CHAPTER 6

REMOVAL AND INACTIVATION OF BACTERIAL CONTAMINATION IN POTABLE WATER USING AQUAGUARD - A DOMESTIC WATER TREATMENT UNIT

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EVALUATING THE EFFICACY OF AQUAGUARD A DOMESTIC WATER TREATMENT UNIT

6.1 INTRODUCTION

Point-of-use water treatment systems are widely used for relatively small scale improvement of the quality of water intended primarily for domestic purposes. The units are mainly used in households for the treatment of water from sources such as rivers, streams, lakes, wells, springs and boreholes which has not been treated by conventional processes for domestic purposes. Even in households with piped supplies of water treated by conventional large scale processes. These units are often applied for the improvement of the water quality with regard to taste, odour and to prevent and potentially hazardous chemical such as chloramines and halogenated hydrocarbons. These units are also being used as an additional safety barrier in case where the fail-safe large scale treatment and distribution of water supplies fails to provide safe water.

In response to the demand, the market is flooded with a wide variety of devices and units collectively known as point-of-use water treatment systems. The present investigation reports an alarming level of opportunistic pathogens in the water supplied by Chennai metro water system and in ground water (see chapter 4). People must be very aware of household water purification systems that will give total protection. With these concern the effectiveness of water purification is aqua guard water purifier is tested.

One of these point-of-use systems is the Aquaguard water filter-cum-purifier marketed world-wide under the trade name Aqua*guard by* Eureka Forbes Ltd., Mumbai, India. The units are manufactured by Aquamall Water Solutions Ltd., India, renowned leaders in the field of ultraviolet light (UV) based water purifiers. Aquaguard is designed for the relatively inexpensive, convenient and reliable domestic on-line purification and decontamination of drinking water. The unit measures 360x300x100 mm, weight 4.75 kg and is designed for mounting on an internal wall at a water supply. Treatment is based on a polypropylene candle prefilter for the removal of suspended particles, a silver impregnated activated carbon filter for the removal of organic compounds and inactivation of micro-organisms, and a UV irradiation (8 watts) chamber for disinfection. *Aquaguard* is intended for the treatment of fresh water from sources such as wells, springs, stream or lakes which are not abnormally polluted. The unit runs at 160 to 270 volts and water pressure of 0.4 to 2.0 kg/cm2. The design output is one litre per minute. Compared with the wide variety of other systems for similar purposes (EPA, 1986; Abbaszadegan et al., 1993; Kuennen et al., 1993), *Aquaguard* has a number of unique safety devices to monitor and ensure fail-safe operation. These include a photo resistor which measures the UV output. The resistor is connected to an automatic shut-off solenoid valve, green and red indicator lamps, and an audio indicator which plays a pleasant tune as long as treatment proceeds satisfactorily.

This study deals with an assessment of the efficiency *Aquaguard* with regard to human bacteria. Test organisms were selected to represent typically water-borne pathogens, bacteria commonly used to assess faecal pollution of water, and surrogate organisms representing the most resistant water-borne pathogens (Grabow et al., 1984a, 1984b, 1992, 1993, 1996; EPA, 1986; IAWPRC Study Group on

Health Related Water Microbiology, 1991; Grabow, 1996; Rochelle et al., 1997). Testing procedures were based on the standard protocol of the United States Environmental Protection Agency (EPA, 1986), and internationally accepted methods established in earlier studies on units of this kind (EPA, 1986; Abbaszadegan et al., 1993; Kuenne et al., 1993; Grabow et al., 1995). Quantitative removal and inactivation of test organisms was determined by conventional cultivation of bacteria.

6.2 MATERIALS AND METHODS

A randomly selected production line *Aquaguard* unit was obtained from Eureka Forbes Ltd. Bombay, India, and operated strictly according to manufacturer's instructions.

Evaluation of the unit was carried out according to principles and protocols described previously (EPA, 1986; Abbaszadegan et al., 1993; Kuenne et al., 1993; Grabow et al., 1995) on the following test waters taken from Chennai Metro Water Supply and a laboratory water supply system seeded with bacterial pathogens.

EXPERIMENTAL STUDY AND METRO WATER:

For the treatment using Aquaguard water filter, water samples collected from public water supply at Annanagar during rainy months were used. Test runs were carried at room temperature 26^0 – 28^0 C. The bacterial load in the water sample during this period is given in Table 4.3 and 4.6 of chapter 4. Two liter volume of water were used in each test. Representative volumes of water of the removal and inactivation of organisms. Total heterotrophic plate count, total coliform, Fecalcoliform, *Aeromonas sp, Pseudomonas sp, Klebsiella sp, Legionella sp,*

Mycobacteria sp, S. aureus were tested in the water before and after the treatment. The detailed procedure for the enumeration of bacteria is given in the chapter 4.

