

With my 'home made' soft water (and of course other factors), I have managed to grow these tosai at one cm per week. This pond contains over 110 koi, with many now up to 40cm. All of this has been possible without making the koi overweight. All pictures courtesy of Mike Snaden

softly does it

Back in the April issue we looked at the benefits that could be gained from nurturing soft water. In the second part of this article we expand on some issues raised in the first part, and also help you realise that living in a hard water area needn't be the end of the world.

Soft water offers great benefits in terms of growth, health, and development, but isn't the 'be all and end all'. More to the point, hard water should be looked upon as a bottleneck, or limiting factor.

At this point, let's try and change the angle from which this whole topic should be looked upon. 'TDS' (Total Dissolved Solids) is the more important factor in all of this because although it will give an indication of water hardness, it more importantly helps us to understand water condition. (Note that sometimes, TDS is also referred to as 'Total hardness').

tds explained

A TDS reading doesn't directly dictate whether water is hard or soft, as it should really be viewed as a 'grand total' when looking at water makeup. A TDS meter will measure anything that is dissolved into water, such as calcium, magnesium, sodium, iron, organics such as uneaten food, or dissolved fish waste. This is the reason that it is often referred to in Japan as a 'water quality meter'. You will no doubt notice that there is no reference to GH levels in this article, as they are reflected in the TDS level, and are generally considered in Japan to be kept ideally below 50ppm, or 2.75dH.

japanese water

The vast majority of areas in England

are unfortunate insofar as they have hard water. In Japan, it's a different story. Water in Japan is extremely soft throughout the country to the point that even Japan's hardest water is still softer than most of England's soft water areas. People think that clays and oyster shells are put into mud ponds as minerals to benefit the koi, but in reality, mud ponds are filled predominantly with rain water.

Acid rain in Japan is a common problem, and apart from shells serving to help the growth of insects and other organisms, they also serve to help prevent pH crashes in times of heavy downpours. Heavy rain is a big ►

This Momotaro Kohaku measured 22cm in March 2002. In the summer of 2002, it suffered from wasting disease and came close to death. I would estimate that it lost two to three months of growth because of this, and consequently, the koi had to regain its lost weight before growing



threat to koi that are in mud ponds, as it can quickly turn the water acidic, hence breeders will often rush out to mud ponds when heavy rain is expected, and will throw in literally tonnes of shells to try to combat the effect.

man-made water

Koi kept in man-made filtered koi ponds require very different methods of water management. For a start, such ponds are heavily stocked, so rain-water isn't an option for filling our ponds, since this will quickly lead to pH crashes. Rain water in Japan generally has a TDS of about 3ppm, and hence absolutely no KH value. But, since the stocking rate is so very low, the soil and shells help create an eco system in which the koi thrive. But, push things too hard by overstocking, and the mud pond's eco

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This is the same koi as the 22cm Kohaku, but as of April 2003, it now measures 48.5cm. When Daisuke Maeda saw this koi in March of this year, he declared the koi female, and confidently said that Colin would be able to grow the koi beyond 85cm in his 7,500 gallon pond



system is very quickly destroyed.

back to our koi ponds

In a filtered pond, the biological activity and production of Carbon Dioxide both turn the water acidic, hence the need for Carbonate Hardness (KH). It is important to remember that because we are trying to keep our ponds clean for viewing purposes, it is impractical to line the bottom with shells or clays, since our koi create so much waste that bottom drains become of paramount importance.

This is the primary reason that rain (with no KH value) is unsuitable for filling our ponds. Those of you who have visited Japan will probably have noticed that the majority of hobbyists ponds are covered to avoid acid rain from entering the pond. When running such soft water, acid rain will very quickly deplete the KH value, and then turn the water acidic.

On a trip to Momotaro's Tosai



The water coming from the hose on the left is from an R/O plant and has a TDS of 5ppm, and KH of zero. The water from the hose on the right is mains water and has a TDS of about 300ppm, and a KH of about 11dH. But, the result of these mixing is a TDS of 75ppm, and KH of 2.75dH... that's more like it

Auction in April, I once again took my TDS meter, so that I could compile notes. Momotaro's water is pumped from a bore-hole (water well), and naturally has a TDS level of 73ppm. Bearing in mind that that reading represents a total of KH, GH, and any other dissolved solids, and that 1KH or 1GH equates to about 17ppm, and the figures start to speak for themselves.

With a figure of 73ppm, the absolute maximum level of KH and GH combined would be a total of 4dH, which for arguments sake is a theoretical 2dH of each parameter, a far cry from those levels recommended back here in England, and that's on the new water, not the pond water, which will always become lower!

reducing tds levels

Now on to the ponds... Most of Momotaro's ponds had a TDS level of around 80ppm, but their best performing tosai growing pond had a TDS level of just 53ppm, and KH level of just 1dH (17ppm), and that's in an indoor filtered pond! It seems odd that the pond TDS level is lower than that of the new water, but Mr Maeda says that their 'Bacteria

our water

It has long been said that it is necessary to maintain high KH values and even GH values in our ponds in England. I personally can't understand this, as there is a vast difference between 'enough' and an 'excess', whereby the extra levels serve no practical or explainable purpose.

