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CHEMICAL QUALITY OF DRINKING WATER, LESSER AND SUBHIMALAYAS MUZAFFARABAD REGION AZAD KASHMIR

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Key words: contamination chemical elements, waste, hazardous chemical elements, chronic diseases

Abstract: The shortage of drinking water in the cities and villages of lesser and Sub- Himalayas of Azad Kashmir is a big problem. The water is contaminated through various sources like rock leaching, soils, rock mining, addition of chemicals for purification of supply and distribution systems, and waste disposal in rivers without treatment. Domestic waste opened in river water, landslides, major and minor chemical elements, leaching from rocks during the rainy season. All those contaminate drinking water.

This research study was under- taken to evaluate drinking water and safe supply to inhabitants of the area. The water samples were collected from all sources and tested using standard methods. The major and minor chemical elements and trace hazardous elements to health were determined. The blood data was collected from CMH Hospital Muzaffarabad. The major, minor and trace chemical elements [Pb CU, Zn Fe, F, Cd, Cr, Cn, Hg, Ca, Mg, Cl, Na, K, CO3, CO2, NO2, NO3, SO4, PH] were determined, because presence of chronic diseases were found in many people. The turbidity, hardness and TDS from three types of sources were evaluated.

The atomic absorption was used for evaluating hazardous elements. The contamination increases through organic and inorganic sources. 60 00 0 to 80000 liters contaminated water / day coming through gutter lines. 30%-40% , from soils, mining of rocks and soils and disposal of wastes in rivers, and in streams. The water is also contaminated through treatment of chemicals like alum potash in treatment plants. The use of potash increased the total aluminum concentration in water from 0.35 to 0.39 u mol/ l. The filtered water examined contains 2.5 to 2 u mol/l. It was found that 13 to 18 % cannot be retained during treatment of water. The remaining product is distributed throughout the system. The remaining alum makes complexes with H2SO4. The PH increases. The increased amount was 9 to 9.9. The TDS increases about 219-250%. Remaining elements like Ca, Mg, Na Cl, CO3 , and K are complexed with Al. The results obtained indicate that sanitary disposal in river water, waste disposal from hospitals and disposed off untreated chemically contaminated material dropped in river is responsible for contamination of drinking water.

INTRODUCTION

Recently a survey for drinking water by the research students in Muzaffarabad region was conducted . Because many people were found disabled or they were caught in neurological problems. About 5% of people were mentally discarded in the city area. About 6-7 %. In Neelum Valley, Chatter, Ghari-dupatta, Seridara, Dauo khan Satt-payalli, and Leepa valley were reported disabled. About 15% were not mindely satisfied. Visits to hospitals and collection of data was 3 fold as compared to city and villages data. Increase in Pb, Cu, Zn Na, Ca, Mg, Co3, Al, and change in PH concentrations of new complexed products were 42-50 u mol/l in water. It was noted during examination that water quality varies and supply problems may arise due to increased turbidity 10-20% . Intestine, lung infections, Neuro problems were reported. The distribution system was affected by deposition of coagulated products on walls of the pipe lines. Complexes Al Mg, Na, K, Co3, So4 and No3 change the water quality. Supply problems become three fold. Increased concentrations of new products in treated water contribute to health problems. Blood samples tested show high intake of Pb , K, Cu, Na ,Mg and Al with neurological disorder and neurological diseases . It was also noted in some patients that they exhibit bone mineralization [CMH hospital Muzaffarabad 1996-2022]. National and international standards have been established by [WHO] as guidelines for drinking water. The Government of Pakistan has concentrated less on health and water purification, but few organizations like Bahria Town installed filter plants for people. The estimated intake of Pb, CU, Zn and Al in water, along with Na, K, Ca, are more than 78 mg/l. As a result, concentration of chemicals in drinking water needs further investigation, to provide quality water to the peoples of Muzaffarabad region.

