

Civil Service Outstanding Service Video Series 2013

Water Supplies Department Biosensing Alert

Named Danio, these five zebrafish are Water Supplies Department's new partners in water quality monitoring. Their important mission is to conduct 24-hour monitoring on the quality of untreated raw water to ensure that water distributed to households in Hong Kong meets safety standards.

The Water Safety Plan under the World Health Organization encourages the use of a multiple-barrier approach to monitor hazards and contaminants in water for preventive risk management.

After years of research and testing, the Water Supplies Department officially launched the Biosensing Alert System in late 2012, a new system using zebrafish for water quality monitoring, to further ensure the safety of water supply.

We'd been researching on water quality monitoring systems which make use of living organisms. We found that some advanced systems used in Western countries are expensive and may not be suitable for local use.

Later, we learned from international research studies that zebrafish are genetically similar to humans. Look at this chart, the coloured portions indicate that the genome similarity between zebrafish and humans is as high as 70% to 80%.

Most importantly, zebrafish are highly sensitive to contaminants in water.

Therefore, we choose zebrafish as our partner in monitoring water quality.

Currently, Dongjiang water arriving at the first treatment point through an aqueduct at Sheung Shui Water Treatment Works will go through processes of sedimentation, filtration and disinfection before being transferred to service reservoirs for public use. Raw water requires at least 2 to 3 hours of treatment after entering a water treatment plant. Testing systems in other countries usually test treated water only.

We think that will be too late to wait until, after the water has left the treatment plant. To be more alert to early signs of problem, we have designed this new biosensing system to test the raw water entering the treatment works.

If no contamination is found in the raw water, certainly there won't be any problem with the water after treatment.

Even if there is a problem with the raw water, we still have enough time to take actions to prevent distribution of the water to the public. So the new system serves

as an additional barrier to safeguard public health.

Untreated raw water keeps flowing into this specially designed fish tank. Data is recorded continuously by the computer system, through which Water Supplies Department staff can conduct 24-hour monitoring via the Internet, keeping the condition of zebrafish under observation, and detecting any changes in water quality.

Zebrafish are highly sensitive. Water Supplies Department staff take good care of them to ensure that they can provide correct detection of water quality changes.

Newly-arrived zebrafish take a week to settle down. We'll observe them for another two weeks to ensure that they are healthy and fit for their "service".

When the zebrafish show signs of abnormal behaviour, such as hiding, dashing around in the tank, gasping for air due to suffocation, or even died, that means there may be hazards or contaminants in the raw water. When that happens, the system will immediately alert the Water Supplies Department team by emails, SMS or better still by direct phone calls for immediate follow-up actions.

In fact, system operation is relatively stable, accurate and sensitive at present. We've spent plenty of time to study to develop it. False alarms had been unavoidable at the early stage of its development and our colleagues had received calls even in the middle of the night.

Apart from automatically alerting the responsible staff, the system will at the same time take water samples at different preset intervals for further toxicity testing at laboratory. With the use of light-emitting bacteria, the toxicity test is capable of rapidly screening over 1,000 harmful substances in water within an hour. This helps us to know how contaminated the raw water is.

Just for this zebrafish tank, we've tried different designs as we found that even subtle changes to factors such as depth, breath, colour combination and light source of the tank, will affect our monitoring on the dynamic movements of the zebrafish, thus quality of data collection. As a result of continual research and improvement, we finally arrived at this 8th generation tank.

Another special feature of this system is its environmental-friendly design. Since raw water flows from a storage tank on a higher ground to the fish tank, no extra electricity is used during the process of water delivery, thus achieving the best effect

with the lowest cost.

I have an education in Chemistry, but the development of this system requires a lot of knowledge outside the field of Chemistry. I've tried my best to learn and research into these areas. We believe that it will be a big step forward in the development of water quality monitoring if we succeed. Water is the source of life and the essence of well-being. The success of the development will benefit all Hong Kong citizens, and I'm also one of them, drinking the same water.

We did encounter lots of different challenges in the development of this Biosensing Alert System. Our colleagues had to get knowledge beyond their professional areas, such as biology, IT, and telecommunication technology.

We believe that water safety is of prime importance to public health. Despite many challenges and difficulties, we consider that it is worthwhile to spend the time and resources in developing this tailor-made monitoring system for our local environments. Looking ahead, we'll be considering to apply this highly effective monitoring technology to other water treatment works to enhance protection of drinking water safety.

To ensure testing accuracy, batches of duty zebrafish in the monitoring system take shifts on a monthly basis. Water Supplies Department staff will also keep caring for the retired zebrafish until the end of their life cycle. Zebrafish help tirelessly in the monitoring water quality for people in Hong Kong. Their service shares the same value as that of staff in the Water Supplies Department to protect public health as the top priority.

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