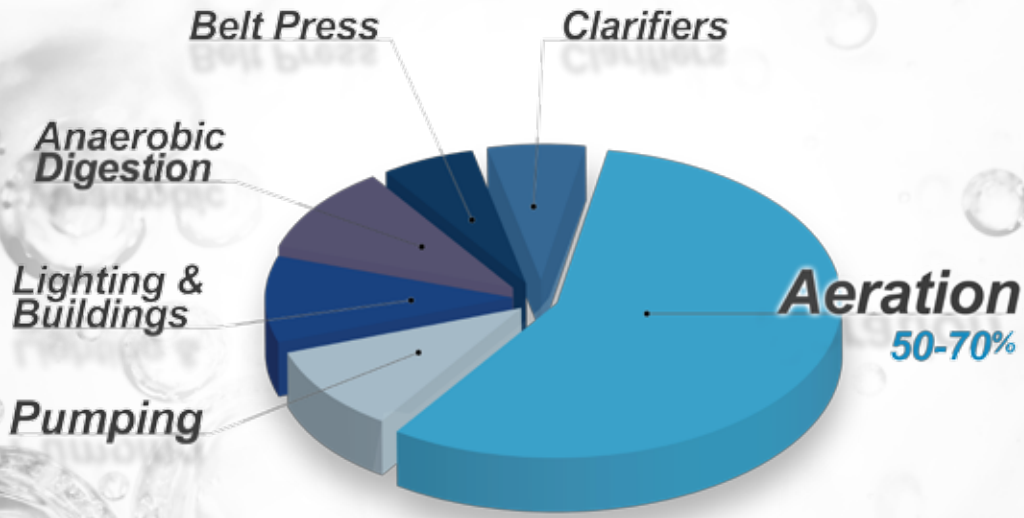
Treatment of wastewater is an energy intensive process. The cost of operating a wastewater treatment facility is increasing dramatically at current and projected energy costs. Energy efficient technologies are an important focal point in the planning and design of today's WWTP facilities.

Treatment Type	No. of Facilities Surveyed	kWh per Million Gallons Treated
Activated Sludge	51	3,954
Aerated Lagoons	15	7,288
Oxidation Ditch	19	6,895

- Derived from data from the State of WI, Focus on Energy, Water and Wastewater Energy Best Practice Guidebook

The table above presents energy use data for several types of treatment facilities. The energy requirement varies considerably, but in all cases, a significant amount of energy is consumed for all types of treatment facilities.

ENERGY USAGE AT A TYPICAL WWTP



This chart shows the electricity requirements for the primary operations in an activated sludge facility. Aeration is the most energy intensive operation in the plant. The selection and design of the aeration components should be carefully considered for maximum economic value.

Aerations systems can be found in many diverse applications such as:

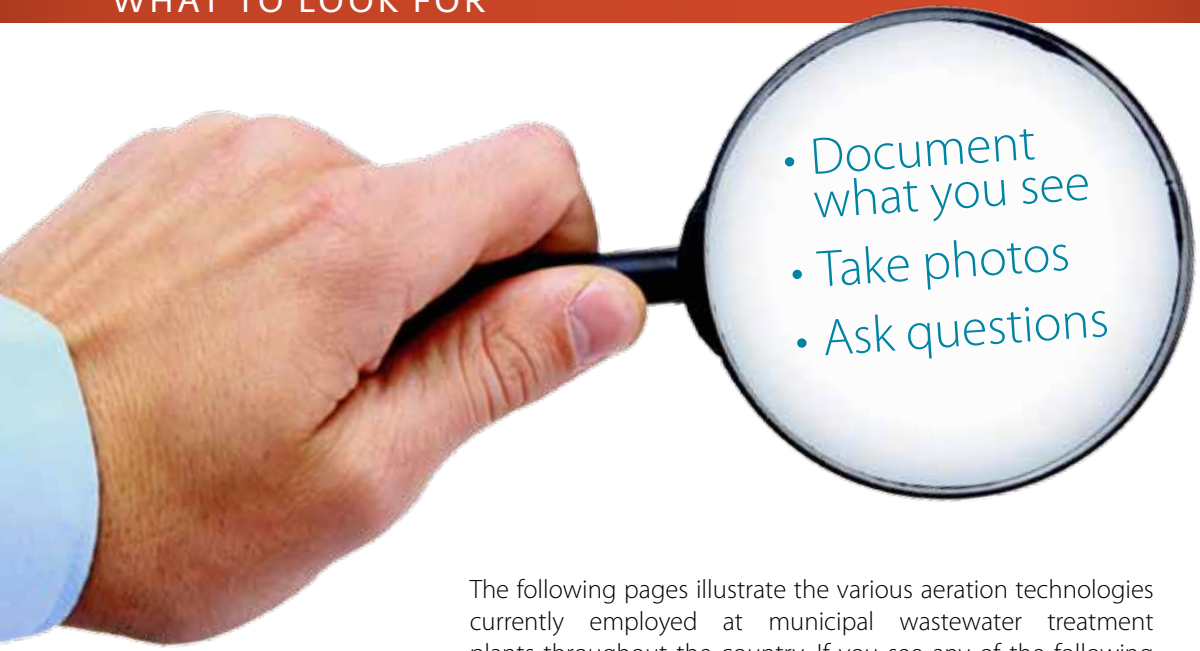
- Municipal Wastewater Treatment Plants
- Industrial Wastewater Treatment
- Food / Beverage Manufacturing
- Pulp & Paper Manufacturing Operations
- Airports
- Agricultural Processing
- Power Plants
- Aqua-culture facilities

