



Milk Waste - BOD, FOG, PO₄

NONAME Milk company operates an evaporated milk plant in NOTOWN, NOSTATE. They generate an average of 58,000gpd of contaminated water with spikes of 1,200 gallons up to 12 times per day. They use two 2,000 gallon batch tanks for pH adjustment before discharge. Most of the flow goes through the tanks. There are two discharge sewer exits from the building. Both include sanitary facilities, but the samples contained no surprises.

The plant discharge limits are on a pounds-per-day basis. Their average limit is 514 pounds BOD and 6.1 pounds phosphorous at a pH at $6 < \text{pH} < 9$. Based on the average flow, this represents 1,062mg/l BOD and 12.6mg/l phosphorous. The typical overall flow is $>1,800\text{mg/l BOD}$.

Initial samples were provided for bench-scale testing and were evaluated in a report beginning on 6-3-03 (Tests 1 through 4). That sample was grabbed from the flow prior to and following pH adjustment. The samples were iced down and tested immediately upon receipt to avoid degradation. Test #5 was added to produce a set of samples for off-site analysis by a contract laboratory.

Tests #6 and #7 were made with a new sample taken over time as a composite. This sample should be more representative of the average flow.

Conclusion

This waste appears to be an excellent candidate for the KASELCO process based on visual indicators and analyses.

It appears that the raw water will treat more easily and completely than the treated water (in other words, do away with the biological treatment). The scheme will require either some pH adjustment of the raw wastewater or set the KASELCO EC system to treat at reduced amperage, and should be followed by DAF solids separation.

The system should be sized at 50gpm (24,000 gallons per eight hour shift) with sufficient equalization capacity to capture spike flows. It may be possible to automate the system so that the collected water's pH is reduced to a given point and the rectifier amperage automatically adjusted to attain the optimum discharge pH of 8.1-8.5.

Bench Scale Kaselco Electrocoagulation Treatment

EVALUATION OF THEIR PRETREATED WATER

Test #1: Treated water sample, tested as received:

The treated water sample was a cloudy water that showed a pH of 7.42 and conductivity of 2,49 μS (microsiemens).

The sample drew the optimum amperage at mid-scale voltage in a type 05 reactor. The water became clear at mid-reactor (1A) and remained clear through the reactor exit (1B). The pH rose steeply from 7.42 to 9.76 at mid-reactor, then more slowly to 9.91 at the reactor exit. A floating, gold floc developed that would separate well using dissolved air flotation. The final pH was higher than desired, and the sample was not analyzed.

Test #2: Treated water sample, pH adjusted:

The pH of the sample was lowered from 7.42 to 6.54 using the equivalent of 0.1 gallons of 50% sulfuric acid per 1,000 gallons of wastewater. The sample pH rose from 6.54 to 8.07 at mid-reactor and to 9.09 at the reactor exit. The sample turbidity was reduced from 191FAU (Formazin Attenuation Units) originally to 49 at mid-reactor and to 30 at the reactor exit. Phosphates were reduced from 108.4mg/l to 11.0mg/l by the reaction. Excess iron was generated, raising the iron level from 0.138 to 2.11mg/l. This water would turn brown on standing.

The water was clear at mid-reactor and remained clear. Sludge generation was 3.75 pounds dry sludge per 1,000 gallons of wastewater, or one cubic foot per 19,000 gallons of wastewater.

Test #3: Untreated water, tested as received:

The untreated water had a cloudy appearance with a pH of 8.95 and a conductivity of 1,450 μ S. It drew the optimum amperage. The pH rose steeply from 8.95 to 10.13 at mid-reactor and to 10.40 at the reactor exit. The water had a light green color, probably excess iron, at mid-reactor and was clear at the finish. The pH was higher than desired and no analyses were done.

