URBAN POLLUTION MONITORING

WASTE WATER SAMPLING STRATEGY

PRESENT BY

SEAN A. ADAM
GREEN WORLD INSTRUMENTS LTD

INTRODUCTION

The presence of pollutants in our water resources is no longer a concern of just the scientific community. In the last twenty years, the world has experienced a tremendous and continually increasing environmental awareness of the hazards associated with water pollution. People are demanding stricter pollution prevention and remediation plans. To be effective, these plans require monitoring programmes for evaluating the physical, chemical and biological characteristics of our waters.

A significant part of the monitoring programme is the collection of water and waste water samples for testing and evaluation.

Why Sample Water

There are three primary objectives for monitoring the quality of water. First, it helps in setting realistic environmental policies. Second, it helps in developing achievable pollution prevention and remediation programmes. Finally, it helps enforcement agencies ensure compliance with the current environmental regulations.

More specific reasons for conducting water and waste water sampling for environmental analysis include:

Determining the current condition of a water resource.
Identify the source of a specific pollutant.
Evaluation on the impact of a pollutant.
Effectiveness of reduction programmes.
Effectiveness of processes.

The Elements of the Sampling Plan

Sampling objects will vary because they are application and site depended. The sampling strategy to comply with regulatory requirements is far different to a storm water RUN-OFF study (or urban pollution monitoring study).

The basis of any sampling strategy is the sampling plan and it is important for the project leader to develop a written document. This document helps in developing a logical working strategy and expresses them in a clear concise form. As a written document a successful programme is ensured as all important questions asked can be effectively answered and put into practice. As we are working with people active in different disciplines, from the field operative through to the laboratory chemist, it is important we all "sing from the same hymn sheet".

Sampling Types and Collection Techniques

There are two basic types of water and waste water samples -

Discrete **Composite**

Each particular type serves a purpose and has its own advantages and disadvantages.

A discrete sample, also known as a grab sample, is an individual sample collected at a set time and deposited in its own container.

The composite sample consists of two or more samples collected at different times and deposited into the same container.

With the discrete sample practise the analysis represents the source at a given time. Should the conditions be consistent then a single discrete sample will be appropriate. However, if the conditions are expected to be variable then a series of samples are more appropriate. Obviously analysis costs are much higher. Composite samples represent the average characteristics of the source over a period of time in which the samples were taken. It does not represent the source at any other time.

It must be emphasised, however, that a composite sample yields less information and may lead to erroneous conclusions. Composite samples are useful in determining the average loading of pollutants over a fixed period especially with setting consents for trade discharges from factories, quarries, mines etc.

Depending on the objective, a variety of composite samples can be collected.

Time composite sample:
Consists of equal volume samples collected at equal time intervals. Gives good average results if the flow is constant.

Flow proportional composite sample:
Flow proportional composite sampling can be effectively achieved using one of two methods. In the first method, the samples are collected of equal volume at equal flow intervals, e.g. every 40m3, and sample of 400 ml.

A second type collects the samples on an equal time basis, but varies the volumes proportional to the flow volume, e.g. the volume discharged in the first hour was 2,000m2, the sample volume taken is 100ml; during the second hour the volumetric flow is 10,000m2 in which a 500ml sample is taken.

A third much used strategy is to composite sequential samples which are taken over shorter time periods or small flow. Often six 10 minute samples are collected into a separate 1000ml which will constitute 24 separate hourly composite samples in a 24 hour period.

What ever the sampling programme might be, the ultimate objective is to get as precise and accurate a picture of the conditions at the monitoring point as possible.

What are the basic elements of an effective sampling plan:-

1 SAMPLING OBJECTIVE
2 SAMPLING LOCATION
3 SAMPLE TYPES & COLLECTION TECHNIQUES
4 SAMPLING EQUIPMENT
5 SAMPLE CONTAINERS & PRESERVATION
6 LABELLING CRITERIA & SHIPPING
7 TYPES OF ANALYSIS
8 CHAIN OF CUSTODY DOCUMENTATION
9 QUALITY ASSURANCE & CONTROL

Sampling Objective:-

All our modern progressive companies in compliance with forward thinking are developing the latest trends THE MISSION STATEMENT.

The leaders of industry have decided that it is very important to put in writing a publicise the mission of each individual company. Companies themselves who see and understand this have a "mission statement" for individual departments.

The sampling objective is the mission statement of Project leader and team. The team being all people involved. Some projects can take long periods of times and the sampling strategy should take this into account. We need at all times to understand the objective of our undertaking.

Sampling Location

This aspect of any pollution monitoring project is given very little attention and yet what happens at this stage can totally invalidate the total data of a project. It is at this point where a sample will or will not ensure a "Truly Representative Sample" why spend £500,000 on a years analysis when the sample taken does not represent the liqueur in the flow channel.

