



## Contamination Emergency Are You Prepared?

Chemical Contamination Incident in  
Drinking Water Proficiency Test



## Introduction

The unexpected gross chemical contamination of a drinking water supply is an event which demands the best of any laboratory that finds itself at the centre of such intense attention. The need to rapidly identify any potential contaminants and assess the risk to the public served by large modern distribution networks is great, in order to provide accurate advice to safeguard public health and at the same time avoid panic if the contamination is not harmful when the water is used or consumed.

Contamination events are not as rare as we might think. In the three-year period 2006-2008, where data was available, there were 70 incidents recorded in the database of the Chemicals Hazards and Poisons Division of the (then) Health Protection Agency in the UK. Of the 70 incidents, 20 were associated with contamination of the public water supply.<sup>1</sup> Outside the UK, in the 13-month period January 2014 to January 2015<sup>2</sup> there were five “Do Not Use” or “Do Not Drink” notices in the USA and Canada.

The EU recognises the importance of potential contamination events, via the European Reference Network for Critical Infrastructure Protection (ERNICIP) and its Thematic Group (TG) for Chemical and Biological (CB) Risks to Drinking Water. Their website states that ‘Today’s organisational structures, scientific methods and regulatory frameworks concerning drinking water quality are designed for long term decision making and not for immediate response in case of an incident.’<sup>3</sup> The TG is working in a number of areas to improve analysis and provide guidance on producing a water security plan for water utility providers across Europe.

The potential sources of gross contamination (in order of likelihood of occurring) are shown in Table 1.

Type	Example
Accidental	Spillage / right chemical in wrong place / Flooding
Non-accidental	Deliberate release / dumping of chemicals
Malicious	Deliberate contamination for extortion purposes
Terrorism	Deliberate contamination for a perceived political or other cause

*Table 1. Types and examples of potential gross contamination incident*





## The Role of the Laboratory

The importance of the laboratory in any gross contamination event is pivotal. They will be required to analyse samples of the contaminated water, whatever the source, and identify/quantify any chemical contaminants present, often with little or no information as to the source of the contamination, and all within as short a timescale as possible. This information in turn will be used to inform senior management and health experts, who will determine what control/remedial steps need to be taken, including notifying consumers whether they should drink or use the contaminated water. The consequences arising from identifying the wrong contaminant, or failing to identify the contaminant present, can be extremely serious.

In all this, the challenge facing the laboratory should not be underestimated. Modern analytical methods are continually evolving and lowering the levels at which contamination may be detected. However, these routine “targeted methods”, such as GC-MS-MS and LC-MS-MS, often rely on the availability of reference standards to compare the spectra obtained from the analysed samples to the reference spectra and identify the contaminant.

It is impossible for even the most well-equipped laboratory to hold reference materials for all the possible chemical contaminants, and therefore routine targeted methods may fail to identify a contaminant. In this case the laboratory must resort to library data from “non-targeted” methods using GC-MS-MS-TOF, LC-MS-TOF or orbitrap instrumentation, and the skills of the laboratory personnel will be tested to the extreme under high pressure conditions.

## How to prepare?

The need to prepare the laboratory, so that there are well-rehearsed procedures and properly trained analytical personnel in place, is essential so that any unknown contamination can be identified and quantified in as short a timescale as possible. This is key in determining the potential risk to consumers and ensuring the correct advice can be given to protect the public health as required.

Regular exercises to mimic the events of a contamination incident should be held, and these should be carried out in conditions as close to the real situation as possible. Fapas® provide a proficiency test for drinking water chemical contamination incidents, which offers the opportunity to test the procedures in place, in a simulation of a real event that aims to replicate the time pressures faced by the laboratory - whilst maintaining the quality of the analysis performed.



## Chemical Contamination Incident in Drinking Water Proficiency Test

Established for over 20 years, we provide 2 rounds of the proficiency test, typically in May and October. The materials are shipped to a member of the senior laboratory management, with a scenario (or description of events) leading to the suspicion that a gross contamination of the supply may have occurred. The receiving manager is required to store the materials refrigerated without the laboratory's knowledge if possible.

At the specified date and time, the scenario and samples are passed to the laboratory for them to carry out the necessary analysis to detect and identify any contamination present in the materials provided (listed in Table 2).

Sample volume	Material	Packaging	Analysis
2 x 1 litre	Drinking water	Glass bottles	Organic contaminants
1 x 1 litre	Drinking water	Plastic bottle	Inorganic contaminants
1 x 250 mL	Acidified drinking water	Plastic bottle	Metal contaminants
1 x 500 mL	Acidified drinking water	Plastic bottle	Gross alpha and beta radiation only

*Table 2. Sample details for the chemical contamination incident in drinking water proficiency test*

The laboratory must analyse the materials as quickly and accurately as possible and email the results to Fapas as they become available, specifically answering the following questions:

- Is there any significant contamination present?
- What is/are the levels of the contamination found?
- What is/are the possible sources of the contamination?
- What warnings/information would be provided to consumers?
- Were any screening tests used?
- What analytical methods were used to detect/identify the contamination?

The maximum time allowed to complete the exercise is just six days and the laboratories are informed of the contaminants present in the material the day after the round has closed. A comprehensive report on the round is published within 25 days of the closing date.



## **Maximum Learning Opportunity: What Will We Gain Through Participating?**

The contamination incident proficiency test is designed to offer the opportunity to learn from the exercise, rather than providing on-going monitoring of laboratory performance; regular monitoring is achieved via the routine drinking water proficiency tests available from Fapas®. All participants are invited to attend an annual best practice meeting to discuss the proficiency tests and contribute their experience and learning for the benefit of all participants. These best practice meetings are as an integral part of the laboratories' participation in the tests. At the meeting, laboratories can gain valuable insights from each other and Fapas®, regarding the exercise carried out. For example, if a laboratory did not detect a contaminant present when using the same analytical equipment and analysis method as other laboratories in the test, those that did detect the contamination may be able to offer advice on the best practice and possible reasons for the non-detection.

The meeting is held under specific conditions to encourage free and open discussion, and which allows information from the meeting to be published, by any attendee, providing the source of the information (individual or company) is not identified (the Chatham House Rule). This also permits detailed minutes of the meeting to be circulated after the meeting to all participants, so if any participant is unable to attend the meeting for any reason, they can still benefit from the group learning.

We believe that the Fapas® chemical contamination incident in drinking water proficiency test offers a unique challenge of the laboratory procedures and policies in a realistic simulation exercise, combining the analytical skills of the laboratory, coordinated by the senior management, through to remedial action and communication with the consumers.

### **Benefits of participation:**

- Allows laboratories to demonstrate their ability to identify unknown chemical contaminants
- Allows laboratories to test new screening techniques in a lifelike situation
- Provides independent feedback; help identify any additional development work required
- Provides a useful training tool for analysts and builds confidence to deal with a real event
- Allows laboratories to measure their performance against other laboratories
- Serves as an ongoing test of laboratories' emergency analysis procedures and processes
- Demonstrates to regulators and customers you are proactively challenging your contamination detection capabilities



## References:

- 1) Paranthaman K. and Harrison H. Case study: the crude MCHM chemical spill investigation and recovery in West Virginia USA. *Journal of Water and Health*. 2010 Dec;8(4) 735-740. Epub 2010 Apr 26.
- 2) Whelton A.J., McMillan L., Novy C.L.-R., White K.D., Huang X. Drinking water incidents due to chemical contamination in England and Wales, 2006-2008. *Environmental Science: Water Research and Technology* 2017 3 312-332.
- 3) <https://erncip-project.jrc.ec.europa.eu/networks/tgs/water>



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