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**Evaluation Of NPDES Permit
Compliance Monitoring Inspections
By The Government Of American Samoa**

**NATIONAL ENFORCEMENT INVESTIGATIONS CENTER
DENVER, COLORADO**

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EVALUATION OF NPDES PERMIT COMPLIANCE MONITORING INSPECTIONS
BY THE GOVERNMENT OF AMERICAN SAMOA

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I. INTRODUCTION

In June 1978, personnel from the National Enforcement Investigations Center (NEIC) evaluated the compliance monitoring inspection capabilities of the Government of American Samoa (GAS). The Van Camp Sea Food Company and Star-Kist Samoa, Inc. tuna canneries compose the major industry of American Samoa. Both canneries, located on Pago Pago Harbor, are required to discharge their industrial wastewater in compliance with the effluent limitations of their NPDES* permits issued in 1974.

The NEIC personnel were in American Samoa at the request of Region IX of the Environmental Protection Agency (EPA). Their purpose was to inspect the tuna canneries** and subsequently prepare EPA's position in an adjudacatory hearing requested by Van Camp for changes in its NPDES limits.

While in American Samoa, NEIC was also asked to assist the GAS personnel in their annual wastewater inspection of the canneries, and to evaluate GAS's capabilities to conduct future compliance monitoring as required by the NPDES permits. Both field work and laboratory analysis were evaluated by NEIC personnel, who also provided classroom and laboratory instruction to Mr. Pati Faiai, Special Assistant to the Governor, and his staff, Mssrs. Ativalu Ativalu, Jr., Isako Matautia, and Toma Tise.

* NPDES: National Pollutant Discharge Elimination System, Public Law 92-500, Sec. 402 of the Federal Water Pollution Control Act as amended in 1972, and subsequently Sec. 402 of The Clean Water Act as amended in 1977.

** Results of the cannery inspections are reported in separate NEIC reports: "Compliance Monitoring and Wastewater Treatment Evaluation, Van Camp Sea Food Company, Pago Pago, American Samoa" and "Compliance Monitoring and Wastewater Treatment Evaluation, Star-Kist Samoa, Inc., Pago Pago, American Samoa."

II. SUMMARY AND CONCLUSIONS

SUMMARY OF THE EVALUATION

NEIC personnel evaluated the field and laboratory aspects of the compliance monitoring capabilities of the Government of American Samoa in June 1978. On June 27 to 30, the GAS had scheduled an NPDES compliance monitoring inspection of the wastewater effluents from the Van Camp Sea Food Company and Star-Kist, Samoa, Inc. tuna canneries.

Before the inspection NEIC personnel instructed the GAS staff in the field operations of measuring flow, calibrating equipment, collecting samples, and keeping data records. NEIC personnel also reviewed with the GAS staff the methodology and quality control procedures of laboratory analysis performed on the wastewater samples, and directed hands-on performance of various lab tests.

During the inspection, NEIC evaluated the GAS field capabilities. After the inspection, the GAS sample data were compared to the split-sample Company data, and NEIC evaluated the GAS laboratory analytical capabilities. NEIC provided written procedures for wastewater monitoring to the GAS staff as reference for future inspections.

CONCLUSIONS

The GAS technicians properly collected manual representative samples of the wastewater effluents during the inspection, and they should be able to do so for future compliance monitoring. The staff understood the recommended method for collecting and preserving composite and discrete samples, demonstrating acceptable techniques over the four-day monitoring period.

Although the technicians can perform the analyses for biochemical oxygen demand, total suspended solids, and oil/grease, they do not have enough experience in evaluating the analytical results to determine if the data are reasonable. Until such experience is gained, caution should be exercised in using their data for enforcement purposes. An experienced analyst should be on-site to supervise the analytical activities.

III. FIELD CAPABILITY

NEIC INSPECTION

The GAS compliance monitoring inspection of the tuna canneries was scheduled for June 27 to 30, 1978. Before the inspection, NEIC personnel discussed field work with the GAS staff. NEIC then trained and advised the staff in techniques of measuring flows, calibrating equipment to measure temperature and pH, collecting effluent samples, and keeping data records while in the field. Previous GAS methods and NEIC instruction in these field operations are given below.

Flow Verification

The GAS technicians did not know how to verify that the Parshall flumes at each cannery were indicating the correct flows. On the day before sampling, the technicians were shown how to measure instantaneous flows through the flume and to determine that the continuous recorders were indicating correct flows. If the recorders were not indicating the correct flows, the technicians were instructed to inform the cannery personnel and request that the recorders be reset.

