Comparation Between Drinking Water Quality Of Point-Of-Use (POU) Treated Water And Tap Water

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Abstract

There are a number of methods available to improve or enhance drinking water quality. People work very hard to improve treatments like purification and disinfections to get perfect product-drink safe for health and necessary for life called simply water. POU (Point Of Use) filters are used one or few technologies whose produced pure water in one object for drinking and preparing meals. Many of the proven technologies are commonly used to effectively reduce specific contaminants in drinking water. EPA (Environmental protection agency) has set drinking water standards for approximately 90 contaminants with legal limit known as maximum level. Water that meets these standards is safe to drink, although people with severely compromised immune systems and children may have special needs. But what happens when POU filters treated water, which doesn't have any contaminants? Advertising can sell anything to anybody regardless of his or her true needs. No single unit takes out every kind of drinking water contaminants; you must decide for yourself who type best meets your needs or you may consulted health professionals.
Water degradation in water treated with POU home system is observed where water entry is from communal system and primary water goes through purification and disinfections-standard methods.
The aim of this paper is to compare drinking water quality before and after treatments with POU household filters.
Laboratory IPH Nis analyzed 35 samples from two different filter types: 21 samples from reverse osmosis filters and 14 samples from ion exchange filters. Samples were taken in series: before filter (tap water from communal system NIVOS), storage and final (filtered water). Results showed that all of primary water corresponding Serbian Drinking Water Standards and hadn't got any contaminant. Two dominant reasons of contamination were founded in samples after filter purification: bacteriological contamination and demineralization. Samples from reservoirs and final water from reverse osmosis filters had got bacteriological growth and fatal drop essential minerals like calcium and magnesium (average forty times). Ion exchange filters produced water with bacteriological contamination but without changes in mineralisation.
Both of filter types have got carbon part. It may be a reason for bacteria presentation in filtered water beside primary water was clean of bacteria. Water treatment process at the home can be adjusted to obtain desirable levels of calcium and magnesium in drinking water but not demineralised water that some filters do.
After installation of POU household system, which can do only professionals, there must exist some regulated rule for obliged water sampling before and after filtering process for comparation drinking water quality. Permission for use-filtered water will be given after analyses of water quality and its health risks from health professionals. Water quality degradation is bad publicity for POU household filter sellers and they may sale filters on areas with local but not communal supplying water system. Water from communal system is already purificated and it is on permanent monitoring from health sector.
In Serbia, Regulation about filtered water still not exist and this paper give initiative for making new water standard toward Directive EU for better health consumers and satisfaction health professionals.

Keywords: POU filters, water quality, bacteriological growth, demineralisation

Introduction

In quantitative term, only one percent world water source is available for different human uses (AWWA 1999.). Based on the reports of World Health Organization (WHO.2006), 1.1 billion people of the world have not access to healthy and uncontaminated water. Entering the International Decade for Action "Water for life", 2005-2015.this year will be year for sanitation.

South Serbia has not problems with safe drinking water in big cities, like town Nis is. Projects for water transfer and treatment have been realized in past century, and communal firms successfully maintenance water supplying system. Water quality parameters are monitoring, according Serbian Water Rule Book, from accrediting laboratory in public health system which part is Institute for public health Nis (IPH Nis).

Water problems are still existing in small communities, but Point of Use (POU) managers aren't want to solve this kind of problem with POU technologies. Application of appropriate technology on water source with problem can prevent health risks through provision a suitable and healthy quality for drinking water.

The first step in correcting a water quality problem is often to have the water tested. When the safety of water is in question, it should always be tested by state-certified laboratory like was laboratory in IPH Nis. Testing the water will help determine the proper treatment necessary.

Contamination of drinking water by microorganisms represents a major human health hazard in many parts of the world. The World Health Organization (WHO) has recently recognized point-of-use water treatment as an effective means of reducing illness in developing country household.

Whether consumers receive their water (from household well or a community water system), they may wish to treat it at its POU system. POU technologies corrected unusual taste, color and odor and some POU devices also reduce harmful contaminants. Each technology is designed to solve one of several different water quality problems. In order to choose the right equipment, it is important to confirm the nature and extent of the problem.