6.2.b Experimental study with laboratory seeded microbes:

To test the efficacy of Aquaguard water purifier, Two litres of water sample that is 100% uncontaminated with bacteria was taken. To this ample seven opportunistic bacterial pathogens were introduced at a known concentration as give in chapter 5.1. Two litres volume water was used before treatment and after the work. As Aquaguard is an online water purifier with an output of 1 litre volume of water per minutes, the treated water was carefully collected in aseptic container without any contamination, Total heterotrophic plate count, total coliform, fecal coliform, and enumeration, Mycobacteria and *S.aureus* in the sample after treatment was carried out as mentioned earlier. Physio chemical factors like turbidity, pH were analyzed in the water before and after the treatment.

Efficacy of Aquaguard water purifier in eliminating bacterial load in the metro water sample supplied at AnnaNagar, Chennai and in tap water seeded with selected bacterial pathogens.

Water collected from metro water supply at Annanagar Chennai during Rainy months 2006			
Test water and organisms	Count		Percentage reduction
	Before	After	
Hetrotrophic plate count MPN INDEX / 100 ml	1456	0	> 99. 9999
Total Coliforms MPN INDEX / 100 ml	17	0	> 99. 9999
Fecal Coliforms MPNINDEX / 100 ml	2	0	> 99. 9999
Aeromonas (CFU/100 ml)	21	0	> 99. 9999
Pseudomonas (CFU/100 ml)	10	0	> 99. 9999
Klebsiella (CFU/100 ml)	6	0	> 99. 9999
Legionella (CFU/100 ml)	5	0	> 99. 9999
Mycobacteria (CFU/100 ml)	4	0	> 99. 9999
S. aureus (CFU/100 ml)	9	0	> 99. 9999
Seeded Water			
E.Coli	$1.8x10^4$ CFU/ml	0	> 99. 9999
Aeromonas	$1.6x10^5$ CFU/ml	0	> 99. 9999
Pseudomonas	$2.1x10^5$ CFU/ml	0	> 99. 9999
Klebsiella	$8.2x10^4$ CFU/ml	0	> 99. 9999
Legionella	$1.2x10^4$ CFU/ml	0	> 99. 9999
Mycobacteria	$0.8x10^4$ CFU/ml	0	> 99. 9999
S. aureus	$4.2x10^4$ CFU/ml	0	> 99. 9999

Counts were the average of 3 test runs using 2 litres for each.

6.3 RESULT AND DISCUSSION

Because of the serious threat to potable water (ground water and metro public water) from many microbes particularly opportunistic pathogens, it is advisable to use an efficient water purification unit. The evaluation of functional efficiency of the most popular brand of water purifier, Aquaguard several experiments were conducted using water from Porur Lake and water seeded with selected opportunistic pathogens. When water Porur lake was allowed to pass through the Aquaguard online water purifier, very effective means of removing bacteria and physical agents were observed.

Average turbidity of Porur Lake water was 21 NTU, However the permissible limit for turbidity is 10 NTU. When Porur water is purified by Aquaguard the turbidity was reduced to 0.7 NTU **(19.3*1000/21).** Aquaguard treatment did not have a significant effect on the pH water, which was an average 7.3.

Results obtained indicate that under prescribed conditions of operation, Aquaguard is capable of reducing numbers of naturally occurring and laboratory strains of bacteria, in water of diverse quality of levels within internationally accepted limits for drinking water (WHO 19931996). The tap water and seeded water tested contained. Numbers of seeded organisms much higher than those expected in water for which the unit is intended to be used. This safety margin was demonstrated for laboratory strains of indictor organisms generally associated with drinking water quality and water-borne disease, as well as naturally occurring indicators in water with levels of organic compounds and turbidity for which the unit is not intended to be used.

This performance of the *Aquaguard* unit conformed to specification for point-of-use water treatment systems (EPA, 1986), and compared favorably with that of similar units described previously (Abbaszadegan et al., 1993; Kuenne et al., 1993; Grabow et al., 1995). Aquaguard was found to remove all the bacterial components cent percent.

General impressions of *Aquaguard* were that it functioned well under prescribed conditions of operation, and that it would certainly appear capable of satisfactorily reducing the numbers of health-related micro-organisms in water for which it is intended to be used.

The functional efficiency of Aquaguard water filter was tested and this water purification unit is very effective in reducing microbial load in the water. When the sample of public water supply system was tested, Aquaguard was cent percent efficient in removing total heterotrophic, bacteria, total coliforms, Faecal coliforms, *Legionella sp, Mycobacterium sp, Aeromonas sp, Klebsiella sp, S. aureus* from the water. Similarly the pathogenic bacteria seeded in the experimental tank were totally removed when the water runs through online Aquaguard purifier. The efficacy of Aquaguard in removing bacterial pathogens in potable water promotes it's household importance.