Preventing Microbial Contamination in Analytical Grade Water with Regular Water System Sanitization

THE CHALLENGE

Preventing microbial contamination in analytical grade water

Microbial contamination in analytical grade water can negatively affect the results of critical laboratory research. For example, pyrogens, viable microorganisms or active virus particles in the water can contaminate cell cultures. Microorganisms in the form of particles can affect particle analyses. Additionally, bacteria could raise total organic carbon (TOC) levels in the water, which could influence the result of chemical analyses such as high-performance liquid chromatography (HPLC). When microbial contaminants interfere with critical laboratory processes, researchers often must repeat their testing, wasting valuable time and money.

Reagent grade water standards specify maximum levels for bacterial growth, as shown in Table 1.

Table 1 - Reagent Grade Water Standards

American Society for Testing and Materials (ASTM)			
Max. Heterotropic Bacteria Count	**Type A**	**Type B**	**Type C**
	10/1000 ml	**10/100 ml**	**100/10 ml**
Endotoxin, EU/ml	**<0.03**	**0.25**	**N/A**

College of American Pathologists (CAP) **National Committee for Clinical Laboratory Standards (NCCLS)**		
Bacterial Growth (cfu/ml)	**Type I**	**Type II**
	10*	**1000**

***Preferably, Type I water should be bacteria-free**

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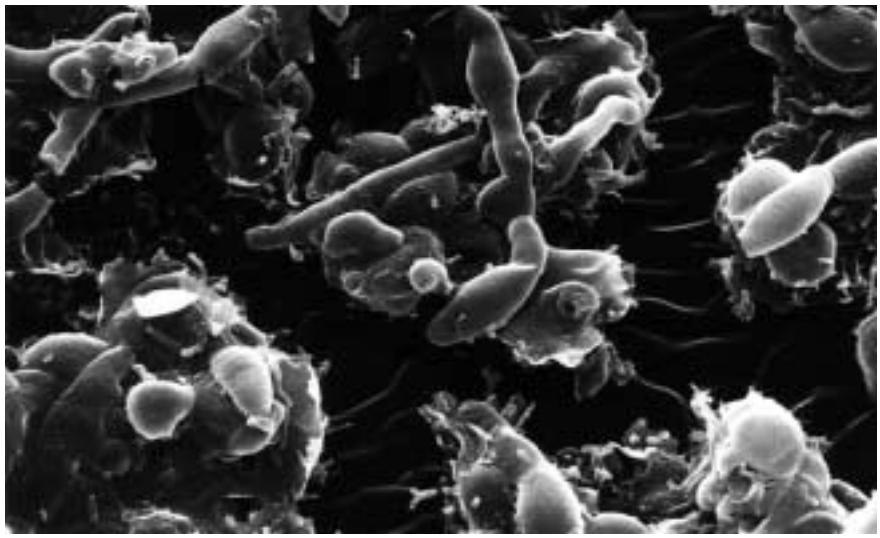

Figure 1 SEM of thin biofilm with rod-shaped bacteria and fungi on the inner surface of a water system product water outlet tube (top view, magnification level 2000x). (Courtesy of Dr. Arnd Goppelsroeder, DWA Ubstadt, Germany)

THE SOLUTION

Sanitization of laboratory water systems on a regular basis will help prevent microbial contamination

Regular sanitization of laboratory water systems is essential for preventing the system and product water from becoming contaminated with bacteria and pyrogens. If allowed to proliferate, bacteria eventually form a layer of biofilm or "slime" on the water system surfaces, and this biofilm continuously releases microbes into the water. Once biofilm forms inside the system, it can be difficult to remove. The scanning electron microscope (SEM) image in Figure 1 shows biofilm growth in water system tubing. Removing this biofilm would require a regimen of several sanitization cycles using alternate sanitants – a time consuming and costly procedure.

To prevent bacterial growth and biofilm formation, the whole system should be regularly disinfected with sodium hypochlorite or chlorine tablets. After sanitization, the unit should be flushed with water until there is no more chlorine in the system. Laboratory water systems used in critical applications should be sanitized at least twice a month, and every time the cartridge packs are replaced. The system should also be sanitized if it has been shut down for more than a week. Although most lab water systems have an automatic recirculation feature that recirculates water through the system, this alone will not prevent bacterial contamination. The microbial level may be initially lower when the system is first placed in the recirculation mode; however, without regular sanitization, this level will most likely increase so that it is similar to the level in a non-recirculating system.

