Technical Bulletin 169

Design of Diffused Aeration System

by:

Environmental Dynamics International

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For more information regarding this bulletin or your specific aeration application, contact Environmental Dynamics International at +1 (573) 474-9456.

EDI is a specialist in the supply and optimization of aeration mixing systems for maximum performance. The performance can be engineered to meet the requirements of minimum energy, minimum capital cost, or maximum mixing. Any one of those items can be selected as the design basis; however, design criteria needs to be provided for an optimized design regardless of the overall objective selected.

EDI manufactures diffuser systems of multiple types. We are flexible in the design to optimize the performance of any one of those types of diffusers based on the needs of the customer. With EDI offering disc diffuser units, tube diffuser units, or panel diffuser units, we can select diffuser type to meet the geometry of the basin or the operating conditions that are present at any given facility. For EDI to offer the process support and the optimization there are some key elements that must be reviewed and data that must be provided. A brief discussion of some key design criteria is enclosed for facilitating working together with our customers, our representatives and partners on Aerated Systems.

What type of diffuser:

As indicated, EDI offers discs, tubes and panels as diffuser solutions. Selection of which type of diffuser to use depends a great deal on the application to be employed or preference of the customer. It should be noted that disc units, tube units, or panel units each have separate materials of construction, so sometimes the type of wastewater will determine the best selection of diffuser types. The membrane that is suitable for the particular wastewater may dictate that a particular geometry of diffuser be employed. For other applications it is a matter of customer preference or economics.

In general, it should be noted that the tube diffuser units which are perforated top and bottom are generally preferred for those places where great capacity is required, medium to high efficiency is required, and particularly where mixing is the primary objective.

Disc diffuser units tend to be the more universal application in many areas with a reasonable amount of mixing, and the geometry of the diffuser is such that it gives easy utilization in small basins or odd shaped basins as multiples of smaller units are sometimes easier to employ than the larger tube, or panel diffuser components. Disc diffuser units are a high-efficiency for many applications as they are technically a circular panel and will give similar performance to panels for a given amount of surface area. The limiting factor on the disc diffusers is generally how much disc area you can put in a tank as the geometry does not allow them to be distributed with a high density i.e. 30% of the floor cover is about a maximum.

Panel diffusers are the system that can give the highest O2 transfer efficiency. The panels are somewhat less flexible and may find it more difficult to fit specific plant geometry. The panels may not be the most economical if you are working at medium or low O2 transfer efficiencies in the application.

Design information:

With the basic discussion on discs, tubes, or panels above we still need design information in order to design with any of those types of diffusers. Some of the items that are required for design are exactly the same regardless of diffuser type you might select:

1. What is the basin size? We must know the following:

    a. Width
    b. Length
    c. Depth

The depth is the most critical item for any diffuser system as it determines the efficiency of that particular device. Without the depth information you cannot design the system.

2. What is the wastewater material that is being treated?

It is clear that we must know the type material being treated i.e. sewage, industrial waste and/or what type of industrial waste. The type of waste that is to be handled is going to dictate materials of construction, perhaps the process that is to be employed, and the expected amount of performance that can be achieved.

3. What is the plants' objective?

We have 3 objectives that can be designed for optimum performance and they are mutually exclusive. You can design for lowest capital cost. You can design for highest O2 transfer efficiency. Or you can design for an optimum performance that is the lowest total cost of ownership over the life of the project. This is a case where you must pick 1 of these objectives otherwise the design will not be optimized.

4. What type of diffuser?

If there is a preference for the customer, you can pick any one of those diffusers and get the same performance in O2 transfer efficiency or energy in most cases. All 3 types of diffusers may give the same energy performance but may have a huge difference in the capital cost. Diffuser type could have a huge difference in the operational flexibility. All of these items are negotiable, so the design objectives must be clearly stated.

5. What process is being employed?

Is this going to be a process for carbonaceous removal only? Carbonaceous plus ammonia? Total BNR operation with nitrification and denitrification plus possibility of phosphorous removal? All of these can impact the type and the operational characteristics of the diffuser selected.

6. Is the system to be fixed to the floor?

This is critical because we can offer the systems with retrievable diffuser systems when desired. It should be noted that all of these types of diffusers can be made retrievable however it is also necessary to point out that retrievable systems typically cost 50% to 100% more than the fixed grid simple piping systems that are attached to the floor. Materials of construction of retrievable grids and the structural component necessary to lift them in and out will dictate they are more expensive. EDI has offered disc units, tube units, panel units all in retrievable systems and have no preference other than to satisfy the needs of the customer.