The elements , [Pb, Ca , Mg, Na, Al, K SO4, NO3, NO2 and CL Table-2,3,4]] as solutions are approximately > 5 mg/l in treatment plant, springs and river water. The examination and observations indicate at this concentration stage, most of the Pb and Ca, M g, K, SO4, Cl2, CO3 are present as complexes . When the PbSO4 solution is mixed with raw water for treatment, the Pb is transformed into various ways . The ways depend on solution conditions , and the concentrations of Pb , mixed in the treatment plant. The temperature of water , concentration degree, other dissolved materials in water like Ca, Mg, K, CO3, NO were present. Ca, Mg, K, CO3 make hydrolysis products like Ca[OH]2, H -CO3, [KOH]. High concentration of complexes and low PH [carbohydrate or sulfate], reactions with Na and carbonates are very rapid.

ADDITION OF HAZARDOUS CHEMICALS IN WATER AND TREATMENT IN STUDY AREA

A comprehensive study was planned on treatment plant, the streams and river water for determination of Pb Cu, Zn, Mn , Cd, Hg,, As, Cr, F, Cl , CO3, SO4, NO3 and concentrate in solution which complexed with SO4, CO3, NO3. When these complexes are added in treatment water tanks, springs or in treatment plants, the concentration of dissolved material becomes high In water solution, and immediately makes hydrolysis products. High concentrations and low PH, and F, complexes rapidly occur [Baker, J. P., and Schofield, C. L., 1982, Barnes, B. R., 1975, Brown , D. W., and Hem, J, D., 1975].

Hydrolysis products are reactants in the formation of precipitates [Barnes, B.R., 1975]. This interaction may be adsorption, or additional hydrolysis and precipitate formed [Baker, J. P., and Schofield, C. L.1982] The formation of hydroxyl solid phase in the water and deposition of this material on the surface was considered because it was important. The PH depend on solubility of products formed during hydrolysis. The complex products frequently used to estimate the deposition of residues [Brown, D.W.,d Hem, J.D., 1975]. At high PH solubility of elements increases. The hydro oxides are more soluble as compared to single element. To reduce Pb, and products of Na, K, Ca, Co3 H2SO4, Al2SO4 was added to reduce PH. The treatment of water containing high concentration of complex products of Ca, Pb , K , F, SO4, Can not be removed by filtration. It was examined during study that residues create problems in supply system . Some organic material form soluble complexes were also noted. . The temperature play an important role in altering rate of reaction. At low temperature the speed of colloids and transportation become slower [Barnes, B. R., 1975]. Causing the reduction in the rate of hydrolysis products i.e , the precipitates. If there are

loose or free precipitates present as ionic colloidal then they can not easily be removed by filtration [WHO, 2022]. As a result, variation in temperature in every season affects filtration plants to a greater degree [Driscoll, C. T., 1984].

TABLE-1 : chemical analysis of spring water

Ca	Mg	K	CO3	HCO3	Cl2	SO4	NO3-
46	14.3	23	-	425.35	3.49	40.38	0.69
76	15	3		376	20	48	0.69
66	20	2.0		397	8	39	0.40
76	17	17		400	15	39	0.6

METHODS USED TO STUDY CHEMICAL ELEMENTS TREATED BY WATER SUPPLY AND SPRING WATER, STREAM WATER, TAP WATER, NALAS AND RIVER WATER"

1 The PH of water was studied by using a PH meter.

2 Atomic absorption and Spectrophotometer was used for testing water samples collected from treatment plant, springs, streams and river water to determine Pb, Ca, Mg, SO4, Fe, Na, K, Cl, NO2, NO3, Ni, F, I, Zn, Mn, Cu, CO3,

METHOD OF STUDY:

