*Technical Bulletin 128*

# Basic Aeration Design Calculations

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# TECHNICAL BULLETIN 128 – BASIC AERATION DESIGN CALCULATIONS

Aeration requirements are usually developed from basic process design data applicable to each site. We have provided common air calculations in the examples below.

Example Number 1

Known data:

- Population: 3,000
- Typical domestic wastewater
- Allow 0.2 lb BOD/person per day (0.0972 kg/person)
- Allow 2 lb O2/lb BOD (2 kg/kg) to accommodate some nitrification when NH3 (ammonia) concentration is not known.

Oxygen Calculations

Estimated field O2 requirement for extended aeration:

- O2/day = 3000 persons * 0.2 lb BOD/person * 2 lb O2/lb BOD = 1,200 lb O2/day (544.32kg/day)

- O2 required = 50 lb O2/hr = 22.68 kg O2/hr = field or process conditions = AOR

- Oxygen Transfer SOTE = 18% at 10 ft Diffuser Submergence (typical) = SOTE (5.5% per meter and 3.05m diffuser submergence)
  Note: SOTE increases as air/diffuser is reduced.

- Assumed AOR/SOR* = 0.45 (typical correction for clean water efficiency to field efficiency). This value is calculated from site elevation, process, DO level in the tank, temperature, and density of diffusers.

- SOR = 50 lb/hr/0.45 = 111.72 lb/hr (50.68 kg O2/hr)

- Air = 111.72/1.044 * 0.18 = 595 SCFM (942 Nm3/hr)
  Note: SCFM = Standard Cubic Foot of Air per Minute. 1 SCFM of air equals 1.584 Nm3/hr or approximately 1.7 Sm3/hr.

*Note: For process calculations of AOR/SOR, see EDI's computerized Design Brief procedures or Integrated Diffused System Analysis Procedures. Calculations are available upon request from EDI.

Example Number 2

Known data:

- Municipal waste – Conventional activated sludge
- Flow – 5 mgd (18,931 m3/day)
- BOD – 250 mg/l
- NH3 (ammonia) – 30 mg/l
- Process O2 requirements
    - 1.2 lb O2/lb carbonaceous BOD (1.2 kg O2/kg of BOD)
    - 4.6 lb O2/lb NH3 (4.6 kg O2/kg of ammonia)
    - % SOTE = 18% @ 10 ft diffuser submergence (clean water efficiency) (5.5% per meter and 3.05 m submergence)
    - Assumed AOR/SOR = 0.45 (typical correction for clean water efficiency to field efficiency)

Oxygen Calculations

Process or field O2 for carbonaceous BOD:

- 5 mgd * 8.34 * 250 mg/l * 1.2 lb O2/lb BOD = 521.25 lb O2/hr AOR (236.5 kg O2/hr)
- SOR = 521.25/0.45 = 1,158.4 lb O2/hr (525.4 kg O2/hr)
- Air for Carbonaceous = 1,158.4/1.044 * 0.18 = 6,165 SCFM (9,765 Nm3/hr)
- O2 for ammonia = 5 mgd * 8.34 * 30 mg/l * 4.6 lb O2/lb NH3 = AOR
    - AOR = 5,754.6 lb/day (2,610.3 kg O2/day)
    - SOR = 5,754.6/0.45 = 12,788 lb O2/day = 532.9 lb/hr (241.72 kg O2/hr)
- Air for ammonia = 532.9 lb/hr/1.044 * 0.18 = 2,836 SCFM (4,492 Nm3/hr)
- Total air = Carbonaceous + Nitrogenous = 6,165 SCFM + 2,836 SCFM = 9,601 SCFM (16,562 Nm3/day)

  Note: SCFM = Standard Cubic Foot of Air per Minute. 1 SCFM of air equals 1.584 Nm3/hr or approximately 1.7 Sm3/hr.

Calculating air volumes allows confirmation of design and blower selections. For Integrated Diffused Aeration Systems analysis and optimization, EDI conducts a more rigorous evaluation.

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