

COTRA Technical Bulletin
Review of the potential for remediation of clogged dispersal systems
with Hydrogen Peroxide

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DRAFT FOR DISCUSSION

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A. Executive summary

This technical bulletin summarizes reported research. Recommendations in this bulletin follow research papers and standard texts. The following summarizes the result of review of the use of Hydrogen Peroxide for remediation of clogged dispersal systems and media:

- Hydrogen Peroxide can clean media that is clogged with organic material.
- Hydrogen Peroxide can be dangerous. Follow safety protocols.
- When addressing clogged soil or media, first determine and address the cause(s).
- Hydrogen Peroxide application will damage structured soils or media which contains fines (silt and clay). Use on these soils and media is not recommended.
- If using Hydrogen Peroxide on clean sand or gravel media, follow a specified procedure.
- Hydrogen Peroxide treatment is only a temporary measure, and may only be effective once.

This bulletin does not include discussion of the use of low concentrations or routine use of Hydrogen Peroxide.

COTRA is not liable for use of methods discussed in this bulletin.

B. Background

B- 1 CLOGGING OF DISTRIBUTION BEDS, FILTERS, SAND MEDIA AND SOIL

When wastewater containing suspended solids and organics is applied to media (sand, fine gravel, soil) a clogging process occurs (McKinley and Siegrist 2011). Clogging reduces the permeability of the media. This is often termed “biomat” formation in conventional soil infiltration or sand media infiltration systems, and the biomat is typically a thin layer at the infiltrative surface.

Multiple factors contribute to clogging, including the following:

- Obstruction of pores in the media by buildup of deposited or filtered non degradable or slowly degradable fine solids such as plastic fabric lint, minerals.
- Obstruction of pores in the media by buildup of deposited or filtered organic particles (the majority of particulate in typical residential effluent), which may accumulate non sustainably in cases where oxygen supply is low.
- Biofilm buildup on media particles and in pore spaces, as microorganisms feed on organic material (dissolved and suspended) in the wastewater. This biofilm can include “recalcitrant” biofilm which is not readily biodegraded. Biofilm includes extracellular polymeric substances and other compounds produced by bacteria which cause the majority of the pore blockage.

- Gas bubbles from microbial action leading to pore clogging.
- Coating of particles and occlusion of pores by deposition of Oil and Grease.
- Clay dispersion and other chemical factors.

The Long Term Acceptance Rate (LTAR) is the rate at which wastewater with a certain organic and solids content can be sustainably applied to the media, without clogging gradually increasing to the point where the infiltrative surface cannot accept wastewater and ponding results. In the case of organic matter, standard loading rates include limits to the organic loading rate to help ensure the Long Term Acceptance Rate is not exceeded (Washington State Department of Health 2002).

A dispersal system overloaded with higher organic loading, for example by discharge of wastewater that is higher strength (higher organic content) than intended by the design, then clogging due to accumulation of organic solids is likely to occur. As clogging worsens, clogging limits oxygen transport to the infiltrative surface and the area below, which results in reduced capacity to digest organic solids and dissolved organic matter because anaerobic or microaerobic digestion is slower than aerobic. This forms a vicious circle. In the worst case, clogging may extend further into the soil or media from the infiltrative surface. Studies have established that the relationship between oxygen supply and clogging is complex, with the worst clogging being likely to occur with low oxygen conditions rather than in anoxic conditions, however highly aerobic conditions reliably result in lower clogging (McKinley and Siegrist 2011).

Clogging typically leads to anoxic conditions and the more obvious visual evidence of black "biomat" that is familiar when looking at malfunctioning systems. Eventually clogging may lead to effluent surfacing.

While some clogging is favorable for soil or sand polishing treatment performance, excessive clogging that leads to anoxic conditions and ponding is not only generally less sustainable but is also likely to result in reduction in performance. Loading rate selection in standards balances a number of factors and link the recommended maximum loading rate to the character of applied effluent, refer to the BC Sewerage System Standard Practice Manual Volume IV Rationale and in standard texts (Ralston and Payne 2014; Otis et al. 2002; Crites and Tchobanoglous 1998; Amador and Loomis 2020).

Oil and Grease are organics which have a special effect on media, they are relatively slowly degraded in comparison to other suspended or dissolved organic matter, and as they coat the surfaces that would otherwise form a substrate for biofilm they reduce the effectiveness of the media for treatment, as well as clogging pores needed for oxygen transport and water movement.

When viewing a dispersal system that is malfunctioning due to excessive clogging, we will often see a ponded infiltrative surface.

It is uncommon for a standards compliant system to malfunction, if properly maintained, during its normal lifespan (Gunady et al. 2015; Prince 2017). Malfunction may be caused by many factors, some of which interact, common issues include the following:

- A system that did not comply with standards, did not address soil type constraints, or where design used incorrect site and soil evaluation information or incorrect assessment of wastewater characteristics and flow rates.
- A system that is not maintained, for example allowing solids carry over to the dispersal system.
- A system that was properly designed and implemented, but is currently overloaded—often with higher organic strength wastewater.
- A dispersal system with compromised oxygen transport to the infiltrative surface, for example due to cover soil compaction or clogging of a geotextile layer.
- A dispersal system loaded with high solids content wastewater, for example from a malfunctioning treatment plant.
- A system loaded with excessive Oil and Grease, for example where a commercial kitchen is discharging to a system originally intended for residential wastewater.
- A seasonal high water table (or mounded water table) that saturates the drainfield for part of the year, or which is high enough to result in capillary rise negatively impacting oxygen transport to the infiltrative surface.

