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RESEARCH ARTICLE

CHEMICAL CONTAMINANTS IN DRINKING WATER IN ALSHOHADA AREA OMDURMAN – SUDAN

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ABSTRACT

Water is essential for all known life forms. For many decades, people were wondering about the source of water, but the answer took long time. Clean drinking water is important for overall health and plays a substantial role in infant and child health and survival (Vega *et al.,* 1998; Rao and Finch, 1989; Volesky, 1994). Today, we live in an era when all scientists tell us that war of the future will be for the water. These wars will occur because of the scarcity of pure water due to the environmental pollution. Therefore, scientists are searching for the remedy of water pollution. Our natural heritage (rivers, seas, and oceans) has been exploited, mistreated, and contaminated because of industrialization, globalization, population growth, urbanization with increased wealth, and more extravagant lifestyles. The scenario gets worse when the effluents or contaminants are discharged directly. In recent years, pollution has become one of the most important problems in the global context. When toxic substances enter water bodies like lakes, streams, rivers, aquifers, and oceans, naturally or through any human activity, they either get dissolved or lie suspended or deposited on the bed in water. This results in the contamination of water bodies whereby the quality of the water deteriorates and can cause diseases, illnesses, epidemics, and health problem to animals and plants (Coffey *et al.,* 2007; Rao *et al.,* 1989; Volesky and Holan, 1995). It has been suggested that it is the leading worldwide cause of deaths and diseases (Patterson, 1985) and that it accounts for the deaths of more than 14,000 people daily (West, 2006). Water has many vital functions in almost every mineral and metal processing operations as described, (mineral Processing and Hydrometallurgy), It is used as a carrier for fine solids, provides a column in which separation processes (jigging, flotation, classification) take place, is used in dust collection and cleaning systems, is employed in smelter refractory cooling systems and is a reagent in hydrometallurgical operations. The water inevitably picks up fine solid particles and soluble slats and organic materials in the course of this use necessitating purification treatment to make it suitable of recycling or before discharge to water courses is permitted .Water is a precious resource, essential for human, animal and plant life (in addition to its wide usage in process and construction industries), making conservation purification and recycle of water is a necessity to ensure its constant availability wherever needed. The searches for new cost-effective technologies for the removal of contaminants from wastewater are swiftly was recommending because huge pollution of water nowadays. This research aims to assess and estimation of inorganic contaminants in Alshohada region. The samples was collected from drinking water in Alshohada area and characterized using AAS and HPLC. The results illustrated that there are many mineral contaminants in samples.

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INTRODUCTION

The world's population growth has tripled since the World War II (Chamie, 2004) and doubled over the past two centuries, with developing countries experiencing more growth than developed countries (Rapport, 1999). This growth has significantly impacted our way of life and the environment (Chamie, 2004), with increased food demand, which in turn is exerting pressure on already stressed natural water resources (Rapport, 1999). Water scarcity and the fast decline of aquatic biodiversity are indicators of ineffective implementation of water protection policies (Rapport *et al.,* 1995; Ross *et al.,* 1988).

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Freshwater is the most essential requirement for life and yet comprises only <1% of the Earth's surface water (Johnson *et al.,* 2001). Sustainable and optimal use of natural resources is imperative in any country due to its concomitant economic implications such as industrial and population growth infrastructure and development demands Urbanization and industrial development also increase. The water demand through household supplies, food processing, mining, industrial cooling systems and power generation (DEAT, 2005) with hydropower contributing about 20% of the world's energy supply (Gleick, 2006). Groundwater is the foremost source of drinking water in many rural areas in Sudan for many decades and it plays an important role in the socioeconomic development of the country. Lack of safe drinking water and improved sanitation has been attributed to the occurrence of about 80% of all reported cases of diseases in developing world. Government is currently developing groundwater resources for water supply to rural communities due to high pollution of surface water sources, lack of requisite human resource capacity and high cost of operating surface water treatment plants in the rural areas. Exploration report by the Water Research Institute indicated that 90% and 25% of the rural and urban communities uses groundwater sources for their domestic use respectively. Chemical composition of water may be rendered unfit for human consumption, and thus may lead to health problems. The importance of groundwater quality in human health has recently attracted a great deal of interest. Research has shown a major link between water supply infra-structure, treatment operations, water quality, waterborne diseases and population health (Young *et al.,* 2008). It has been indicated that a lot of waterborne disease epidemics have been preceded by customer complaints about aesthetic water quality problems (Vega *et al.,* 1998). Therefore, this study investigated physico-chemical water quality parameters in and around Omdurman City. The water inevitably picks up fine solid particles and soluble slats and organic materials in the course of this use necessitating purification treatment to make it suitable of recycling or before discharge to water courses is permitted .Water is a precious resource, essential for human, animal and plant life (in addition to its wide usage in process and construction industries), making conservation purification and recycle of water is a necessity to ensure its constant availability wherever needed. This research describes some of the techniques used or proposed to evaluation contamination of drinking water.

What is Water Pollution?