Equipment Calibration for Temperature and pH

Although the technicians knew how to verify that the pH and temperature recorders were indicating correct values, they had not checked the recorders on previous sampling inspections. They were instructed by NEIC personnel to take a wastewater sample and measure the pH and the temperature with a calibrated pH meter and thermometer and then check

the continuous recorders' instantaneous values. If the recorders were not indicating correct values, the technicians were instructed to notify cannery personnel to recalibrate the recorders.

Sampling

The NPDES tuna cannery permits require collection of composite wastewater samples; a composite is defined as the:

"combination of not fewer than 8 individual samples obtained at equal time intervals over the specified time period. The volume of each individual sample collected shall be proportional to the discharge flow rate at the time of sampling. The sampling period shall be the period between 8 a.m. and 4 p.m. for each day of sampling."

Formerly, the GAS technicians collected a sample aliquot in a quart jar every hour between 8 a.m. and 4 p.m., and recorded the flow after each aliquot was collected. Then, after taking the last aliquot, they composited all 9 aliquots into one sample on a flow-weighted basis.

Although this method is acceptable, an alternate method was recommended by NEIC which would reduce the possibility of error. Instead of collecting 9 aliquot samples and compositing after eight hours, the technicians were instructed to collect one aliquot hourly and pour the correct amount into the composite sample container immediately after collection. This method eliminates extra sample containers and possible mixups in identifying hourly aliquots with the correct flow. Also, at the end of the 8-hour monitoring period, the sample is complete and can immediately be split with the cannery personnel.

Field Data Records

The GAS technicians were instructed to keep records in their field logbooks including:

1. Dates of sampling
2. Names of samples
3. Calibration of company-owned equipment (pH, temperature, and flow recorders) including the indicated readings before and after calibration.
4. Instantaneous flow, pH, and temperature values, each time aliquot samples are collected.
5. Amount of hourly aliquot sample poured into composite sample.
6. Physical appearance of the wastewaters (e.g., color, solids, oil sheen).
7. Comments made by Company personnel concerning the wastewater treatment facility including names or personnel, dates and times.

Written Instructions

Written instructions of the compliance monitoring procedures were provided for future reference [Appendix A]. These instructions were to be translated into Samoan by Pati Faiai.

EVALUATION OF GAS WASTEWATER MONITORING

Flow Measurement

The GAS technicians checked the flow recorders at Van Camp and Star-Kist on June 26, the day prior to sampling. The recorders on the 9" Parshall flumes at each cannery did not indicate the correct

flows. The technicians observed the calibration of the recorders, then verified that the flows indicated were correct. Flows were checked periodically during the 4-day monitoring period. The technicians understood the flow verification procedure and during future inspections should be able to verify that flows are accurate.

Temperature and pH Calibration

The pH and temperature recorders checked on June 26 were indicating correct values. Because the technicians do not have a portable pH meter, they were instructed to calibrate Company-owned pH meters in the canneries' quality control laboratories to verify the wastewater pH's.

Sample Collection

The technicians collected hourly sample aliquots of the Star-Kist wastewater and flow-composited the aliquots into one sample. At 4 p.m. each day, the sample was split with Star-Kist personnel. Because samples of the Van Camp effluent are collected with an automatic sampler which collects an equal volume aliquot for each 15 m³ (4,000 gal) of flow, the GAS technicians were asked by NEIC personnel to collect a sample aliquot each time the automatic sampler collected an aliquot so that sampling methods could be compared. For future inspections, the technicians were advised to collect one aliquot hourly and composite on a flow-weighted basis as was done at Star-Kist.

During the monitoring period, representative samples were collected and composited correctly by the technicians. They should be able to collect representative samples on future inspections.

Field Data Records

Field notes including instantaneous and total flows, pH, temperature, and amount of sample aliquots added to the composite sample were entered into their logbooks. Entries were also made on preservation temperature, times and dates of flow calibration, and remarks made by Company personnel.

IV. LABORATORY CAPABILITY

NEIC INSTRUCTION

From June 25 to July 2, 1978, NEIC personnel reviewed the GAS analytical procedures for biochemical oxygen demand (BOD), total suspended solids (TSS) and oil/grease (O/G). The first part of the training consisted of classroom lectures. The methods for the above parameters were discussed in detail, including topics such as choice of equipment and supplies, detailed description of the test procedures, instrument calibration procedures, and quality control techniques. The second phase of review consisted of hands-on performance of the tests, by the GAS staff at the LBJ Hospital laboratory.

