A STUDY OF THE PERFORMANCE OF SELECTED POUS AND POES WATER FILTERS ON THE MAINTENANCE OF POTABLE WATER QUALITY

Nur Atiqah Annuar*, Mohammad Ismail Yaziz, Puziah Abdul Latif and Zuber Mohd Saad

M.Sc (GS 19283)
5th Semester

INTRODUCTION

Currently, there are two types of water treatment systems that are currently available i.e the Point-of-Use (POU) and the Point-of-Entry (POE) water filter. POU devices are designed to purify only that portion of incoming water that is being used for drinking and cooking purposes. POU systems typically treat water in batches and deliver water to a single tap, such as the kitchen sink faucet or an auxiliary faucet mounted next to the kitchen sink.POE devices treat all the water coming into a house or facility. POE devices are connected to the mains water pipe in the system and are usually installed after the water meter. Ideally, drinking water should not contain any microorganism known to be pathogenic-capable of causing disease-or any bacteria of indicative of faecal pollution. To ensure that the drinking water supply should meet these guidelines, samples must be taken regularly.the detection of E.coli provides definite contamination of fecal pollution. Coliforms bacteria are widely used as indicators of microbiological quality and safety of drinking water. These total coliforms and E.coli are routinely monitored by drinking water utilities and their detection is often an indication of inadequate treatment, breech in distribution system integrity or even regrowth (Williams and Braun-Howland, 2003). Once been initiated into the distribution systems, the presence of E.coli and the total coliforms can become a concern of drinking water safety and public heatlh. Based on Lisle *et al*., 1998 study, it is shown that these coliforms are capable of persisting in drinking water distribution system biofilms in the presence of disinfectants.

OBJECTIVE

This study was designed to evaluate the efficacy of POU and POE water filters in the preservation of potable water quality.

MATERIALS AND METHOD

Sample collection. Water collection was carried out in accordance to the Standard Method procedures. Samples were collected in sterile 1L glass sampling bottles with blue cap containing 1mL 10% sodium thiosulfate. Before collection, the samples' site must be flushed for about 5-10 minutes and the temperature, pH also free chlorine concentration were recorded. Samples were then be transported to the laboratory for further analysis within 24 hours.

Site description. Three residential houses in Taman Cheras Prima and Taman Cheras Jaya in the state of Selangor were selected in the study. The houses were selected based on the following criteria:

- At least 4 occupants per household
- Do not have a water filter yet (POE or POU)
- Obtain water from the same primary source (DWTP)

One type of POE and one type of POU water filter was selected based on the most commonly used types. The water filters were then installed in the respective houses. Some pipe connections in the house were altered to allow for sampling of unfiltered and filtered water from the water filters. Samples were obtained at the filter inlet (unfiltered water), filter outlet (filtered water), kitchen water tap and the storage tank.

The potable water quality was monitored by taking samples at regular intervals i.e twice a week for one year. The parameters analyzed include physical, chemical and microbiological determinants (Table 1).

Parameters Analyzed

Table 1. Parameters analyzed and the measuring equipment.

Parameters	**Measurement Unit**	**Measuring equipments/Method**
pH	-	HACH Sension 1 pH meter
Temperature	ºC	HACH Sension 1 pH meter
Total Solids	mg/l	Filtration
Turbidity	NTU	HACH 2100P turbidity meter
Conductivity	µS/cm	YSI multiparameter meter
Total Coliform	cfu	Membrane Filter
E.coli	cfu	Membrane Filter
Free Chlorine	mg/l	HACH DR2000 Spectrophotometer
Ferum	mg/l	Direct Air-Acetylene (Atomic Absorption Spectrometer)
Lead	mg/l	Direct Air-Acetylene (Atomic Absorption Spectrometer)
Zinc	mg/l	Direct Air-Acetylene (Atomic Absorption Spectrometer)
Magnesium	mg/l	Direct Air-Acetylene (Atomic Absorption Spectrometer)
Manganese	mg/l	Direct Air-Acetylene (Atomic Absorption Spectrometer)

Drinking Water Quality Standard - Ministry of Health Malaysia

Table 2. Drinking Water Quality Standard - Ministry of Health Malaysia

No.	Parameter	MOH Standard
1	pH	6.5-9.0
2	Turbidity (NTU)	5 NTU
3	Coliform Count, org/ml	Must Not Be Detected In Any 100ml Sample
4	Free Chlorine (as CI2)	Not Less Than 0.2
5	Total Solids	1000mg/l
6	Iron (as Fe), mg/l	0.3
7	Lead (as Pb), mg/l	0.01
8	Manganese (as Mn), mg/l	0.1
9	Zinc (as Zn), mg/l	3.0
10	Magnesium (as Mg), mg/l	150

E. coli and coliform were detected using membrane filtration technique followed by incubation for 24hours at 35-37C on pads sterilized by Millipore saturated with m-Endo for E.coli and m-FC for coliform.The membrane filtration technique was carried out according to the standard method.

