CHAPTER 4

MATERIAL AND METHOD

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4.1 Records and Sampling

Reliable record keeping is an essential part of a WWTP operation. Well-kept records will facilitate planning for future needs and meeting typical operating situations. More importantly, records are used to assess plant operation and to determine control parameters for treatment. However, it is important that only pertinent information should be recorded. In this study, some of the readings were taken from on line monitoring available at the plant.

Auto Samplers (refer to Plate 4.1) were used to accumulate flow proportional samples from CUF and CUF customers (ASGP, VCM and BPPA). There are two auto samplers situated in the plant. One is to check the waste before entering the plant and the other is to check the Final Discharge after the clarifier. The specifications for the Auto Samplers are as follows :-

Manufacturer	:	ISCO
Model	:	3700FR.
Height/Width/Depth	:	1190/660/660 mm
Sample Temperature	:	$(4 \pm 1)^{o}C$
No. of Sample Bottle	:	24 bottles (1L)
Material of Bottle	:	Polypropylene

Plate 4.1

Auto Samplers For The Incoming Wastewater

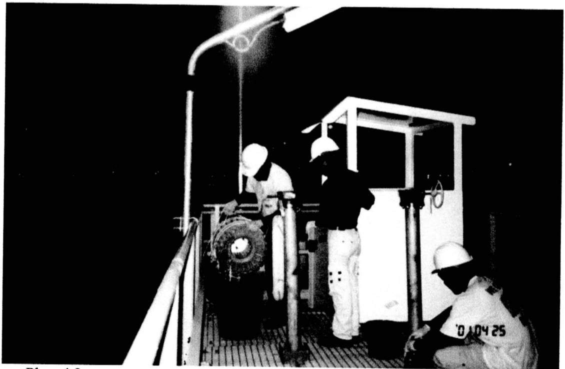

Plate 4.2

Collection Of Composite Samples From Auto Samplers At Final Discharge Point

The composite samples of each incoming wastewater were collected individually and hourly using the Auto Samplers (refer to Plate 4.2 and 4.3). The composite samples were poured into a plastic container of 1L. A composite sample is a mixture of individual grabs proportioned according to the wastewater flow pattern. Composting is commonly accomplished by collecting individual samples at regular time intervals, for example, every hour on the hour, and by storing them in a refrigerator or ice chest; coincident flow rates are read from an installed flow meter or are determined from some other flow recording device. Here the 24 hourly collection of each incoming wastewater is later combined into one sample of each wastewater.

Plate 4.3

Collection Of Composite Samples Of Incoming Wastewater

A representative sample was then integrated by mixing portions of individual samples relative to flow rates at sampling times. Composite samples representing specified time periods were tested to appraise plant performance and loadings. Average daily BOD and Total Suspended Solid (TSS) data were used to calculate plant loading while mean influents and effluent concentrations yield treatment efficiencies (Hammer, 1986).

Samples were obtained from the aeration tank and Equalizing Sump by dipping in a bucket. The samples were poured into a 1L plastic container and transported immediately to the plant laboratory. After proper labelling the sample was kept in the refrigerator. For Oil & Grease readings, samples were poured into a 1L Glass beaker. Preliminary reading of pH, DO and temperature were done during the sampling and were recorded on site

4.2 Plant Design Parameters

Very few water treatment plants have the luxury of an influent at a constant flow rate and of a constant composition. Here, the influent composition and flow rate varies for each respective customer. Table 4.1 show typical effluent load characteristics obtained from the respective customers. These readings are used to design the plant.

Table 4.1

VCM Influent

VCM INFLUENT PARAMETERS	NORMAL READING	MAXIMUM CONCENTRATIONS
Flow, m^3/h	60	105
Suspended solids, mg/L	160	160
Toxic chemicals, mg/L -EDC - VCM -other byproducts from VCM manufacturer	1	1
Metals, mg/L - Cu, Cd, Cr, Pb, Zn, Ni	1	1
Oil & Grease, mg/L	20	20
Cyanides and sulphides, mg/L	1	1
Synthetic detergents: Ionic, mg/L	25	25
Non-ionic, mg/L	5	5
H_2CO_3, wt %	0.5	0.5
$NaHCO_3$, wt %	1.0	1.0
NaCl, wt %	1.4	1.4
Na_2SO_4, wt %	0.09	0.09

Consultants data (Personal Communication, Year 2001)

Table 4.2 shows the effluent from Ammonia Syngas Plant (ASGP). From time to time, the ASGP process will generate an off-specification process condensate stream. The flow will be $20.4m^3/h$ and will have the following composition:

Table 4.2

ASGP Influent

ASGP INFLUENT PARAMETERS	NORMAL RANGE (mg/L)
NH_3	$\pm$ (300 ~ 400)
CO_2	$\pm$ (1000 ~ 750)
CO	$\pm$ 110
H_2	$\pm$ 25
CH_4	$\pm$ 20
Formic Acid	$\pm$ (<7)

Consultants data (Personal Communication, Year 2001)

All of the NH_3 is expected to stay in solution during transfer to the effluent treatment plant. Nitrification is the biological oxidation of ammonia to nitrate with nitrite formation as an intermediate. When nitrification does not occur, the presence of ammonia will result in poorer settling. In addition, poorer dewatering might also be expected because of the more fragile nature of the flocs. The extent of deterioration with mixing would vary depending on the solids- handling procedures and equipment (Novak, 2001).