Methodology

Mr. Ativalu had prepared written procedures for BOD and O/G from methods given him during previous visits by NEIC and Region IX personnel. The BOD method closely followed the procedure given in Standard Methods for the Examination of Water and Wastewater. The method was reviewed and specific sample dilution and data calculation instructions were well provided [Appendix B].

All samples for BOD analysis were pre-diluted in a graduated cylinder. The first day all samples were pre-diluted 1/10; thereafter, the influents were diluted 1/20 and the effluents 1/10. Then 5, 15 and 20 ml of each diluted sample were set up in duplicate. Several BOD bottles were set up only with dilution water to check its quality each day.

Dissolved oxygen (DO) measurements were performed by the Winkler procedure. The initial DO of all samples was taken to be the average of the DOs of the duplicate dilutions of all samples. The mean depletion of the blanks was 0.1 mg/l or less, except for one day. The blank depletion was subtracted from the sample depletions in the calculations.

The O/G analytical procedure closely followed Standard Methods. The samples were extracted in separatory funnels with freon, the emulsion was drawn off into a beaker and dried with sodium sulfate. The dried freon was filtered through Whatman #40 paper into a tared beaker. The freon was evaporated on a water bath, and the beakers were desiccated and weighed.

The GAS personnel did not have a written procedure for TSS. The NEIC procedure was provided [Appendix C], consisting of sample filtration through Whatman GF/C glass fiber filters on a membrane filter holder.

Quality Control

A simple technique to calibrate the analytical balance was demonstrated, and the balance was calibrated before each use. A mercury thermometer was calibrated, and the temperature of the solids oven and BOD incubator were measured.

The BOD dilution water quality was checked and met the criteria in Standard Methods.

The cleanliness of the O/G glassware and the purity of the freon was checked by analyzing blanks each day. Blank results were negligible.

All TSS samples were analyzed in duplicate. In addition, blank samples were analyzed daily. The results were corrected for the blank values.

COMPARISON OF DATA

The effluent composite samples collected by the GAS technicians and the Company-collected influent and effluent composite samples were split to allow a comparison of results [Tables 1 and 2]. Discrete samples for O/G analyses were collected simultaneously by the GAS and Company representative. Because the O/G samples were not from the same aliquot, the results could be different and still be representative of the wastewater [Table 3].

The Star-Kist analyses of the composite samples for BOD and TSS were approximately 40% greater than the GAS analyses and the Star-Kist O/G analyses were about 30% greater than the GAS analyses, excluding three O/G samples (GAS analyses appeared to be incorrect for the three samples).

The Van Camp analyses for BOD averaged 60% greater than the GAS analyses. However, the Van Camp data do not appear valid because of the large DO depletions in the dilution water.* Eight of 12 samples analyzed by Van Camp for TSS were less than the GAS results, but 4 of the 8 were influent samples which contained very high solids and were difficult to analyze. The O/G values reported by Van Camp averaged 25% of the GAS results. The Van Camp O/G data does not compare with results previously reported in the Discharge Monitoring Reports; the method used by Van Camp may be responsible for their low values.**

* The large DO depletions were investigated by NEIC personnel and the Company personnel were instructed on proper techniques. The DO depletions were normal as of July 3, 1978.

** "Compliance Monitoring and Wastewater Treatment Evaluation Van Camp Sea Food Company, Pago Pago, American Samoa, Oct. 1978," Appendix E (EPA-330/2-78-016).

Table 1
COMPARISON OF SPLIT SAMPLE BOD DATA
VAN CAMP SEA FOOD COMPANY, AMERICAN SAMOA
June 27-30, 1978

Date	Sample Identification	GAS ^a Analysis mg/l	Van Camp Analysis ^b mg/l	VC/GAS
27	GAS Effluent Composite	1,740	2,570	1.48
28	GAS Effluent Composite	1,140	2,750 ^c	2.41
29	GAS Effluent Composite	2,340	3,260 ^c	1.39
30	GAS Effluent Composite	3,060	2,730	0.89
27	Van Camp Effluent Composite	2,160	3,309	1.53
28	Van Camp Effluent Composite	1,140	3,463	3.04
29	Van Camp Effluent Composite	1,860	3,800	2.04
30	Van Camp Effluent Composite	2,940	3,334	1.13
27	Van Camp Influent Composite	2,100	3,640	1.73
28	Van Camp Influent Composite	2,800	3,840	1.37
29	Van Camp Influent Composite	4,920	5,560	1.13
30	Van Camp Influent Composite	6,840	5,530	0.81

a GAS = Government of American Samoa

b Results of consultant

c Only one sample not depleted for GAS and Van Camp composite, therefore same value reported for each sample

