American Journal of Applied Sciences 1 (4): 273-275, 2004
ISSN 1546-9239

Evaluation of a New Device, Automated Shower head on Water Conservation in Bath Showers

[1]Shamsi, M. and [2]G.H. Shahidi Bonjar
[1]Department of Agricultural Machinery,
College of Agricultural Engineering Bahonar University of Kerman, Iran
[2]Department of Plant Pathology,
College of Agricultural Engineering Bahonar University of Kerman, Iran

Abstract: In cosmopolitan areas and big cities of the world, shortage of drinking water during the peaks of consumption hours is a noticeable problem. Many people may not have piped water during these critical hours especially in summer times. To minimize this problem, an electronic control valve was designed and developed which saved about 70% of water in each showering session at Kerman city in Iran. The calculations showed that the price of conserved water during one year for a family with 5 members covers the price paid for the installation of the new automated control outlet.

Key words: Electronic Control Valve, Showering Device, Water Shortage, Water Conservation

INTRODUCTION

United Nation Commission on Sustainable Development expresses that the world will be 20% short of fresh water by the year 2025. According to the Commission, the world's population is expected to grow by 50% in the next 25 years[1]. In those years, the majority of people will be in the arid and semiarid regions of the world and water will be a serious obstacle regarding food security, reduction of poverty and protection of the environment. Clearly, the potential world water-crisis stems principally from the needs of food production, domestic water supply and industrial purposes. But if water is expected to produce the extra food, how can this be reconciled with the poor efficiency of the water consumption and the overall inadequacy of current fresh water resources to meet the future demands? The problem can be approached in two ways. First, development of new water resources, however, there is no inherent shortage of water on the planet, but often it is not in the right place at the right time. Second, proper management of water consumption and enhance its efficiency. The latter is mainly the challenges of how to elaborate use of existing resources, recycling and lowering the water wastage. The first way is expensive and also puts the basic food needs of people in conflict with the environment; the second option is much more in favor of the developing world and is finding routes for using the existing resources more efficiently[2].

One method of domestic water-conservation is the installation of water-efficient appliances and low-flow plumbing fixtures. The most common devices are low flush toilets, faucet aerators, low-flow showerheads, and reduced water-use washing machines and dishwashers[3]. Faucet aerators alone can cut water flow through that faucet by 50%. Faucet aerators mix air with the water which serves to reduce splashing and cuts the flow[4].

A study of household water use conducted in the Netherlands examined the difference of per capita consumption before and after water-efficient appliances had been installed. The overall daily per person consumption declined 4 liters, due mostly to the appliances, rather than changes in water use habits[5]. Another study, located in Seattle, Washington, demonstrated that the most effective water-efficient items were toilets, washing machines and faucet aerators. Retrofitting a home with these devices accounted for an 18 gpcd (gallon per capita per day) decrease in water use[6]. Installation of these appliances can cut a community's water consumption by 20%[7].

A major concern with this method is the user cost for the installation of such devices. A survey of home builders and municipal officials indicated that only 22% of these individuals felt that home buyers would pay over $100 U.S. to have water-saving fixtures in their homes[8]. One possible remedy is the creation of a trust that could subsidize the installation of the appliance and fixtures. One such trust has been proposed in the United Kingdom, but has yet to be put in place. Funding could come from fines on water companies that are not vigilant in leak detection, or from an increase in water abstraction charges[9].

In some areas of the United States, rebates are offered to home builders if they equip new homes with water saving appliances[10]. It was estimated in California, that if only 2% of households installed these devices, savings alone could pay for the installation of the devices in all households[11].

Finally, internal Wise Water Use strategies involve changes in water use habits, including bathing and household cleaning. However, personal water use habits can be hard to change.

Supplying domestic water during the last 5 years of drought for people in some cities of Iran has been a major problem. In Tehran water has been cut for several hours each day on a regular program proposed by the city council and people have been advised to use water carefully. This problem may expand to other cities. This study was conducted in Kerman city to suggest a saving method for mentioning the problem. One of the most water consuming tasks in urban areas is shower-taking which is often accompanied with high waste of quality water. This huge amount of waste is generally produced since the shower tub is on from the beginning and throughout the showering session. This study explores feasibility of a new innovation, automated shower head, on water conservation in bath showers with the goal of helping optimization of water consumption.

MATERIALS AND METHODS

Data Collection for Showering Habits: Between domestic uses, the water consumption of bath showering is considerably high compared to other uses. Personal washing includes about 33 % of the total domestic water uses[12, 13] so the study was fixed in this area. Personal water use habits of people were studied. In this regard, a group of 50 people from different social background were asked that why they do not shoot the tab off when the water is not needed during shower taking sessions. The summary of answers is summarized as:

1. Closing and opening tab is a boring action and is difficult to repeat several times during a period of 10 or 15 minutes, the average required time for taking a shower.
2. The soap or shampoo penetrates the eyes and hurt, waiting to raise water from a closed tap increases the problem.
3. It is difficult to adjust the water temperature again, especially when the cold and hot water taps are separate.

