



This is where the magic takes place and if we want results, we have to try to emulate the benefits of the mud pond

The Mystique of the Mud Pond - Water Hardness

Carrying on with his series on the benefits of mud ponds, Mike Snaden focuses on water chemistry...

In Japan, breeders generally expect koi to grow. In many cases the breeder doesn't really understand why. They just know that if they put them out in the mud pond, they will simply come out in the autumn as bigger koi! You see, in Japan, they take their water chemistry for granted. In the same manner, Westerners take it for granted that they can't grow koi. But if you look closely you will see that Japan's water chemistry (and indeed most of Asia) is incredibly soft, and I mean 'incredibly' soft! I know that one or two people will disagree with me on this and claim that the secret to the mud pond lies in the 'mineral rich soil', but it is in fact the complete opposite.

water in Japan

Japan in its entirety has very soft water, with Niigata having the softest. As much as this water is wonderful for koi, it is also the reason that farming in Niigata is almost impossible. The soil is so devoid of minerals that the only thing that can be successfully grown is rice. If you spend a lot of time in Japan, you will frequently see Niigata on the news and in the papers, expressing the hard times they are having in that region because of the soil being so mineral depleted. However, on the bright side, this is also the reason that Niigata's rice is known throughout Japan to be the best and why the water is so good for koi!

Water hardness is made up by whatever ▶

About the author:



Mike Snaden is the proprietor of Yume Koi in Bristol, specialising solely in very high end koi. He has supplied three out of the last four BKKS Grand Champions. Mike's specialised field is water and growing koi to their maximum potential, as a Japanese breeder would. This approach has given him considerable insight into koi.

Theory has it that in soft water the pigment cells stand up, giving a thick, soft, healthy appearance to the beni (red)



Living proof that you can have great fun raising £90.00 tosaï to become six years old (82cm) in a 6,500 gallon pond in the UK that is overloaded with koi

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kind of rock or soil the water passes through before being collected in reservoirs or lakes. This water falls as rain, with a TDS (total dissolved solids) typically of just 3 parts per million in Japan (indicating extreme purity as H₂O). As it falls down over mountains it permeates through the soil and rock, picking up and dissolving minerals on the way. Japan's rock is not limestone based, unlike much of the UK, and this is the reason that very few mineral ions, affecting hardness, are taken into solution.

In the West, there is a lot of misconception about water that is good for koi. People generally feel that because common carp thrive in our relatively hard water lakes, then this water is the kind best suited for koi. However, koi are a far removed species from common carp and since many of generations of koi have been raised in Japan in soft water, we should strive to replicate the same conditions that these fish are genetically suited to. However, before we can do this we need to take a look at water chemistry in Japan.

mains water

Mains water GH (hardness) in Japan is very low, usually below 50ppm (2.8dh). KH (alkalinity or bicarbonate hardness) levels are generally similar, running below the 50ppm level. TDS levels are typically around 70ppm in most areas. This may sound like it doesn't add up, but remember that GH is the measure of calcium and magnesium (positive) cations, whereas KH is the level of carbonate and bicarbonate (negative) anions.

The assumption with the test kit of both parameters is that either ions are assumed to exist, as if present as part of CaCO₃ (calcium carbonate), as an anion will always be connected with a cation, until its bond is broken by chemical reactions. The measurement is given in this manner as it merely needs a unit of measurement as a reference benchmark, as both Ca ions or CO₃ ions will always be attached to something. However, since we don't know which, we make the assumption of CaCO₃ for either parameter.

mud pond water

Mud pond water in Japan is usually softer than mains water. Water in the mud pond may look dirty but this is caused by algae and suspended solids (turbidity). This is reflected in the TDS, hardness (GH) and KH levels. TDS levels in mud ponds typically range from around 35ppm to 90ppm. This reading includes GH, KH, dissolved fish waste/organics and all gases such as oxygen, carbon dioxide etc.