Table 2
COMPARISON OF SPLIT SAMPLE TSS DATA
VAN CAMP SEA FOOD COMPANY, AMERICAN SAMOA
JUNE 27-30, 1978

Date	Sample Identification	GAS ^a Analysis mg/l	Van Camp Analysis ^b mg/l	VC/GAS
27	GAS Effluent Composite	214	167	0.78
28	GAS Effluent Composite	169	162	0.96
29	GAS Effluent Composite	329	424	1.29
30	GAS Effluent Composite	198	318	1.61
27	Van Camp Effluent Composite	226	200	0.88
28	Van Camp Effluent Composite	208	188	0.90
29	Van Camp Effluent Composite	426	436	1.02
30	Van Camp Effluent Composite	245	328	1.34
27	Van Camp Influent Composite	1,540	1,510	0.98
28	Van Camp Influent Composite	1,990	1,640	0.82
29	Van Camp Influent Composite	2,450	2,180	0.89
30	Van Camp Influent Composite	2,355	2,090	0.89

a GAS = Government of American Samoa

b Results of consultant

Table 3
COMPARISON OF O/G DATA, SAMPLES COLLECTED SIMULTANEOUSLY
VAN CAMP SEA FOOD COMPANY, AMERICAN SAMOA
JUNE 27-30, 1978

Date	Sample Identification	Time of Collection	GAS ^a Analysis mg/l	Van Camp ^b Analysis mg/l	VC/GAS
27	Effluent	9:00 am	62	8.1	0.13
		11:00 am	28	9.0	0.32
28	Effluent	9:00 am	57	10.6	0.19
		11:00 am	23	9.3	0.40
29	Effluent	9:00 am	41	23.2	0.57
		11:00 am	70	18.3	0.26
30	Effluent	9:00 am	278 ^c	19.2	0.07
		11:00 am	269 ^c	12.7	0.05
27	Influent	9:00 am	264	34	0.13
28	Influent	9:00 am	413	25	0.06
29	Influent	9:00 am	231	57	0.25
30	Influent	9:00 am	231	99	0.43

a GAS = Government of American Samoa

b Results of consultant

c Data appears to be too high, possible analytical error

EVALUATION OF GAS ANALYTICAL CAPABILITY

The GAS technicians have very limited experience in analyzing tuna cannery wastewaters. The sampling inspection survey conducted once per year does not provide the staff sufficient opportunity to practice their laboratory techniques or gain experience in evaluating data.

The GAS technicians performed all of the laboratory work during the June 27-30 survey with the exception of the preparation and weighing of some of the TSS filters. Several problems in analytical technique, such as weighing procedure, preparation of standard solutions, volume measurements and sample aliquoting procedure, were evident. Most of the problems were corrected but this does not mean that the errors will not be repeated.

A mixup in sample bottles occurred on June 27; fortunately the mixup did not affect the monitoring results. Six composite samples were to be analyzed daily for BOD and TSS; one influent and two effluent samples (Company-collected influent and effluent composite samples, and GAS-collected effluent composite sample) from each cannery. On June 27, the personnel at Star-Kist did not collect an influent sample due to a communication error, however the GAS technicians provided BOD and TSS data for the missing sample. When questioned about the analysis, they did not know what sample container they used for the analysis. The data provided for a non-existent sample shows that experienced supervision is necessary.

The technicians have not had enough experience in analyzing wastewater samples and evaluating the data to know when the results are reasonable. Generally they could not determine when the results should be re-checked. It is apparent that while the GAS technicians can analyze for BOD, TSS and O/G, mixups and errors might occur. Because

of the present state of GAS training, the data would be questionable and unsuitable for enforcement action. The problems could be corrected by having an experienced analyst supervise laboratory operations.

The GAS should either hire an experienced analyst familiar with wastewaters from the canneries and municipal wastewater treatment plants or send one of the technicians to an EPA laboratory for an extended period of training. Short-term training will not be adequate

APPENDIX A

COMPLIANCE MONITORING PROCEDURES FOR TUNA CANNERIES

COMPLIANCE MONITORING PROCEDURES FOR TUNA CANNERIES

Day Prior to Sample Collection

A. Calibrate the Company's pH meter (either step 1 or 2)

1. With Government of American Samoa meter

Calibrate GAS meter with pH buffers 4, 7 and 9, then determine pH of the effluent. If Company meter and GAS meter pH values differ, recalibrate GAS meter and recheck pH of effluent. If pH values still differ, have Company recalibrate their pH meter. Record all pH readings and calibrations in field log book.

