WATERFALL & O'BRIEN
LIFE QUALITY ANALYTICAL CHEMISTS

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Sampling And The Answer to Everything

> *When you can do the common things in life in an uncommon way, you will command the attention of the world.* (George Washington Carver)

The testing of materials is a major part of our business and we are proud of the fact that our expertise provides valuable information in the development of new products and assesses the impact of those developments on the environment and the risk to human health. The data we provide allows our customers to make informed decisions concerning their business activities. To help us do this we have collected together a portfolio of related analytical tests that meet the requirements of each industry. This Fact Sheet is aimed at the sampling of materials prior to analysis.

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There are many types of sampling regimes specified in the literature, dependant upon the type of material being sampled and the results required, but in general they deal with the process of sampling and the reasoning behind each process; they do not focus on the sampling frequency and the rationale behind that.

To understand the reasons behind the confusion and complexity of the sampling process it is important to grasp the principles of the sampling strategy. This is best described by a simple definition; or is it?

Sampling;

1. *'the process of selecting a small part or quantity of something to represent the whole'.*
2. *'the policy of inferring the behaviour of a whole batch by studying a fraction of it'.*

Definition (1) clearly emphasises the importance of the selection process and therefore assumes the 'whole' is static, but not necessarily homogenous. Therefore the complexity of the sampling regime will be dependant upon the homogeneity of the sample. This is the most common interpretation of the sampling process and is the usual starting point for the development of a sampling policy. But its' usefulness is usually restricted to manufactured products.

In definition (2) the sampling process is subjugated to an interpretation of the behaviour of the whole. In other words, it doesn't assume that the whole is static and that any sampling process applied must be justified within the context of the nature of the material being studied.

Understanding the similarities and basic differences between these two definitions provides the rationale for the sampling frequency.

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In the application of sampling, as derived by definition (1), the sampling frequency can be mathematically represented with basic statistical formulae representing the population and sample size. However, the mathematical model is unreliable when this simple sampling regime it supports is applied to a dynamic system, where the potential for change is infinite (e.g. water effluent output).

Within the context of definition (2), the whole process becomes a 'risk-based' strategy. Sample size and the number of samples taken at any one time are still represented mathematically, but the sampling frequency is designed to reduce the risk of non-conformance by validating the control measures used to produce the product. Using this strategy, both static and dynamic products can be sampled and the resulting data used to '*infer the behaviour of the whole batch*'. For example; a drinks manufacturer producing bottled water with good control over the production process has a small risk of failure and the consequence of failure to human health is small, may only need to sample the product once in every ten batches. On the other hand, a manufacturer with a similar set up, producing tablets for the pharmaceutical industry where the consequence of failure and the risk to human health is substantial will sample every batch of product.

This is the essence that defines the difference between sampling definitions 1 & 2.

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Case Studies.

Case Study 1:

A structure built in the 1980's is exhibiting a substantial deterioration in the integrity of the south-facing wall, when compared to the rest of the building. The surveyor, commissioned to identify and resolve the problem before the building can be sold on, suspects the problem is associated with the mortar used to construct the south-facing wall.

The original builder of the premises used commercially available pre-mixed concrete products. If there was a problem with the pre-mixed mortar, the whole wall would have been affected; this issue is contained within a small area of the wall. The only way to resolve this issue is to take a representative sample of the suspect mortar and obtain a laboratory analysis for the cement content of the mortar used.

In this case, the building, wall, mortar and cement content are static; a sample taken now and five years ago will yield the same cement content value. Therefore one sample, of adequate size, taken form the suspect area will suffice and can be considered to be representative of that whole area.

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Case Study 2:

The drinking and bathing water supplied to a farm is provided for by a borehole. The borehole was sunk 4 years ago as a backup system in case of drought, but it is now the main source of water supply. Since installation the borehole has been regularly serviced, but the water has never been routinely tested for compliance to the Drinking Water Specification.

Seasonal weather patterns can affect the taste and colour of the water and the inhabitants of the farm complain of occasional stomach upsets.

In this case the water quality is changing with changing weather patterns, there is no way of predicting the quality of the water based on a single sample. The objective here would be to validate the borehole *equipment and process*. This can be simply achieved by taking and testing a sample of water from the borehole after any routine service and maintenance work has been performed.

In this way we can begin to improve the control in the quality of the water and subsequently investigate the relationship between local weather patterns and borehole water quality.

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