Scottish Environment Protection Agency
Buidheann Dìon Àrainneachd na h-Alba

Discharge of Chlorinated Effluents v3 Supporting Guidance WAT-SG-41

November 2021

Update Summary

Version	Description
v1.0	First issue for Water Use reference using approved content from the following documents: WAT-SG-41 Discharge of Chlorinated Effluents-GD.doc
v2	Chlorine standards updated, Background Chemistry section revised, docs use direct QP doc links
v2.1	Env Stds text revised, ES table deleted
v2.2	Text added relating to requirement when to have an appropriate assessment
V3	Added information about discharges from hot tubs.

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1. Key Points

This document provides additional information on regulating discharges of chlorinated or brominated effluents and should be read in conjunction with the key regulatory methods relating to discharge of sewage and trade effluent and WAT-RM-12: Regulation of Discharges from Water Treatment Works.

Other means of disinfection in swimming pools and hot tubs (spas) can be used. If bromine is used, the same approach as chlorine should be taken.

Chlorinated effluent can be generated through several processes, most commonly:

- Disinfection of sewage discharges where there is a need to achieve specified microbiological standards in the receiving water;
- Disinfection of water prior to use, such as potable water supplies, cooling water and swimming pool and hot tub water. The process using the treated water will then produce chlorinated effluent that requires to be discharged.

  Individual household hot tub discharges can be made without a SEPA authorisation as long as best practice measures are followed (see 5.1.1).

SEPA will require that discharges of chlorinated effluents containing or to waters with high organic matter are to have an appropriate risk assessment with reference to the use and release of chlorine and its reaction by-products the water environment. The concentration of chlorine by-products increases with higher organic content of wastewater and higher doses of chlorine.

However, SEPA recognises that chlorination of sewage effluents to achieve specified microbiological standards in the receiving water may be required as a short-term measure pending completion of capital works or for experimental purposes (see section 4).

SEPA will encourage, where possible, alternative methods of disinfection of sewage effluents. However, SEPA recognises some other methods also have the potential to result in pollution of the environment (e.g. copper biocides, ozonation).

Discharges of chlorinated effluent with a lower organic matter content (e.g. cooling water, potable water, swimming pool effluent) may not pose a significant risk to the water environment, as the amount of chlorinated by-products will be very low. SEPA will encourage the use of alternative

forms of disinfection and alternative discharge arrangements where possible but may authorise low organic matter chlorinated discharges to the water environment (see section 5).

2. Introduction

Chlorination is a recognised method of disinfection of sewage discharges where there is a need to achieve specified microbiological standards in the receiving water. Chlorination is also applied to water supplies to ensure that water is potable, and less frequently for industrial discharges (e.g. alginate industry which uses chlorine during processing); cooling water discharges from power stations; swimming pools and fish processing (to minimise the release of infectious material during the handling of mortalities and wastes).
This guidance is therefore divided into two categories:

- High organic content discharges
  Authorisation of discharges of chlorinated effluents with high organic content, such as sewage and fish processing.
- Low organic content discharges
  Authorisation of discharges of chlorinated process effluent, or other effluent, with lower organic content, such as swimming pool effluent, cooling water and potable water treatment.

3. Background Chemistry[1]

There are several chlorinating strategies involving any of the following agents: chlorine gas, hypochlorite, chlorine dioxide and chloramines. It is its oxidising power which gives chlorine its disinfection capability.

Elemental bromine (Br_2), bromine monochloride (BrCl), hypobromous acid (HOBr) and bromodimethylhydantoin are used in some swimming pools and hot tubs as a replacement for chlorine. The chemistry is somewhat similar to chlorine and so the same principles can be applied in terms of controlling environmental release. Chlorine (Cl_2) added to water forms hypochlorous acid (HOCl) which dissociates to give an equilibrium mixture of hypochlorite (OCl^-) and hydrogen

[1] Information in this section based on the following publications: Mananhan, S(1994). Environmental Chemistry (6th Ed), CRC Press; Environment Agency. (2008). Methods for the Examination of Waters and Associated Materials – Chemical Disinfectants in Waters and Effluents. Taylor, C.J.L, 2006. The Effect of Biological Fouling at Coastal and Estuarine Power Stations. Marine Pollution Bulletin 53:30-48.

