ACQWS Paper No. 7

Quality of Water in Buildings

Preamble

1. This paper sets out possible strategies for enhancing the entire water supply system such that Hong Kong citizens can have confidence in drinking high quality water directly from their taps. Members' advice on the possible strategies is sought.

Background

2. The Water Supplies Department (WSD) is responsible to ensure that the quality of water supplied up to the connection point of buildings complies with the World Health Organization (WHO) guidelines. The consumers or their agents are then responsible for taking care of the internal plumbing which has a direct influence on the quality of water at consumer taps.

3. With the banning of unlined Galvanized Iron (GI) pipes since 1995, corrosion-resistant materials are now used for the internal plumbing of new buildings and re-plumbing in existing buildings. Discolouration and turbidity due to rusty pipes should not be a problem in these buildings. For those buildings still using unlined GI pipes, discoloured water may result when corrosion in the pipes occurs, particularly after the water has been stagnant inside the pipes for a period of time. Drinking water with traces of iron should not cause health concern and under normal circumstances, the aesthetic problem can be overcome by running the tap for a short while.

4. When the extent of corrosion becomes serious to the extent of

resulting in water wastage due to leaking pipes, replacement of the pipes becomes necessary. In such cases, the Waterworks Ordinance empowers WSD to require the consumers or their agents to carry out remedial work with a warning that water supply will be disconnected if they fail to comply. However, where wastage of water cannot be established, WSD can only assume an advisory role and urge the consumers or their agents to repair or replace the corroded pipes. In practice, WSD seldom effects disconnection of supply as a result of corroded pipes, particularly when the corroded pipe sections form part of a communal system. A disconnection of supply in such cases will cause suffering to a large number of consumers including those who are willing to oblige, but because of the failure to reach a consensus among landlords and residents who are individual consumers, the repair work cannot proceed.

5. Another cause of water quality problems in buildings is the poor maintenance of water tanks, normally the sump tanks at the base of buildings and the roof tanks. An unclean water tank can be a source of contamination. In case lack of cleanliness of a water tank is found either on visual inspection or by bacteriological tests, WSD will issue a repair notice to the consumers or their agents requiring them to clean the water tank. Such repair notices are always complied with without exception. The problem is that there are over 40,000 high-rise buildings in Hong Kong and with the limited resources available, WSD can only take a reactive role and act on receipt of complaints.

6. In 1998, WSD commissioned a consultancy study to look into the quality of fresh water supply in 120 randomly selected residential buildings less than 10 years old. The study found that a small percentage of these buildings had discoloured water problems and the causes were mainly due to rusting of the internal plumbing system or poor maintenance of their water tanks and water pumps. (The executive summary of the report is attached in Appendix 1 for reference).

7. As a follow up to the study, WSD stepped up the publicity programme to advise customers of the need to properly maintain the internal

plumbing and clean the water tanks at least once every three months through issuing free advisory booklets, leaflets and a Consumer Guide Book at WSD's Customer Enquiry Centres. Advisory messages are also publicized through water bills and posters. Recently, a 30-second Announcement of Public Interest (API) has been broadcast on the television to drive home these messages. All these have raised the awareness of consumers and agents on the need to properly maintain the internal plumbing system. However, the number of discoloured water complaints has only been stabilised but not reduced significantly.

Current Practice Elsewhere in the World on How to Ensure Quality of Water in Buildings

8. The problem of water quality in buildings is not unique to Hong Kong. A literature research of publications and through the internet has been conducted. The situation in the United Kingdom, United States of America, Canada and Singapore has been briefly reviewed.

9. In the UK and USA, the most common problem is the presence of lead in water since during their development stage, lead pipes and lead-soldered copper pipes were widely used. The problem has to be addressed by dosing inhibiting chemical additives during the water supply treatment process to suppress ionization of lead and by re-plumbing. These countries also have discolouration complaints attributed to various causes including rusting of internal plumbing, since the use of unlined GI pipes is still permitted. On the other hand, Canada and Singapore, like Hong Kong, have banned the use of unlined GI pipes in tackling the corrosion problem.

10. To enable drinking of water directly from the tap, the UK Water Supply Byelaws contain a unique requirement to avoid contamination from internal plumbing that:-

"In every premises to which this byelaw (i.e. byelaw 96) *applies, a draw-off tap convenient for drawing drinking water shall be connected to –*

(a) a service pipe (i.e. a direct supply from the mains system)*; or*

(b) a pump delivery pipe drawing water from a service pipe; or

(c) distributing pipe drawing water exclusively from a storage cistern which is

(i) installed in accordance with byelaw 30[(1)]

(ii) supplied with water from a service pipe, or a pump delivery pipe drawing water from a service pipe."

This practice however may not be quite practicable in Hong Kong because of our practice of full separate metering of supply to premises in our high density and congested living environment.

