Aerobic Digester Volume, Oxygen and Air Requirement

Aerobic digester sludge flow and volume from SRT, volatile solids destroyed, oxygen at 2.3 kg per kg VSS, and air with oxygen transfer efficiency.

Input parameters

Unit system: SI

Parameter	Value	Unit
Waste sludge to the digester (dry)	300.00	kg/d
Thickened sludge solids	2.0000	%
Sludge specific gravity	1.0200	
Solids retention time	40.000	d
Volatile fraction of the sludge	75.000	%
Volatile solids reduction (from degree-days)	40.000	%
Oxygen per VSS destroyed	2.3000	kg/kg
Air density at standard conditions	1.2040	kg/m³
Oxygen transfer efficiency	8.0000	%
Liquid temperature (for degree-days)	20.000	°C

Calculated results

Parameter	Value	Unit
Sludge flow	14.706	m³/d
Digester volume	588.24	m³
VSS destroyed	90.000	kg/d
Oxygen required	207.00	kg/d
Air at standard conditions	741.06	m³/d
Air supplied	6.4328	m³/min
Air per digester volume	0.010936	1/min
Degree-days	800.00	

Notes for this case

• Take the volatile solids reduction in the degree-day curve (about 45 % at 900 °C·d, 50 % at 1,500 °C·d). Air is 23.2 % oxygen by mass. If the air per volume is below the mixing range (about 0.02-0.04 m³/min·m³ for diffused air), mixing governs the blower size.

Formula and method

$$Q = \frac{M}{\rho_w SG\, P_s}, \quad V = Q \cdot SRT, \quad O_2 = 2.3\, f_v R_{VS} M, \quad V_{air} = \frac{O_2}{0.232 \rho_a}, \quad q = \frac{V_{air}}{OTE}$$

Variables

M	Waste sludge to the digester (dry)	kg/s
P_s	Thickened sludge solids	-
SG	Sludge specific gravity	-
SRT	Solids retention time	s
f_v	Volatile fraction of the sludge	-
R_{VS}	Volatile solids reduction (from degree-days)	-
r_{O_2}	Oxygen per VSS destroyed	kg/kg

ρ_a	Air density at standard conditions	kg/m³
OTE	Oxygen transfer efficiency	-
T	Liquid temperature (for degree-days)	K
Q	Sludge flow	m³/s
V	Digester volume	m³
VSS_{red}	VSS destroyed	kg/s
O_2	Oxygen required	kg/s
V_{air}	Air at standard conditions	m³/s
q_{air}	Air supplied	m³/s
q_{air}/V	Air per digester volume	1/s
$T \cdot SRT$	Degree-days	-

Method and standards

Aerobic digester design.

Assumptions and limits

- Single-stage complete mix; nitrification complete.

Report details

Report reference	FCC-MK42-GDR0 (the same inputs always give the same reference)
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Release checks	3 reference cases of this calculator, computed independently, are checked on every release

Results are for engineering estimation. Verify critical designs against the referenced standards and your own data.

This calculator online

https://calc.firecad.com/environmental/wastewater/aerobic-digester-design

Open this case on calc.firecad.com →

Reopens the calculator with the inputs of this report.