

Turning a primary clarifier into a fermenter: Analysis using titrimetry



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Efficient Denitrification AIR > ===== $6NO_3 - + 5CH_3OH \rightarrow 3N_2 + 5CO_2 + 7H_2O + 6OH$ M-230 M-250 M-240 Needs adequate COD source LSHH-210 Creates alkalinity to maintain optimum pH

Fermenter

::: AIT-110

LSLL-100

SBH

V-111

DÉLAIS RESET LSLL

5.00

OUT

P-110

P-120

Titrimetry, a titration based method to measure VFAs

Primary clarifier

Objective:

IN

V-102

Figure 1. pilEAUte plant bioreactor (anoxic zone in red)

Soluble organic matter in the form of **VFAs** by a *higher degree* of fermentation in the primary sludge blanket.

Nutrient removal rate in the downstream treatment plant.



Figure 6. Titration curve of a sludge blanket sample

Figure 7. Methrom Titrino device with a Sample Processor

Buffer capacity curves: An application of titrimetry





SLUDGE

How to turn a primary clarifier into a fermenter?

Operational factors for VFA enhancement

Increase sludge age in blanket

Qr

- Recirculation line from bottom back to inlet
- pH conditioning by dosing alkaline



Figure 3. Schematic of the primary clarifier with recirculation





Figure 4. Internal recirculation set-up

Sample Composition	Concentration mg/L	pKa 1	pKa 2
Alkalinity (HCO ₃)	100.12	6.37	10.5
VFA (as CH ₃ COOH)	442.72	4.76	-

Figure 8. Buffer Capacity Curve in meq/L/pH

What is my wastewater's composition?



Simulating a down-titration with PHREEQC



Solution 2 Wastewater sample Wastewater sample after titration

Running PHREEQC

Reading database Simulating titration Time-series

Solution 1

Experimental curve ≅ PHREEQC curve (calculated) (titration)

Running OpenSolver

Table 2. Calculated concentrations of VFAs & Alkalinity using PHREEQC as a simulator

Sample Composition	Concentration mg/L
Alkalinity (HCO ₃)	110.3
VFA (as CH ₃ COOH)	446.32



Figure 5. pH, VFA, and alkalinity profiles along the sludge blanket height

Table 1. Operating and environmental conditions HRT SRT QW HRT SRT

m3/d

0.04

2.1



Sample composition V

Figure 9. PHREEQC simulated curve fitted with least error on the experimental curve

TAKE HOME MESSAGE

Titrimetry allows analyzing the pH and alkalinity profiles in a primary clarifier to monitor the reactive settler's performance and evaluate the VFAs produced in the sludge blanket. It allows assessing the benefits for improved denitrification in the subsequent bioreactors.

