A Review on Drinking Water Quality Monitoring System

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Abstract: Drinking water quality monitoring technologies have made significant progress in monitoring water resources and water treatment plants. The use of these technologies in the distribution system was not cheap due to the high cost of installation, maintenance, and calibration of a large number of distributed surveillance sensors. This has led to the search for new technologies that can be used economically on a large scale. This paper contains a brief description of the important parameters for drinking water and the technologies currently available used in this field.

Keywords: Water Quality,Distribution System, Monitoring, Safety.

I. INTRODUCTION

Water is precious for the life of people and ecosystems. The safety of drinking water is today one of the most important problems, since various dangers (natural and of human origin) can endanger public health. The World Health Organization has registered 27 different waterborne diseases and other waterborne hazards. Drinking water safety is increasingly recognized as a challenge [1]. Contaminated water can cause epidemics, disrupt economic life and cause severe panic. Water distribution systems (WDS) are complex systems that include pipes, pumps, valves, storage tanks, fittings, counters, etc., most of which are buried, of different materials and diameters up to several kilometers. The complexity of the system makes it extremely vulnerable to various threats. Although the institutional framework for water quality is constantly improving, it has been found that the methods used present a delay in the treatment of events that have a negative impact on water quality [2].

A changing climate and increasing population have put a strain on traditional water resources, which typically rely on natural catchment water. This has made water security an increasing concern for many water system managers, who have investigated options for reducing demand and supplementing supply. Alternative water sources, such as harvested stormwater, recycled waste water and desalination, are increasingly being used to improve water security of cities and towns [3]. Methods for simulation, analysis and optimization of traditional potable water distribution systems (WDSs) cannot necessarily be directly transferred to systems that use alternative water sources. Therefore there is a need to develop a methodology specifically for alternative water source systems, which includes both hydraulic and hydrologic considerations, as well as the many additional parameters and variables associated with alternative water sources. There are many modelling tools used in current practice for integrated water management, such as eWater Source, WEAP (Water Evaluation and Planning System) and Mike Basin. These modelling tools do not include hydraulic simulation, and therefore may not accurately represent performance of urban water networks. Moreover, such framework is designed for purpose to guide water system managers in how to best simulate and optimize their systems, particularly those that integrate multiple water sources, and natural and human-made systems. The framework should beused to determine which system components need to be modelled, which type of modelling tools are most appropriate, what regulations and policies need to be taken into account and how to evaluate the performance of the system [4].

II. EFFECTS OF NATURAL PHENOMENA ON WATER QUALITY

Although the deterioration of water quality (WQ) is almost always the result of human activity, some natural phenomena can cause WQ to drop below the standard required for certain purposes. Natural events such as heavy rains and hurricanes cause excessive erosion, landslides and landslides, which in turn increase the level of suspended matter in the affected rivers and lakes. Seasonal water spills in some lakes can bring water to the surface with little or no dissolved oxygen (DO). These events can occur frequently or occasionally and have increased due to climate change. In some areas, permanent natural conditions can make water unsuitable for consumption or for certain purposes, such as irrigation. There are also natural areas with a high content of nutrients, traces of metals, salts and other components that can limit the consumption of water [5]. Common examples are the salinization of surface waters by evaporation in arid and semi-arid regions and the high salinity of some aquifers in certain geological conditions. Many aquifers are naturally rich in carbonates (alkalinity) and must therefore be treated before they can be used for some industrial applications.They can also contain specific ions (such as fluorine) and toxic elements (such as arsenic IV, V) and selenium in harmful quantities, while others contain elements or compounds that cause other types of problems (such as coloring) of healthcare facilities with iron and manganese). The type and concentration of chemical elements and compounds in a fresh water system can change due to different types of natural processes - physical, chemical, hydrological and biological - caused by climatic, geographical and geological conditions.

The main environmental factors are:

- Climate and vegetation: Regulation of erosion and mineral alteration; Concentration of dissolved matter by evaporation and evapotranspiration; increased turbidity and high levels of silt in rivers that cross hills of Quaternary origin are climatic parameters that affect water quality.

- Composition of rocks and sediments (lithology) and geological position: They determine the natural physical and chemical properties of the aquifers.
- Terrestrial vegetation: The production of terrestrial plants and the way in which the tissues of plants are broken down in the soil affect the amount of organic carbon and nitrogen compounds in the water.
- Aquatic vegetation: The growth, death and decomposition of aquatic plants and algae affect the concentration of nitrogen and phosphorus nutrients, the pH value, carbonates, oxygen and other chemicals sensitive to oxidation / reduction conditions. Aquatic vegetation has a profound impact on the chemistry of lake waters and a less pronounced but perhaps significant impact on river water.