7. What is the process or type of basin? Is this going to be in a concrete basin? Is this going to be in a lagoon?

EDI has different configurations of diffusers that can be selected for piping if it is fixed to floor in a concrete basin or in the case of lagoons it can be floating piping with suspended diffusers. The

Lagoon Solution is an excellent way of designing systems, but it is critical to know it is a lagoon application or is it a concrete basin application?

8. How much is the loading that is to be handled?

The flow, the BOD, the ammonia content, or O2 demand are critical in order to be able to optimize the sizing of the diffusers and to help size the blowers that go with the diffuser systems. EDI can design any system if it is given the airflow and the efficiency we must provide, however we always like to know the process details, so we can do a rough check and confirm if there are areas where we might offer suggestions on the design of the process or optimization of the diffuser solution for benefit of the customer. Knowing the process details is more than the average diffuser manufacturer cares to employ however, we find it very helpful in our support of our customers.

9. In order to do a detailed design, we have design brief calculations that can be run. In this design brief we need all the process information requested for the loadings above however, there are other details that must be considered, including the elevation of the site above sea level, the temperature of the water being treated, the temperature of the ambient air for summer and winter, and any other details that could be influencing the performance of the system. If we are given the SOR, or clean water transfer requirements of the system we can design it without all these other details however, we would caution that the SOR values for different types of devices may be different and it is helpful to know what basis of calculation was used to develop the SOR value.

10. EDI has a data form that can be used to provide data to allow EDI to optimize a design for each application. If we understand the emotional or economic design requirements of the system, we can use this data to optimize the selection of diffusers by type, how many diffusers, the blower capacity that might be required, and give some cost estimates that may be helpful. It is clear that the there are ways to buy diffusers as simply commodity items. EDI does not consider diffuser design as a commodity solution and believes it is very beneficial to our customers and partners to have an optimized design prepared so we can work together for best customer value.

If there are questions on any of this information, please let me know. In those cases where we need to supply a system design or cost analysis please complete the attached data form as it will give us great information to either give you the analysis or enough information we can ask proper questions in order to do a proper analysis in more detail.

Sincerely yours,

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Chairman

aeration for life™

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AERATION DESIGN DATA CHECKLIST

1. Project Name or Job#: _____
   Project Location: _____

2. Contact Name:_____
   Company: _____
   Contact Email:_____ Phone: _____

3. Type of Project: New Upgrade

4. Which Design Objective (circle one)
   a) Lowest capital cost
   b) Lowest lifetime cost
   c) Lowest energy cost
   d) Cost of energy per KWH _____

   Hardware Selections (circle answers below)
   a) Type of Diffuser: Fine Coarse
   b) Disc Tube Panel
   c) Pipe Materials _____

5. Type of Wastewater: _____

6. Treatment Process: (circle one)

   SBR Activated Sludge Extended Aeration Lagoon Sludge Digester Other: _____

7. Number of Aerated Basins: _____ (If multiple basins – attach sheet with details for each basin)

   Depth Length Width . (m/ft)

8. Are mixers in the aeration basins? YES NO (If yes show on dwg or sketch)

9. Design SOTR (Cleanwater) _____ kg O2/day (____pounds O2/day)

   Peak SOTR _____ kg O2/day (_____pounds O2/day)

NOTE: EDI prefers the SOTR of process oxygen (Item 9) be supplied when available. This minimizes variation in design values and provides quicker answers for your use. Items 10-17 are helpful in all cases, but* MUST *be provided if no values for item 9.

10. AOR / Field process O2 _____ kg O2 /day (____pounds O2/day)
11. Bio-Reactor Liquid Temperature: Summer ____°F/C Winter ____°F/C
12. Plant site elevation above sea level: m/ft
13. Basin Dissolved Oxygen Concentration mg/l design
14. Alpha and Beta Factors: Alpha Beta _____(to compute SOR)
15. Design Avg. Flow _____ Peak Flow _____ m3/day or MGD
16. Influent - BOD mg/l _____ Effluent Required - . mg/l
17. Influent – NH3-N mg/l _____ Effluent Required - .mg/l
18. Attach sketch, drawing(s) or engineer's specifications, if available