return to contents page

Dioxin Sampling – A Long Term View

M.J.Smurthwaite, Westech Instrument Service Ltd

1) Introduction

The expansion of the number of processes requiring measurement of emitted dioxins and the release of a new CEN Standard - EN 1948 - will significantly alter the market for instrumentation. Within the EU, individual member states will implement their own strategies for process approval based on dioxin sampling. However, typically processes are assessed quarterly, biannually or annually using isokinetic sampling trains often operated by consultants. The resultant data is very often open to public criticism as the tests are infrequent, short term and may not be truly representative of the overall, annual emission rate.

This paper describes a programme for the development of a prototype variable term dioxin sampler. The instrument will give an integrated sample of emitted dioxins over extended sampling periods for subsequent analysis. The sampler is designed to operate in process environments for periods up to one month without attention and to maintain the resultant sample in a representative, undegraded condition for the sampling period. A back-up analysis cartridge is provided to act as a check on sampling integrity.

The prototype will be evaluated on-site against a standard commercial isokinetic dioxin sampler that follows a fixed methodology such as EN1948 and/or USEPA Method 23. The analysis of samples from both instruments will be conducted under a fixed quality scheme by a single laboratory to ensure consistency.

2) Background

There is a clear indication in Europe, and in particular at this time in the UK, that the assessment of dioxins is not always carried out in a rigorous manner nor as often as is truly necessary. WHO are expected to reinforce the requirement for a new, extremely low emission standard to be introduced and therefore an increased number of stack samples would be required over the next 5 years. Processes that cannot comply will be made to adjust operational parameters which would also lead to additional monitoring.
Processes that up to present have not been required to undertake dioxin monitoring will do so in future to meet new directives. For example, on-site chemical incinerators have not been required to sample in the past as they do not burn chlorine-based compounds. However, new legislation for authorisation does emphasise monitoring regimes for such units, if only to prove that they are clean.

There are said to be 300 municipal incinerators that require some form of additional measurement in Europe, 178 in the USA and 1854 in Japan. There are an estimated 800 non-municipal units in the rest of Europe alone. Other processes including steel/iron production and cement may also be included.

The cost of existing Long Term Dioxin Samplers is felt to be too great to fully enforce a requirement for installation of these types of samplers on many processes. This paper outlines the development of a Low Cost instrument that would be more applicable to the commercial constraints of the application.

3) Outline Design

The proposed “proof-of-concept” design is shown in the attached schematic. As far as possible in concept, the instrument will follow the methodology of EN 1948 and this standard will act as the specification and as the benchmark of performance for the instrument.

The sample is extracted isokinetically from the process flow using a low-flow quartz-lined water-cooled probe with integral nozzle.The instrument is considered to be a fixed installation and therefore, unlike previous samplers which are short-term, requires a rigorous presurvey of the process to ascertain the system parameters necessary to ensure a good, representative sampler which will be comparable with the independent analyses.

The sample is cooled to less than 20C and passed with condensate through a cooled absorption cartridge. The design of this cartridge and the combination of the use of Poly Urethane Foam and an absorption resin such as XAD2 is central and critical to the instrument’s concept. It is particularly crucial that the efficiency of this device in removing both particulate and vapour phase dioxins is characterised during the proving trials. The design of the cooling and coolant recirculating systems is part of the development programme.