Water is the contamination of water bodies (e.g. lakes, rivers, oceans, aquifers and groundwater). This form of environmental degradation occurs when pollutants are directly or indirectly discharged into water bodies without adequate treatment to remove harmful compounds. Water pollution affects the entire biosphere – plants and organisms living in these bodies of water. In almost all cases the effect is damaging not only to individual species and population, but also to the natural biological communities. Water they say is life, and indeed they were right. With about 70% of the earth's cover being water, it undeniably becomes one of our greatest resources. water is used in almost every important human chores and processes. It is an important element in both domestic as Water pollution is an appalling problem, powerful enough to lead the world on a path of destruction. Water is an easy solvent, enabling most pollutants to dissolve in it easily and contaminate it. The most basic effect of water pollution is directly suffered by the organisms and vegetation that survive in water, including amphibians. On a human level, several people die each day due to consumption of polluted and infected water. Water is polluted by both natural as well as man-made activities. Volcanic eruptions, earthquakes, Tsunamis etc are known to alter water and contaminate it, also affecting ecosystems that survive under water. well as industrial purposes. However a closer inspection of our water resources today, gives us a rude shock. Infested with waste ranging from floating plastic bags to chemical waste, our water bodies have turned into a pool of poison. The contamination of water bodies in simplest words means water pollution. Thereby the abuse of lakes, ponds, oceans, rivers, reservoirs etc is water pollution. pollution of water occurs when substances that will modify the water in negative fashion are discharged in it. This discharge of pollutants can be direct as well as indirect (Moss, Brian, 2008; EPA, 2005).

Sources of Water Pollution

There are various classifications of water pollution. The two chief sources of water pollution can be seen as Point and Non Point (92). Point refer to the pollutants that belong to a single source. An example of this would be emissions from factories into the water. A Non Point on the other hand means pollutants emitted from multiple sources. Contaminated water after rains that has traveled through several regions may also be considered as a Non point source of pollution (Michael Hogan, 2010).

Categories

Although interrelated, surface water and groundwater have often been studied and managed as separate resources. Surface water seeps through the soil and becomes groundwater. Conversely, groundwater can also feed surface water sources. Sources of surface water pollution are enerally grouped into two categories based on their origin.

Causes

The specific contaminants leading to pollution in water include a wide spectrum of chemicals, pathogens, and physical changes such as elevated temperature and discoloration. While many of the chemicals and substances that are regulated may be naturally occurring (calcium, sodium, iron, manganese, etc.) the concentration is often the key in determining what is a natural component of water and what is a contaminant. High concentrations of naturally occurring substances can have negative impacts on aquatic flora and fauna. Oxygen-depleting substances may be natural materials such as plant matter (e.g. leaves and grass) as well as man-made chemicals. Other natural and anthropogenic substances may cause turbidity (cloudiness) which blocks light and disrupts plant growth, and clogs the gills of some fish species. Many of the chemical substances are toxic. Pathogens can produce waterborne diseases in either human or animal hosts (USGS, 2001). Alteration of water's physical chemistry includes acidity (change in pH), electrical conductivity, temperature, and eutrophication. Eutrophication is an increase in the concentration of chemical nutrients in an ecosystem to an extent that increases in the primary productivity of the ecosystem. Depending on the degree of eutrophication, subsequent negative environmental effects such as anoxia (oxygen depletion) and severe reductions in water quality may occur, affecting fish and other animal populations.

Organic, inorganic and macroscopic contaminants

Contaminants may include organic and inorganic substances. A garbage collection boom in an urban-area stream in Auckland, New Zealand.

Organic water pollutants include:

- Detergents
- Disinfection by-products found in chemically disinfected drinking water, such as chloroform

- Food processing waste, which can include oxygen-demanding substances, fats and grease
- Insecticides and herbicides, a huge range of organohalides and other chemical compounds
- Petroleum hydrocarbons, including fuels (gasoline, diesel fuel, jet fuels, and fuel oil) and lubricants (motor oil), and fuel combustion byproducts, from storm water runoff (Johnson *et al.,* 2001; Joseph *et al.,* 2008)
- Volatile organic compounds, such as industrial solvents, from improper storage.
- Chlorinated solvents, which are dense non-aqueous phase liquids, may fall to the bottom of reservoirs, since they don't mix well with water and are denser.
- Polychlorinated biphenyl (PCBs)
- Trichloroethylene
- Perchlorate
- Various chemical compounds found in personal hygiene and cosmetic products
- Drug pollution involving pharmaceutical drugs and their metabolites

Inorganic water pollutants include

- Acidity caused by industrial discharges (especially sulfur dioxide from power plants)
- Ammonia from food processing waste
- Chemical waste as industrial by-products
- Fertilizers containing nutrients--nitrates and phosphates which are found in storm water runoff from agriculture, as well as commercial and residential use (Johnson *et al.,* 2001).
- Heavy metals from motor vehicles (via urban storm water runoff) (Johnson *et al.,* 2001; West, Larry, 2006) and acid mine drainage
- Secretion of creosote preservative into the aquatic ecosystem
- Silt (sediment) in runoff from construction sites, logging, slash and burn practices or land clearing sites.

Macroscopic pollution large visible items polluting the water may be termed "floatables" in an urban storm water context, or marine debris when found on the open seas, and can include such items as:

- Trash or garbage (e.g. paper, plastic, or food waste) discarded by people on the ground, along with accidental or intentional dumping of rubbish, that are washed by rainfall into storm drains and eventually discharged into surface waters
- Nurdles, small ubiquitous waterborne plastic pellets
- Shipwrecks, large derelict ships.

Water pollutants also include both organic and inorganic factors. Organic factors include volatile organic compounds, fuels, waste from trees, plants etc. Inorganic factors include ammonia, chemical waste from factories, discarded cosmetics etc. The water that travels via fields is usually contaminated with all forms of waste inclusive of fertilizers that it swept along the way. This infected water makes its way to our water bodies and sometimes to the seas endangering the flora, fauna and humans that use it along its path. The current scenario has led to a consciousness about water preservation and efforts are being made on several levels to redeem our water resources. Industries and factory set-up's are restricted from contaminating the water bodies and are advised to treat their contaminated waste through filtration methods. People are investing in rain water harvesting projects to collect rainwater and preserve it in wells below ground level. Water Pollution is common, and is an area of high alert. Water needs to be preserved and respected today, for us to live a tomorrow.