RESULTS AND DISCUSSION

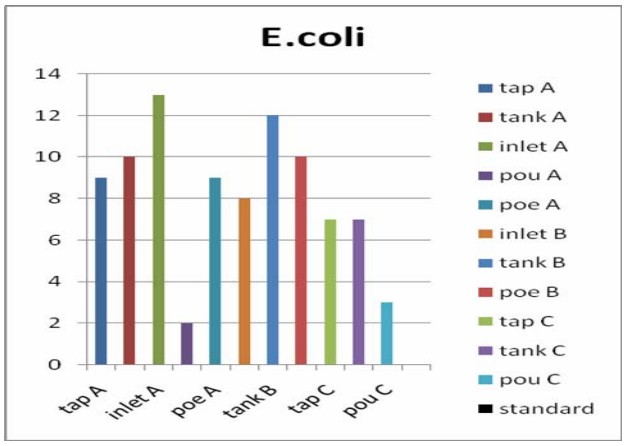

Figure 1.Total E.coli detected

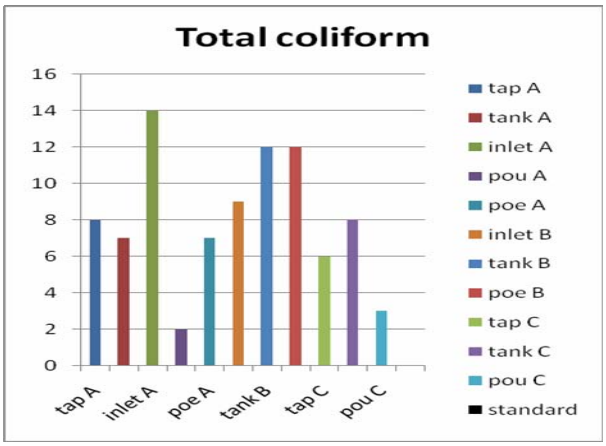

Figure 2. Total coliform detected

Throughout the sampling, it was found that the house installed with both, POE and POU filters tend to provide the greatest reduction in E.coli and total coliform. The presence of coliform bacteria suggests that the water may also contain other disease agents such as Cryptosporidium and also Giardia. According to Ali *et al. (*2004), the high counts of coliform bacteria in the final treated water indicate inadequate quality control in the treatment or delivery system or both. There were variations in the occurrence of E.coli in each premise. These could be due to re-growth in distribution systems or breakdown of the treatment barriers (Frias *et al.,* 2001; Niquette *et al.,* 2001). Other factors that maybe

contribute to the occurrence are corrosion control and also the availability of organic and inorganic nutrient (Power and Nagy 1999; Chu *et al.*, 2005)

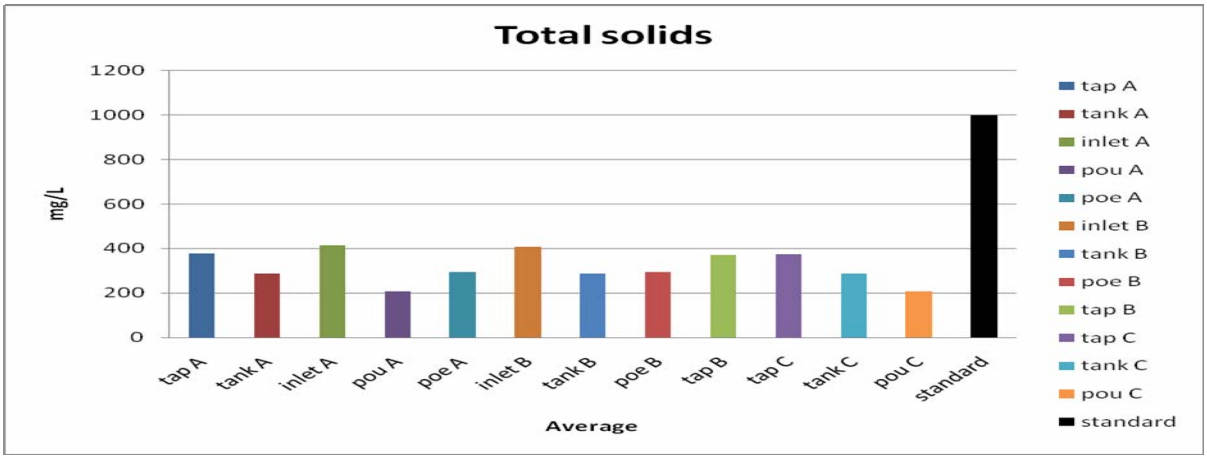

Figure 3.Total solids value throughout the monitoring period.