Devices for booster purification of tap water in home are one of the ways for regulation water quality. POU systems are appropriate for all of people who have doubts about tap water quality. They treated tap water - water from communal water supply systems which past from different treatment of purifications and disinfections, and also laboratory control for hygienic correctness according Serbian Rule Book for safe water.

Principles of work reverse osmosis POU system are:

1. Tap water is first passed through a pre-filter, 5 microns preferred, to remove particulates and sediment from the water.
2. The water is applied under pressure to a semi-permeable membrane.
3. The membrane will remove up to 98% of the total dissolved solids including bacteria, cysts and some viruses allowing only small molecules of water and soluble chemicals to pass.
4. The water is then passed through an adsorption filter to improve taste, odor, and color and reduce chemical contaminants.
5. A residential system can produce anywhere from one to twenty gallons per 24 hour day depending upon the size of the system.
6. Stores the product water in a sealed storage facility.
7. A final adsorption filter is used to reduce tastes and odors, which can be introduced by the storage unit.

Water past through a carbon filter and then is forced through a semi-permeable membrane separating clean water from contaminants (such as bacteria and viruses; arsenic, chloride, fluoride, nitrate, sulphates and lead, mercury, other heavy metals and some organic). The semi-permeable membrane needs replacing annually but the carbon filter must be replaced more often. Care must be taken to replace the carbon cartridges when need; otherwise contaminants in the cartridge may be flushed into the clean water reservoir. Combination with ion exchange may pose a health risk to people with high blood pressure and heart disease because separated calcium and magnesium and sodium has high concentration in blood.

But, beside advantages, there are some of reverse osmosis (ro) disadvantages:

1. Slow production requires large holding reservoir.
2. Removes minerals.
3. Most need a drain to flush away impurities.
4. Membrane susceptible to damage or rupture.
5. Requires pre and post filters to be efficient.
6. Hot water use will destroy many ro membranes.
7. Expensive systems to maintain.
8. Chlorine will affect life of the ro membrane.
9. Bacteria will pass through ruptured membrane.
10. Damaged membrane not easy to detect. Electronic monitoring should be used.
11. Requires technician to install and service.
12. Water is flat and has little or no life to it.

Aim and Methodology

There are numbers methods of water purification with POU filters, which produced with different materials and in various forms. In this research, the efficiency of water impurities removal by reverse osmosis and ion exchange filters was studied.

Table 1. Effectiveness from filter type according method of water purification on different contaminants

Contaminants	Reverses osmosis	Ion exchange
Faecal bacteria	**++**	**-**
Organic compounds	**++**	**-**
Trihalometans	**++**	**-**
Chlorine	**++**	**-**
Pesticides	**++**	**-**
Colors and odor	**++**	**-**
Sodium	**++**	**++**
Lead	**++**	**++**
Cadmium	**++**	**++**
Potassium	**++**	**++**
Sulphates	**++**	**++**
Calcium	**++**	**++**
Magnesium	**++**	**++**
Chemical faecal contaminants	**++**	**++**
Chlorides	**++**	**++**

But, what happened when POU device been installed on faucet with tap water from communal water supplying system?

In POU system has got two critical points. Integrated part of POU system is usually activated carbon cartridge that used to improve the taste and odor. This is a risk point for bacterial growth that capable of causing opportunistic infections and because of that might present a public health risk. Second critical part of POU system is membrane for reverse osmosis. Water, with stabile mineral structure, is passing through membrane. Membrane isn't usually selective and water after membrane treatment became demineralised. It carried health risk, too (WHO 2004).

Some people with health problems in Nis (mostly cardiovascular patients) are buy POU devices and expected benefits from POU water. But, after very short time, POU water developed in health risk medium because contaminated with bacteria and became demineralized. These patients turn to doctor for help and IPH Nis realized this pilot project.

The basic objective of this study is to compare drinking water quality before and after treatments with POU household filters.