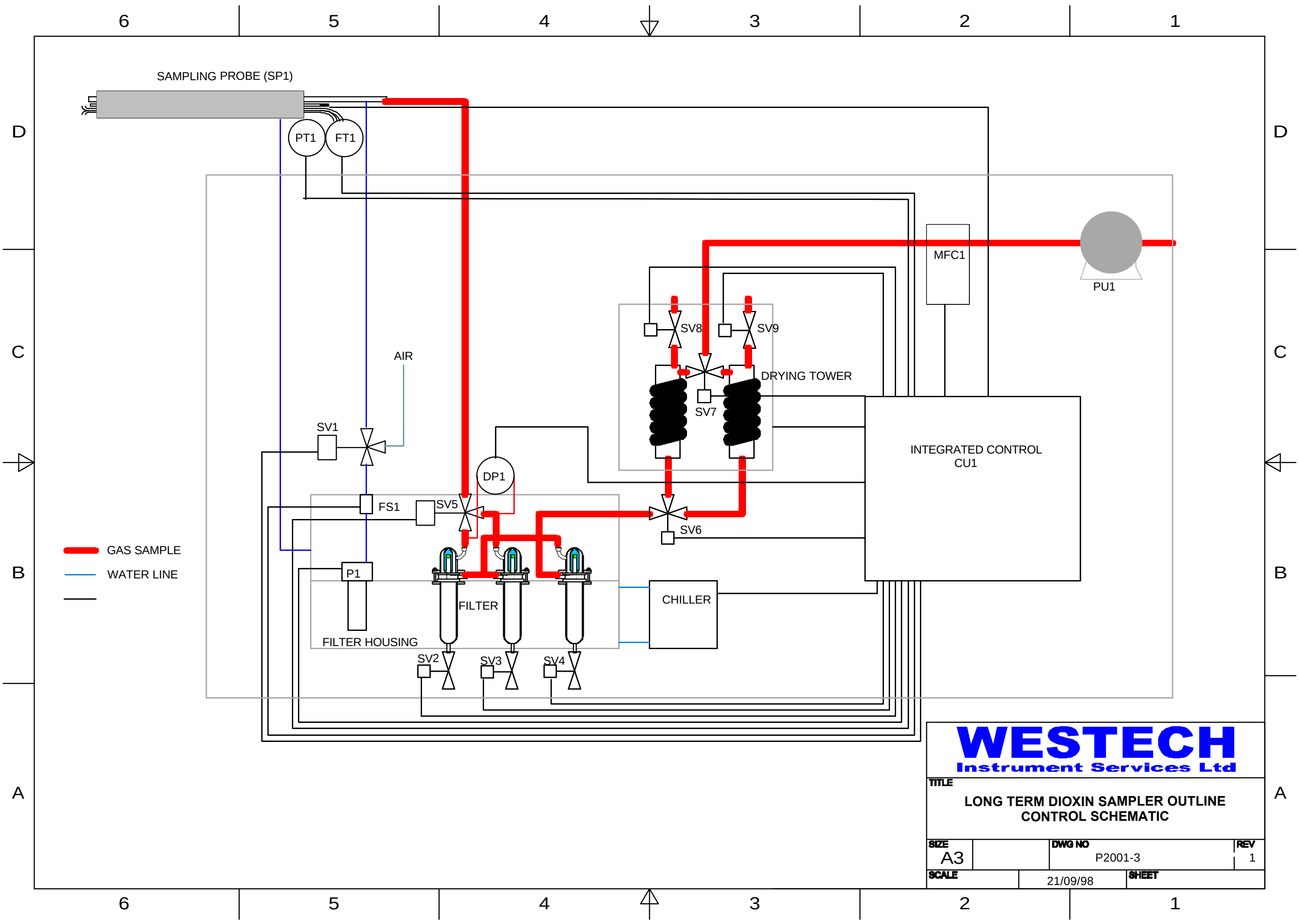
Two cartridges are employed in the extraction process. The second cartridge is essentially used as a standby in the event that the main cartridge becomes overloaded with particulate. It is the intention that in any one analysis period only a single analysis cartridge is produced. If the pressure drop across this primary unit becomes too great then the system will switch to the secondary cartridge, and will signal the changeover as an alarm. It is expected that such an occurrence will result in the primary and secondary cartridges being removed for analysis and the instrument reset for the next period.

A final PUF plug is situated in the condensate removal system to act as an overall efficiency check on the system. This plug would always accompany the primary cartridge (and secondary where necessary) for analysis.

The sample gas exits the condensate removal to a drying train and subsequently a typical isokinetic stack sampling train controlled by microprocessor-based electronics.

Clearly, the system relies on the stability of the process to achieve accurate results and therefore not all processes producing and emitting dioxins will be suitable for this approach. It is the purpose of the evaluation stage to make some assessment of the limits of variation that will still allow the instrument to operate within the specification.

The control systems will be based on a Programmable Logic Controller interfaced with an external PC. PLC type systems are rugged and designed for process applications, are readily available and are composed of individual modular function units which can be cascaded together without extensive software requirements. In essence the design of this isokinetic sampler is viewed as a control not a firmware problem.



WESTECH
Instrument Services Ltd

TITLE
LONG TERM DIOXIN SAMPLER OUTLINE CONTROL SCHEMATIC

SIZE	DWG NO	REV
A3	P2001-3	1

SCALE		SHEET
	21/09/98	