Sources of wastewater

Wastewater is not just sewage. All the water used in (a) home, which includes baths, showers, sinks, dishwashers, washing machines, and toilets; (b) commercial/service like schools, hospitals, restaurants, offices, hotels, and small industries; (c) industries; and (d) nonpoint sources that goes down the drains or into the sewage collection system (Metcalf and Eddy, 1981) is the wastewater. Small businesses and industries often contribute large amounts of wastewater to sewage collection systems. The considerable public concern about the potential risks associated with pathogens and inorganic and organic contaminants to the environment and human health (Abdulraheem,, 1989). The important source of biological pollution is domestic sewage and industrial wastes; solid excrete from human bodies and decomposable organic matter of sewage are the best medium for the development of bacteria in water (Sharma *et al.,* 2005). The sources of organic contaminants are proteins, fats, carbohydrates, etc., as well as synthetic compounds like dyes, pesticides, and herbicides. The synthetic organic derivation causes more harm to the environment than naturally occurring ones. The classes of inorganic pollutants are acids, alkalis, heavy metals, and anionic radicals. Mainly the heavy metal source assessment has divided heavy metal sources into three main source pathways: domestic wastewater, trade effluent, and storm runoff. Trade effluents are further divided into commercial effluents, which arise from non consented trade activities, and industrial effluents, which arise from consented trade activities. Major sources of pollution are industries producing metals, paper and pulp, textiles, and food and beverages. The mining industry is also a significant contributor (Evans *et al.,* 2012; Joseph and McGinley, 2008).

Composition of wastewater

The constituents in wastewater can be divided into main categories according to Table.1. The composition of wastewater may differ from community to community; all wastewater contains the following groupings of constituents.
Since all the pollutants are hazardous to the living things, the heavy metals are highly concern due to its abundance. On the basis of chemical properties, applications, and physiological effects on life, metals were divided into four main categories. They are (i) toxic heavy metals, (ii) strategic metals, (iii) precious metals, and (iv) radionuclides (Volesky and Holan, 1995). So far, 23 metals are regarded as heavy metals such as antimony, arsenic, bismuth, copper, cadmium, cerium, cobalt, gallium, gold, iron, lead, manganese, mercury, lead, nickel, platinum, silver, tellurium, thallium, tin, uranium, vanadium, and zinc (Glanze, 1996). In that, "the big three" toxic heavy metals were mercury, lead, and cadmium by considering their major impact on environment (Volesky and Holan, 1995). For the survival of living things, pure water is much essential. The constituents in untreated wastewater can be divided into three types: physical, chemical, and biological. Physical constituents are the particles or solids in the effluent. Effluent is defined as liquid waste that is untreated, partially treated, or completely

treated. Chemical constituents include nutrients and heavy metals (Table 1). Biological constituents (Table 2) include coli form organisms and other microorganisms such as bacteria, protozoa, helminthes, and viruses (DEAT, 2005; Fewtrell *et al.,* 2005). In order to meet the growing demand for potable water and water of good quality for industrial use, it has become necessary to treat wastewaters for renovation, reuse, and pollutant removal before mixing with natural water bodies containing good quality water.

Government agencies and research organizations have published standardized, validated analytical test methods to facilitate the comparability of results from disparate testing events (Wachman, Richard, 2007).

Collection of water samples quality

Water-quality samples were collected by the USGS from population drinking water.

Table 1. Illustrate the physicals – chemicals and biological composition of waste water

Physical	Chemical				Biological
	Inorganic	Organic	Typical domestic waste		
Solids,	Nutrients (nitrogen,	Aggregate organic constituents		Individual compounds	
color,	nitrogen, phosphorus,	Organic constituents	40–60% protein,	Phenols, pesticides,	Microorganisms
temperature,	ammonium),	with similar	25–50%	detergents, esticides,	pathogenic
density	Metals (Hg, Pb, Cd, Cr, Cu, Ni)	characteristics that cannot be	carbohydrate,	fat, oil and grease	bacteria, virus,
turbidity,	gases, chloride,	distinguished	8–12% oil–fat	coloring, solvents,	and worms eggs
conductivity	chloride, sulfur, alkalinity	separately		phenols, cyanide	

Table 2. World Health Organization (WHO) tolerance limits in drinking water

Heavy metal	Maximum acceptable concentration (mg/L)
Zinc	5
Arsenic	0.01
Magnesium	50
Calcium	50
Cadmium	0.003
Lead	0.01
Silver	0.0
Mercury	0.001
Copper	0.5
Chromium	0.1

MATERIALS AND METHODS

Materials

Drinking water Sampling and Analyses

The drinking water samples from Nile river surface water used by the local population after simple purification were collected by grab sampling method in the sampling stations from August 2016 to January 2017 to compare of chemical contaminants. Samples were collected in polythene containers of 2.5 litres capacity. pH of the water samples were noted at the sampling sites itself. Dissolved oxygen (DO) was fixed at the sampling sites immediately after collection. The two sampling sites were selected on the discharge of secondary settling tank (denoted as KI2) and on the discharge of final clarifier for the chemical coagulation process (denoted as KI3), respectively. In this study, turbidity, TOC, and conductivity were used to represent the fine particles, the remaining parameters were analyzed according to the procedures of APHA (1998). Organic compounds/ colloid materials, and inorganic salts in the wastewater, respectively. For KI2 (KI3), the turbidity, TOC, and conductivity were 44.65(14.63) NTU, 26.8(21.8) mg/L, and 5.25(4.32) ms/cm, respectively. Moreover, the zeta potentials of KI2 and KI3 were −32.23 and −30.12 mV, respectively. Water pollution may be analyzed through several broad categories of methods: physical, chemical. Most involve collection of samples, followed by specialized analytical tests. Some methods may be conducted *in situ*, without sampling, such as temperature.