When you look at TDS figures near the 35ppm end, it is obvious that the water simply cannot contain any significant level of

KH or GH. Of course, in a mud pond it doesn't really matter too much as the stocking level is very low, so fish's acidic by-products aren't too much of an issue. That said, many mud ponds will run with a pH often going down to around the 6.5 region, with 6.8 to 7 being quite commonplace and 7.5 being the general upper end of the scale.

Such water and pH levels offer great benefits in terms of both growth and colour condition. You see, colour pigment cells are very much a living thing in their own right, much like fauna in your garden. Theory has it that in soft water the pigment cells stand up, giving a thick, soft, healthy appearance to the beni (red). However, when the koi are pulled up and put into harder water, the pigment cells are said to try to lie flat, as if attempting to make a protective barrier. This makes the colour redder in the short term but causes pigment cells to die, resulting in a hard red that is much thinner. As such, if a breeder has high hopes for a koi, he will try to prevent its beni from finishing until it becomes big, as a koi that is finished later in life will have a much more youthful and longer lasting beauty.

why oyster shells?

There is a big misconception that Japanese breeders use an abundance of oyster shells as they want to make their water harder. This is a somewhat ridiculous notion for several reasons. Firstly, oyster shells won't harden water at all, as their use simply buffers pH. Secondly, shells only really dissolve on demand, as the water starts to become acidic. The reason vast quantities are used is to provide more surface area of shells, so that they can buffer the pH more speedily if needed. If you only had a handful of shells in a pond that was turning acidic, it is unlikely that they would be able to dissolve quickly enough to stop the pH from crashing.

You should also bear in mind that breeders use these shells for their indoor holding ponds when they bring the koi in for the winter. The stocking levels of these ponds are so high that without masses of shells the pH would just plummet, as the breeder's fresh water has a virtually negligible KH level.

water in the UK...

Our water is generally very hard. Some northern areas have slightly softer water with only Wales and parts of Devon and Cornwall having what I would call soft water. Many people believe that water in these areas should be buffered up with copious amounts of sodium bicarbonate. In some cases, even attempting to raise the hardness (GH) levels! Japanese experts on the other hand believe that if GH levels are higher than 50ppm, you should make efforts to lower it!

Mineral contents within pelleted foods are



27cm

Tosai like this 27cm Takeda Kohaku are not produced in abundance. So, if the breeder trusts you enough to sell you such a koi, it is important not just to admire it but to try to get a result that would make them proud



53cm

This is the same koi at nisai and is 53cm, with this being last summer's growth. Reaching sansai this coming autumn she should measure around 65cm



The TDS meter clearly indicates that this murky, dirty looking Japanese mud pond has a TDS of just 36ppm. These ponds run with barely any KH or GH level at all and are an environment in which koi simply thrive in an unparalleled manner

generally plentiful enough that if you don't change enough water, your GH levels will rise in the pond over a period of time and, as such, need to be kept in check. As for KH, this parameter has a somewhat sliding scale effect against pH. If the KH level is too high, you will generally find your pH becoming too high. For raising koi, a pH of between 7 and 7.5 is most desirable. In my experience, KH of even as low as 1dH (17.8ppm) will prevent a pH falling below 7, with a KH of 2 to 3 giving a pH of around 7.3 to 7.5. Once you start running KH levels of above 5 (89ppm), you will most likely find your pH running somewhere between 8 and 8.4. At a pH of 8 or over, however, koi will lose their appetite and no feeding means no growing!

balancing act

On our main growing pond here, I try to run KH levels between 1 and 2dH. The reason I say 'try' is that over a long period of time you will find that your KH will slowly rise or fall, until it finds a level where it is in equilibrium with the feeding, stocking and maintenance levels of the pond. Getting it right means a

fine balance, with very slow fluctuations that will sometimes see the KH running up to 3dH perhaps every couple of months or so.