The only remedial action that will be sustainable for medium- or long-term operation is one that addresses the causes of malfunction.

In some cases, there may be an option to combine addressing the key causes with a temporary renovation of the infiltrative surface or media.

There are various options for this. The topic of this technical bulletin is the use of Hydrogen Peroxide to rapidly degrade deposited organic matter and recalcitrant biofilm (biofilm that is not readily biodegradable). While this may be effective as a temporary measure in some very specific use cases, in general it is not advisable due to the risk of damage to the soil or media system.

B- 2 APPLICATION OF HYDROGEN PEROXIDE AND ITS EFFECT

Hydrogen Peroxide is a strong oxidizing agent. When applied to media contaminated with biofilm, microbial biomass, organic solids and other deposited organic matter, the Hydrogen Peroxide will oxidize organic matter, including recalcitrant biofilm (Nivala and Rousseau 2009).

The method has been commercially applied, with mixed results (Hargett et al. 1983; Hewey 1956; Harkin 1977).

Typical application rates necessary to effectively oxidize these materials, result in the media “boiling” as gases are rapidly released.

Where the media is soil or sand with silt and clay particles, these fine particles are mobilized during this process. This can result in sorting and so to reduced permeability. In structured soils the structure at the infiltrative surface is severely disturbed and clay particles are likely to be dispersed by chemical as well as physical action. Given that soil structure relies on soil organic matter, destruction of recalcitrant organic matter in soil aggregates will also be likely to degrade those aggregates.

C. Performance

C- 1 NATIVE SOILS OR SAND MEDIA WITH HIGHER FINES CONTENT

Application of Hydrogen Peroxide to native soils or to sand medias with fines content over 2% passing the #100 sieve is not recommended. When applied to sand media or soils with higher fines or to structured soils, the process commonly leads lead to irreversible damage to the infiltrative surface, and dispersal system major repair or replacement is likely to be necessary (Hargett et al. 1983; Bicki 1988; MPCA 2011; Otis et al. 2002).

C- 2 CLEAN SAND MEDIA, GRAVEL FILTERS

Application of Hydrogen Peroxide for remediation of clogged dispersal or filter systems has shown some success in the case of sand-based or gravel-based systems (M. Mickelson et al. 1989; Nivala and Rousseau 2009). Clean sand systems have shown good response to a single remediation, with reduced or negligible response for future interventions. Constructed wetlands using sand or gravel media have shown good response, with peroxide appearing to be effective in addressing recalcitrant biofilm (Nivala and Rousseau 2009).

Application rate guidelines vary and experimental basis for the method is inconsistent. A number of factors affect recovery rate, including type of clogging (biomat, oil and grease, inorganic solids) and the silt and clay content of the sand. Recovery rates found in research studies vary from 19 to 58% recovery, and typically additional treatments are very much less effective.

The intervention must include addressing the original cause of clogging, or systems treated with Hydrogen Peroxide will not maintain their recovery.

C- 3 NON-ORGANIC CLOGGING

Hydrogen Peroxide will not address clogging with inorganic fine particles or the majority of mineral deposits. While the “boiling” action may rearrange clogging particles at the infiltrative surface, or cause them to slough from media to which they are attached, this may worsen long term permeability. Assessment of media during testing allows this risk to be evaluated for the specific situation.

D. Recommendations

D- 1 DETERMINE CAUSES AND CORRECT

It is essential to determine the causes of system malfunction and correct those causes. Applying temporary measures without correcting the underlying cause will be ineffective.

In all cases, identify the proximal cause and any ultimate causes of malfunction and correct them prior to any remedial action (Otis 1981).

D- 2 THE USE OF HYDROGEN PEROXIDE

Based on review of the research, we strongly recommend against using Hydrogen Peroxide for treatment of native soil infiltrative surfaces or for sand media systems with higher fines (greater than 2% passing the #100 sieve as a conservative starting point). We caution that a practitioner who uses this method may be liable for the cost of dispersal system replacement.

If used with clean sand media or gravel filters, we recommend consideration of other options, and using Hydrogen Peroxide application only with great care. We recommend experimentation with the media in question prior to application, experimentation should include particle size analysis as well as trial application to (preferably undisturbed) samples of the media. Consult the bibliography for information on techniques.

An example where application may be appropriate is for a system with an organically clogged subsurface flow wetland where the only alternative is to remove and replace the wetland media, and where alternate discharge is not practical.

D- 3 SAFETY

Concentrated Hydrogen Peroxide is hazardous and safety measures are essential.

Resources are available from suppliers; an example of a governmental guide is available at:

<https://nj.gov/health/eoh/rtkweb/documents/fs/1015.pdf>

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