11. COOLING TOWERS/BOILER BLOWDOWN

Preface

Liquid waste generated by industry, small business and commercial enterprises is referred to as trade waste. The Water Supply (Safety & Reliability) Act 2008 prohibits the unauthorised discharge of wastes, other than domestic sewage, into the sewerage system.

1. The definition of trade waste is;
    - *The waterborne waste from business, trade or manufacturing property, other than:*
    - *Waste that is a prohibited substance; or*
    - *Human waste; or*
    - *Stormwater.*
2. The definition of Domestic waste is;
    - *Faecal matter and urine of human origin and liquid household wastes from water closet pans, sinks, baths, basins and similar fixtures designed for use in private dwellings*

Cooling towers

Description of activity

The continuous blowdown, or “bleed off” and other wastewater from both commercial and industrial cooling towers is liquid trade waste.

- “Comfort and process air-conditioning cooling towers” are defined as cooling towers that are dedicated exclusively to (and are an integral part of) heating, ventilation, air-conditioning or refrigeration systems associated with commercial living space air-conditioning, or commercial process air-conditioning such as computer rooms. The discharge rate from cooling towers in this classification should not exceed 500 L/h.
- “Industrial Cooling Towers” are cooling towers used in manufacturing for rejecting heat extracted from a manufacturing process. This activity is classified as High Risk and an application must be forwarded to WRC.

Other issues

Commercial and industrial cooling towers generate wastewaters that vary considerably in the contaminants they may contain according to the water treatment utilised.

Certain cooling tower water treatments involve chemicals which can be harmful to the sewerage system or the environment into which they are discharged. Use of these harmful chemicals is either restricted or prohibited.

Some water treatment systems do not rely upon chemicals and are quite harmless to the sewerage system and the environment. Where appropriate these “chemical free’’ water treatment systems should be encouraged for use.

Boiler blowdown

Description of activity

Boiler blowdown, or bleed-off, is the water discharged from a boiler. During the boiler blowdown process, water is discharged from the boiler to avoid the negative impacts of dissolved solids (impurities) on boiler efficiency and maintenance. As water evaporates within a boiler, dissolved solids in the water remain and settle, resulting in build-up of sludge and scale. This is alleviated by discharging some boiler water through a valve at the bottom of the boiler.

The build-up of solids can also lead to foaming near the top of the boiler. Skimming or ‘surface blowdown’ removes the dissolved solids near the surface of the liquid. The amount of blowdown depends upon the boiler operating pressure, the amount of make-up water (water to be added), impurity levels in the makeup water, and the dissolved concentrations that a given boiler can tolerate. Typical blowdown volume ranges from 3% to 15% of a boiler’s steam-generating capacity.

The discharge from boilers is generally continuous. However, WRC trade waste may approve applications for a one-off discharge from closed boiler water systems (e.g. due to periodic maintenance/cleaning). These discharges may involve high volume of trade waste over a short period of time and can be approved provided that the discharge is at an approved rate.

If chromate has been used in a closed boiler water system, the wastewater must not be discharged to the sewerage system. It should be collected in containers and transported off site for disposal in accordance with EPA requirements.

Pre-treatment requirements

The boiler blowdown water is often very hot and can cause damage to sewerage infrastructure, especially in large quantities. It can also increase biological activity, which in turn can rapidly reduce the oxygen content of the sewage, resulting in the generation of sulphides and corrosion of the sewerage system.

A cooling pit/tank is required to reduce the wastewater temperature to less than 38°C. To achieve the temperature requirement, the volume of the proposed cooling pit/tank should be at least three (3) times the maximum blowdown volume. If the pit/tank is smaller than this, WRC trade waste would require the applicant to provide cooling pit size calculations for pit/tank to achieve the required temperature. Pits should also be ventilated to assist with the cooling of the water within the pit.

As boiler blowdown water contains metals pH adjustment may be required to drop-out the metals and then pH correction prior to discharge.

Chemical additives

Chemicals may be added to the boiler water to inhibit corrosion or reduce scale. Some of these may contain chromium. Alternative chemical additives should be used in place of chromate additives, as these compounds are toxic and the discharge of chromium-bearing liquid trade waste is prohibited. There are some treatment systems that do not rely upon chemicals and which are harmless to the sewerage system and the environment. Applicants should be encouraged to consider such chemical-free water treatment systems where suitable.