2. With Known Buffers

Calibrate the Company meter with pH buffers 4, 7 and 9, or have the Company calibrate their meter with the buffers. Either furnish the buffer solution yourself or observe the Company making up the solutions. Record all pH readings in field log book.

B. Calibrate the Company's temperature recorder (either step 1 or 2)*

1. With GAS thermometer

Determine effluent temperature with GAS thermometer that is known to be accurate. If temperatures do not agree, have Company recalibrate their recorder. Record all temperature readings in field log book.

2. With Company thermometer

Determine effluent temperature with Company thermometer that is known to be accurate. Follow procedure in step 1 above.

C. Calibrate the Company's flow recorder at the Parshall flume

1. Have Company measure depth of flow in flume at the 2/3 C location (see attached diagram). The depth of flow will be in tenths of feet, not inches. If depth is given in inches, 4 inches for example, this must be converted to tenths of feet. $4 \text{ inches} \div 12 \text{ inches/foot} = 0.33 \text{ feet}$. Observe the Company's measuring rule and confirm the depth reading. You may also make the reading with your own rule.
2. Record instantaneous flow from recorder indicator in field note book. Also record the depth measured in step 1 above.
3. The instantaneous flow at Star-Kist is given in units of gallons per minute. Using the depth of 0.33 feet in step 1

The drawings and dimensions following are reproduced with permission from "Design and Calibration of Submerged Open Channel Flow Measurement Structures—Part 2—Parshall Flumes, Utah State University

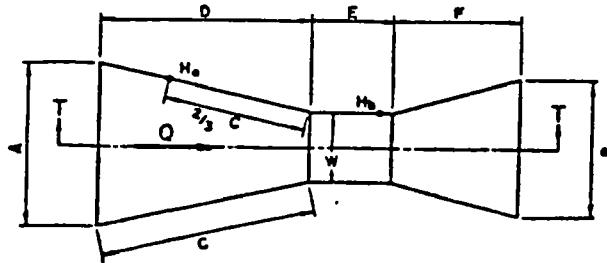


Fig. 29 Plan view of a Parshall measuring flume.

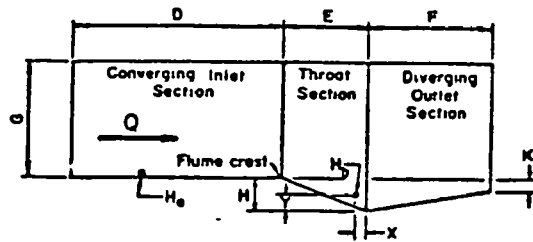


Fig. 30 Sectional view of a Parshall measuring flume.

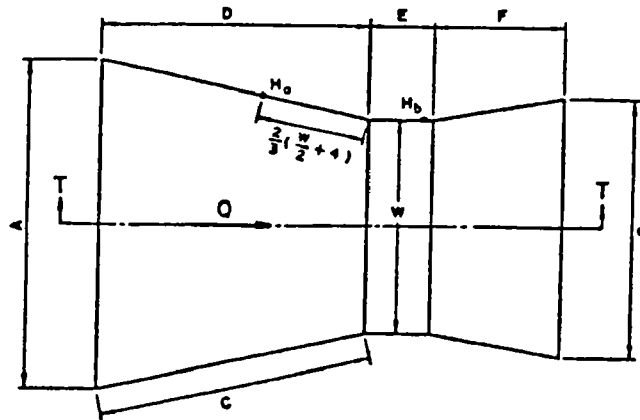


Fig. 31 Plan view of a large Parshall measuring flume.

above, the instantaneous flow for a 9-inch flume equals 0.36 mgd (million gallons per day).^{*} Convert this value to gallons per minute by dividing by 1,440 minutes/day.

$$0.36 \text{ mgd} = 360,000 \text{ gallons/day} \quad \text{Gallons per minute} = \frac{360,000}{1,440} = 250$$

If the recorder's instantaneous flow indicated 250 gpm, the flow recorder is correct. If another value is indicated, have Company reset their flow recorder and repeat steps 1, 2 and 3 again.