III. WATER QUALITY AND THE DISTRIBUTION SYSTEM

New pipes are added to distribution systems as development occurs. The additions result in a wide variation in:

- Pipe sizes
- Materials
- Methods of construction
- Age within individual distribution systems and across the nation

As these systems age, deterioration can occur due to corrosion, materials erosion, and external pressures. Deteriorating water distribution systems can lead to:

- Breaches in pipes and storage facilities
- Intrusion due to water pressure fluctuation
- Main breaks

IV. LITERATURE REVIEW

Dariusz Kowalski et al. [1] proposed methods to correct the water quality in the water distribution system, with which it is possible to reduce the potential loss of water.The applicability of the methods to the water quality management process was tested by computer simulations, with two municipal water distribution systems selected as examples.

J. H. G. Vreeburg et al. [2] presented the concept that has been used effectively to design new networks in the Netherlands. Alternatively, measures could be taken to limit or prevent the entry or generation of particles into the network, for example by improving treatment or preventing the formation of corrosion by-products by doubling or replacing iron pipes. The cost advantage of such an investment in capitalizations or an ongoing opening is uncertain, as the quantification and relative importance of the factors that can lead to an accumulation of materials are poorly understood. Therefore, this is an area where significant research and further practical development are needed.

Markku Lehtola et al. [4] investigated whether cleaning the pipes would improve the quality of drinking water in the pipes. Cleaning was carried out by washing the pipes with compressed air and water. The soft deposits in the pipeline have been released into groundwater, increasing the levels of iron, bacteria, organic carbon and microbial phosphorus available in drinking water.

Perkins et al. [5] conclude that ammonium is key for stimulating cyanobacterial productivity and production of T&O compounds. Whilst it is well understood that adequate availability of phosphorus is required for rapid growth in cyanobacteria, and hence should still be considered in management decisions.

Jalal et al. [6] intended to control the quality of the drinking-water using wireless sensor networks. This architecture uses a new generation of wireless sensors to detect the chemical, physical and microbiological water parameters. After, the water quality limits according to the Tunisian standard will exposed. Then author developed a new detection model of water anomalies.

Rafał et al. [7] proposed an approach to optimised sensor placement by addressing a single, bi and multi-objective problem formulations including a comparison of the proposed methods in terms of the number of hard sensors placed and the performance of the monitoring system. During the design of optimized sensors placement algorithms, the interval observer, recently developed by the authors is applied as the soft sensors. Finally, for the purpose of validating the performance of the algorithms, they are applied to the model of a real drinking water distribution system.

Poornisha et al. [8] proposed a system that has two sensors for namely turbidity and pH sensor to check water quality and temperature sensor and current sensor for motor monitoring, Single microcontroller chip, a wifi chip is used to send the data of various borewells to a single sever. Thus by this system it is possible to monitor multiple borewells in a township remotely in a single mobile application.

V.PARAMETERS AFFECTING WATER QUALITY

A. Physical Parameters:

Turbidity: Drinking water should be free from turbidity.Interferes with disinfection and microbiological determination.Acceptable level of turbidity must be less than 4 NTU.

Color: Drinking water should be free from color. The guideline value is 15 true color units (TCU).

Taste and Odour: Develop due to contamination by chemicals.Indicative of pollution or malfunction during water treatment or distribution.

Temperature: Low water temperature decrease the efficiency of treatment process.High water temperature Enhances the taste, odour. Corrosion problem may increase with temperature.

B. Inorganic Parameters

Chlorides: All water including rain water contain chlorides. Standard level for chloride - 200 mg/ litre.Maximum permissible level - 600 mg/ litre.

Hardness: Taste threshold for calcium ion - 100-300 mg/ litre. Excessive soap consumption and scum formation causes hardness. Forms deposits of calcium carbonate scale on heating.Soft water has low buffer capacity,corrosive for water pipes.

Ammonia: Ammonia originates from metabolic, agricultural and industrial processes and from disinfection with chloramine.Natural levels - below 0.2 mg/litre. Anaerobic ground water contains 3mg/ litre. Its presence indicates pollution by bacteria, sewage or animal waste.

Hydrogen Sulphide: Acceptable limits is about 0.05-0.1 mg/l. Gives rotten egg odour (stagnant water).
Iron: On exposure to atmosphere ferrous iron oxidizes to ferric ion Gives reddish brown color to water. Deposit slimy coating on pipes.
Sodium: Measured with Flame photometer.Average taste threshold for sodium - 200 mg/l.Total Dissolved Solvents. Important effect on taste of waterAcceptability levels of TDS -5mg/litre gives opalescent look and greasy film on boiling.

VI. CONCLUSION

Water is the source of life and its safety is fundamental. Since WDS systems are complex systems and the quality of drinking water is influenced by many factors, it is difficult to guarantee the safety of drinking water. This paper reviews the literature on continuous monitoring systems, drinking water quality modeling and optimization techniques. Continuous monitoring of water distribution is used to monitor the quality characteristics of the water and promptly identify any contamination incidents. In future, this survey will be helpful for designing a framework for reduction in inorganic components concentrations from all sources is likely essential for reservoir and catchment management in order to reduce the growing issues associated with drinking water.Machine Learning Approach will help in determining the inorganic compound and its optimal level estimation as well as action plans.

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