Cooling systems

Discharges to sewer from any of the following types of cooling water systems are affected:

- Cooling towers (usually large systems).
- Evaporative condensers (refrigerant in closed circuit, water in open circuit)
- Industrial fluid coolers (closed circuit evaporative coolers cycling a process fluid rather than a refrigerant).

Cooling tower modules may include a plate heat exchanger between the cooling tower and the chiller machine. Dumps from the closed chiller machine circuit are also subject to this guideline.

Discharges from affected cooling systems may involve:

- continuous or nearly continuous bleed-off,
- periodic blowdown releases, and /or
- dumps of total inventory.

In order to gain WRC approval, the customer must:

- submit an application accompanied by technical information.
- use chemical and non-chemical treatments in accordance with this Trade Waste Guideline; and
- comply with any conditions specified by WRC as part of the approval.

Good industry practice

General and non-chemical options

Chemical loadings in cooling water system wastes can be kept to a minimum with sound design and installation. Some specific examples of this are:

- use of compatible system metals to minimise corrosion,
- enclosure of cooling towers can:

a) reduce airborne contamination leading to slime build up, and hence reduce the need for slimicide dosing; and

b) reduce evaporative losses and hence reduce the bleed rate to sewer.

Chemical loadings in cooling water system wastes can also be minimised with appropriate operating and maintenance practices. Examples are:

- ensure chemicals in the system are compatible with each other; oxidising biocides are capable of neutralising the active ingredients of some non-oxidising chemicals and care in selection is essential,
- closely monitor bacterial level in the system; if the bacterial colony count trends towards high levels, a change in the water treatment program may be necessary (the cause may not rest in the biocide itself but in other chemical parameters such as excessive organic material present in the system or inappropriate pH for the biocide in use),
- ensure that at least one of the chemicals in use has bio-dispersant properties so that biofilm (microbial slime) is kept under control,
- recognising that the circulating water system is dynamic with constant water loss and replacement taking place. On small systems up to about 500 L water volume, the water turnover may be as rapid as 2 or 3 times per day. It may be cost-effective to avoid chemicals at small evaporative condensers or fluid coolers by ensuring that the water is drained on a frequent basis, e.g. each evening; automatic dump valve arrangements are available for this purpose. Such daily dumps would not only entail better environmental practice in terms of chemical use, but may also be financially cheaper (cost of water less than cost of buying, dosing & monitoring chemicals).
- overdosing of chemicals must be avoided. The total system volume should be accurately assessed in order to calculate the chemical dose and to ensure the level of accumulating dissolved salts does not become excessive.
- Biocides have limited shelf life. Expired stock must NOT be used to dose cooling water systems, NOR may they be tipped into the drains, but should be taken away by a waste contractor or returned to the supplier. More information on appropriate practices can be found in Standards Australia documents:
- AS/NZS 3666: Air handling and water systems of buildings - Microbial control (Pt 1: Design, installation and commissioning, and Pt 2: Operation and maintenance).
- Handbook SAA/SNZ HB32: Control of microbial growth in air-handling and water systems in buildings.

Chemical control

General

Chemical treatments are used to control:

- rate of corrosion of metals in the system,

- scaling on surfaces,
- fouling of heat exchangers with organic and inorganic material; and
- biological growths, including algae and bacteria, which affect heat transfer and pose public health risks such as that of legionellosis.

Some of the chemicals involved can render the dosed water unsuitable for acceptance into the sewer system.

Cooling system waste water may also contain high concentration of suspended or dissolved solids drawn from airborne dust.

Corrosion control

Corrosion control can be in one of the following ways:

- anodic inhibition: modification of naturally occurring metal oxide surface films to make them more protective,
- cathodic inhibition: using the chemistry of corrosion cells to generate a protective film at the cathodic sites; and
- film forming inhibition: the use of certain organic compounds to form physically bound protective films on metal surfaces.

A formulated corrosion inhibitor will normally employ a combination of these processes. The actual inhibitors used will depend upon:

- the type of system and its operation,
- water quality,
- operating temperatures,
- materials of construction; and
- environmental constraints.

