

Hydrogen Sulphide in Koi Ponds

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Hydrogen Sulphide Gas (H₂S) and Koi Ponds



A build up of dirt and decaying organic matter such as fish waste and leaves is undesirable in a Koi pond. This material is referred to as mulm by pond keepers and it can accumulate in filter chambers, plant channels and on the bottom of the pond itself. Good pond design incorporating bottom drains and flushable drains on all the chambers can remove and prevent the build up of mulm in your system; providing the drains are flushed regularly. A short, daily flush is ideal. When you open the drain valve the water initially runs clear. Then there is a pulse of dirty water followed by clear water, at which point the drain can be closed.

In ponds where regular flushing is not carried out, you can smell the water when it is flushed. One characteristic smell is the unpleasant odour of hydrogen sulphide (H₂S). This is the instantly recognizable, pungent smell of rotten eggs or stink bombs. H

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S is a highly poisonous gas which can kill humans. It acts in a similar manner to cyanide by blocking the uptake of oxygen to all parts of the body. Victims of H

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S poisoning suffocate.

H₂S gas is soluble in water (4 grams per litre at 20°C) and is poisonous for koi. Less than 5.3 milligrams per litre will kill Koi and less than 0.4 milligrams per litre has sub-lethal effects such as gill damage and stress.

A classic scenario is that of a pond without bottom drains that is cleaned about once every year. When the bottom layer of mulm is disturbed is released and the koi die. So, paradoxically, when you finally get around to spring cleaning, you may kill all of your fish. So, if you have a thick layer of mulm to clean or you detect the smell of H₂S, catch your koi and put them in a temporary home filled with clean, dechlorinated water. After the cleaning process, perform a water change, dechlorinate the water if necessary and reintroduce the koi.

How is H₂S produced?

It is a waste product of certain bacteria that live in the mulm. In deep layers of mulm the oxygen level drops. Certain types of bacteria called anaerobic bacteria thrive in these oxygen poor environments. They utilize mulm as a food source and produce H₂S as a by-product. Pipes in a pond system that have been standing unused for some time may also accumulate H

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S. The water in these unused pipes becomes oxygen depleted allowing anaerobic bacteria to thrive. Pipes that have not been used for some time should be flushed out to waste as they can return H

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S to the pond system with disastrous results.

Small, non-lethal amounts of H₂S stress Koi and make them more prone to disease and ulcers. We have often noticed that ponds which have ulcer problems usually have the smell of H

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S when the drains of the filter chambers are flushed. Until recently, we believed you had to have oxygen poor or anaerobic conditions to produce H

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S. For such conditions to occur a deep layer of mulm, poor water flow or poorly oxygenated water is required. To prevent the possibility of creating anaerobic areas in the pond we keep our plants separate in a plant channel and do not use soil or gravel in plant baskets. The root systems of plants, however, are ideal at trapping particles and causing a build up of mulm around the roots. In the nitrate rich water of a Koi pond, plants and their roots, can grow extremely big. Last year we thinned out our plants and needed a large truck to remove the

excess!

While working with our plants, we noticed a faint smell of H₂S. This was puzzling as the plant channel is well oxygenated with its own waterfall. Also we only use large, 5 centimetre pebbles to anchor the roots. While there was dirt trapped in the root mass, the conditions did not appear to be low in oxygen or anaerobic. We sampled the water from around the roots and took the samples to the microbiology laboratory. The bacteria that were isolated from this water were all aerobic, that is they like to live and grow in well oxygenated water. No anaerobic bacteria, that prefer oxygen poor environments, could be grown from the water sample.

These aerobic bacteria were then cultured to examine their characteristics and some produced H₂S gas in the laboratory. This indicated to us that relatively small amounts of mulm in well oxygenated conditions can still produce H₂S.

How do you prevent H₂S from being produced in your pond?

Systems that are flushed regularly do not smell of H₂S, so we would recommend the daily flushing of all chambers and vortexes. Clean your pond regularly and keep a careful eye on your plants. The plants grow very rapidly and large root masses hinder water flow as well as encouraging the build up of trapped particles and mulm. Include the rinsing of plant baskets in your pond cleaning regime. We believe plants have an important role to play in removing nitrates from the pond system but like all the bio filtration material in your pond, dirt or mulm must not be allowed to accumulate around them. The old adages still apply - good Koi keeping is good water keeping.

Cleanliness is next to Godliness.

As an addendum to Reggie and Jims Article -

Hydrogen Sulphide Fact Sheet

Hydrogen Sulphide is very toxic to koi at very small amounts.

Hydrogen Sulphide is produced in koi ponds in areas where organic matter accumulates and then decomposes. The deeper the layers of dead organic matter the quicker the lower areas will become cut off from the passing oxygen in the water. This causes anaerobic bacterial activity and the by-product of this is Hydrogen Sulphide.

Hydrogen Sulphide is a potent chemical asphyxiant as it combines with haemoglobin in red blood cells as well as with intracellular cytochromes. Once in the blood Hydrogen Sulphide interferes with the transport of oxygen in the body rapidly stopping oxygen from entering cells and shutting down the cellular metabolism (just like gases such as carbon monoxide and hydrogen cyanide).

H₂S is considered by many researchers to be more toxic than as Hydrogen Cyanide HCN.

In humans Hydrogen Sulphide is an irritant of mucous membranes including the eyes and respiratory tract and minute quantities affects fish in a severe way.

The toxicity of Hydrogen sulphide is affected by pH, temperature, and dissolved oxygen levels. H₂S is most toxic at a pH levels lower than 6.5. Most koi ponds have a pH range from 7.0 to 9.0. However, pH fluctuates and can decrease significantly during early summer mornings because of plant and animal respiration allowing H₂S levels in the pond to become lethal.

The problem is that even at low pH levels H₂S can become toxic because of high temperatures.

Well oxygenated ponds with sediments will be more resistant to Hydrogen Sulphides levels as the H₂S will not escape from sediments unless they are disturbed as during planting, seining, or pond maintenance.

Hydrogen sulphide can be more of a problem in warm months because higher water

temperatures result in rapid organic decomposition plus lower dissolved oxygen levels, and large pH fluctuations.

Concentration

Consequence

0.002 mg/l

- 1. Acceptable for short periods of time.
- 2. Be aware of any organic build-up that is not flushed from the system quickly and efficiently.

0.002 - 0.4 mg/l

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| 1. | Sub-lethal effects, gill damage, high levels of stress. | |
| 2. | The main health concern caused by H | 2 |
| 3. | Koi may seek areas under waterfalls or near aerators in order to obtain more oxygen. | |
| 4. | Continuous exposure to sub-lethal levels of H | 2 |

0.01 - 5.3 mg/l

- 1. Lethal depending to koi
- 2. Very high levels of Hydrogen Sulphide can cause rapid death.

Overcoming Hydrogen Sulphide in Koi Ponds

1. Increased oxygen levels.
2. Regular maintenance.
3. Correctly designed filters (for easy maintenance).
4. Keep a watch out for organic material accumulating anywhere (including inside piping from bottom
5. Keep plants under control with their roots regularly trimmed and their planting areas must be regul