Because of these problems people usually prefer to leave the tab open and so the water would be wasted considerably. The required characteristics of an automatic system[14] were driven from the above answers. It ended to design an automatic tab which:

1. Works and reacts quickly.
2. Can adjust the desired water temperature precisely.
3. It had to be safe and work with maximum of 12 volts.
4. The parts should be well accessible in local markets and the system be well assembled in local workshops.

The system was assembled in personal houses and water consumption was measured with 10 different persons showering with and without the automated shower heads. Water drainage was collected for volume measurements. The same persons were asked to operate both tests without changing their normal showering habits.

System Parts, Assembly and Working Principles: A 12 volt electric valve designed and made by modifying a 220 volt valve available in the market[14]. This valve was set on the shower pipeline. An infrared sensor was located somewhere on the opposite walls of the bathing room such that its beam was interrupted when a person stands under the shower. At this time the infrared sensor sends a signal to the electronic circuit. The activated circuit opens the valve and lets the water flow. The water flow stops when the person steps back or forward, hence the beam is stabilized, electronic circuit cuts off and the valve is shut off. The system performance was evaluated by ten different persons. The flow rate, total showering time, proper on and off timing and general performance were recorded The average of water preservation was calculated.

RESULTS AND DISCUSSION

As indicated in Table 1, the results showed that the automated valve in average can save approximately 70% of the water being consumed in each shower session. An economic analysis was done to find out the amount of money saved by lunching this system. Market label-prices of the system main parts are listed in Table 2.

Table 1: Data of Water Usage Collected to Compare Water Consumption and Conservation With and Without Automated Shower heads in 10 Separate Measurements

No.	Flow rate (Lit. min.$^{-1}$)	Total showering Time (min.$^{-1}$)	Electric valve Opening time (min.)	Consumption without the electric valve (lit.)	Consumption with the electric valve (lit.)	%Water conservation
1	9	15	5	135	45	66
2	12	10	4	120	38	60
3	8	13	3	112	24	78
4	14	20	6	280	84	70
5	10	13	3	130	40	71
6	12	17	3	204	48	76
7	11	12	5	132	55	58
8	9	15	3	135	36	73
9	10	11	4	110	30	73
10	6	22	5	132	30	77
Average	10	14.8	4.1	150	45	70

Table 2: Average Prices for Parts Used to Assemble the Automated Showerhead for Water Conservation in Iranian Rials (IR)

Part	Electric valve	Joints	Electronic circuit	Safety valve	Transformer	Total
Price in IR	15000	10000	6500	5000	11000	47500

The currency is Iranian Rials (IR). We conclude that if the parts are produced in local workshops, the price of the components can be cut to half of the market label-prices; hence make it more affordable for the general public. Considering the cost for ordinary urban water, the average price is 600 IR cubic meter^{-1}. With the assumption of two showering sessions for an ordinary person per week and conservation of 105 lit of water each time, a 5-member family will preserve over 55 m^3 and save over 30000 IR annually. This simple calculation indicates that not only that the installation price would be paid back in less than two years, but conservation of the large amount of high quality water in urban areas has many environmental, ecological, social and economic benefits-impacts. We assume this simple device can be used in similar systems were delayed or interrupted water flows are desired, e.g. Washing conveyors in fruit processing factories.

REFERENCES

1. United Nations, 1997. Comprehensive Assessment of Fresh Water resources of the Word. Commission on sustainable development, United Nation department for policy coordination and sustainable Development (UNDPCSD).
2. Kay, M., 1999. Water for Irrigation-Does efficiency Matters. Landwards, 54: pp. 8.
3. Maddaus, W.O., 1987. The effectiveness of residential water conservation measures. J. Am. Water Resources Assoc., 70: 52-58.
4. Water Department Consumer Articles. Home Water Conservation, Faucet Aerators, 2004. Available on Internet at: http://www.icgov.org/water/waterfaucetaer.htm
5. Achttienribbe, G.E., 1996. Domestic Water Consumption under the Microscope. H2O, 29: 278-279.
6. DeOreo, W.B., P.W. Mayer, D.M. Lewis, A. Dietemann, T. Skeel and J. Smith, 2001. Retrofit Realities. J. Am. Water Works Assoc., 93: 58-72.
7. Clouser, R.L. and W.L. Miller, 1980. Household water use. Technological shifts and conservation implications. Water Resources Bulletin, 16: 453-458.
8. Cartee, P. and D.C. Williams, 1979. A study of factors related to the implementation and use of water conservation technology in Mississippi. Water Resources Research Institute, Mississippi State University.
9. Creighton, S.1996. Saving Water. Utility Week, 5: 18-19.
10. Consortium for Energy Efficiency, 2004. Available on Internet at: http:ceeformt.org/resid/seha/New_Con_PS.pdf
11. Sharpe, W.E., 1979. Water Conservation. Water Problems of Urbanizing Areas. Proceedings of the Research Conference. The American Society of Civil Engineers. pp: 225-241. Available on Internet at: http://www.rainharvesting.co.uk/images/pie.gif
12. Household water use, 2004. Available on Internet at: http://www.rainharvesting.co.uk/images/pie.gif
13. Our Environment, Water conservation, 2004. Available on Internet at: http://www.gippswater.com.au/environment/conservation.asp
14. Cross, N., 1994. Engineering Design Methods.