For analysis of major chemical constituents and trace metals. Location coordinates, diameter of casing, land-surface and screen altitudes. Samples were analyzed for major ions, trace metals, selected organic compounds, and volatile organic compounds. The abundances and size distributions of free-living bacteria were determined for samples collected from two regions in Alshohada area are selected.

Preparation Samples for physical and chemical testing

Sampling of water for physical or chemical testing can be done by several methods, depending on the accuracy needed and the characteristics of the contaminant. Many contamination events are sharply restricted in time, most commonly in association with rain events. For this reason "grab" samples are often inadequate for fully quantifying contaminant levels. Scientists gathering this type of data often employ auto-sampler devices that pump increments of water at either time or discharge intervals. Sampling collection from drinking water .The original resource is the surface water body (Nile river). Depending on the type of assessment, the organisms may be identified for chemo surveys (population counts) and returned to water body the, or they may be dissected for chemo assays to determine toxicity.

Methods

Physical testing

Common physical tests of water include temperature, solids concentrations (e.g., total suspended solids (TSS)) and turbidity.

Chemical testing

Water samples may be examined using the principles of analytical chemistry. Many published test methods are available for both organic and inorganic compounds. Frequently used methods include pH, biochemical oxygen demand (BOD), (Karr, James, 1981). chemical oxygen demand (COD),(33) nutrients (nitrate and phosphorus compounds), metals (including copper, zinc, cadmium, lead and mercury), oil and grease, total petroleum hydrocarbons (TPH), and pesticides.

Water testing methods

pH Testing Procedure

It is important to measure pH at the same time as chlorine residual since the efficacy of disinfection with chlorine is highly pH-dependent: where the pH exceeds 8.0, disinfection is less effective. To check that the pH is in the optimalae water. (b) Fill the tube to the 5mL line with sample water. (c) While holding a dropper bottle vertically, add 10 drops of Wide Range Indicator Solution. (d) Cap and invert several times to mix. (e) Insert the tube into the Wide Range pH Comparator. Hold the comparator up to a light source. Match the sample color to a color standard. (f) Record the pH value. (g) Wash your hands.

Nitrate Testing Procedure

a. Fill the sample bottle with sample water. Use gloves if drawing the sample by hand. (b) Rinse and fill one test tube to the 2.5 mL line with water from the sample bottle. (c) Dilute to the 5 mL line with the Mixed Acid Reagent. Cap and mix. Wait 2 minutes. (d) Use the 0.1 g spoon to add one level measure (avoid any 50-60 times in one minute). Wait 10 minutes.(e) Insert the test tube into the Nitrate Nitrogen Comparator. Match the sample color to a color standard. Record the result as mg/L(ppm) Nitrate Nitrogen (NO_3-N). To convert to mg/Nitrate (NO3) multiply by 4.4. (f) Place the reacted sample in a clearly marked container. Arrangements should be made with toxic material handlers for safe disposal. Please wash your hands after this water test is completed.

Dissolved Oxygen Testing Procedure

a. If you have a barometer, record the atmospheric pressure. Remove the cap and immerse the DO bottle beneath the river's surface. Use gloves to avoid contact with the river. b. Allow the water to overflow for two to three minutes (This will ensure the elimination of bubbles). c. Make sure no air bubbles are present when you take the bottle from the river. (d) Add 8 drops of Manganous Sulfate Solution and 8 drops of Alkaline Potassium Iodide Azide. (e) Cap the bottle, making sure no air is trapped inside, and invert repeatedly to fully mix. Be very careful not to splash the chemical-laden water. Wash your hands if you contact this water. If oxygen is present in the sample, a brownish-orange precipitate will form (floc). The first two reagents "fix" the available oxygen. (f) Allow the sample to stand until the precipitate settles halfway. When the top half of the sample turn S clear, shake again, and wait for the same changes. (g) Add 8 drops of Sulfuric Acid 1:1 Reagent. Cap and invert repeatedly until the reagent and the precipitate have dissolved. A clear yellow to brown-orange color will develop depending on the oxygen content of the sample.(h) Fill the titration tube to the 20 mL line with the "fixed": sample and cap. (i) Fill the Direct Reading Titrator with Sodium Thiosulfate 0.025 N Reagent. Insert the Titrator into the center hole of the titration tube cap. While gently swirling the tube, slowly press the plunger to titrate until the yellow-brown color is reduced to a very faint yellow. If the color of the fixed sample is already a faint yellow, skip to step 10. (j). Remove the cap and Tritrator. Be careful not to disturb the Titrator plunger, as the tiration begun in step 8 will continue in step 11. Add 8 drops of Starch Indicator Solution. The sample should turn blue. (k). Replace the cap and Titrator. Continue titrating until the sample changes from blue to a colorless solution. Read the test result where the plunger top meets the scale. Record as mg/L (ppm) dissolved oxygen.