ions (H^+). The relative proportion of these is pH and temperature dependent. Hypochlorite and hypochlorous acid are known as free available chlorine and this is very effective at killing bacteria. In polluted water, chlorine reacts with ammonia (where present) forming chloramines (mono-chloramine, di-chloramine and nitrogen trichloride). The chloramines are known as combined available chlorine, which is a weaker disinfectant than free available chlorine but is more stable, therefore more persistent in solution. Monochloramine is commonly used to purify drinking water. In seawater the chemistry of chlorine is more complex. Seawater contains ~68 mg/l bromide at full salinity: when chlorine is added it oxidises the bromide ions yielding hypobromous acid (HOBr). Many different chlorination by-products (CBPs) are generated. Production of CBPs and their toxicology is highly dependent on salinity, pH and concentration of organic substances in the seawater.

The chlorination of organic compounds in water can result in the production of disinfection by-products such as trihalomethanes (THMs) e.g. chloroform, from the chlorination of humic substances.

SEPA will require that discharges of chlorinated effluents containing high organic matter, or to waters with high organic matter, are to have an appropriate risk assessment with reference to the use and release of chlorine and its reaction by-products to the water environment. This is because discharges of chlorinated effluent have chlorine by-products present, especially trihalomethanes (THMs). The concentration of byproducts increases with higher organic content of the wastewater and increased doses of chlorine. De-chlorination of the effluent does not remove the THMs that are formed as a by-product of the hypochlorite's reaction with ammonia or organic matter. Of the THMs, chloroform is significant and has been shown to bioaccumulate in the vicinity of chlorinated wastewater discharges.

Under the Water Framework Directive (2000/60/EC), and the Priority Substances Directive (2008/105/EC) chloroform (trichloromethane) is identified as a Priority Substance and chlorine as a Specific Pollutant. Chloroform is listed by SEPA as a hazardous substance under the Groundwater Directive (2006/118/EC). Chlorine and chloride are non-hazardous substances under the Groundwater Directive (2006/118/EC).

4. Discharges and/or Receiving Waters with a High Organic Content

As mentioned above, SEPA will require that discharges and/or receiving waters with high organic matter are to have an appropriate risk assessment with reference to the use and release of chlorine and its reaction by-products to the water environment. The same principles apply for the use of bromine disinfectants and their reaction by-products.

If, due to technological or other advances, a discharger adequately demonstrates to SEPA that the use of chlorination does not pose an increased environmental or human health risk over other disinfection techniques, then SEPA may authorise the chlorination of effluents.

SEPA has a presumption for discharge to sewer or use of alternative forms of disinfection. Where neither option is feasible, given the likely high organic content of the discharge and likely production of chlorination by-products guidance in this section should be followed.
Consideration should be given to dechlorination (e.g. by dosing with sodium thiosulphate) before discharge. However, de-chlorination of the effluent does not remove the trihalomethanes that are formed as a by-product of the hypochlorite's reaction with ammonia or organic matter.

The following guidance should be followed where short-term chlorination of sewage or organic effluents is necessary:

- Any discharge containing significant discharge of chlorine or its reaction by-products shall be licensed by SEPA through imposing numeric limits on the discharge at the point of entry to the aquatic environment.
- These limits must ensure that current environmental standards for those substances are not exceeded at the mixing zone / allowable zone of effect. See Section 6 for the relevant environmental standards.

Authorisation of such discharges should be in accordance with the following key documents:

- WAT-RM-03: Regulation of Sewage Discharges to Surface Waters
- WAT-RM-05: Regulation of Trade Effluent Discharges to Surface Waters

5. Discharges with a Low Organic Content

SEPA recognises that discharges of chlorinated (or brominated) effluent with a low organic matter content (e.g. cooling water, potable water, swimming pool) may not pose a significant risk to the receiving water. Trihalomethanes (THM) content in these effluents will be very low compared to that found in effluent with high amounts of organic matter and therefore pose less of an environmental concern.