The following parameters shown at Table 4.3 were analyzed for a period of 2 months during the pre-commissioning of the plant.

Table 4.3 :

Parameters Analyzed

Sample Marking	**Parameters Sampled And Analyzed**
CUF, BPPA VCM and ASP	Average flow (per day), pH, Phosphorus (P), COD (Chemical Oxygen Demand), Chloride (Cl^-), Ammonia (NH_3), Oil & Grease (O&G), BOD (Biological Oxygen Demand) during commissioning only.
Off Spec Tank	pH, COD and Total Suspended Solid (TSS)
Aeration Tank A & B	pH, DO, TSS and Volatile Suspended Solid (VSS). MLSS (Mixed Liquid Suspended Solid) and Settling Test during commissioning only.
Final Discharge	pH, Oil & Grease, COD, TSS and Average Flow (per day), BOD during commissioning only.

4.3 Method Of Analysis

On site measurement were conducted where feasible using the Hach DR/2010 Spectrophotometer. Measurements such as BOD_5, which needs laboratory facilities, were sent to the nearest lab to be analyzed.

4.3.1 pH

pH meter used was of CyberScan pH 10. The method used was APHA 4500-H^+B; Electrometric Method. The meter is calibrated everyday using Buffer 7.0, 4.0 and 10.0 obtained from Fisher & Scientific (APHA, 1995).

4.3.2 DO

DO reading was obtained by using a DO Meter CyberScan DO 100. The method used was APHA 4500-OG; Membrane Electrode Method. The membrane electrodes provide an excellent method for DO analysis in polluted waters, highly coloured waters, and strong waste effluents. The electrode was covered with an oxygen-permeable plastic membrane that serves as a diffusion barrier against impurities. The calibrations of the meter were done according the manufacturer's calibration procedure. The membrane electrodes were calibrated by reading against air as well as in a sample with a zero DO. The zero sample was prepared by adding excess sodium sulfite and a trace of cobalt chloride, to bring the DO to zero (APHA 1995). The readings are taken insitu and noted down (APHA, 1995).

4.3.3 COD

COD is widely used to characterize the organic strength of wastewaters and pollution of natural waters. COD is measured through oxidation of organics by a boiling mixture of potassium dichromate and sulfuric acid and through determination of the amount of dichromate reduced during the oxidation. Interference caused by halides, nitrite, and reduced inorganic have been reported. Mercuric sulfate and sulfamic acid are added to overcome interference from chloride and nitrite, respectively. Chloride alone can reduce dichromate and cause a false COD reading (Byung, 1989). The COD test was done using the Hach DR/2010 Spectrophotometer (Colorimetric Determination, 0 to 1500 and 0 to 15000 mg/L COD). The wavelength used was 620nm. A 2.0 ml sample was added into a prepare COD Digestion Reagent Vial. The sample was 'closed refluxed' for 2 hours using a COD Reactor of Hach. After 2 hours, vials were left to cool at room temperature before readings were taken by using the spectrophotometer. The COD reading for a prepared standard solution, potassium hydrogen phthalate (KHP) was also carried out to check the performance of the spectrophotometer (Hach,1996).

4.3.4 Chloride

Chloride reading was taken using the Hach DR/2010 Spectrophotometer (Mercuric Thiocyanate Method). The chloride in the sample reacts with mercuric thiocyanate to form mercuric chloride and liberate thiocyanate ion. Thiocyanate ions react with the ferric ions to form an orange ferric thiocyanate complex. The amount of this complex is proportional to the chloride concentration. The readings were taken using the 455nm wavelength (Hach,1996).

4.3.5 Phosphorus

P reading was taken using the Hach DR/2010 Spectrophotometer (PhosVer 3 Method, Test 'N Tube Procedure); wavelength 890nm. The orthophosphate reacts with molybdate in an acid medium to produce a phosphomolybdate complex. Ascorbic acid then reduces the complex, given an intense molybdenum blue colour (Hach,1996).

4.3.6 Ammonia (NH_3)

NH_3 reading was taken using the Hach DR/2010 Spectrophotometer (Salicylate Method), wavelength 655nm. NH_3 compounds combine with chlorine to form monochloramine. Monochloramine reacts with salicylate to form 5-aminosalicylate. The 5-aminosalicylate is oxidized in the presence of a sodium nitroprusside catalyst to form a blue colour compound. The blue colour is masked by the yellow colour from the excess reagent present to give a green solution (Hach,1996).

Operating Temperature	:	25 – 40^{o}C
Operating Pressure	:	Atm. + Immersion
Probe type	:	Ultrasonic sensor (emitting ultrasonic pulse and detecting echo)

4.3.10 Settling Test

The settling test of a biological suspension is useful in routine monitoring of biological processes. For activated sludge plant control, a 30-min settled sludge volume has been used to determine the returned-sludge flow rate and when to waste the sludge. The test was carried out insitu beside the aeration tank. The method used was adapted from the Settled Sludge Volume APHA 2710C, (APHA, 1995).

4.3.11 BOD_5

The BOD_5 test was carried out using the APHA 5210 B. 5-Day BOD Test. The BOD_5 determination is an empirical test to determine the relative oxygen requirements of wastewaters. The test measures the molecular oxygen utilized during a 5-days incubation period for the biochemical degradation of organic material (carbonaceous demand) and the oxygen used to oxidize inorganic material such as sulfides and ferrous iron. The BOD probe used was of YSI 5100 model.