Physicochemical analysis

Chlorine residual

The disinfection of drinking-water supplies constitutes an important barrier against waterborne diseases. Although various disinfectants may be used, chlorine in one form or another is the principal disinfecting agent employed in small communities in most countries. Chlorine has a number of advantages as a disinfectant, including its relative cheapness, efficacy, and ease of measurement, both in laboratories and in the field. An important additional advantage over some other disinfectants is that chlorine leaves a disinfectant residual that assists in preventing recontamination during distribution, transport, and household storage of water. The absence of a chlorine residual in the distribution system may, in certain circumstances, indicate the possibility of post-treatment contamination. Three types of chlorine residual may be measured: *free chlorine* (the most reactive species, i.e. hypochlorous acid and the hypochlorite ion); *combined chlorine* (less reactive but more persistent species formed by the reaction of free chlorine species with organic material and ammonia); and *total chlorine* (the sum of the free and combined chlorine residuals). Free chlorine is unstable in aqueous solution, and the chlorine content of water samples may decrease rapidly, particularly at warm temperatures. Exposure to strong light or agitation will accelerate the rate of loss of free chlorine. Water samples should therefore be analysed for free chlorine immediately on sampling and not stored for later testing. The method recommended for the analysis of chlorine residual in drinking water employs *N*,*N*-diethyl-*p*-phenylenediamine, more commonly referred to as DPD. Methods in which *o*-tolidine is employed were formerly recommended, but this substance is a recognized carcinogen, and the method is inaccurate and should not be used. Analysis using starch–potassium iodide is not specific for free chlorine, but measures directly the total of free and combined chlorine; the method is not recommended except in countries where it is impossible to obtain or prepare DPD. Procedures for the determination of free chlorine residual are described in Annex 9.

Guidelines for drinking-water quality

68 range for disinfection with chlorine (less than 8.0), simple tests may be conducted in the field using comparators such as that used for chlorine residual. With some chlorine comparators, it is possible to measure pH and chlorine residual simultaneously. Alternatively, portable pH electrodes and meters are available. If these are used in the laboratory, they must be calibrated against fresh pH standards at least daily; for field use, they should be calibrated immediately before each test. Results may be inaccurate if the water has a low buffering capacity. Procedures for measuring pH using a comparator are described in Annex 10.

Turbidity

Turbidity is important because it affects both the acceptability of water to consumers, and the selection and efficiency of treatment processes, particularly the efficiency of disinfection with chlorine since it exerts a chlorine demand and protects microorganisms and may also stimulate the growth of bacteria. In all processes in which disinfection is used, the turbidity must always be low—preferably below 1 NTU or JTU (these units are interchangeable in practice). It is recommended that, for water to be disinfected, the turbidity should be consistently less than 5 NTU or JTU and ideally have a median value of less than 1 NTU. Turbidity may change during sample transit and storage, and should therefore be measured on site at the time of sampling. This can be done by means of electronic meters (which are essential for the measurement of turbidities below 5 NTU). For the monitoring of small-community water supplies, however, high sensitivity is not essential, and visual methods that employ extinction and are capable of measuring turbidities of 5 NTU and above are adequate. These rely on robust, low-cost equipment that does not require batteries and is readily transportable in the field, and are therefore generally preferred. Procedures for measuring turbidity in the field using a simple "turbidity tube" are described in Annex 10.

Aesthetic parameters

Aesthetic parameters are those detectable by the senses, namely turbidity, colour, taste, and odour. They are important in monitoring community water supplies because they may cause the water supply to be rejected and alternative (possibly poorer-quality) sources to be adopted, and they are simple and inexpensive to monitor qualitatively in the field.

Colour

Colour in drinking-water may be due to the presence of coloured organic matter, e.g. humic substances, metals such as iron and manganese, or highly coloured industrial wastes. Drinking-water should be colourless.

Water sampling and analysis

69 surveillance of community water supplies, it is useful simply to note the presence or absence of observable colour at the time of sampling. Changes in the colour of water and the appearance of new colours serve as indicators that further investigation is needed.

Taste and odour

Odours in water are caused mainly by the presence of organic substances. Some odours are indicative of increased biological activity, others may result from industrial pollution. Sanitary inspections should always include the investigation of possible or existing sources of odour, and attempts should always be made to correct an odour problem. Taste problems (which are sometimes grouped with odour problems) usually account for the largest single category of consumer complaints. Generally, the taste buds in the oral cavity detect the inorganic compounds of metals such as magnesium, calcium, sodium, copper, iron, and zinc. As water should be free of objectionable taste and odour, it should not be offensive to the majority of the consumers. If the sampling officer has reason to suspect the presence of harmful contaminants in the supply, it is advisable to avoid direct tasting and swallowing of the water. Under these circumstances, a sample should be taken for investigation to a central laboratory.

Selected Inorganic Solutes

By Jennifer A. Coston (U.S. Geological Survey), Robert H. Abrams (Stanford University), *and* Douglas B. Kent (U.S. Geological Survey). Selected inorganic-solutes concentrations were determined for water samples from the MLS and the MMR sewage-treatment-plant effluent by the USGS, WRD, National Research Program laboratory in Menlo 20 Water-Quality Data and Methods of Analysis for Samples of Sewage-Contaminated Water, Ashumet Valley, Mass., 1993-94 Park, Calif. (table 1). Inorganic solutes analyzed include aluminum, boron, calcium, copper, iron, lead, manganese, magnesium, phosphorus, potassium, sodium, silicon, and zinc. The results of analyses described in this section are shown in tables 29 and 33. Results for chromium, lead, and nickel are not presented in table 29 because their concentrations were less than the method detection limits described below. Samples were filtered in-line (0.45-µm Millex filter; see Effects of Pumping Rate and Filtration on Measured Concentrations of Inorganic Solutes, p. 11) during collection, acidified with 6N hydrochloric acid (trace metal grade) to pH 2, and chilled within minutes. Samples were shipped to Menlo Park, Calif., and analyzed within 3 months of collection. Inorganic solutes were analyzed by inductively atomic absorption spectroscopy (AAS). Element lines were standardized on the instrument (Thermo-Jarrell Ash Model 61) with the two-point uncalibrated method recommended by the manufacturer. Multi-element standards were matrix matched to the samples to minimize viscosity effects during analysis. All standards discussed here were mixed from certified ICPAES 1,000 mg/L stock standards and acidified, double-deionized water.