Laboratory IPH Nis analyzed 35 samples from two different filter types: 21 samples from reverse osmosis filters and 14 samples from ion exchange filters. Samples were taken in series: before filter (tap water from communal system NIVOS), storage and final (filtered water). Seven series of three water samples (21) were collected from POU devices with reverse osmosis and analyzed on water quality parameters (microbiological and chemical). Samples were taken from three sources: entry point on POU device (tap water), reservoir and exit point on POU device (final POU water).

Photo 1. Faucet with visible POU device

Photo 2. Faucet with tap water from NIVOS

Results and discussion

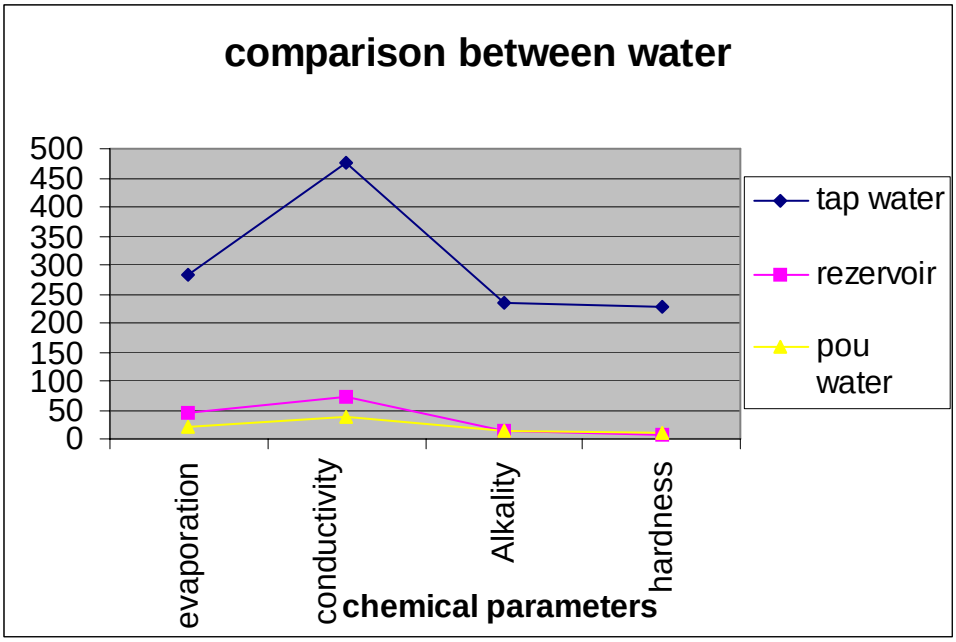
Results showed that all of primary water corresponding Serbian Drinking Water Standards and hadn't got any contaminant. IPH Nis evaluated results annual monitoring water quality for over 3.000 samples from NIVOS. The samples had been done in laboratory accord valid book of regulation about drinking water quality in Serbia. The rate of physicochemical quality is one percent, and bacteriological contamination is detected in NIVOS' water only in 3 samples in 2007. (0.11%).
Two dominant reasons of contamination were founded in samples after filter purification: bacteriological contamination and demineralisation.
Samples from reservoirs and final water from reverse osmosis filters had got bacteriological growth. The high concentration of heterotopy plate count (HPC) bacteria was found in POU-treated water (reservoirs and final faucets. Concentration is ranging from 10^2 to 10^7 colony forming units/ml. Neither total nor faecal coloforms were recovered from any samples.
Fatal drop essential minerals like calcium and magnesium (average forty times) showed in Table 2. Ion exchange filters produced water with bacteriological contamination but without changes in mineralisation. Both of filter types have got carbon part. It may be a reason for bacteria presentation in filtered water beside primary water was clean of bacteria. Water treatment process at the home can be adjusted to obtain desirable levels of calcium and magnesium in drinking water but not demineralised water that some filters do.