The term "total solids" refers to matter suspended or dissolved in water and is related to both, specific conductance and turbidity. Figure 3 shows 50% to 70% reduction of total solids especially when using both, POE and POU water filters. Besides the high value

from the inlet, the value of total solids from the tank is also high. This may be because of resuspension of settled sediment in the tank as a result of tank filling during high demand period. Although the values are high, it is still 50% lower than the standard (1000 mg/l).

Figure 6. Values for Ferum throughout throughout monitoring

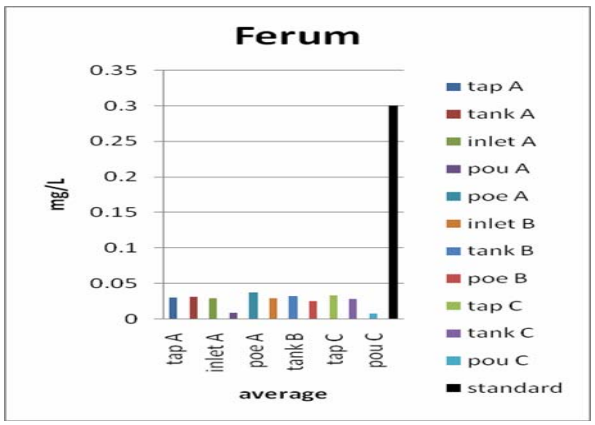

Figure 7. Values for Manganese throughout monitoring

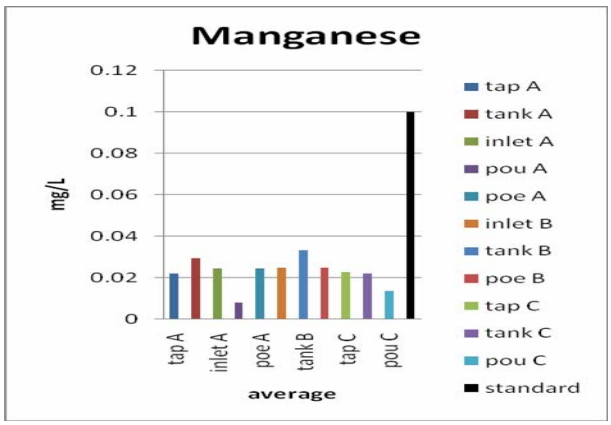

Figure 6. Values for Zinc throughout monitoring

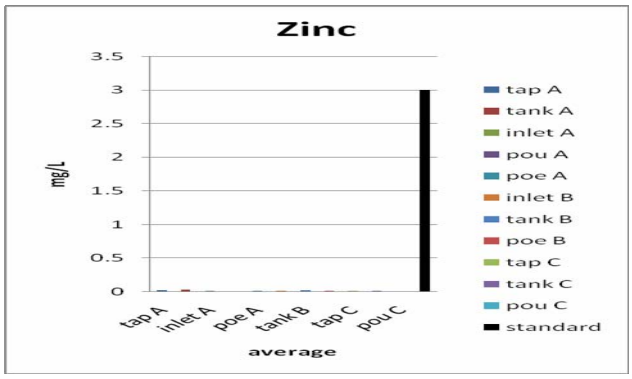

Figure 7. Values for Magnesium throughout monitoring

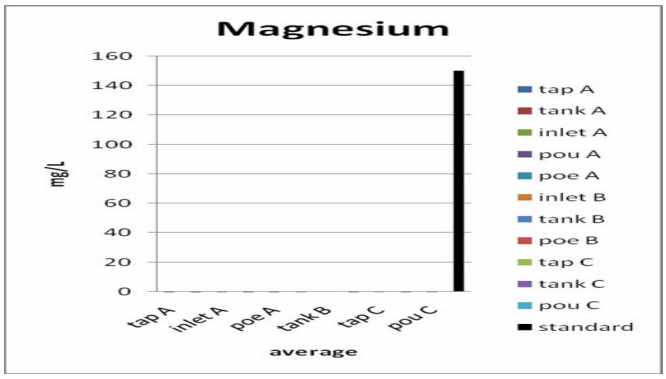

Figure 8. Values for lead throughout monitoring

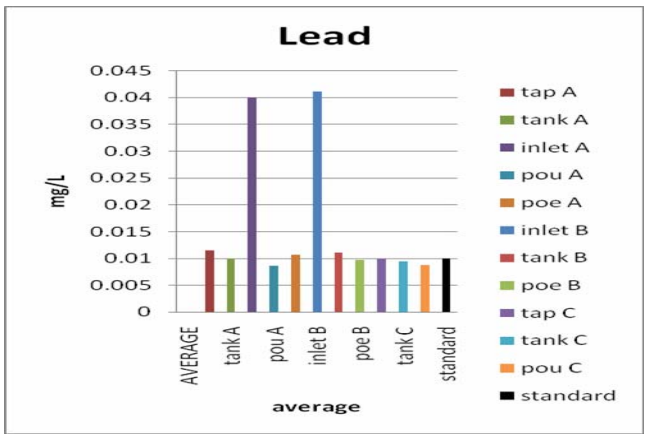

Figure 9. Values for TOC throughout monitoring

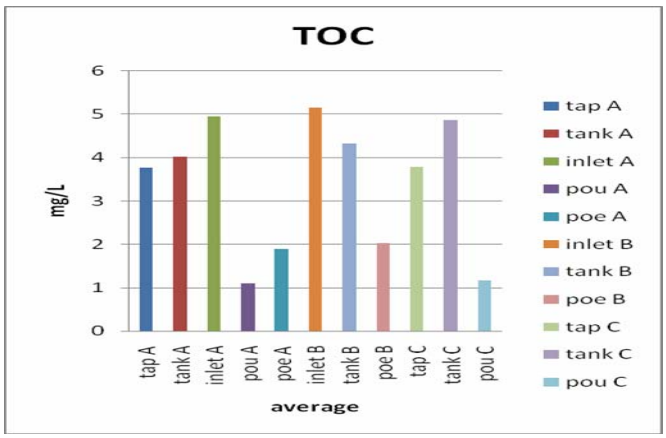

Figure 4 to Figure 8 shows the variations in heavy metals concentrations in the different water samples. All of the values are below the standard limit required by Ministry of Health Malaysia (Table 2) except for Lead. The data also show a reduction for every heavy metal when the water passes through the filters. Figure 9 shows the Total Organic Carbon values that had been detected during the monitoring. Nearly 80% reduction of

TOC when comparing the reading from the inlet and after being filtered through POU filter.

To guarantee high quality drinking water, chlorine is by far the most common disinfectant used to eliminate disease causing organisms. Drinking water standards and regulations specify the minimum chlorine residual which must be present in drinking water to not less than 0.2mg/l (Ministry of Health Malaysia, 2000). The incoming water still meet the standard, but as it passes through the POU water filters, the level of free chlorine was reduced until below 0.08mg/l. This phenomenon does not explain the presence of E.coli and total coliform as there is free chlorine in the water. The rationalization is that the existence of trace organics in the water provides nutrients to the bacteria which help it to multiply.For pH, temperature and turbidity, the readings are almost the same for the three premises. The