WHERE TO LOOK FOR AERATION SYSTEMS

- Aerated Grit Chambers
- Equalization Basins
- Activated Sludge Basin / Process Aeration Basin
- Aerobic Digesters
- Sludge Holding Tanks
- Post Aeration Basins / Reaeration Basins
- Aerated Channels
- Lagoons – Complete Mix Cell / Partial Mix Cell

When in doubt, follow air distribution piping from blower units

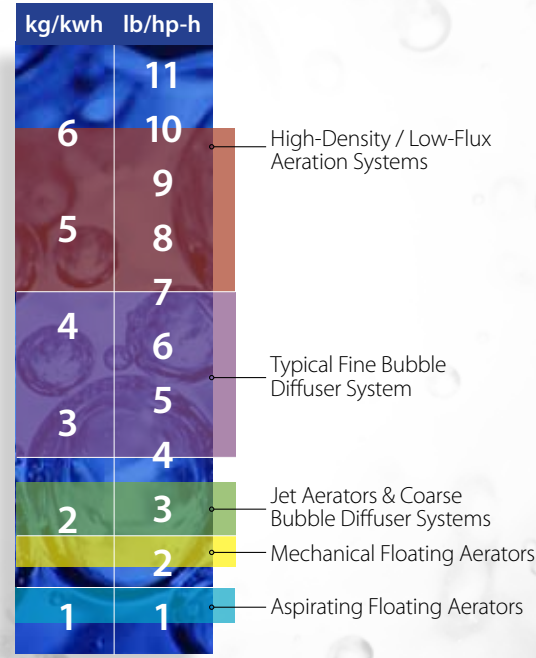
WHAT TO LOOK FOR



The following pages illustrate the various aeration technologies currently employed at municipal wastewater treatment plants throughout the country. If you see any of the following equipment, there is potential for energy conservation measures.

General Oxygen Transfer Efficiency

(standard conditions)



COARSE BUBBLE AERATION


Typical wide band coarse bubble diffuser


"Snap Cap" Style Diffuser

While certain applications require coarse bubble aeration, conversion from coarse bubble to fine bubble aeration represents a substantial energy saving opportunity.

SURFACE AERATION

Floating "aspirating" surface aerator/mixer

Deck mounted "splash" aerator

Brush type aerator

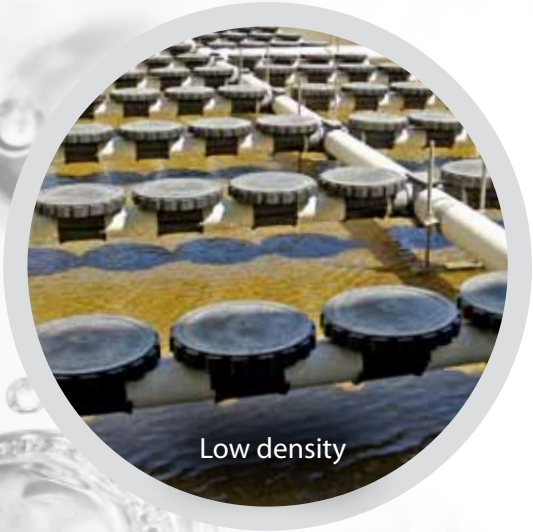
JET AERATION

While less common in municipal wastewater applications, jet aeration is less efficient than fixed-grid fine bubble aeration.

RBC'S

Rotating biological contactors are devices used in certain "package" wastewater plants. While fairly efficient, let us know and we'll check to see if we can improve energy performance.

