GUIDANCE NOTE – GN 4
BACTERIA WITHIN CLOSED CIRCUIT PIPEWORK SYSTEMS

2019 Edition

GUIDANCE NOTE – GN04

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Introduction

Most engineers are well aware of problems encountered with bacteria in open circuit pipework systems, but there is much less understanding of closed system bacteria.

This document gives brief guidance on the types of bacteria commonly encountered in closed water systems, means of identification and control.

Effects

Bacteria can cause several problems within closed pipework systems including:-

1. Unrepeatable commissioning readings due to the generation of gases.
2. Corrosion due to the formation of organic acids, ammonia, hydrogen sulphide etc.
3. Blocking or partial blocking of strainers, valves and pipework.
4. Reduction of heat transfer in heat exchangers.
5. Reduced efficiency of corrosion inhibitors due to their inability to access pipe surfaces
6. Overall reduced efficiency of the pipework system.

Methods for Detection

To ascertain whether a system contains heavy bacterial contamination there are some simple tests that can be carried out on a water sample.

1. Visual – cloudy turbid water is often due to organic substances produced by the bacteria micro-organism.
2. Odour – a strong smell of ammonia or sulphur etc, will indicate possible contamination.
3. A basic dip slide test can potentially determine the level of contamination.
4. Analysis is the best method of detection, this would normally be carried out by an independent UKAS approved laboratory using samples provided by the water treatment specialist who is competent in the method of taking samples in accordance with BS8552. If it is required for the actual bacteria to be identified then more detailed laboratory tests can be carried out.

Incoming Water

The incoming mains or the site water supply used to fill the system can often be the source of bacterial contamination and therefore the condition of these waters should be checked prior to first filling and treated as necessary by the water treatment specialist. As per BSRIA guidance BG29/2012 Table 8 the following tests should be undertaken.

Parameter	Suggested Range
Sulphate	<250 mg/l
Chloride	<250 mg/l
pH	7.0 – 8.5
Hardness	<350 ppm
TVC	<10,000 per ml
Pseudomonads	<1000 per 100 ml

It is recommended that all site water supplies that will be utilised for water treatment works are disinfected prior to use.

Filling & Testing

The most efficient way of controlling bacteria from the incoming mains is via proportional biocide dosing during initial filling. A common alternative method is the introduction of ultraviolet (UV) light.

Many water treatment specialists recommend that all closed systems be initially filled with treated waters through a proportional filling rig. This would then ensure acceptable chemical and microbiological fill waters are introduced, affording initial microbiological and corrosion control of the internal pipework surfaces.

Where systems are filled for prolonged durations (>4 weeks) samples shall be taken from the already filled system and sent for independent laboratory analysis. In the event of an unsatisfactory sample result being returned then remedial works will be discussed and agreed with all parties involved with the works.

Where possible system filling and pressure testing should be delayed as long as possible and done as close to the start of flushing.

Wherever possible, sections filled with treated and inhibited water should not be drained to minimise corrosion.

Pre-commission cleaning should be carried out as per BSRIA BG29/2012 and the relevant specialist's own approved method statement. Upon completion of the pre-commission cleaning stage chemical levels should be checked and adjusted to prevent microbiological growth and corrosion.

It is important that pressurisation units are treated as part of the system as they can, if left untreated, become a breeding ground for microbiological growth.

Methods of Control

As described above, it is important to check and control the levels of bacterial contamination from an early stage and by regular water quality sampling and analysis.

It must be noted that if early control is not carried out and microbiological contamination is allowed to become well advanced, it will be extremely difficult to eradicate the problem.

Water treatment specialists will normally specify and use a broad spectrum biocide which has generally proved to be effective in controlling ~~the~~ bacteria. However this biocide must be compatible with system components and any existing chemistry to work efficiently.

If during the on-going monitoring of the water quality within the closed water systems, microbiological contamination is identified, it could be recommended that Bio-Screening is carried out by the water treatment specialist. Bio-Screening will help to identify the most appropriate biocide that has the best "kill rate" against the particular strain of bacteria present in the system.

Sampling as per Tables 5 & 6 (BG29/2012) should be undertaken bi-weekly following completion until final handover.

Note: If sampling results show a reduction in chemical concentration this could be an indication of possible water loss. If this occurs, then the cause of the water loss should be identified / rectified and chemical levels should be adjusted accordingly.

Note: If there is found to be a loss of nitrite inhibitor but no loss of Total Dissolved Solids (TDS), it may indicate microbiological activity and therefore careful examination should be carried out.

Bacteria in water systems is widespread, they occur more frequently than other micro-organisms and are more difficult to keep under control. Bacteria under favourable growth conditions, will cause problems. Optimum temperature for microbial growth is commonly between 20 – 40 °C however this does not mean that the bacteria concerned cannot survive outside these conditions. Bacteria are particularly good at adapting themselves to unfavourable conditions enabling them to remain dormant. As soon as conditions become more favourable they awaken to form complete cells and then multiply by binary division.