Wastewater treatment: Neutralization

Exercise:

A wastewater flowrate of 0.38 m³/min is highly acidic and requires neutralization prior to biological treatment. This flow is to be neutralized to a pH of 7.0 using hydrated lime.

A two-stage neutralization system will be used with lime consumption according to the titration curve obtained in the lab (total lime consumption 2250 mg/L).

Determine:

(1) The **daily lime consumption** for each stage.

(2) The **annual cost of lime**, considering a price of 150 €/ton of lime.

(3) The **volume of the neutralization tanks**, considering a HRT of 5 min for each stage.

(4) **Power for mixing** the tanks, considering a power requirement of 40 W/m³.
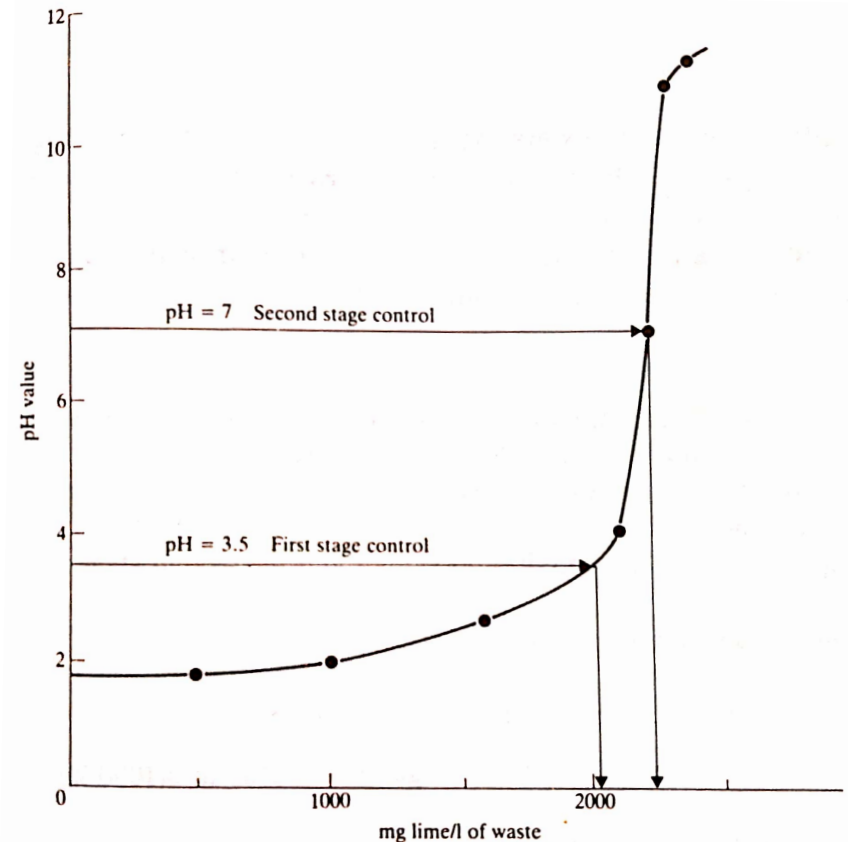
Solution:
(1) 1094 kg/day and 137 kg/day
(2) 67408 €/year
(3) 1.9 m³ each stage
(4) 76 W

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(1) Daily consumption of lime, for each stage:

L1 = 0.38 m^3/min · 1000 L/m^3 · 1440 min/day · 2000 mg/L · 10^{-6} kg/mg = 1094 kg/day

L2 = 0.38 m^3/min · 1000 L/m^3 · 1440 min/day · 250 mg/L · 10^{-6} kg/mg = 137 kg/day

(2) Annual cost

Cost = (1094+137) kg/day · 10^{-3} ton/kg · 365 day/year · 150 €/ton = 67408 €/year

(3) Volume of the tanks

V = Q·HRT = 0.38 m^3/min · 5 min = 1.9 m^3

(4) Power for mixing

P = V · power requirement = 1.9 m^3 · 40 W/m^3 = 76 W