Test #4: Untreated water, pH lowered:

The test was repeated after lowering the pH from 8.95 to 6.45 using the equivalent of 0.19 gallons of 50% sulfuric acid per 1,000 gallons of wastewater. The pH rose to 8.08 at mid-reactor and to 9.45 at the reactor exit. Clarity improved from 174 to 18FAU at mid-reactor and to 2.5FAU at the exit. Phosphates fell from 41.25 to 2.5 following the reaction. Iron rose, with excess iron at 3.88mg/l in the final water. The BOD was reduced from 149 to 54mg/l, oil and grease from 17.7 to 9.5, turbidity from 174FAU to 4FAU, phosphates from 108.4 to 11.0, and iron increased from 0.063 to 3.88. The test was also run at one-half scale amperage with equivalent results.

Sludge was produced at the rate of 4.67 pounds dry sludge per 1,000 gallons of waste.

This test definitely constituted over-treatment. The water was essentially treated at mid-reactor.

Test #5: Repeat Test #4, filter, and re-run:

This test was conducted to test a concept used for seawater where the solids are removed between successive passes through the reactor. There was little difference seen in the result.

EVALUATION OF THEIR RAW, UNTREATED WATER**Test #6:** New sample tested as received:

The sample showed a pH of 10.63, conductivity of 4,410 μ S, BOD at 1,092mg/l, and oil and grease at 30.6mg/l. The pH was lowered to 6.4 using the equivalent of 0.68 gallons of 50% sulfuric acid per 1,000 gallons of waste. The pH then rose to 9.00 at mid-reactor and to 10.23 at the reactor's exit. The conductivity rose to 4,600 μ S following the reaction. Floc production was normal. The large pH shift indicated the reaction could be accomplished at a lower amperage.

Test #7: Repeat #6 at half-scale amperage: The test was repeated at half-scale amperage. The pH rise was less, to 6.75 at mid-reactor and to 8.46 at the reactor's exit. The BOD was reduced from 1,092 to 531mg/l. The oil and grease was reduced from 30.6 to less than detectable limits. Only a slightly larger lowering of the BOD was seen when tested at 4 amps.

Lab Data

NONAME MILK PRODUCERS 06-04-03

TEST # 1 (as is) Treated Sample

PROFILE: pH 7.42. Conductivity 2,490 μ S. Appearance is cloudy white water. Run in # 05 steel reactor.

<u>PASS</u>	<u>pH</u>	<u>COND</u>	<u>AMPS</u>	<u>VOLTS</u>	<u>%</u>
1-A	9.76	2,330	4	30	66
1-B	9.91	2,360	4	34	68

COMMENTS: 1A Clear water, floating green floc. 1-B Clear water floating gold floc.

TEST # 2 (pH adjusted) Treated sample

Added 7 drops H₂SO₄. Adjusted profile: pH 6.54. Conductivity 1,870 μ S. Appearance is cloudy white water.

Run in # 05 steel reactor.

<u>PASS</u>	<u>PH</u>	<u>COND</u>	<u>AMPS</u>	<u>VOLTS</u>	<u>%</u>
1-A	8.07	2,310	4	28	60
1-B	9.09	2,380	4	28	60

COMMENTS: 1A clear water, floating green floc. 1-B Clear water floating gold floc.

<u>PASS</u>	<u>Turbidity</u>	<u>PO4</u>	<u>Fe</u>
PROFILE	191	108.4	0.138
1-A	49	22.6	1.07
1-B	30	11.0	2.11

1000ml wet sludge test, 170ml @ 15min. 130ml @ 30min. & 100ml @ 60min.

100ml dry sludge test 0.045 g

TEST # 3 (as is) Untreated Sample

PROFILE: pH 8.95. Conductivity 1,450 μ S. Appearance is cloudy white water. Run in # 05 steel reactor.

<u>PASS</u>	<u>PH</u>	<u>COND</u>	<u>AMPS</u>	<u>VOLTS</u>	<u>%</u>
1-A	10.13	1,429	4	23	54
1-B	10.40	1,499	4	23	54

COMMENTS: 1A light green water, floating green floc. 1-B Clear water, floating green floc.

TEST # 4 (pH adjusted) Untreated sample

Added 13 drops H₂SO₄. Adjusted profile: pH 6.45. Conductivity 1,363 μ S. Appearance is cloudy white water.