A quality-control standard was run at the beginning of each MLS set (every 10 to 16 samples). The quality-control standard contained concentrations of calcium and magnesium similar to those in typical ground water from the sewage plume (10 and 5 mg/L, respectively); all other inorganic solutes had concentrations of 1 mg/L. When analysis of the quality-control standard gave a concentration outside the established concentration range (± 5 percent) for any of the three critical inorganic solutes (calcium, copper, or zinc), the instrument was re-standardized. A consistency standard (CS) having concentrations of selected solutes similar to those in sewage-contaminated ground water near the sewage-infiltration beds was prepared using double-deionized water. Inorganic-solutes concentrations were lower and phosphorus concentrations were higher in the CS than in the quality-control standard. The method detection limits (MDL) and statistical summary for the inorganic solutes measured in the consistency standard are reported in table 4 and were estimated from repeated measurements of solutions spiked with low concentrations of the inorganic solutes of interest. Thus, the MDL are instrument and solution-matrix dependent and represent the minimum quantifiable concentrations of the inorganic solutes. The relative accuracy is within 5 percent for all the inorganic solutes except iron and magnesium, although the precision of all the analyses degrades when concentrations approach the MDL. Measured concentrations of inorganic solutes in the CS are shown in table 4. Results for aluminum, chromium, and nickel are not presented in table 4 because they were not added to the CS. The CS was analyzed in the middle of the set of samples from a particular MLS.

Table 3. Method detection limits for inorganic solutes and statistical summary of measured inorganic-solutes concentrations in the consistency standard

Element	Method detectionlimit (mg/L)	Average measured concen-tration (mg/L)	Percent relative standard deviation	Percentrelative accuracy
Calcium	.010	20.0	9.0	102
Chromium	.010	-	-	-
Copper	.006	.061	12	104
Aluminum	0.05	-	-	-
Iron	.008	.051	15	106
Lead	.08	.10	22	103
Magnesium	.04	3.63	8.2	109
Manganese	.01	.051	9.8	103
Nickel	.03	-	-	-
Phosphorus	.1	5.2	9.1	103
Potassium	.40	9.7	15	99.6
Silicon	.1	2.82	8.6	102
Sodium	.1	52	8.6	105
Zinc	.016	.061	9.7	104
Boron	.003	0.37	11	102

[Total number of replicate analyses performed, 36. Percent relative standard deviation: (2 × (standard deviation)/average element concentration in sample) × 100. Percent relative accuracy: (measured concentration / known concentration) × 100. mg/L, milligram per liter; --, not included in consistency standard]

CS names in table 5 refer to the MLS sample set with which the CS analysis is associated. At MLS SDW 318 M01, three different filtering procedures were compared. In addition to the normal protocol, sets of unfiltered ("ra" for raw acidified) and filtered samples, where a new filter was used for each sample ("nf" for new filter), were collected.

RESULTS AND DISCUSSION

Water contamination is now a major problem in the global context as a consequence of industrialization, globalization, population growth, urbanization and warfare combined with increased wealth and more extravagant lifestyles USEPA, (1976). The ground water samples collected were analysed for the above said parameters and the results are tabulated in Table 3, 4 and 5 respectively.

Total Solids (TS)

All natural waters contain dissolved and suspended inorganic and organic substances. The major dissolved solids are sodium, potassium, calcium, magnesium, chloride, sulphate, carbonate, bicarbonate and silica. The maximum and minimum values of Total solids are 6560 mg/l and 2870 mg/l in Ariyamangalam and Thuvakudi respectively.

Total Dissolved and Suspended Solids (TDS) and (TSS)

These solids on the other hand include anything from silt and plankton to industrial wastes and sewage which pollute the groundwater through seepage. The maximum and minimum values of Total Dissolved solids are 4995 mg/l and 2250 mg/l in Ariyamangalam and Thuvakudi and the maximum and minimum values of Total Suspended solids are 2775 mg/l and 600 mg/l in Kattur and Thuvakudi respectively.

Total Hardness

Water hardness is the state or quality of being hard caused by various dissolved salts of calcium, magnesium or iron. Water hardness can cause other problems in the home such as increased soap consumption by preventing soap and detergents from lathering by giving rise to an insoluble curdy precipitation.

The maximum and minimum values of Total hardness, calcium and magnesium hardness in the sampling stations are 1955 mg/l and 860 mg/l, 1099 mg/l and 585 mg/l and 990 mg/l and 183 mg/l in Kattur and Thuvakudi respectively. The Bureau of Indian Standards has proposed the total hardness reading should be 600 mg/l (considered to be excellent). The high level value in hardness is mainly due to pollutions that are considered by non-point sources such as washing and bathing.

Nitrate

Nitrate is highly soluble in water and is stable over a wide range of environmental conditions. It is easily transported in streams and groundwater. The maximum value of Nitrate 25.8 mg/l was recorded in Ariyamangalam and Kattur and minimum value of 8.6mg/l in Thuvakudi. It is evident from the tables that the nitrate levels in the sampling sites are below the desired levels of BIS and WHO. Hence water can be used for domestic purposes.

Dissolved Oxygen (DO)

The amount of groundwater entering a river or stream can influence oxygen levels. Groundwater usually has low concentrations of DO and it is often colder than stream water. But the groundwater later improves the ability of the water to hold oxygen. The maximum and minimum values of DO in the sampling stations are 3.89 mg/l and 2.1 mg/l, in Ariyamangalam. From the result it is evident that DO levels for all the sampling sites are within the safe limit.

