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Water Sampling – a Risk Assessor's Approach to Water Sampling Rationale

Testing, Testing Water Sampling – a Risk Assessor’s Approach to Water Sampling Rationale

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It appears that in the media or at conferences a great deal has been said about the importance of adhering to water controlling schemes known as keeping the right water temperatures. Keeping regular water turnover to avoid stagnation, flushing little used outlets (LUO’s), ensuring the design of the domestic water supply (DWS) reflects best practice recommendations (suitable materials, design structure etc) is emphasised, but I feel that there appears to be noticeable gap in the consideration of the benefits of *regular* water sampling.

I consider the subject of water sampling to be an unsung hero in our battle regarding the control of legionella. Though within this article and my observations I am focusing on legionella, I nevertheless recognise the equal importance of *Pseudomonas aeruginosa*, or other waterborne pathogens.

To be fair, when changes appear in some of the water industry normative regulations, there has been some input on this subject, though such publications have not fully covered the intricate theme of the benefits of regular water sampling.

Mandatory Sampling

Whilst it can be said that sampling in certain settings may be seen as ‘mandatory’ (HTM 04-01 Part A), where there is a *new build or refurbishment works and prior to handover immediately* (though not specified how soon), *but no sooner than 48 hrs after the disinfection* of the water system, for example, they may be seen as a ‘one-off’ water quality check. This would not necessary be deemed by the said regulations as being repetitive and ongoing unless the initial sampling shows positive results.

BS 8680:2020 “Water quality — Water safety plans — Code of practice” recommends that there is a sampling plan and procedures for sampling, where necessary, and as agreed during

the design process for buildings (also see BS 8554 for sampling and monitoring). It also advises that sampling plans within the water safety plan should be designed to support control strategies, which could involve indicating either the effectiveness or ineffectiveness (temporary or long term) of controls. Sampling should not, however, be used as a substitute for controls. The sampling plan should have clear objectives (which are likely to influence the type of sampling) and should be designed to ensure results are relevant and can be easily interpreted. Detailed guidance on planning sampling can be found in BS EN ISO 5667-1, BS EN ISO 5667-20 and BS EN ISO 5667-24.

Furthermore, we should consider the additional requirements within augmented care units due to the nature of the risk relating to those who may potentially be exposed to legionella and other waterborne bacteria.

However, my interest in regular sampling methodology lies in what I would call ‘less intense areas’. Areas such as hand wash basins (HWBs) in generally used facilities like toilets, kitchen sinks, plantroom taps, external taps, and let’s not forget the little used outlets (LUOs), may still provide favourable conditions for the proliferation of the pathogenic matter and present a level of risk as far as the water quality is concerned.

In my opinion, regular microbial testing of DWS can be a very helpful



tool to complete the usual control tasks driven by water industry. The word ‘regular’ I feel would need to be quantified within the risk assessment document to empower the user to apply a structured/practical approach, rather than a conjectural one. Its definition and application, I think, should be based on the level of risk dictated by both the condition of the water system and the profile of users potentially exposed to pathogens such as legionella.

Dogmatic understanding of the HTM 04-01, or other related guidance, may take away the focus on how to control the growth or eradication of the bacteria. The tendency might be to pay more attention to the means and not to the deliverables we are intending to achieve, which I think is more important. I am led to believe that the real question is not how long or how many samples it takes to deal with the bacteria, but what successful steps one needs to take to get rid of it or be in control of it regardless of how many samples it would require to confirm this.

What I mean by that is this: let’s not dwell on how many samples we have already been told to take, but let’s take enough so you would know that the issue has been effectively dealt with. It may take more than three or



six months to fully get to grips with the 'no doubt' remedial program application. I refer here to HTM 04-01 Part B figure 4 and HTM 04-01 Part B pp.D14.

And above all, the majority of the codes of practice stipulate a minimum of required controlling actions so there is definitely some room for more! Let's not be afraid to see what we can find in water.

Let's take a closer look at some of the other references to water sampling in the water industry guidance notes.

The way I read HSG 274 Part 2 is that it does not specifically 'encourage' water sampling to be included as part of the ongoing control program. I am not excluding here 'emergency' sampling when it is apparent that the water system has been compromised and it is now being brought back to a fit-for-purpose condition, for example, by a chemical clean.