LOW VS. HIGH DENSITY FINE BUBBLE AERATION

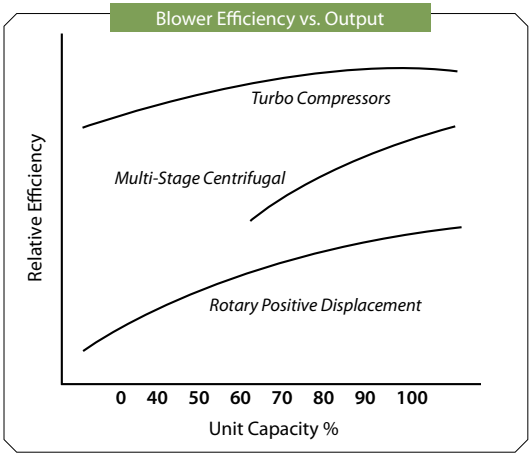


Even if the aeration system is relatively new, conservative design standards typically allow for higher density designs resulting in higher efficiency.

Rotary Positive Displacement
(60-65% mechanical efficiency)

Multi-Stage Centrifugal
(65-80% mechanical efficiency)

High Speed Turbo Blowers
(80-85% mechanical efficiency)



Rotary positive displacement and multi-stage centrifugal blowers decrease in efficiency with turndown. High speed turbo blowers provide more constant efficiency.

Variable Frequency Drive (VFD)

Dissolved Oxygen Probe (DO Probe)

The use of variable frequency drives (VFD's) and dissolved oxygen (DO) probes can greatly decrease aeration operating costs by maintaining correct oxygen levels within aeration basins and reduce airflow from the blowers. Ask the operator the operating DO levels of the basins. Dissolved oxygen levels greater than 2 mg/L = wasted energy.

ECM DESIGN FORM QUESTIONNAIRE

1. Project Name
2. Project Location (get plant address)
3. Consulting Engineer (if applicable)
4. Type of Project (New/Upgrade)
5. Type of Waste (Municipal/Industrial)
6. Treatment Process (Activated Sludge, Lagoon, Oxidation Ditch, etc)
7. Basin Liquid Temperature (Summer OF / Winter OF)
8. Elevation (WWTP elevation above sea level)

9. Basin(s) Dissolved Oxygen Level (mg/L)

10. WWTP Design Average Flow, Current Flow, Peak Permitted Flow (GPD/MGD)

11. Influent BOD (mg/L) & Permit Effluent BOD Requirement (mg/L)

12. Influent Ammonia (mg/L) & Permit Effluent Ammonia Requirement

13. Number & Type of Aeration Basins (ie., lagoon, oxidation ditch)

14. Basin Dimensions: (Length x Width x Operating Depth)

15. What type of aeration system is currently employed? Manufacturer?

16. Collect any available data logs from operator.

ADDITIONAL ITEMS TO NOTE

- Air drops (note number, size & location)
- DO probes (if any, note quantity & location within basin)
- Surface Bubble Pattern (Is it a coarse bubble or fine bubble pattern?) (When in doubt shoot a photo or video.)
- Blowers (photograph nameplates & serial plates – very important)
  - Manufacturer/Type
  - Number (qty) & number currently operating
  - Size of blower (HP)
  - Serial #'s / Nameplates – shoot a photo when possible
  - SCFM & PSIG
  - Approximate distance from blowers station to basin
  - VFD info (note any output information)
  - Note/photograph any meters that may indicate pressure (PSIG), energy usage, etc.
- If aeration basins are full, ask what type of aeration system lies beneath.

EDI ECM RECOMMENDATIONS

In preparation of ECM recommendations, Environmental Dynamics International uses a comprehensive approach to develop value solutions designed to address the unique opportunities presented by each project. EDI solutions include the evaluation of biological processes, aeration, blower & control technologies to achieve each project's energy efficiency requirements while meeting the project's financial return objectives.

EDI takes into consideration each facility's existing infrastructure, influent wastewater properties and permitted effluent requirements. EDI then conducts a biological process review and models the aeration system to optimally treat the waste stream under current operating conditions.

EDI then selects the appropriate aeration technology from a variety of diffuser platforms. Our design approach insures that the best suited technology offered by EDI is matched to the application's specific requirements.

Finally, EDI evaluates blower and control technologies and makes a selection based upon capital cost, returns investment, payback terms, operational flexibility, maintenance requirements, and long-term operational efficiency.

EDI provides streamlined project delivery and support by offering installation & maintenance services, replacement parts and on-going technical support.

NOTES

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