4. The 9-inch flume recorder at Van Camp indicates an instantaneous flow in tenths of a million gallons per day. If the depth is equal to 0.33 ft, the flow equals 0.36 mgd.^{*} This value should be indicated on the flow recorder. If another value is indicated, have Company reset their flow recorder and repeat steps 1, 2 and 4.
5. The 2-inch flume recorder at Van Camp indicates an instantaneous flow in million gallons per day. This reading must be multiplied by 0.001 to obtain the actual value. If the depth of flow is measured to be 0.12 feet, the actual flow from the tables will be 0.016 mgd. The instantaneous flow should be indicating 16 mgd. If another value is indicated, have Company reset their flow recorder and repeat steps 1, 2 and 5.
6. Record all calibration values in field log book.

II. SAMPLE COLLECTION AND PRESERVATION

A. Star-Kist

1. Read flow recorder totalizer at 8:00 am. Value is given directly in gallons.
2. Collect one sample per hour from flume between 8:00 am and 4:00 pm, a total of 9 samples. Rinse sampler bottle prior to each sample collection.
3. Record pH, temperature, flow, and collection time in field log book.
4. Pour aliquot of hourly collected sample into one-gallon container. Pour 1/2 ml of sample per gpm of flow. Example: If flow is 300 gpm, pour in 150 ml of sample. Remember to shake sample bottle before pouring into gallon container. Record the amount of sample poured into gallon container each time.
5. Collect one grab sample for oil/grease analyses, preserve with 2 ml of sulfuric acid, and tie tag on bottle for identification. Place in ice chest. Record, time, temperature, pH and flow when sample collected.
6. At 4 p.m., read flow totalizer and record in field log book.
7. Split composite sample with Company. Remember to shake well. Tag the composite sample for identification.

8. Read flow recorder totalizer at 8:00 am the next morning for total flow.

B. Van-Camp

1. Read flow recorder totalizer at 8:00 am for the 9-inch and 2-inch flume. The totalizer value for the 9 inch flume must be multiplied by 400 to obtain gallons. The totalizer for the 2-inch flume must be multiplied by 20 to obtain gallons.
2. Collect one sample per hour from the outfall sump between 8:00 am and 4:00 pm, a total of 9 samples. Rinse sampler bottle prior to each sample collection.
3. Record pH, temperature, and collection time in field log book.
4. Record the instantaneous flows from the 9-inch and 2-inch recorders each time a sample is collected and add flows together. Remember the instantaneous flow on the 2-inch recorder must be multiplied by 0.001 and the 9-inch instantaneous flow is given in tenths of million gallons. For example, if the 9-inch recorder indicates 0.28 mgd and the 2-inch recorder indicates 12 mgd, the total flow equals $0.28 \text{ mgd} + (12 \text{ mgd} \times 0.001) = 0.28 + 0.012 = 0.292 \text{ mgd}$.
5. Pour aliquot of hourly collected sample into one-gallon container. Pour 100 ml of sample per 0.1 mgd of flow. Example, if flow is 0.29 mgd, pour in 290 ml of sample. Remember to shake bottle before pouring. Record the amount of sample poured into gallon container each time.
6. Collect one grab sample for oil/grease analyses, preserve with 2 ml of sulfuric acid, and tie tag on bottle for identification.

Place in ice chest. Record time, pH, temperature and flow when sample collected.

7. At 4 p.m. read flow totalizers on both recorders and record in field log book.
8. Split composite sample with Company. Remember to shake well. Tag composite sample for identification.
9. Read flow recorder totalizers at 8:00 am the next morning for total flow.

C. Too Much Sample

1. If the composite sample will overflow the gallon container before all 9 samples are collected, place the remaining samples in another gallon container.
2. At 4:00 pm, shake containers well, and pour contents into a clean, rinsed bucket. Completely stir the bucket contents with a graduated cylinder and pour mixed sample into one of the gallon containers. Then split sample with Company.

D. Preservation

1. Keep composite sample container packed in ice inside an insulated ice chest. This maintains the temperature at 4°C.

AFTER SURVEY

- A. Request photo copies of the temperature, pH, and flow charts for period of survey. Also request daily production tonnage which is confidential.
- B. If survey two or more days in duration, recalibrate the flow recorders.

IV Other

- A. You may request that the Company split half of their sample with you for data comparison.
- B. Record all information Company personnel tell you about the treatment system in your field log book.
- C. Keep observations of the effluent quality (color, solids, etc.) in field log book.
- D. Always sign your name next to entries in field log book.
- E. Keep field log book, data, strip charts, and other information together in one file.

Conversion of mg/l or ppm into lb/day and kg/day

"Parts per million" or "milligrams per liter" is simply a more convenient way of expressing concentration, either dissolved or undissolved material. As used in the environmental field, mg/l represents the number of pounds of dry solids contained in one million pounds of water, including solids. One mg/l may be expressed as 8.345 pounds of dry solids to one million U.S. gallon of water.