Instead, HSG 274 suggests focusing on the risk assessment; this may stipulate the requirement for sampling, or advise it to be undertaken when the monitoring reveals there is a problem with the DWS. One might therefore reasonably conclude that the risk assessor's role can contribute to, and promote, water sampling by making reference to it within the legionella risk assessment.

ACoP L8 refers to water sampling in the context of periodic sampling and testing for the presence of legionella being relevant to show that adequate control is being achieved. (I think this is in connection with microbiological control when biocide is being continually added to the water system). In addition, we read in ACoP L8 that *'a negative result is no guarantee that legionella bacteria are not present in the system and, conversely, a positive result may not indicate a failure of controls, as legionella are present in almost all natural waters.'*

As has already been said using references from the HTM 04-01, in a similar way BS 7592:2022 considers water sampling as a validation factor in the control measures which should remain effective; there is an increased need to sample potential sources for the presence of legionellae. Sampling, as we further read in the said standard,

is also required when investigating sources of infections in cases of Legionnaires' disease, to validate new control processes and to verify that disinfection and commissioning processes have been effective.

So, when we put all this knowledge together, where do we stand in relation to a 'voluntary' sampling plan? What should we suggest to our clients when it comes to water sampling?

At a certain point in my career, I heard the following comment from an Estates Manager (hospital) that *'we do not look for this bacteria in our water system' (Pseudomonas aeruginosa)*. At the time the comment was made, we were dealing with high volumes of *Pseudomonas aeruginosa* found in the water system of the hospital! To me, this attitude reflected either a lack of knowledge and appreciation of the benefits of acquiring this type of data or just simply a lack of willingness to be more proactive in Health and Safety (H&S) management practices as far as the water quality and safety of the users is concerned.

And that is why I would see a long-term benefit in shaping the professional attitude of the decision makers towards the investigative data, to enhance planned programmes of maintenance (PPM) and to appreciate the positive impact on the ongoing monitoring of water quality. If it evolves around management behavioural practices, this could be addressed using data stemming from what one may consider an unassuming analytical task.

It is stated in the HSG 274 that *'legionella monitoring (microbiological) should be carried out where there is a doubt about the efficacy of the control regime or it is known that recommended temperatures, disinfectant concentrations or other precautions are not being consistently achieved throughout the system'*. 'Doubt' is a subjective notion and may be understood differently by those who deal with the upkeep of water systems. It may be difficult to find a water installation that works 100% without any problem and, as such, it might lead to some degree of doubt in some facets of the controlling program. This means that 'doubt' could be an unquantifiable parameter in stimulating a decision process to

implement regular water quality analysis.

Based on my own professional experience, I am a great supporter of this voluntary and regular maintenance task. I see it as an enhancement to the control scheme by providing simple and scientifically proven data. There is something the user can see to demonstrate the current water quality trend. This pragmatic approach may allow us to stay one step ahead just in case there is something sinister lurking in the water system, especially where the users could be immune compromised.

When reading some sections of the BS 7592:2022 and HTM 04-01 one might have a question about best practice in relation to the pre- and post-flush sampling of single taps. In Note 1 p.7.4.1 (small print on the bottom of the page 17 of the BS 7592:2022), it is explained that for routine water quality monitoring, only pre-flush samples should be taken as the *'post-flush samples are not suitable for routine monitoring'*. Further on in the same document, it is understood that the post-flush sampling should be carried out when there are positive results from the pre-flush analysis. This is especially applicable for healthcare settings.

From my experience, and the commercial point of view, it might be more cost effective to do them both at the same time (one after the other) to reduce the time required for the sampler to re-visit the site and to cut 50% of the costs of transport to the Laboratory, not to mention the ecological impact (CO₂). Some Laboratories may even offer their regular customers a discount based on the number of samples submitted on the day.

My clients have benefitted from a full understanding of the water quality based on the pre and post flush method. This approach provided greater insight into the workings of the water systems. When positive readings were identified, two important issues were noted: – (1) either the problem was localised or (2) it was systemic. The Figure 4 from HTM 04-01 Part B could help to apply a more robust water monitoring protocol.

The quantity of bacteria identified

in a sample can give us further appreciation of the problem and what remedial actions we should consider. As we have already mentioned, the legionella risk assessment can be a key instrument in helping to establish and propose an effective water sampling plan, given the nature of the setting and the type of hot and cold-water design/function. Having said that, not all those who are responsible for water systems seem to share this opinion.