TDS

This has to be what I consider, the single most useful parameter within keeping koi, as it can tell you so much about both your water and your pond maintenance. If I were stranded on a desert island with a koi pond and just one item for water testing, this would be it! The reading that a TDS meter gives you is basically the sum of everything dissolved in the water.

We first advocated the use of TDS meters back in 2000 and over the last few years they have slowly caught on. The reason they are so incredibly useful is that used in the simplest manner, they tell you whether your water changes are adequate. It is so often the case that when someone first buys a TDS meter, they will proudly state, "Of course, my TDS levels should be good as I flush my drains and filters three times a week and my water is crystal clear!" A short while later, I receive a phone call saying, "I can't believe it, my

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Next time you visit Japan, don't judge your pond by the breeder's fish house, but instead turn your attention and thoughts to his mud ponds, where the real magic takes place

mains water measures 250ppm but my pond is 900ppm, what should I do about it?"

The whole package of KH, GH and TDS all kind of go hand in hand to some degree. What I mean by this is that in the instance of the above koi keeper, his mains TDS of 250ppm is a rough indication that his water is generally pretty hard. This water will probably have a GH level of 7dH and KH of 7dH. However, the pond TDS of 900 is a clear indication that the pond has been lacking water changes or is simply overloaded with koi/waste. Such a pond will often run low KH levels, as whilst the TDS levels would have risen over time to this ridiculous level, the KH would have also fallen.

Due to mineral contents within the food, the GH level in the pond is almost certain to be higher than the fresh water being introduced. It is likely that the keeper in question has to add some sodium bicarbonate from time to time to stop his pH falling too low. Generally speaking, if a pond has been running perhaps ten years, but only been very slightly under-maintained, the TDS levels will slowly rise over the years to astronomical levels, often with slowly depleted KH levels.

In the instance of the above koi keeper, if he checked his pond TDS from the first day the pond was filled and then tried to maintain a TDS differential (difference between fresh mains water and pond water) of perhaps 50ppm, then ten years down the track, his pond would still be running a TDS of 300ppm (differential still at 50ppm), with his KH levels being very close to the levels in his fresh water.

KH

Now that we have covered TDS, let's take a look again at KH. Some people advocate maintaining crazy levels of KH within the pond. I have never managed to fathom out why? KH (otherwise known as alkalinity or carbonate hardness) is simply the level of ions present in the water that are capable of 'mopping up' acids. There is a myth that

biological filters need KH to survive. This is completely incorrect! Filter bacteria feeds on fish waste and organic matter. In the process of breaking down this matter, acids are produced. These acids are neutralised by the bicarbonate ions, which are alkaline. This keeps the pH from turning acidic.

It doesn't matter whether there is 20mg/l of KH in a pond or 100mg/l, it won't affect the filter or koi in any way. In fact, if the KH is too high, your pH will ride too high. Remember, KH is purely an acid neutraliser, not a filter food source! What does matter however is whether your KH level is stable from day to day or month to month. If you find yourself having to buffer your KH, then it is most likely because you aren't changing enough water.

As far as running low KH levels are concerned, if your pond is working efficiently and there is no trapped decaying waste in the system, then you will find that even after going away on holiday for a couple of weeks, you would see very little change on your return. It is also important to realise that even with high KH levels, it is still possible to induce a pH crash, particularly if the pond is covered.

conclusion

Koi are raised in Japan in soft water, with an ideal pH of 7 to 7.5, with very low TDS levels and low KH levels. If your koi collection consists of pets that you have had for years and you aren't obsessed with jumbo koi, then run your pond with 'safety' in mind. If however, you have a high end collection worth astronomical sums of money and you wish to do them justice, at the same time as impressing the breeder, then I would suggest that you re-evaluate your beliefs of how to grow koi. My own obsession is the latter and to make sure that others get the absolute most out of their koi. Champion koi that come back bigger and better can't be raised any other way. 鯉

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