House' filter media actually reduces TDS levels. Between Daisuke Maeda, and Toyota-san (who is responsible for water testing at Momotaro Koi Farm), we managed to talk about water hardness, and Mr Toyota was fully in agreement that soft water was better for growth, and that a KH level was only needed to be high enough to give a stable pH, if monitored daily.

'money for old rope'

Let's take a look at a typical pond scenario whereby a fictional pond is situated in a soft water area, and the water is buffered with Sodium Bicarbonate to a level that is somewhat exaggerated above those levels that many people would recommend, to see the cost involved. Let's assume that your mains water runs a KH of 1dh, and that you have been advised by someone that sells Bicarb, to keep your pond KH at 10dh.

If your pond had zero KH value, it might take 100kg of Bicarb to get your KH up to 10dh. Then, you flush your bottom drains on a daily basis, wasting 10% of your water, and hence top up with your mains water (of 1dh value). This top up drops your KH level to about 9dh, so you add 10kgs of Bicarb to get back up to 10dh.



This Kohaku also measured 22cm last year as tosaï, and is now 47cm. In my eyes, this will become an outstanding koi, and is also female, so will become very big. We will photograph this koi for the next part of this article

Assuming that your 10kg of Bicarb costs £10, it would cost you £70 per week to maintain the target KH level.

So, let's assume that you are in the same position, but are only aiming to maintain a KH of 3dh. The same 10% water change would lower your KH to perhaps 2.7dh, so you might need 3kg to get back to the target 3dh. Doing this every day would only cost you £21, a great saving of £49 for you, and a great loss of income from your Bicarb source!

why run a high kh?

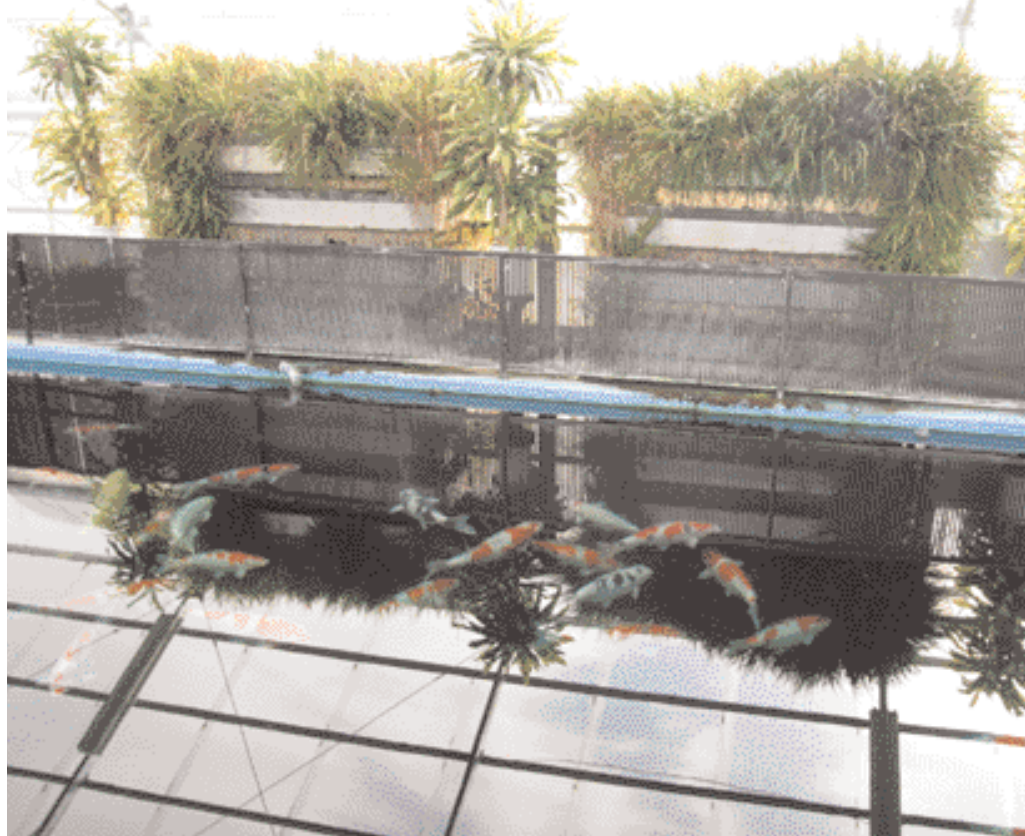
Even in a reasonably heavily stocked pond, a KH level of 3dh is almost impossible to deplete in a week, and let's face it, you would be guilty of bad koi keeping if you didn't flush your bottom drains at least three times a week during the summer months anyway.

so, what do you do?

