Assessment of the Bacterial Pollution in the Distribution Network/Case Study of Souk Ahras Town, Algeria

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Abstract The provision of safe drinking water has been one of humanity's most successful public health interventions and is a defining aspect of a developed country. The pathogens that may be transmitted through contaminated drinking water are diverse. The contamination of drinking water by pathogens causing diarrheal diseases is the most important aspect of drinking water quality. In this paper, the bacterial pollution was assessed to predict the risk of contamination of the drinking water. Several samples were collected at different timepoints and analyzed in the distribution system. The study area is part of the main distribution of the City of Souk Ahras called "Faubourg". Based on the results an urgent strategy is needed to protect the drinking water quality and avoid the consequences of contamination.

Keywords Drinking water distribution system · Bacterial pollution · Waterborne disease, Souk Ahras (Algeria)

1 Introduction

Water is one of the main causes of diseases and mortality in the world. In fact, according to the World Health Organization [4], every year we count the following:

– 30 million people die as a result of an epidemic or contagion due to water pollution;

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Table 1 Epidemiological situation in Algeria during the period 1983–1992 [1]

Year	Typhoid fever	Viral hepatitis	Cholera	Dysentery
1983	5942	6037	2106	9902
1984	4924	3249	45	6978
1985	4754	5601	/	4692
1986	2807	3163	8008	2645
1987	2939	4681	1593	3460
1988	2017	3187	699	2044
1989	1640	3078	414	1889
1990	2497	3805	1556	1744
1991	3188	2199	164	/
1992	2911 (08 deaths)	/	70 (06 deaths)	/

– 02 million people die from diarrheal diseases;
– 01 million people die of malaria.

Table 1 shows the evolution of the epidemiological situation of various waterborne infections during the 1983–1992 period in Algeria. It should be noted that these different diseases usually evolve in a random way. This is undoubtedly due to the way of life of the populations, which is mainly dependent on the way how water is supplied and stored.

Some Wilayas have to make huge efforts to improve this situation which remains worrying. In addition, Table 2 shows the epidemiological situation of waterborne diseases during the period 1994–2004 in the city of Oran [1].

Table 2 Number of cases of bacteriological pollution related to water [3]

Years	Total Number of analyses	Positive	Low-p	Highly-p
2015	781	42	23 +	19 +++
2016	901	71	60 +	11 +++
2017	975	72	60 +	12 +++
2018	553	12	7 +	5 +++

Where: Positive: good bacteriological water
Low-P: poor quality (presence of germs)
Highly-p: water of totally poor quality (large presence of germs)

2 Materials and Methods

2.1 Distribution System

The distribution system infrastructure is the major asset of most water utilities, even though most of the components are either buried or located inconspicuously. Drinking water distribution systems are designed to deliver water from a source (usually a treatment facility) in the required quantity, quality, and at satisfactory pressure to individual consumers in a utility's service area. Drinking water infrastructure generally consists of storage reservoirs/tanks, and a network of pipes [6], pumps, valves, and other appurtenances and is collectively referred to as the drinking water distribution system [5].

Treated water may be free of fecal indicating organisms and detectable enteric pathogens and therefore present a tolerable level of risk of enteric illnesses; drinking water entering the distribution system may contain free-living amoebae and environmental strains of various bacterial species, often referred to as heterotrophic bacteria.

Through the network, some points offer entry routes to contamination by microorganisms. This is the case of reservoirs where the water is in contact with the air, and where the poorly protected openings can allow the passage of dust or insects bringing contamination.

2.2 Study Area

The "Faubourg" sector is fueled by two tanks of the same name with a capacity of 400 m^3 each. It is an old urban area that has reached saturation. This area is small, it includes 398 domestic subscribers, 15 governments, and 34 small businesses in the ADE file in the first three quarters of 2017 [2].

2.3 Bacteriological Parameters

For the study of drinking water quality in distribution networks, bacteriological analyses are essential to ensure the absence of germs or bacteria that can make a risk to the health of consumers.

To know the bacterial pollution in the distribution network the following values were used.

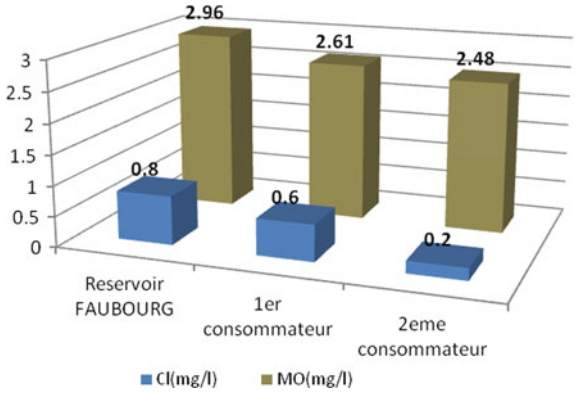

Fig. 1 The variation of residual chlorine Cl and organic matter at Faubourg Reservoir—Summer period

3 Discussion

The bacteriological parameters analyses are of prime importance to monitor the decay of drinking water quality in the distribution network. From the analyzed samples at different time points we concluded the following:

The results obtained show that the bacteriological parameter is strongly related to that of pollution. Generally, the presence of bacteria is due to the infiltration of wastewater into the drinking water distribution network, as well as the proximity of sewerage main pipes with those of the drinking water network. See Fig. 1.

Several positive cases were recorded at the main source; this contamination is due to the cross connection, failure, interruption, or failure of treatment with chlorine.

Incidents in the distribution channels water interconnection wastewater—water [7] or siphoning dirty water into the drinking water system.

4 Conclusion

The greatest risk from microbes in water is associated with consumption of drinking water that is contaminated with human and animal excreta. An adequate supply of safe drinking water is one of the major prerequisites for a healthy life. To assess the bacterial risk of the drinking water several samples from different points of the network were analyzed. The results show that the drinking water network was probably crossed by the dirty water which needs an emergency plan to protect people against any likely spread of the dirty water. The old parts in the network should be replaced too.

References

1. Bensoltane, M.A.: Dégradation de la qualité d'eau potable dans les réseaux de distribution/Cas de la ville de Souk-Ahras, These Magister, Université de Souk-Ahras (2010) [Drinking water quality decay in distribution network/Case study of Souk Ahras city. Magister thesis, Souk Ahras University (2010)]
2. Bensoltane, M.A., Zeghadnia, L., Djemili, L., Gheid, A., Djebbar, Y.: Enhancement of the free residual chlorine concentration at the ends of the water supply network: case study of Souk Ahras city—Algeria. J. Water Land Dev. **38**(1), 3–9 (2018)
3. D.S.W. Rapport de la direction de la santé de la wilaya de Souk-Ahras (2018)
4. Organisation Mondiale de la Santé (OMS): Guidelines for drinking-water quality. In: Recommendations, vol. 1, 3rd ed. World Health Organization, Geneva (2004)
5. Walski, T.M., Chase, D.V., Savic, D.A., Grayman, W., Beckwith, S., Koelle, E.: Advanced Water Distribution Modeling and Management. Haestad Methods, Inc., Waterbury, CT (2003)
6. Zeghadnia, L.: Computation of the pressurized turbulent flow in circular pipe. Magister thesis, Badji Mokhtar University, Algeria (2007)
7. Zeghadnia, L.: Contribution au dimensionnement d'un réseau d'assainissement en tenant compte de l'aspect stationnaire et non stationnaire de l'écoulement. Thèse de doctorat, Université Badji Mokhtar Annaba (2014) [Contribution for the dimensioning of sewer network for two cases of flow: steady and unsteady. Doctorat thesis, Annaba University (2014)]