11. In relation to the requirements on the consumers/agents in respect of maintenance of internal plumbing, the Code of Practice CP48:1989 of Singapore recommends that

"(a) Samples of water from various outlets (from internal plumbing systems) *should be examined periodically by a water analyst. A chemical examination is useful to show whether corrosion of the pipes and fittings is taking place. Bacterial pollution originating within the installation will be indicated by a bacteriological examination.*

(b) Cisterns should be regularly inspected, not less frequently than once a year, and should be cleaned internally."

Strategies to Reach the Situation that People can Drink Water Direct from Taps

12. In line with the promotion of Hong Kong into a world class city, WSD intends to set a vision for enhancing the entire water supply system

(1) Byelaw 30 as interpreted in the UK Water Supply Byelaws Guide states that "to restrict microbiological growth, it is important that stored potable water should be kept at as low a temperature as practicable, ideally less than 20°C."

including the internal plumbing systems of buildings such that citizens can have confidence in drinking high quality water directly from the tap. To achieve this goal, the following strategies can be considered:

Continue Efforts in Upkeeping Existing Distribution Systems

13. All along, WSD is successfully keeping the government distribution systems well maintained to ensure the good quality of water supply from the government distribution systems. These efforts include but are not limited to constant monitoring, replacement/rehabilitation of old water mains and regular flushing of dead-end mains. WSD will continue such good practice to upkeep the good quality of water supplied from the government distribution systems.

Adopt Plumbing Designs to Enhance Water Quality

14. The developers for new building projects are encouraged to adopt plumbing designs with long term water quality at taps as the prime objective. High quality corrosion-resistant pipes and fittings should continue to be required in plumbing systems. Furthermore, the use of pneumatic pumping systems for example can minimise the number of water storage tanks and hence minimise water quality problems arising from unclean tanks (see Figure 1). However, these systems have the disadvantage that water supply will stop immediately upon electricity supply interruption or pump failure since there is no buffer storage downstream of the pumps to mitigate the effects of such events. If pneumatic systems are to be made mandatory, a corresponding legislative amendment will be necessary. Alternatively, if such systems are only to be recommended practice, then promotion can be made through issuing Circular Letters and Code of Practice to those in the industry.

Educate the Public

15. Publicity on the water treatment process and high standard of treated water quality will also be useful to strengthen public confidence in water quality and to combat prejudice against drinking water from taps. WSD will further strengthen the community publicity programmes/campaigns to propagate the responsibility of consumers and agents to properly maintain internal plumbing and clean water tanks regularly. Joint efforts with other government departments will be made to instill to home owners a greater awareness on all aspects of building management and particularly the need to set up owners' corporations, the lack of which often results in problems in coordinating repair work when required.

Encourage the Inclusion of Renovation of Plumbing Systems into the Building Maintenance Programme

16. As leaking plumbing systems can cause corrosion of reinforcement bars in reinforced concrete structures, peeling off of external/internal finishes or electric short circuiting, they do pose potential safety concerns. Renewal of plumbing systems is a must at some point in time in a full-scale building maintenance programme. Buildings Department (BD) has introduced the "Co-ordinated Maintenance of Building Scheme" (CMBS) to enhance building safety and maintenance. Under this new initiative, owners of private buildings are required to take extra care of their buildings in order to comply with the requirements of BD. They are encouraged to include the renovation of plumbing systems in their maintenance programme. Those in need may apply for loans from the BD's Building Safety Improvement Loan Scheme operated since August 1998.

17. In addition to the CMBS, BD is contemplating a possible Preventive Maintenance of Buildings Scheme (PMBS). In this scheme, BD is thinking of conducting initial inspections of buildings 20 to 40 years old to determine whether they require maintenance. If the findings confirm the need, BD would then issue a preventive maintenance order to require owners to appoint

building professionals to carry out further detailed inspection and appropriate repair works to cover structural safety, integrity of external finishes and fire safety etc. In view of the potential safety problems that may arise from leaking plumbing systems as stated in para. 16 above, it may be an option to include plumbing systems into the scope of inspection required under the PMBS and to extend financial assistance in the form of loans to those in need.

Add A New Requirement on Building Management to Carry Out Periodical Checking and Submit Inspection Report

18. The degree of success of the aforesaid strategies will very much depend on the voluntary cooperation of the consumers or their agents and will require a considerable time to take effect. Even then success could only be partial. For quicker results, regulatory actions may have to be considered.

19. To ensure that the internal plumbing systems are in a good and clean condition, it may be considered desirable to follow a practice similar to that in Singapore by requiring consumers or their agents to employ Licensed Plumbers or registered plumbing contractors to arrange for periodical checking and submit inspection reports to WSD. The Licensed Plumbers or registered plumbing contractors will carry out remedial action whenever defects are found and a water analyst will confirm by water sampling and testing whether the quality of water supply within the internal plumbing systems is up to the required standard.

20. For those buildings failing to submit periodical reports to WSD, consideration may be given to impose a fine on the consumers or their agents. WSD staff will carry out random checks on these buildings and recover the inspection cost from them.