Therefore, to convert mg/l with a known flow to lbs, the following formula is used.

$$\text{lbs.} = \text{concentrations in mg/l} \times \text{flow in million gallons} \times 8.345$$

- Example 1: How many lbs of solids are in 30,000 gallons of water if the concentration is 250 mg/l?

$$\text{Answer: } \text{lbs} = 250 \text{ mg/l} \times 0.030 \text{ million gallons} \times 8.345 = 62.69 \text{ lbs}$$

- Example 2: What is the daily load of solids discharged from an effluent pipe if the flow is 640,000 gallons/day with a concentration of 440 mg/l?

$$\text{Answer: } \text{lbs/day} = 440 \text{ mg/l} \times 0.640 \text{ million gallons/day} \times 8.345 = 2,350 \text{ lb/day}$$

How many kilograms (kg) are discharged per day?

$$\text{Answer: } 1 \text{ pound} = 0.454 \text{ kg, therefore } 2,350 \text{ lb/day} \times 0.454 \text{ kg/lb} = 1,066 \text{ kg/day}$$

- Example 3: What is the unit load discharge in example 2, if daily production is 153 tons/day. The unit load is expressed as lb/1,000 lb or kg/1,000 kg.

Example 3: What is the unit load discharge in example 2, if daily production is 153 tons/day. The unit load expressed as lb/1,000 lb or kg/1,000 kg.

$$\text{Answer: } \frac{2,350 \text{ lb/day} \times 1,000 \text{ lb}}{153 \text{ tons/day} \times 907.18 \text{ kg/ton} \times 1,000 \text{ kg}} = 7.68 \text{ kg/1,000 kg}$$

$$\begin{aligned} \text{in kg/kkg (kg/1,000 kg)} &= \frac{1,006 \text{ kg/day} \times 1,000 \text{ kg}}{153 \text{ tons/day} \times 907.18 \text{ kg/ton} \times 1,000 \text{ kg}} \\ &= 7.68 \text{ kg/kkg} \end{aligned}$$

APPENDIX B

BOD PROCEDURES AND CALCULATIONS FOR TUNA CANNERY WASTEWATERS

BOD PROCEDURES AND CALCULATIONS FOR TUNA CANNERY WASTEWATERS

Procedures

Shake the samples well before withdrawing an aliquot. Dilute the effluent 1/10 by measuring 25 ml of sample and diluting to 250 ml with dilution water.

Dilute the influent 1/20 by measuring 25 ml of sample and diluting to 500 ml with dilution water.

Shake the graduated cylinder well and pipet 5, 15 and 20 ml of each sample into BOD bottles and fill with dilution water. Prepare duplicate bottles for the 20 ml sample size.

Titrate the D.O. on the two blanks and the 20 ml sample size bottles. Use the mean D.O. as the initial D.O. for all samples.

Calculations

$$\text{BOD} = \frac{\text{SAMPLE D.O.}_{\text{initial}} - \text{SAMPLE D.O.}_{\text{final}} - \text{BLANK DEPLETION}}{\text{DECIMAL \% DILUTION}}$$

Example:

$$\begin{aligned} \text{For 20 ml effluent, DECIMAL \% DILUTION} &= 1/10 \times 20 \text{ ml}/300 \text{ ml} \\ &= 0.00667 \\ \text{For 15 ml influent, DECIMAL \% DILUTION} &= 1/20 \times 15 \text{ ml}/300 \text{ ml} \\ &= 0.002 \end{aligned}$$