In all cases the corrosion inhibitors must be compatible and applied continuously. Their success will be dependent on the presence of clean metal surfaces.

Scale control

Chemicals used to control scale are known collectively as scale inhibitors. Specifically they function by holding up the precipitation process, distorting the crystal shape and dispersing the misshapen crystals, thereby preventing the build-up of a hard adherent scale.

The specific chemicals used as scale inhibitors will depend upon the type of scale predicted from the water chemistry and system operating conditions. However, the key to the success of the treatment program depends on:

- the compatibility of all chemical components used; and
- the adherence, at all times, to the recommended application, monitoring and control procedures.

Control of fouling

Deposition of particulate can lead to general fouling and can be overcome by the use of dispersants. The principal role of these is to reduce the tendency for small particles to collide, thereby causing them to stay in suspension rather than agglomerate and settle out. This is achieved by imparting a minute electrical charge to suspended particles so that they repel each other and hence remain in a dispersed condition.

Control of microbiological growths

The type of chemicals used to control microbiological growths (bacteria and other micro-organisms such as algae, fungi and yeasts) fall into two broad categories:

- oxidising biocides,
- non-oxidising biocides; and
- biodispersants.

A combination of these may be needed to achieve the required result.

The process of chlorination is well proven and widely available. Its advantages are that it provides a residual biocide where the treated water flows, and, very importantly, it can be readily checked. Its effectiveness in cooling towers is increased when used with non-oxidising biocides and biological dispersants.

Approval for waste acceptance to sewer

General

The customer will need to complete an application to *Discharge Trade Waste to Sewer form*

In addition, attach to the above application:

- the type of cooling water system, and
- the system total water capacity.
- indicate the trade name(s) and manufacturer(s).
- indicate the chemical names of all active ingredients OR attach data sheets (e.g. Material Safety Data Sheets) which list active ingredient components and their concentrations.
- a certificate from an engineer who is currently registered on the Queensland Professional Engineer Register showing the total volume of water in the system which may require dosing, and
- data sheets as above.
- a management plan (to be written into the customer's contract with the servicing agent for the cooling water system) for operation of the cooling water system indicating
    - Maximum rates of bleed-off,
    - dosing method and equipment type,

- dosing frequencies and concentrations of each chemical,
- methods used to evaluate need for and adequacy of dosing,
- maintenance and cleaning schedules; and
- extent of any non-chemical management methods.

Applications submitted prior to installation of cooling water system

For a new installation where equipment details and operational regime are not known at the time of seeking approvals, WRC Trade Waste will accept and approve an initial application which:

1. is incomplete with reference to the technical information referred to above,
2. includes a statement from the customer that the system is not yet installed, and
3. has attached a letter from the customer undertaking to submit a full application as specified above once the system is installed and before operation of the system begins.

The full application should, however, be submitted to WRC trade waste prior to entering into the contract for operation and maintenance of the unit(s) since WRC trade waste may need to apply discharge conditions which will need to be met by the contractor.

Approval conditions

Chemicals for which limits are not indicated above or in the TWEMP substance acceptance guidelines, or which a customer may wish to discharge in concentrations in excess of these limits, will be considered for acceptance to the sewer on the basis of their potential to affect the sewerage system, i.e. that the chemical(s) will not detrimentally effect:

- Biological sewage treatment processes,
- Value of reuse products derived from the sewage stream,-
- In-sewer conditions such as to create public or OH&S risks,
- Fabric of the sewerage system; and
- The environment from resulting sewerage system discharges or emissions.

Some chemicals may be unacceptable for entry to the sewerage system. The customer may need to incorporate such restrictions into the specification for the operations and maintenance contract. Overdosing of chemicals and use of expired date chemicals is not permitted.

WRC trade waste may prescribe discharge flow rates as part of the approval conditions. Customers must keep service contracts which include the cooling water system management plan available for inspection by WRC trade waste.

Stormwater

The discharge of stormwater to sewer is not permitted. All areas draining to sewer must be roofed and bunded to prevent the entry of stormwater, including rain descending at an angle of up to ten degrees from the vertical.