Do you buy a KH test kit and keep

Koi kept in man-made filtered koi ponds require very different methods of water management

Mr Mori of Okayama, Japan, has koi that he has grown from tosaï of around 22cm, in this pond which is about 24,000 gallons. One Sanke that resides here will be three-years-old in August, and is already in excess of 70cm. Who says that koi can't be grown big in a filtered pond? We should all learn from this, and strive to achieve more from our koi



track of the levels, or do you throw in loads of Bicarb to raise the KH value to excessively high levels? Chances are that if you carry on with regular water changes with new water with a KH value of 4dh, your KH would always run at perhaps 3dh – the result? No expense wasted on Bicarb!

In a pond with a KH of just 1dh, the pH would probably run at around 7, and seldom drop at all, whereas at a KH of 2dh the pH would tend to run at 7.5, but push the KH higher than 6, and the pH will have a tendency to run higher... perhaps up to 8.0. Why bother? The Japanese generally feel that a pH is better below 7.5 rather than higher.

If you live in a hard water area, it is possible to make water soft, if you use the right equipment. You would be forgiven for thinking that you could use an 'ion-exchange' water softener to make your pond water soft, but in reality this would prove to offer no significant benefits, because as the technique suggests, you would be quite simply 'ion-swapping'!

what is ion exchange?

Ion exchange is where the water



This particular R/O plant wastes very little water. But, RO water alone is dangerous, and must be mixed with mains water in order to obtain the kind of water you desire

softener swaps Calcium and Magnesium ions for Sodium ions. A popular misconception with water softeners is that they put salt into the water, which simply isn't true. The salt (Sodium Chloride) is used to regenerate the ion-exchange resins during a flushing process, once their capabilities are exhausted.

The problem with water softeners is the fact that they ion swap, rather than simply removing them. This means that by swapping ions on a one for one basis, the TDS level remains exactly the same, when the aim of the game is to lower the TDS. But, by using a 'Reverse-Osmosis' (R/O) plant, the water can be completely stripped of all minerals and contaminants, essentially producing pure H₂O, or distilled water.

This water will usually have a TDS of perhaps 5ppm, depending on the efficiency of the R/O plant used. Most of that 5ppm figure would actually be Carbon Dioxide, which makes the water acidic, but will quickly gas off, leaving you with a pH of around 7. R/O plant water on its own is very dangerous for aquatic life, as it has absolutely no pH stability, and no mineral content. But, when mixed back in with untreated mains water, you can make wonderful water, which can give you wonderful results!

how I can achieve my 'ideal' water

My Bristol mains water currently has a TDS level of 335ppm. Contained within that reading is the KH, which runs at 11dH (190ppm). As far as growth and koi

development (and shimmies) are concerned, our local water is terrible! But, since my R/O plant produces water with a near zero TDS, I can mix this water with untreated mains water at a ratio of 75% R/O water, and 25% mains water, which results in a TDS of just 84ppm, and a KH of 2.75dH, which I feel is ideal.

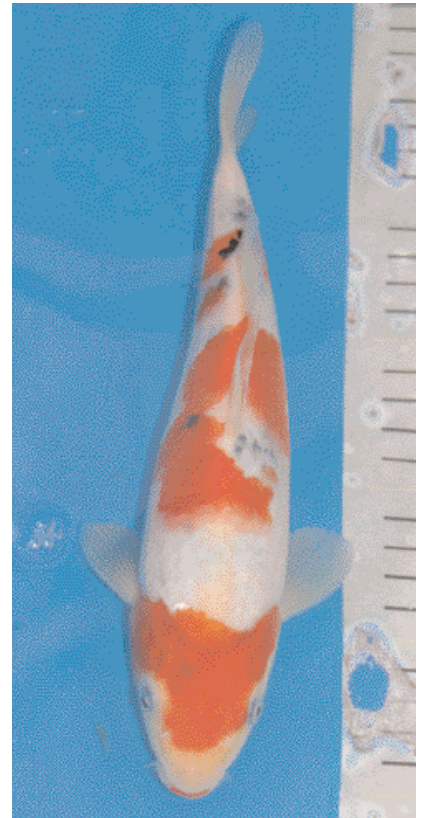
This may sound complicated, but

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provided that you know the KH value and TDS of your mains water before you mix it with R/O water, you can use the TDS meter to determine the KH value of your mixed water. In this case, if my mixed water TDS level rises above 84ppm, I just reduce the flow of mains water a little, and if it's too low, then the flow is increased. Running the above KH reading is perfectly safe if you carefully watch and make regular notes of your pond KH level. Obviously, if the KH depletes below the desired level, I have to either change more water, or add a 'harder' mix of water.

The next part in this series will focus on how to safely run soft water, and how to do it in a 'Water board friendly' manner. 鯉

This Sanke arrived in December 2002 at just six months old, and 23cm



As you can see, this Sanke has grown from 23 to 33cm in four months (up until April), with most of the growth having been achieved in the latter six weeks despite being one of over 110 koi in the 4,400 gallon pond



Looking back to the original Water Hardness article in April's *Koi Carp* magazine, if you wish to see some of the koi that were featured and grown in soft water... see us at the BKKS National Koi Show at Newark!