All too often a site is selected more for being convenient for the installation team than achieving results. Perhaps nobody has had it explained before. Too many times we come across the sample strainer weighted down sat in the sludge at the bottom of a channel sampling years of settlement rather than the content of the waste water, or alternatively, the strainer is seen bouncing on the surface of a fast flowing stream sampling what could be the cleaner liquid or 'CONCENTRATED VOCs'.

All we are looking for is a natural point of mixing. This point of turbulence will resolve the problem of the representative sample. Ideal points are downstream of a weir or flume, any natural point of fall in the channel. Should these not be readily obvious then artificially putting a restriction in the flow will give the necessary mixing.

Sampling Equipment

In the early days sample objectives were simple and expectations low.

With time however our improved knowledge and performance standards increased and this has created a need for more sophisticated sampling programmes. In the 1970's the sampling strategies led to the development of the automatic waste water sampler. With the 1980's seeing manual grab sampling virtually disappearing, sampling frequency volumetric flow measurement and compositing of samples make manual sampling labour intensive and costly.

The 1990's saw a greater move towards conditional sampling based on parameters such as:

- flow
- level
- pH
- temperature
- conductivity
- DO
- rainfall
- 4-20mA
- turbidity/suspended solids

or any other event that is common to today's monitoring needs.

Automatic samplers can be classified into portable and fixed site/refrigerated. As indicated by the obvious titles, survey work is carried out by battery powered portable samplers, whilst factories, treatment works, etc., are more suiting to the permanently installed mains supply automatic samplers.

Through the importance of storm water monitoring and urban pollution monitoring there are specific sites that would greatly benefit from having a true environmental refrigerated sampler, (maintaining 4 Deg C from -25 to +50). It is with the preparation of the sampling plan that we can ensure that the ***correct*** equipment is selected for each individual site.

Sample Containers and Preservation

It is important to understand exactly which pollutants are being considered for analysis.

Generally, the sample storage system consists of one or more bottles or bags in which to collect and store the liquids until they are shipped to the laboratory for analysis. There are a wide range of bottles and containers offered by the sampler manufacturers to supply a variety of needs. These can range from ml of liquid through to 10's of litres.

The number and size of bottles depends on the type and number of samples needed by the laboratory to analyse. To maintain the integrity of the sample care must be taken in selecting the right sample bottles. Bottles are generally available in glass, polypropylene, polyethylene and Teflon. Each material offers advantages and disadvantages. The project leader must be concerned with the chemical compatibility, leaching, absorption, desorption and the requirement stipulated by the relevant standards authority.

The table below indicates selected parameters and their required containers:-

Parameter	Container Type
Acidity	Plastic, Glass
Alkalinity	Plastic, Glass
Ammonia	Plastic, Glass
Biochemical Oxygen Demand (BOD)	Plastic, Glass
Chemical Oxygen Demand (COD)	Plastic, Glass
Chlorinated hydrocarbons	Glass, Teflon-lined cap
Chlorine, Total residual	Plastic, Glass
Chromium	Plastic, Glass
Coliform, fecal and total	Plastic, Glass
Colour	Plastic, Glass
Cyanide	Plastic, Glass
Fluoride	Plastic
Nitrate	Plastic, Glass
Oil and Grease	Glass
Organic carbon	Plastic, Glass
Oxygen, dissolved (probe)	Glass
Phenols	Glass
Silica	Plastic
Temperature	Plastic, Glass
Turbidity	Plastic, Glass

The preservation of samples is critical and the sample containers should fit into a holding base that is capable of storing ice, or in conjunction with a refrigerated sampler. However, there are times when a chemical additive is required to assist in the preservation of the sample, for example

Parameter	Preservative
Cyanide -	**Cool to 4 Deg C, NaOH to pH>12**
Organic carbon	**Cool to 4 Deg C, H_2SO_4 or HCL to pH < 2**
Phenols -	**Cool to 4 Deg C, H_2SO_4 to pH < 2**

Sampling Programmes

A sampling programme is a set of instructions that prescribe the type or types of samples to be collected, the volume of each sample and sub-sample and the conditions under which these samples are taken. The conditions may be based on time, flow or any other parameter.

Before we venture down the road of placing a great number of samplers in the field, we need to look at the technologies available to us and using these technologies to determine a standard for triggering the sampler.

It is most unlikely that a project manager having some 70 samplers in the field can afford the man power to have a decision maker at each sampling point to decide when the storm condition is such that he is able to switch on the sampler.

Perhaps we could look at a determination of rainfall, against flow/level, against an increase in pH.

I can ask a sampler to switch on under the following conditions:

1. 15mm of rainfall in the last 30 minutes.
2. An increase of water level of 100mm.
3. And the day has to be Wednesday.

With the sophisticated range of inputs to today's sampler

HOW DO I WISH TO INITIATE MY SAMPLER AT THIS LOCATION ON THIS PARTICULAR PROJECT, BEARING IN MIND THE POLLUTANTS I AM TAKING INTO CONSIDERATION?