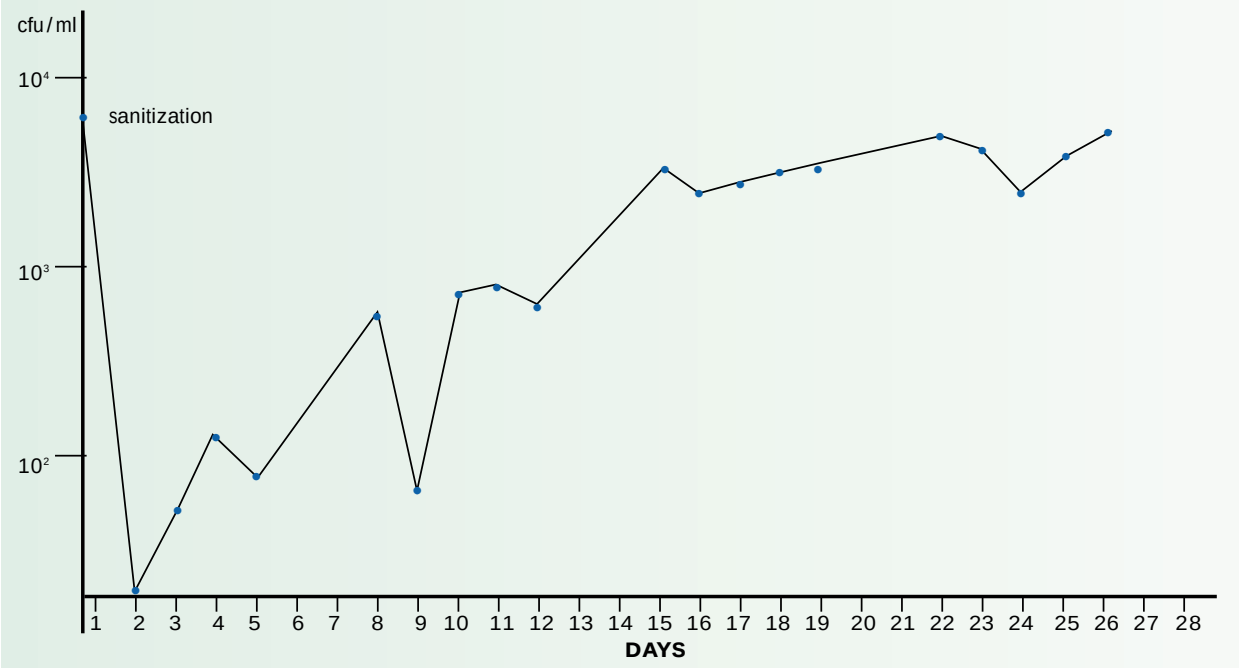

Figure 2 The effect of water system sanitization on bacteria levels. Maximum feedwater bacteria level was no more than 100 cfu/ml.

Figure 2 shows the effect of water system sanitization on the bacteria levels in the system (from a feed water bacteria level of no more than 100 cfu/ml). After one sanitization, the level of bacteria decreased from nearly 10^4 cfu/ml to a non-detectable level. The graph also shows that the bacteria level begins to increase again over time, so that by the 22nd day, it has increased to pre-sanitization levels.

SANITIZATION MADE SIMPLE AND ECONOMICAL

Frequent sanitization of lab water systems is much easier in units equipped with an automatic sanitization feature. Some models on the market today include a display that lets the user know when the system should be sanitized. Other system conveniences include: a sanitization cycle that takes only several minutes to initiate; a built-in chamber that accommodates chlorine tablets; or an optional liquid sanitization chamber that allows the use of a solution of hydrogen peroxide or peracetic acid. During the automatic sanitization cycle, which lasts approximately six hours, sanitant is automatically recirculated through the system, completely sanitizing all wetted parts with the exception of the ion exchange cartridge and final filter. After the sanitant has been recirculated through the system, the unit automatically rinses to drain to flush out all the sanitant.

SYSTEM FEATURES OFFER ADDITIONAL PROTECTION

Systems with ultraviolet (UV) photo-oxidation units (185 and 254 nanometer) are less prone to bacterial growth, as the UV destroys organic contaminants and microbes.

In systems containing an autoclavable ultrafilter (UF), the UF can be removed from the system and autoclaved at 121˚C (250˚F) for 20 minutes. The high autoclave temperature kills microorganisms within the UF cartridge. Most systems include a bacteriological retentive final filter at the point of use, which protects the system from retrograde contamination, and helps ensure the quality of the product water.

CONCLUSION

With regular sanitization, lab water systems can deliver microbial-free analytical grade water

Regular sanitization of lab water systems is vital in preventing microbial contamination and the formation of biofilm, thus ensuring high-quality product water for critical laboratory research. Sanitizing at least twice a month, and every time the cartridge packs are replaced or the system is shut down for more than a week, will help prevent bacterial contamination.

Systems that incorporate a UV, autoclavable UF and bacterio-logical retentive final filter, offer additional protection from bacterial contamination. And, an easy-to-use automatic sanitization feature that accommodates liquid or tablet sanitant makes regular maintenance that much simpler for busy laboratory personnel.

USFilter's PURELAB Plus™ UV/UF is an example of a lab water system with an ultraviolet unit, an ultrafilter and automatic sanitization.

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