SEPA will encourage discharge to sewer, soakaway or to the land surface (where appropriate) before consideration of a discharge to surface waters. Note that a discharge should not be made to either a septic tank or other sewage treatment system or to the soakaway serving this discharge of sewage effluent.

If alternative discharge arrangements are not feasible, SEPA may authorise a discharge of chlorinated effluent to surface waters. Specific guidance for different types of effluent with low organic matter is given below.

Authorisation of such discharges should be in accordance with:

- *WAT-RM-05: Regulation of Trade Effluent Discharges to Surface Waters*
- *WAT-RM-06: Regulation of Trade Effluent Discharges to Groundwater*
- *WAT-RM-12: Regulation of Discharges from Water Treatment Works*

The level of authorisation will depend on the volume and content of the discharge.

5.1 Swimming Pool Effluent and Effluent from Hot Tubs (Spas)

Effluents from swimming pools may be generated from intermittent backwash water from cleaning of filters and from draining the swimming pool (generally 1-2 times per year).

Most domestic hot tubs only get emptied a few times a year. On some commercial premises, such as caravan parks, they may be emptied between guests e.g. weekly. They normally contain chlorine or bromine which act as disinfectants and can also contain a range of surfactants.

SEPA's preference is for effluents from swimming pools and hot tubs to discharge to the foul sewer. Commercial premises should contact Scottish Water to check any approval required.

If the effluent is discharged to the water environment, the level of authorisation required is set out in Table 1. Chalet/holiday parks may have dozens of hot tubs, each of which are normally emptied weekly into an individual soakaway. The level of authorisation should be based on the total volume of the discharge from all the hot tubs on site. If an authorisation is required, the conditions set out in section 5.1.3 below should be included.

Table 1: Level of authorisation for hot tubs and swimming pool effluent

	Discharge to land or soakaway	Discharge to surface waters
Discharge from a site with only one household hot tub.	No authorisation required but we recommend the good practice guidance below.	Registration under the category of inorganic effluent
Discharge of ≤10m^3/d from a swimming pool or from a site with more than one hot tub but ≤10m^3/d	Registration under the category of inorganic effluent	
Discharge of >10m^3/d from a swimming pool or from a site with more than one hot tub and >10m^3/d	Licence under the category of inorganic effluent	

5.1.1 Discharge to land or soakaway

Good practice guidance for the discharge of hot tub and swimming pool effluent to land or soakaway is:

- The effluent should be discharged to the land surface or to a soakaway such that it infiltrates into the ground.
- The effluent should not enter a septic tank, or other sewage treatment system and their associated soakaway.
- The effluent is debrominated or dechlorinated and cooled to less than 20 degrees centigrade prior to being discharged.
- The discharge point is at least 10m from any surface water and the effluent does not run-off or enter a surface water drain.
- The discharge point is at least 50m from any wells, springs or boreholes used for potable water supply.
- The water table is at least 1m below the base of the soakaway.
- The discharge point is greater than 50m from a wetland directly depending on groundwater.

The preferred method of debromination or dechlorination is non-chemical removal of chlorine or bromine by leaving to stand for at least 5 days or until no chlorine or bromine is detectable. In the case of hot tubs that are emptied between guests, a holding tank may be required and/or chemical dosing to allow this to take place.
For licence level discharges consisting of numerous hot tub discharge on one site, it is recommended that the discharges are not to a single point. This is because there is a greater risk of the formation of trihalomethanes.

5.1.2 Discharges to surface waters

We don't recommend discharges of hot tub or swimming pool effluent to surface water. This is because of the risks to aquatic life should effluent not be adequately dechlorinated/debrominated. We recommend applicants contact SEPA prior to applying for a discharge to surface water. We will normally require:

- An explanation as to why a discharge to land or soakaway is not possible.
- The use of a partial soakaway.
- That the effluent is debrominated or dechlorinated and cooled to less than 20 degrees centigrade prior to being discharged.

In addition, for licence level discharge to surface water, a site-specific risk assessment will be required to determine if the environmental standards will be met once diluted in the receiving water.