21. The frequency of checking of plumbing systems and submission of reports mentioned in para. 19-20 above will depend on the age of the plumbing systems and the type of materials used for pipes and fittings. However, individual

preferences and considerations will also have to be respected and a balance has to be struck between these and desirable water quality requirements.

22. To ensure effective running of this arrangement, a system should be established to register plumbing contractors for cleaning and inspection of internal plumbing systems. Also, a database will need to be set up for monitoring inspection of plumbing in old buildings.

WSD to Carry out Repair for Non-compliance Cases

23. When consumers or their agents do not comply with WSD's requirement to repair the plumbing or clean the water tanks, WSD seldom takes the step to carry out the work and then recover the costs from the consumers/agents. This is to avoid the potential risk of causing damages to private properties during the work and the difficulty of recovering costs from the consumers/agents for the work done. It may be an option to consider empowering WSD in future to carry out necessary repair/remedial work when technically feasible for consumers/agents, with or without their consent and recover the costs from them. Should they fail to reimburse WSD, it may be necessary to register by memorial in the Land Registry against the premises to which the work relates.

Amend Waterworks Ordinance and Waterworks Regulations

24. The possible strategies in para. 14 & 19-23 above would require amendments to the Waterworks Ordinance and should only be implemented after extensive consultation, as they will have significant impact on consumers. Consultation with relevant departments particularly the Buildings Department will also be very important to co-ordinate and synchronize all building maintenance initiatives put forth by the government.

Advice Sought

25. Advice is sought from Members on the possible strategies outlined above or on the way forward and any other proposals that Members might have. On the basis of this advice a 5-year strategy programme will be developed.

INVESTIGATION INTO THE QUALITY OF FRESH WATER SUPPLY WITHIN RESIDENTIAL BUILDINGS IN HONG KONG.

EXECUTIVE SUMMARY

A recent Water Utility Survey carried out in Hong Kong by Asian Development Bank showed that 30% of the 100 respondents considered the quality of fresh water to be poor. The cause of the problem was thought to be due to defects in the service pipes and tanks within residential buildings. Water Supplies Department appointed Babtie BMT Harris & Sutherland as consultant to carry out a more detailed study of the fresh water quality within residential buildings in Hong Kong.

The purpose of the study was to determine the fresh water quality with specific reference to total iron content and turbidity and to determine the causes leading to degradation of water quality. The study covered 120 residential buildings of less than 10 years old chosen from all water supply districts in Hong Kong. The number of buildings selected in each district was chosen to bear proper weighting to the district population. The individual buildings were chosen randomly.

Water specimens were taken for laboratory testing from the following locations:-
- 1 specimen from the pump sump tank
- 1 specimen from the roof tank
- 2 specimens from the inside services (indirect supply)
- 1 specimen from the inside services (direct supply)

Pro forma inspection sheets were completed during the visit to provide data on the type and condition of both the water tanks and the inside service pipework in the buildings.

Water samples were tested by a HOKLAS accredited laboratory. The results were analysed against the standards recommended by the World Health Organization for iron content ($\leqq$0.3 mg/l)) and turbidity ($\leqq$5.0 NTU). The following conclusions were drawn-

a) The quality of potable water supplied by the Water Supplies Department to residential buildings in Hong Kong is generally satisfactory when determined by iron content and turbidity.
b) The water quality problems found within residential buildings are usually caused by defects in the internal plumbing system, in particular the rusting of internal pipework, and possibly the water pumps.
c) With regard to water quality in water tanks inside the buildings, sediment was recorded in many of the water tanks, together with rusting of many fittings. However, the quality of water was generally acceptable with a few failures of water specimens. This shows that the water tanks may not significantly affect the quality of water with respect to iron content and turbidity. The major source of rust in the water is from corroded inside service pipework or possibly corroded water pumps (as some failures are recorded in buildings fitted with copper pipework).
d) The small number of failures of water samples obtained from roof tanks shows the supply pipework to the roof tanks is generally satisfactory.
e) There is little difference between the results taken from different internal locations in the buildings, with almost equal numbers of specimens failing from the three different specimen locations. This shows that the water pipes leading to individual water taps have an internal corrosion problem.
f) There were high levels of turbidity and iron content to specimens taken from some top floor flats. For a number of specimens, despite being the closest to the roof tank, the readings were very high, indicating the pipework has corroded severely, possibly due to slow water flow in the pipework.
g) The type of pipework within a building has been shown to affect the quality of water with respect to iron content and turbidity. Generally, unlined GI pipework accounted for far more failures than with copper pipework. The water quality problem in copper pipework could be caused by corroded water pumps, iron pipe fittings and water fixtures or sections of concealed unlined GI pipework in the building.
h) The age of the buildings was examined against the percentage failure for each type of pipework. No correlation could be gained from the results because the study only covered 120 buildings of less than 10 years old.
i) Specimens taken from an indirect supply have a slightly higher test failure rate than specimens from a direct supply. This is because the length of water pipes leading to a tap on an indirect supply is usually longer.
j) The water quality of samples taken from the building using lined GI pipes was satisfactory.