pH ranged between 6.5 to 9 and complies with the standard while for temperature, it ranged from 26°C to 32°C. It was noticed that the inlet water has higher pH and that the pH after filtration through the home water treatment devices was lower. The turbidity values ranged from 0.2 NTU to 1.25 NTU and it is still below the standard which is 5 NTU. The next phase of the study involves inoculation of the filters with different concentrations of coliform organisms and evaluating the removal or survival of the organisms in the filter via analysis of the treated/filtered water at the different sampling locations. This phase of the study was carried out in a different premise.

SUMMARY

The threat of harmful contaminants in drinking water can no longer be reasonably ignored. The correlation between contaminated drinking water and many significant health diseases and health problems is far too strong too discount. There are many home treatment alternatives that can purify drinking water to a greater extent than existed drinking water treatment plant. The absolute best technology that is now available is treating. Generally, potable water supply in the study area is intermittently contaminated. The findings of this study suggest that a properly operated and maintained POE and POU home water filter is a practical approach for the removal of physical, chemical and biological contaminants. Most water quality parameters at the house with POE and POU

water filters shows a sigificant reduction compared to other houses that has either a POU or POE water filter only.

REFERENCES

Ahmedna, M., Marshall, W.E., Husseiny, A.A, Rao, R.M. and Goktepe, I., 2004. The use of nutshell carbons in drinking water filters for removal of trace metals. **Journal of Water Research 38**: 1062–1068.

Chong, C.K., Vijayakumar, G, Teoh L.H., Siti Zubaidah AR, Mohamed SaPian M. and Abdul Rahim, A., 2003. Effectiveness of domestic water filters in removing suspended solids, residual chlorine and coliform bacteria. **Malaysian Journal of Public Health Medicine 3 (2)**: 38-40.

Chu, C., Lu, C. and Lee, C. (2005) Effects of inorganic nutrients on the regrowth of heterotrophic bacteria in drinking water distribution systems. **Journal Environmental Management 74, 255–263.**

Frias, J., Ribas, F. and Lucena, F. (2001) Effects of different nutrients on bacterial growth in a pilot distribution system**. Antonie Van Leeuwenhoek 80, 129–138.**