Table 2. Changes in mineral's structure from different type of water

Minerals	Tap water	Reservoirs	POU water
Potassium	0,4	0,1	0,7
Calcium	116	3,0	3,5
Magnesium	4,1	0,1	0,2
Sodium	0,95	0,1	0,2

Beside changes in mineral's structure, POU water has got drop of some chemical parameters such as rest of evaporation, elektroconductivity, alkality and hardness-Graph 1. All of that give good basis for bacteriological contamination and increase risk for consumer's health.

Graph 1. Comparison in some chemical parameters between water



Studies about comparison water quality between tap and POU water exist in different parts of world (Ahmedna, 2004.; Chaidez, 2004.; Clasen,2003.; Naddafi, 2005.; Rob, 2003.Souter, 2003. etc) but tap water was contaminated. In Nis, tap water from communal system NIVOS is with very good quality and it doesn't need to treat with booster purification from POU devices.

Conclusion

This research showed that filters had not efficiency to product safe water from communal tap water. On the other hand, POU devices product water with bacteria growth and without essential minerals. POU water carried health risks for vulnerable category of population (especially patients with diagnosis of cardiovascular diseases) and must be on special monitoring control according new Water Standards.

In Serbia, Regulation about filtered water still not exist and this paper give initiative for making new water standard toward Directive EU for better health consumers and satisfaction health professionals.

In Great Britain, the law about filtered water existed since 1990., and in USA POU filters are on strict control. POU systems could be good choice for rural areas with contaminated water, but there is a still problem on pointing the priorities, which should be, solve or sold.

After installation of POU household system, which can do only professionals, there must exist some regulated rule for obliged water sampling before and after filtering process for comparation drinking water quality. Permission for use-filtered water will be given after analyses of water quality and its estimable health risks from health professionals. Water quality degradation is bad publicity for POU household filter sellers and they may sale filters on areas with local but not communal supplying water system. Water from communal system is already purificated and it is on permanent monitoring from health sector.

Photo 3. Safe water

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Quality and tastiness of tap water is on par with bottled water as well. In the infographic below, I compare the differences between tap water and bottled water. Youâ€™ll also learn why you should stop wasting money on bottled water. Enjoy! Feel free to share and/or publish this infographic, as long as there is a link back to this post (for credit). Below, you can find a written comparison between tap water and bottled water. The written version includes extra facts and stats that arenâ€™t found on the infographic. Table of Contents The water quality from point-of-use (POU) water activated carbon treatment devices and that of tap water with POU-connections and tap water without POU devices were compared. Heterotrophic plate count (HPC) bacteria, total and faecal coliforms, and acid-fast organisms (Mycobacteria spp.), as well as, the opportunistic bacterial pathogens Aeromonas hydrophila, Plesiomonas shigelloides, and Pseudomonas aeruginosa were enumerated. The highest concentration of bacteria was found in POU-treated water.Â Based on a daily ingestion of two liters of POU treated water, A. hydrophila and P. aeruginosa had a probability of less than 10(-6) of colonizing the gut; however, annual risks could be as much as 100-fold greater. POU devices treat only the water intended for direct consumption (drinking and cooking), typically at a single tap or limited number of taps (Exhibit 1.1), while POE treatment devices are typically installed to treat all water entering a single home, business, school, or facility (Exhibit 1.2). The cost savings achieved through selective treatment may enable some systems to provide more protection to their consumers than they might otherwise be able to afford.Â Separate faucets allow for the use of untreated water for washing and cleaning, thus helping to reduce operating costs of the treatment device. The water quality regulations specify that the tap water should have a pH level of 6.5 to 9.5. Water leaving the treatment works should have a pH of 7 and 9. However, this can change as it passes through the network of water mains and reservoirs. We consume various beverages and foods with a wide range of pH.Â Unluckily, not every kind of water available is pure water, and the chance of getting the actual neutral level is in fact rare. But, why do pH levels change? The fluctuation is caused by varying factors affecting the alkalinity and acidity of water.Â One of the newest trends today is the use of alkaline water. It has now made its way to the overcrowded world of health and wellness. Some say that drinking alkaline water can offer various health benefits to people.