Run in # 05 steel reactor.

<u>PASS</u>	<u>PH</u>	<u>COND</u>	<u>AMPS</u>	<u>VOLTS</u>	<u>%</u>
1-A	8.08	1,504	4	34	70
1-B	9.45	1,509	4	34	70

COMMENTS: 1A light green water, floating green floc. 1-B Clear water, floating green floc.

<u>PASS</u>	<u>Turbidity</u>	<u>PO4</u>	<u>Fe</u>
PROFILE	174	41.25	0.063
1-A	18	8.1	0.924
1-B	4	2.5	3.88

1000ml wet sludge test, 130ml @ 15min. 100ml @ 30min. & 90ml @ 60min.
100ml dry sludge test 0.056 g

OUTSIDE TESTING 06-13-03

PASS	BOD	OIL & GREASE
PROFILE /Treated sample	149	17.7
1-B / Treated sample	54	9.5
PROFILE / Untreated sample	438	6.9
1-B / Untreated sample	221	<0.005

TEST # 5 (repeat test #4, then filter and run again) Untreated sample

Added 13 drops H₂SO₄. Adjusted profile: pH 6.51. Conductivity 1,360μS. Appearance is cloudy white water.

Run in # 05 steel reactor.

<u>PASS</u>	<u>PH</u>	<u>COND</u>	<u>AMPS</u>	<u>VOLTS</u>	<u>%</u>
1-A	8.10	1,510	4	34	70
1-B	9.52	1,522	4	34	70

COMMENTS: 1A light green water, floating green floc. 1-B Clear water, floating green floc.

NOTE: Sample was filtered, then tested again.

<u>PASS</u>	<u>PH</u>	<u>COND</u>	<u>AMPS</u>	<u>VOLTS</u>	<u>%</u>
2-A	10.24	1,520	4	32	68
2-B	10.51	1,532	4	33	69

COMMENTS: 1A & 1-B Clear water floating green floc.

<u>PASS</u>	<u>Turbidity(FAU)</u>	<u>PO4</u>	<u>Fe</u>
PROFILE	174	41.25	0.063
1-B	4	2.5	3.88
2-B	<0.005	11.4	1.40

NEW SAMPLE 08-01-03

PROFILE: pH 10.63. Conductivity 4,410μS. Appearance is cloudy white water. Run in # 05 steel reactor.

TEST # 6 (pH adjusted) sent for outside testing

Added 1.5 ml H₂SO₄. Adjusted profile: pH 6.49. Conductivity 4,610μS. Appearance is cloudy white water. Run in # 05 steel reactor.

<u>PASS</u>	<u>PH</u>	<u>COND</u>	<u>AMPS</u>	<u>VOLTS</u>	<u>%</u>
1-A	9.00	4,540	4	21	50
1-B	10.23	4,600	4	16	40

COMMENTS: 1A & 1-B clear water floating green floc.

TEST # 7 (pH adjusted & lower amps) sent for outside testing

Added 1.5 ml H₂SO₄. Adjusted profile: pH 6.40. Conductivity 4,600µS. Appearance is cloudy white water. Run in # 05 steel reactor.

<u>PASS</u>	<u>PH</u>	<u>COND</u>	<u>AMPS</u>	<u>VOLTS</u>	<u>%</u>
1-A	6.75	4,705	2	10	26
1-B	8.46	4,740	2	10	26

COMMENTS: 1A cloudy water, floating gold floc. 1-B clear water, floating green floc.

OUTSIDE TESTING 08-11-03

PASS	BOD	OIL & GREASE
PROFILE	1,092	30.6
1-B / 4 – AMPS	516	<5.0
1-B / 2 – AMPS	531	<5.0

Glossary

- Profile: The characteristics of the waste being tested.
- Range Percent: Bench scale rectifier control setting.
- 1A: Equivalent of half a pass through a full-scale production reactor.
- 1B: Equivalent of one full pass through a full-scale production reactor.
- Type: KASELCO EC reactors come in three electrical configurations and is chosen based on the wastewater's conductivity.