

Oxygen and Airflow Calculation for Coarse Bubble Diffuser

If you want to properly size a coarse bubble diffuser system, understanding oxygen demand is the step, which can be estimated by the formula:

$$O_2 \text{ (Theoretical Demand)} = a \times Q \times (S_0 - S_e) + b \times V \times X$$

Formula Parameter Description:

- **a:** Oxygen required to degrade 1 kg of BOD (kg O₂/kg BOD). Empirical range: 0.4–0.6 (commonly 0.5 for the activated sludge process).
- **b:** Oxygen consumed daily by endogenous respiration per kg of MLSS (Mixed Liquor Suspended Solids) (kg O₂/kg MLSS·d). Empirical range: 0.1–0.15 (commonly 0.15).
- **Q:** Design wastewater flow rate (m³/d).
- **S₀:** Influent BOD concentration (kg/m³, i.e., g/L; e.g., 200 mg/L = 0.2 kg/m³).
- **S_e:** Effluent BOD concentration (kg/m³).
- **V:** Effective volume of the biological tank (m³).
- **X:** MLSS concentration in the biological tank (kg/m³; e.g., 3000 mg/L = 3 kg/m³).

Actual Oxygen Supply:

$$O_2(\text{actual}) = O_2(\text{theoretical}) / EA \text{ (Oxygen Transfer Efficiency)}$$

Aeration Rate:

$$G = O_2(\text{actual}) / (\text{Oxygen content in air})$$

● Example:

For a plant treating 10,000 m³/day of wastewater with influent BOD of 200 mg/L (0.2 kg/m³), effluent BOD of 20 mg/L (0.02 kg/m³), MLSS of 3 kg/m³, MLVSS = 0.8 × MLSS, and tank volume of 5,000 m³, assuming a=0.5, b=0.15, and SOTE of 15% (coarse bubble), the oxygen and airflow requirements can be calculated as O₂(theoretical)=2,556 kg/day, O₂(actual)=17,040 kg/day, air volume ≈ 61,126 m³/day ≈ 2,547 Nm³/h (at standard conditions: 20°C, 1 atm). With this, you can quickly estimate the blower capacity and energy implications for each diffuser type.