Trickling Filter BOD Removal (NRC Equation)

BOD removal efficiency of a single-stage stone trickling filter from BOD load, media volume and recirculation by the NRC equation, corrected for temperature.

Method: Metcalf & Eddy; Wastewater Engineering: Treatment and Resource Recovery; ...

Input parameters

Unit system: SI

Parameter	Value	Unit
Wastewater flow	4,000.0	m³/d
Settled influent BOD	180.00	mg/L
Filter diameter	25.000	m
Media depth	2.0000	m
Recirculation ratio	1.5000	
Wastewater temperature	20.000	°C

Calculated results

Parameter	Value	Unit
BOD load	720.00	kg/d
Media volume	981.75	m³
Recirculation factor	1.8904	
Efficiency at 20 °C	78.367	%
Efficiency at T	78.367	%
Effluent BOD	38.940	mg/L

Notes for this case

- The NRC equation comes from military-camp stone filters treating domestic sewage after primary settling; apply it to plastic media and industrial wastes with care.

Formula and method

$$E = \frac{100}{1 + 0.4432\sqrt{\frac{W}{VF}}}, \quad F = \frac{1+R}{(1+R/10)^2}, \quad E_T = \min\left(E_{20}\,1.035^{T-20},\ 0.99\right) \quad (W\ \mathrm{kg/d},\ V\ \mathrm{m^3})$$

Variables

Q	Wastewater flow	m³/s
BOD	Settled influent BOD	kg/m³
D	Filter diameter	m
H	Media depth	m
R	Recirculation ratio	-
T	Wastewater temperature	K
W	BOD load	kg/s
V	Media volume	m³
F	Recirculation factor	-
E_{20}	Efficiency at 20 °C	-
E_T	Efficiency at T	-
BOD_e	Effluent BOD	kg/m³

Method and standards

NRC first-stage equation.

Assumptions and limits

- The temperature-corrected efficiency is capped at 99 % (the page says when the cap applies); the NRC equation was not fitted to removals that high.
- Single stage; domestic-type wastewater.

References

• Metcalf & Eddy
• Wastewater Engineering: Treatment and Resource Recovery
• 5th ed. (McGraw-Hill, 2014)
• ch. 9 (NRC equations for stone-media trickling filters, SI form, θ = 1.035)

Report details

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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/trickling-filter-nrc

Open this case on calc.firecad.com →

Reopens the calculator with the inputs of this report.