Chloride

It is a one of the major anions found in the water and are generally combined with calcium, magnesium or sodium. The suggested maximum contaminant level for chloride in drinking water is 250 mg/l. Since all the chloride salts are highly soluble in water, its concentration ranges from 10 – 100 mg/l. The maximum and minimum values of chloride in the sampling stations are 360 mg/l and 225.6 mg/l, in Kattur and Thuvakudi respectively. The high level of chloride concentration may be due any of the following reasons like a) rocks containing chlorides, b) agricultural runoff and c) wastewater from industries.

Elements analyzed

Table 4. Elements analyzed of drinking water sample

Element name	Chemical formula	Concentration% mg/L
calcium	Ca	54
magnesium	Mg	52.0
ferric	Fe	84.36
zinc	Zn	2.712
manganese	Mn	1.966
chromium	Cr	2.23
copper	Cu	22.592
Phosphorus	P	0.24
Sodium	Na	55
Boron	B	12.3
Potassium	K	17.5
cadmium	Cd	1.250
ECDS/m	-	0.306

Conclusion

As population multiply and nations become more industrialized, water is being used more heavily than ever. The rapid paces of urbanization, industrialization as well as agricultural activities have made environmental pollution a growing concern globally. In the present investigation the surface water quality in Alshohada area have been studied over a period of five months from August 2016 to januaryb2017. The results reveal that the values of TS, TDS, TSS, Total hardness, calcium and magnesium hardness are very higher than the prescribed limit. The results of these investigation tools for those involved in water resources planning and management. Evaluating drinking water resources in developed areas, prudent management of water resources and protection of its quality are current groundwater problems. Thus, prediction of the capacity of the drinking water resources for long – term pumpage, the effects of that pumpage and evaluation of water quality conditions are among the principal aims of modern – day hydrologic practice in achieving proper management of drinking water. These decisions will be more judicious and reliable if they are based upon knowledge of the principles of drinking water occurrence. The water-quality data contained in this report will be useful to residents and officials concerned about future drinking water supplies and the discharge of contaminated ground water to ecologically sensitive streams, ponds, and coastal environments in and near the Ashumet Valley. The comprehensive data set also will aid researchers in understanding the fate and transport of contaminants in ground water. The water-quality data include analyses of physical properties, major ions, nutrients, metals, dissolved gases, organic compounds, other sewage-related constituents, such as boron and MBAS, and bacterial size and abundance. These data show that the plume of contaminated ground water extends more than 18,000 ft down gradient from the sources on the MMR. All the results show that the drinking water of Alshohada area in Omdurman city – Sudan is very contaminant because it has very high of chemicals contaminant and unfit for human use.

Recommendation

The researcher strong recommended to continue study to determine the other organic and biological contaminants for alshohada drinking water. And this water must developing the methods purification to maintain human health.

REFERENCES

Abdulraheem, M. Y. 1989. Health considerations in using treated industrial and municipal effluents for irrigation. Desalination, 72(1–2), 81–113.

Anderson, B. A., Romani, J. H., Phillips, H. E. and van Zyl, J. A. 2002. Environment, access to health care, and other factors affecting infant and child survival among the African and Coloured populations of South Africa, 1989–94. *Population and Environment,* 23, 349–364.

APHA – (American Public Health Association) 1998. Standard Methods for the Examination of Water and Wastewater. American Water Works Association and Water Environment Federation. 20th Edition. APHA. Washington DC, USA.

Archived from the original on April 23, 2006.

Baker, Richard W., 2004. *Membrane Technology and Applications,* John Wiley, New York.

Bolto, B. A. and Pawlowski, L., 1987. Wastewater Treatment by Ion Exchange, Spon, London.

Chamie J. 2004. Statement to the commission on population and development (Thirty-seventh session. Population Division, Department of Economic and Social Affairs. United Nations

Coffey, R., Cummins, E., Cormican, M., Flaherty, V. and Kelly, S. 2007. Microbial exposure assessment of water borne pathogens. Human and Ecological Risk Assessment, 13(6), 1313–1351.

DEAT - (Department of Environmental Affairs and Tourism) (2005. Inland water – factors affecting availability and water quality.

Evans, A. E. V., Hanjra, M. A., Jiang, Y., Qadir, M. and Drechsel, P. 2012. Water pollution in Asia: The urgent need for prevention and monitoring. Canberra, Australia: Global Water Forum (GWF).

Economic Assess in an urbanizing world Drechsel . P. : Qadir . M. :Wichelns . D. Eds.) 2015 , XII, 282p. 45 illus., 1o illus. in color ., Hardcover ISBN: 978 – 94 – 017 – 9544-9

Fewtrell, L., Kaufmann, R. B., Kay, D., Enanoria, W., Haller, L. and Colford, J. M., Jr. 2005. Water, sanitation, and hygiene interventions to reduce diarrhoea in less developed countries: A systematic review and meta-analysis. The Lancet Infectious Diseases, 5, 42–52.

Glanze, W. D. 1996. Mosby medical encyclopedia (Rev. ed.. St. Louis, MO: C.V. Mosby.

Goncharuk, V. V., Kucheruk, D. D., Kochkodan, V. M. and Badekha, V. P. 2002. Removal of organic substances from aqueous solutions by reagent enhanced reverse osmosis. Desalination, 143, 45–51.

Gleick P.H. 2006. The world's water 2006-2007. Island Press. Washington DC, USA.