5.1.3 Authorisation Conditions

The following conditions, where applicable, should be included in the authorisation:

- The effluent must be dechlorinated or debrominated prior to discharge in accordance application or as agreed in writing with SEPA.
- The effluent must contain no residual chlorine or bromine.
- The effluent must have a pH value of not less than 6 nor greater than 9.
- The temperature of the discharge must not exceed <$$>^{o}C. (optional, not normally required for discharges to land)

The pH and temperature of the discharge should be carefully controlled as these affect the toxicity of chlorine. The temperature condition may however be omitted where dilution in the receiving water renders this control unnecessary. Further guidance on inclusion of temperature conditions can be found in *WAT-SG-85: Application of Standards to Thermal Discharges*.

5.2 Cooling Water

Certain types of cooling waters will require disinfection prior to use. Given the volume of cooling water needed it is unlikely that a discharge to the sewer or soakaway will be feasible. SEPA should, however, encourage efficient water use on the site to minimise the chlorinated effluent.

A discharge of chlorinated cooling water will require to be licensed under the simple licence category. Consideration should be given to dechlorination (for example, by dosing with sodium thiosulphate) before discharge.

Modelling of the discharge will have to be undertaken to determine that the relevant Environmental Standards are met in the receiving water. Numeric limits for chlorine should be included if determined significant as detailed within WAT-SG-53: Environmental Quality Standards and Standards for Discharges to Surface Waters.

The following conditions, where applicable, should be included in the authorisation:

- The discharge shall not contain more than xx milligrams per litre of chlorine (total available chlorine or total residual oxidant as appropriate).
- The discharge shall have a pH value of not less than 6 nor greater than 9.
- The temperature of the discharge shall not exceed <$$>^{o}C. (optional)

The pH and temperature of the discharge should be carefully controlled as these affect the toxicity of chlorine. The temperature condition may however be omitted where dilution in the receiving water renders this control unnecessary. Particular consideration should be given to controlling the temperature for discharges to water designated under the *Fresh Water For Fish Directive (2006/44/EC)*. Further guidance on inclusion of temperature conditions can be found in *WAT-SG-85: Application of Standards to Thermal Discharges*.

5.3 Potable Water Treatment and Supply

There should be no routine discharges of chlorinated (potable) water from a water treatment works. Discharges from the water treatment works and supply system which result from construction or maintenance work can be adequately controlled via the conditions of Section 33 of the Water (Scotland) Act 1980. Licensing of such discharges should only be considered in those circumstances where regular discharges are made to sensitive waters.

Planned releases of treated water should be dechlorinated prior to discharge to the water environment in accordance with Scottish Water's 'Water Hygiene Code of Practice'. The present water distribution network uses chlorine as the primary disinfectant. Chloramination may occasionally be used as an alternative form of disinfection to chlorination. SEPA considers that the environmental risk from the use of chloramines is comparable to that from chlorine. Planned releases to environment should be treated according to current practice and provide little or no additional risk to the health of freshwater fish from the ammonia released due to dechlorination.

Further guidance on this issue is available in WAT-RM-12: Regulation of Discharges from Water Treatment Works.

6. Environmental and Drinking Water Standards

The environmental standards for chlorine and chlorine reaction by-products should be used for determining numeric discharge quality standards and for monitoring significant discharges. The current standards can be found in WAT-SG-53. Where appropriate drinking water standards may need to be used, and these are given in Table 1 below.

Guidance on modelling of water use activities is available in WAT-RM28: Modelling of Water Use Activities and should be undertaken where appropriate. Modelling of discharges to rivers should be undertaken in accordance with WAT-SG-02: Modelling Continuous Discharges to Rivers and WAT-SG-11: Modelling Discharges to Coastal and Transitional Waters.

Table 1 Drinking Water Standards for Chlorine-related products

Determinand	Drinking Water Standard	Source
Trihalomethanes - Total (THM)	100 µg/l for one or any combination of the individual members of the family	Standards for the protection of drinking water (UK, EC(80/778/EEC and 98/83/EC), WHO)

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