I dare to suggest a thesis that, on occasion, proposing analytical checks of the water quality might even be frowned upon as something 'alien'. The motive behind such an attitude might have several root causes. Undoubtedly, the frequently mentioned additional outlay of finance may cause resistance from the user but also, the possible fear of 'disturbing' the status quo and that the water sampling may reveal that something might not be right with the water which may lead to some changes in the day-to-day tasks or processes.

From my experience in dealing with water management, I have a feeling that water sampling has been seen as a non-essential part of the maintenance regime unless it has become an obligation due to such circumstances as known clinical infections due to legionella or *Pseudomonas aeruginosa*.

When supporting medical environments I had a client who, very wisely, considered water sampling to be a regular and ongoing part of the DWS checks, regardless of the last set of analytical test results. Prior to regular water sampling being added to the list of tasks, there had been a discussion held with the client to present the pros and cons of this task becoming a regular entry on the PPM chart. The sampling routine would normally be carried out on an agreed 6-monthly basis. Yes, there was a cost involved for that service, but the benefits being sought far outweighed the usual 'saving money' argument and ideology.

When meeting with my client's Procurement Manager, I heard the rather unorthodox statement: *'If you need a million pounds to keep us way out of trouble, so be it.'* I can assure you that much less was needed to keep the water system in a fit-for-purpose condition, and it was all achievable since we kept control of the water

system and obtained data to confirm that was the case.

I view that as a potential *one million pounds saving* rather than an unnecessary, additional financial commitment on the part of the owner of the water installation. But not every user is so supportive. I think of those who question the very rationale of sampling, never mind the number of samples needed to demonstrate the efficacy of the control program.

Can water samples be useful?

The simple answer is 'yes'. The more we know, the better we can be prepared for the unexpected.

Why? Because water quality can change unpredictably. Such has been my experience when dealing with mobile diagnostic clinics. They usually take water from different locations as they move from one location to another, and the possibility of taking on and retaining some bio-pathogenic material is heightened. On a number of occasions, it has been possible to determine the risk of bacteria proliferation before the units were despatched to new locations; all of that was possible due to regular sampling.

Water installations within buildings (not mobile units as we have been discussing) can also face some unplanned changes of the water quality. It is almost impossible to quantify how many times the substandard water quality could have become a problem had the routine water quality checks not been carried out.

I am a strong believer that, every time I work on water systems, I have to be mentally prepared to face the fact that there may be something wrong with the water quality. If so, I should engage this issue in an effective and swift manner. Obviously, involving the user in this process is paramount so that operational decisions can be informed and ultimately lead to a positive conclusion of any possible challenge.

At the end of the day, as per HSG 274, *'the ultimate responsibility for the safe operation of the water system rests with the Duty Holder.'*

Commercial usefulness

The evidence provided by regular water

sampling, from a good sample plan, can also deliver secondary benefits and be a great management tool when it comes to the commercial aspects of running a contract. It can evidence that the strategy, previously devised and implemented, has been working effectively, and thus the water quality has been kept within the required industry standards.

Such a practice sends a strong and positive signal to my clients' business partners and customers that the water quality is not taken for granted or treated lightly and that more than reasonable measures are being taken to keep it under control.

The water quality certification issued by a UKAS laboratory gives tangible evidence about the condition of the system at the time of the samples being taken. It also helps when disputes occur between two or more parties in instances when responsibilities for the water installation have not been clearly defined at the outset of the contract.

Apportioning blame could be minimised when the regular maintenance plan includes data on water quality that is proactively sought through water sampling.

I could cite numerous examples of when the provision of sampling data has had a direct, positive impact on improving (and protecting) the commercial relationship between parties (one of them being my client). Without the hard data, the discussions would have been based on suppositions which could have only led to unnecessary mutual accusations and potential deterioration of the business relationship between the parties.

Samples taken from identified locations will also help to determine who should be taking direct responsibility for the water quality and the water system, if shared between users. This is a further important benefit of keeping water sampling on the list of regular (not sporadic) tasks.

Who should be taking the samples?

Those who have been adequately trained and competence checked in this area of water management. Ideally, those who display in-depth practical knowledge on how to carry out these tasks properly, ensuring



that all aspects of sample collection, including record-keeping, are carried out efficiently and without compromising the integrity of the samples.