Chmiel, H., M. Kaschek, C. Blöcher, M. Noronha and V. Mavrov, Concepts for the treatment of spent process water in the food and beverage industries, Desalination, 152 (2002) 307

Joseph, S. and McGinley, M. 2008. Population. Washington DC: Environmental Information Coalition, National Council for Science and the Environment.

Johnson N., Revenga C. and Echeverria J. 2001. Managing Water for People and Nature. Science 292:1071-1072.

Jump up to: [a] [b] West, Larry (2006-03-26. "World Water Day: A Billion People Worldwide Lack Safe Drinking Water". About.com.

Pink, Daniel H. April 19, 2006. "Investing in Tomorrow's Liquid Gold". Yahoo. Archived from the original on April 23, 2006.

West, Larry (2006-03-26. "World Water Day: A Billion People Worldwide Lack Safe Drinking Water". About.com.

An overview of diarrhea, symptoms, diagnosis and the costs of morbidity (PDF). CHNRI. 2010. Archived from the original (PDF) on May 12, 2013.

China says water pollution so severe that cities could lack safe supplies. Chinadaily.com.cn. June 7, 2005.

Wachman, Richard, 2007-12-09. "Water becomes the new oil as world runs dry". The Guardian. London. Retrieved 2015-09-23.

United States Geological Survey (USGS), Denver, CO (1998. "Ground Water and Surface Water: A Single Resource." Circular 1139.

United States. Clean Water Act, section 502(14), 33 U.S.C. § 1362 (14).

U.S. CWA section 402(p), 33 U.S.C. § 1342(p)

Moss, Brian, 2008. "Water Pollution by Agriculture" (PDF. Phil. Trans. Royal Society B. 363: 659–666. doi:10.1098/rstb.2007.2176.

EPA. "Protecting Water Quality from Agricultural Runoff." Fact Sheet No. EPA-841-F-05-001. March 2005.

Michael Hogan, C. 2010. "Water pollution.". Encyclopedia of Earth. Topic ed. Mark McGinley; ed. in chief C. Cleveland. National Council on Science and the Environment, Washington, DC.

USGS. Reston, VA. "A Primer on Water Quality." FS-027-01. March 2001.

Newton, David, 2008. Chemistry of the Environment. Checkmark Books. ISBN 0-8160-7747-9.

Karr, James R. 1981. "Assessment of biotic integrity using fish communities". Fisheries. 6: 21–27. doi:10.1577/1548-8446(1981)006<0021:AOBIUF>2.0.CO;2. ISSN 1548-8446

Tennessee Department of Environment and Conservation. Nashville, "Tennessee Erosion and Sediment Control Handbook.TN (2012)."

Concrete Washout (Report. Stormwater Best Management Practice. EPA. February 2012. EPA 833-F-11-006.

Pink, D. H. 2006. Investing in tomorrow's liquid gold. Yahoo. Ttp// finance.yahoo.com /columnist /article/trenddesk/3748

Patterson, J. W., 1985. Industrial Wastewater Treatment Technology, Butterworths, Boston.

Postel S.L. 2000. Entering an era of water scarcity: the challenges ahead. Ecological Applications 10: 941-948.

Rapport D.J. 1999. Biodiversity and saving the earth. Environmental Monitoring and Assessment 49: 169-175.

Rapport D.J., Gaudet C. and Calow P. 1995. Evaluating and monitoring the health of large ecosystems. Springer-Verlag, Berlin, Heidelberg. New York, USA.

Ross, J. A., Rich, M., Molzen, J. and Pensak, M. 1988. Family planning and child survival in one hundred developing countries. New York: Center for Population and Family Health, Columbia University.

Rao, S. R. and Finch, J. A., 1989. A review of water re-use in flotation, *Minerals Eng.,* 2, 65-85. 2

Sharma, V. K. 2005. Iron (VI) and iron (V) as oxidants and disinfectants in water treatment. In Disinfection 2005 Sharing disinfection technologies: Water, wastewater, and biosolids, WEF disinfection spec. conference. Alexandria, VA: Water Environment Federation.

Sharma, J. K., Kaushik, C. P. and Kaushik, N. 2005. Low cost adsorbents in decolorization of effluents from dying of cotton fabric with congo red and chryosophenine-G. *Indian Journal of Environmental Protection,* 25(1), 61–65.

USEPA – (United States Environmental Protection Agency) (1976. Quality Criteria for Water. USEPA, Washington, DC, USA. Federal Regist. 14:79318-79379. November 28.

Vidyasagar, D. 2007. Global minute: Water and health—Walking for water and water wars. *Journal of Perinatology,* 27, 56–58.

Volesky, B. 1994. Advances in biosorption of metals: Selection of biomass types. FEMS Microbiology Reviews, 14, 291–302.

Volesky, B. and Holan, Z. R. 1995. Biosorption of heavy metals. Biotechnology Progress, 11, 235–250.

Water Environment Federation, 2001. Standards methods for the examination of water and wastewater (20th ed.. Washington, DC: American Public Health Association.

West, L. 2006. World water day: A billion people worldwide lack safe drinking water. http://environment.about.Com/od/environmentalevents/a/waterdayqa.htm.

Metcalf & Eddy. 1981. Wastewater engineering: Collection and pumping of wastewater. New York: McGraw Hill, Inc.

VegaM., Pardo R., Barrado E. and Debán L. 1998. Assessment of seasonal and polluting effects on the quality of river water by exploratory data analysis. *Water Research*, 32: 3581-3592.

Young R.G., Matthaei C.D. and Townsend C.R. 2008. Organic matter breakdown and ecosystem metabolism: functional indicators for assessing river ecosystem health. *Journal of North American Benthological Society*, 27:605–625. ^

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