APPENDIX C

NEIC TOTAL SUSPENDED SOLIDS PROCEDURE

TOTAL SUSPENDED SOLIDS

STORET NO. 00530

1. Scope and Application
 - 1.1 The method is applicable to drinking, surface and saline waters, and to domestic and industrial wastes.
 - 1.2 The detection limit of the method is 1 mg/l.
2. Summary of Method
 - 2.1 A homogenized sample is filtered through a pre-washed glass fiber filter. The residue retained on the filter is washed and then dried to constant weight at 105°C and weighed to the nearest 0.1 milligram. The TSS is calculated from the amount of residue per unit volume of sample.
 - 2.2 The filtrate from this method may be used to determine the total dissolved solids.
3. Sample Handling and Preservation
 - 3.1 Samples should be stored at 4°C and analyzed as soon as possible, but no later than 7 days after collection.
4. Apparatus
 - 4.1 Whatman GF/C glass fiber filter discs, 43 mm.
 - 4.2 Millipore membrane filtering apparatus with reservoir and a coarse fritted disc as a filter support.
 - 4.3 Aluminum drying pans, 50 mm and metal tray.
 - 4.4 Tekmar SDT Tissuemizer.
 - 4.5 Drying oven, 103°-105°C.
 - 4.6 Desiccator, with Drierite indicating desiccant.
 - 4.7 Analytical balance, 160 g capacity or larger, sensitive to 0.1 mg and one weight equivalent to the optical range of the balance.
 - 4.8 Graduate cylinder and wide bore pipets.
5. Balance Calibration
 - 5.1 Using a balance with an optical range of 1.0 g, place a 1.0 g (15%) weight on the balance pan, set the weight control knob to 1.0 g, release the balance and set the zero point with the optical zero knob. With the balance released, slowly turn the weight control knob back to zero. The optical scale should come to rest exactly at 1.0 g. If the reading is more or less than 1.0 g, arrest the balance, remove the top housing cover and adjust the sensitivity weight. Repeat the calibration check.
6. Procedure
 - 6.1 Preparation of glass fiber filter disc: Place the glass fiber filter on the membrane filter apparatus with wrinkled surface up. While vacuum is applied, wash the disc with 100 ml of distilled water. Remove all traces of water by continuing to apply vacuum after water has passed through. Remove filter from membrane filter apparatus, place in aluminum pan, and dry in an oven at 103-105°C for one hour. Remove to desiccator and store until needed. Weigh immediately before use. After weighing, handle the filter with forceps only.

- 6.2 Homogenize all non-uniform samples with blender and shake the bottles before withdrawing an aliquot to assure taking a representative sample.
- 6.3 Choose a maximum sample volume that will filter in 5 minutes or less. Measure volumes smaller than 15 ml with wide bore pipets and larger volumes with graduate cylinders. Discard any sample which does not filter in 5 minutes and filter a smaller sample volume.
- 6.4 Wash the graduated cylinder or pipet and with the suction on, wash the filter funnel wall, filter and residue with two twenty-five ml portions of distilled water allowing complete drainage between washings. Remove all traces of water by continuing to apply vacuum after water has passed through.
- 6.5 Carefully remove the filter from the filter support. Place in an aluminum pan and dry at least one hour at 103-105°C. Cool and weigh immediately or place in a desiccator for later weighing. Re-dry and re-weigh 10% or at least one filter per set of samples. If the incremental weight loss is less than 0.5 mg, calculate the results based on the original weights. If the weight loss exceeds 0.5 mg, re-dry and re-weigh all of the filters and re-check 10% of the filters.
- 6.6 Analyze two blanks per set of samples by filtering 100 ml of distilled water through two prepared filters. The amount of additional weight loss after the filters have been prepared is nearly independent of the volume of water filtered. Therefore, add the mean blank weight loss to the residue weight for each sample.
- 6.7 Analyze 10% or at least one sample per set in duplicate.
- 6.8 Analyze a standard sample with each sample set.
- 6.9 Calculate the results as follows:

$$TSS = \frac{(W_G - W_T) + B}{V_S}$$

W_G = Gross weight of filter and residue, mg

W_T = Tare weight of filter, mg

B = The mean of the two blank results, mg

$$\text{Where } B = \frac{B_1 + B_2}{2}$$

$$B_1 = B_T - B_G$$

B_T = Tare weight of filter, mg

B_G = Gross weight of filtering

V_S = Volume of sample filtered, l

ISS DATA/CALCULATION SHEET, REV. 6/9/78

Analyst _____ Study _____ Date/Time Filters in Oven _____
 Date/Time Out _____

Sample No.										
Sample Vol., l										
Re-check Wt., mg										
Gross Wt., mg										
Tare Wt., mg										
Residue Wt., mg										
Blank Corr., mg										
Corr. Res. Wt., mg										
TSS, mg/l										
Sample No.										
Sample Vol., l										
Re-check Wt., mg										
Gross Wt., mg										
Tare Wt., mg										
Residue Wt., mg										
Blank Corr., mg										
Corr. Res. Wt., mg										
TSS, mg/l										
Sample No.										
Sample Vol., l										
Re-check Wt., mg										
Gross Wt., mg										
Tare Wt., mg										
Residue Wt., mg										
Blank Corr., mg										
Corr. Res. Wt., mg										
TSS, mg/l										

Balance Calibration

	Reading on 100 mg weight, mg
Tare	
Gross	
Re-check	