

GUIDELINES ON CLEANING AND DISINFECTION OF COOLING TOWERS FOR THE CONTROL OF *LEGIONELLA* BACTERIA

This set of Guidelines serves to provide guidance to cooling tower owners on cleaning and disinfection of cooling tower.

Regular Maintenance

Cooling towers shall be maintained in a good working condition. A good working condition would mean that there is no defect in the operation, and the cooling towers should be free from physical damage or deterioration which may arise from defects, such as, rusty pipes.

A comprehensive maintenance program including cleaning, disinfecting and water treatment for every cooling tower shall be carried out to prevent *Legionella* bacteria from multiplying and to allow water treatment chemicals to work more effectively. The regular maintenance of the cooling system shall be carried out by competent persons, familiar with the prevention of any hazard arising from the work.

Physical devices incorporating use of copper-silver ionisation, filtration, ultraviolet (UV) light or ozone may be incorporated to complement maintenance, but they shall not replace a proper and regular maintenance program.

Cleaning and disinfection shall also be carried out in cooling towers:

- i. that have been contaminated during construction, or by dusts or organic matter;
- ii. that have been shut down for more than five consecutive days;
- iii. that have been mechanically altered or disrupted in a manner which may lead to contamination;
- iv. at regular intervals where the surrounding environment is dusty or
- v. where the water quality is out of control; and
- vi. where the adjacent cooling tower has been implicated as a source of an outbreak of *Legionnaires' disease*.

It is mandatory under the Regulations to carry out thorough cleaning, disinfection and manual desludging of cooling towers at least once in six months.

Remedial Action for Failed Water Quality Results and/or when there is Reported *Legionellosis* Case in the Building

If the cooling tower does not comply with the regulatory parameter limits for water quality and/or when there is reported *Legionellosis* case in the building, the owners/occupiers are required under the Regulations to take the following

steps:

- i. Disinfect cooling tower as soon as practicable within 3 days after date of failed test result report;
- ii. Do another round of water quality sampling within 24 hours after disinfection and ensure that the water quality complies with the regulated limits; and
- iii. Submit the test results to NEA via NEA ePortal within 7 days after completion of test (date of test results).

Procedures for Cleaning and Disinfection

During the procedure, the cooling tower fans should be switched off. The procedures for cleaning and disinfection shall be as follows:

- a. The system water shall be pre-chlorinated to achieve a measured residual of 5 mg/litre free chlorine, to minimise health risk to cleaning staff. Circulate water together with a biodispersant, to enhance the effectiveness of chlorination, for 6 hours, maintaining a minimum of 5 mg/litre free chlorine at all times. If the circuit pH value is greater than 8, the measured residual will need to be in the range of 15-20 mg/litre free chlorine in order to achieve the required disinfection level. An alternative procedure to provide a more effective use of chlorine is to introduce a heavy bleed-off for several hours to reduce the pH of the system and its chlorine content;
- b. The circuit shall be drained and the tower, sump, and distribution system manually cleaned. Accessible areas of the towers and its pack shall be adequately washed. Scale and other deposits that have not been removed shall be dissolved using chemical descalants, carefully chosen to avoid damage to the circuit/cooling tower;
- c. Cleaning methods which create excessive spray such as high pressure water jetting shall be avoided. If this is not possible, the cleaning shall be carried out when the building is unoccupied or in the case of permanently occupied buildings, windows and air inlets in the vicinity closed. Staff involved in water jetting shall be adequately trained and wear suitable respiratory protective equipment;
- d. The system shall be refilled with fresh water, and re-chlorinated to maintain a minimum level of 5 mg/litre free chlorine throughout the period of 6 hours. A biodispersant shall be used to enhance the effectiveness of chlorination; and
- e. The system shall be drained and flushed, refilled with fresh water, and dosed with the appropriate start-up level of treatment chemicals, including

biocides.

Monitoring the Effectiveness of Cleaning and Disinfection

Conduct a water quality re-sampling within 24 hours after disinfection and ensure that the water quality complies with the regulatory parameter limits below before resuming the operation of cooling tower.

Parameter	Parameter Limits
Heterotrophic Plate Count (HPC) at 48h, 35°C	≤ 100,000 cfu/ml
<i>Legionella</i> bacteria count	≤ 10 cfu/ml

cfu: colony-forming unit

ml: milliliter

Pointers to Note when Using Biocides

At least two (2) types of biocides shall be used alternately on a weekly basis to prevent emergence of resistant strains of microorganisms and shall be chemically and physically compatible with processed water and neutral to piping materials.

The biocide shall be effective against a wide range of micro-organisms (including all *Legionella* bacteria) at the recommended dilutions, and its effectiveness supported by official independent reports, proven to be effective when dosed in accordance to the manufacturer's recommendations (frequency, dose strength, preparation). The biocide shall already have been in widespread use for similar field application in the country of manufacture for no less than 3 years.

The chemicals used and the subsequent end-products of the treatment programme shall be degradable with minimal hazards to the environment in the event of accidental spillage or through draining into effluent treatment plants, meeting all the necessary requirements under the Environmental Protection and Management (Trade Effluent) Regulations.

Published by:
Sanitation and Compliance Division
Environmental Public Health Operations Group
National Environment Agency, Singapore

28 August 2023