In accordance with the Code of Practice BS 7592:2022, persons selecting sample points and collecting samples should have the appropriate competence to understand the rationale for selecting sampling points and be able to follow strict procedures while collecting the samples. The same standard refers to HTM 04-01 Part B that *'for healthcare premises, all staff need to be trained in sampling techniques and have undertaken a water hygiene training course as prescribed within section 6.29'* though there is no specific reference to water sampling itself from section 6.27 through to 6.30. ACoP L8 states that all persons tasked with sampling should have relevant competence in the systems and any associated equipment to be sampled so they can identify areas with risk factors for legionella growth.

How should the samples be taken?

BS 7592:2022 suggests that, for routine monitoring purposes, only pre-flush samples should be taken and, where possible, these should be taken from non-mixed outlets. No disinfectant required and no need to remove any flow aerators present.

The standard gives detail on how to sample from different taps and from showers or hot water storage vessels (calorifiers). Potable cisterns should NOT be opened for routine sampling but samples should be taken from an outlet as close to the cistern as possible. Post-flush samples for legionella require terminal fittings to be removed and a specific disinfection procedure to be applied.

Clear method statements for water sampling based on the latest guidance should be created in order to assure quality and consistency between operatives. So-called 'composite' samples should NOT be collected (a little water from a number of outlets collected in the same bottle). Unfortunately, I have seen operators displaying a 'lack of procedural knowledge' which caused the quality of the samples to be potentially compromised.

For any further details on legionella

sampling methodology, it would be advisable to consult BS 7592:2022.

When should the samples be taken?

The best time for any samples to be collected is when the water outlet has not been used for several hours. If these conditions cannot be met, note any relevant factors that might affect the sample collected e.g. date and time that a biocide was most recently added. There may be different requirements when investigating an outbreak.

Water sample containers

Water sample containers should be strictly identified relating to what type of samples we are intending to collect. Legionellae samples would normally require 1000 mL bottles. A biocide neutralising agent should be present inside the bottle. Where access to the tap is limited, BS 7592:2022 suggests using a suitable, sterile, single-use, wide-necked screw cap container.

From my experience, I have learnt that the use of two 500 mL bottles (smaller size) for the same sample would still be acceptable. Less hassle but the results should be the same. In other words, water being collected in two 500 mL bottles from the same outlet one after the other (with the water flowing continually) would still be acceptable for a laboratory to process the sample in an uncompromised way, providing that they are informed and their method statement allows it.

Storage and transportation of samples

When those of us who are LCA registered and offer analytical services face the audit, we can corroborate that details of storage and transportation of the samples come under the LCA Auditor's scrutiny. Mine does every year, and rightly so. Again, such issues should be in accordance with the current BS 7592:2022 p.8.

Samples of hot and cold water should not be mixed together for storage. They should be in separate thermal containers. There is no need to use coolants in the thermal bags. However, if temperature control is required, samples should be transported in refrigerated conditions or in an ice-box. The cooling agent (ice packs) should not touch the bottles to prevent adverse temperature changes in samples, as per BS 7592:2022.

Delivery should ideally take place on the day of sampling and, if that is not possible, then within 24 hours after the samples have been taken. Yes, there is a window of 48 hours but I personally would avoid that as the sample quality may be negatively affected by then.

Interpretation of the sample results

ACoP L8 states that a suitably experienced and competent person should interpret the results of the monitoring and testing. The certification for the user should be an original, issued by the laboratory, and should not be reproduced (either in part or in its entirety).

Conclusions

Water sampling can form an important part of a control program and should be considered as a source of data for future decisions on how the system should be maintained. If applicable, this fact should be clearly established in a legionella risk assessment and a corresponding water sampling plan, which has been approved by the Responsible Person or the Water Safety Group.

Though the sampling may be perceived as an additional cost within an overall risk management strategy, it can pay dividends in the long run by tangibly highlighting areas of higher risk where additional management and/or engineering elucidation should be sought. The selection of localities and assets to be tested should be identified at the preparation stage of the legionella risk assessment. It can be incorporated and understood as a basic platform for future water sample planning and revision of the risk management.

Certainly, it is always better to know early enough before the unexpected escalation of challenges can oblige us to choose the more expensive alternative.



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