1. To determine the chemistry of the raw water and to evaluate the salt products a detailed study was carried out at Sources of supply of drinking water and at a treatment plant which was constructed at a distance of 1 km from the city of Muzaffarabad. The MWS to Muzaffarabad city and nearby areas where a supply scheme was launched and a very big water tank was constructed to store and supply . The supply system consists of a raw water pumping station on river Neelum and a raw water treatment plant and water pumping station at Neelum river. A raw water treatment plant and pumping station were located 1 km north of Muzaffarabad city at Makri. A 3 km long pipeline was used to transport the treated water. A 5000 L reservoir was located at the same place. The water was pumped and distributed to pipe lines. Presently the plant was under the health department. Alum potash was used to purify water during high turbidity [Baker, J. P., and Schofield, C. L., 1982]. The average chlorine about 25 mmol/l is maintained as free chlorine residual in plants. .PH caused by the consumption of CO2 minimizes residual alum in water for drinking use. It was observed that besides the indirect, direct filtration plays a better role. It was also suggested by Ahmed, K., 1991. It was noted during experiment that the treatment of water with other chemicals and associated products increase PH values. It was observed that residual material increases. To examine the treated water some other products were added to the water tank like KMNO4, C, H2SO4 [Baker, J. P., and Schofield, C. L., 1982]. These products control the taste and odor of water. The pumping station works 24 h. In the months of June to August [Table -1,2,3]. demand for water increases at least 6 to 7 thousand gal /day. About 150 samples were collected per week from the reservoir and pumping station to analyze the water. The samples were tested for PH, Pb, So4, Hg, ZN, F, CL, Cd, As ,Cr, NO3, Zn, Cu, K, Ca, Mg and Al, [Table-1,2,3]. After that the color, odor, turbidity, TDS, and hardness were measured in the field and laboratory. The temperature was measured because it changes elements to other chemical products which are a health hazard. The samples were preserved and transported to PCSIR for testing. The samples were immediately analyzed for [DIC] dissolved inorganic carbon, and [DOC]. Samples were also

tested for other water chemistry. ALSO4, SO4, ALF, ALOH were determined using Driscoll, [1984], a fractionation procedure. Contamination comes from septic tanks, waste disposal from city and hospitals, gutterlines opened in river water, mining rocks, crushers working for crushing material, for construction mining soils. A detailed description of equilibrium constant values was undertaken and numerical procedure was adopted [Back, W., R.N., Cherry, and B. B., Hanshaw, 1966]. Uncertainty analysis were used to evaluate the relationship between CO2 and Al. The aluminium hydroxide and solubility of potassium sulfate, saturation indices were calculated by using QP/KP LOG where QP = ion activity product . To evaluate the fate of Pb , CO2 , Cl, No3, Mg, Cu, and aluminum, element mass balance calculations were made for the water treatment plant at Muzaffarabad. The DOC [dissolved organic carbon] range 0-160 mg/l in Jan, and 155 mg/l in august was also noted. Overall it was between 150-250 mg/l. The saturation indices [SI] 0.2-4.4 mg/l. from Jan to august were found.

DISCUSSION

The addition of alum potash and other products for the water purification at treatment plant and the addition and presence of Pb cd, Ca, Mg, Hg, K, So4, Co3, ,As, Cr, No3, Cu, So4, Zn, made the water contaminated. These elements were detected because they cause blood diseases, Meta-hemoglobin, cyanosis, for the baby and also NO3 have a reaction with amines in the body forming nitroamine may be the cause of cancer [A medical report 1996, M.H, Rawalpindi]. The source of mentioned elements are the rocks through which the water comes, the soil, infill material through which the water is coming, in addition spring water, nalas, the tap water all coming from rocks and soils. The aluminium , copper iron and Zn pipes are also a cause. These elements contaminate water when water passes through the rocks and soils. The sources of Pb are soil and mining the rocks. It is also present in air and near petroleum products and vehicle stations constructed near drinking water. It was also detected from lead pipes. Average quantity of intake is 0.1-0.5 mg /day [WHO 2001-2022]. It was found in drinking water as a product of lead. The lead in the blood ranging from 0.1-0.2 mg/ l dehydrogenase enzymes. [JICA, 2022]. To protect Pb concentration in water plastic pipes be used for distribution of drinking water

The Zn concentration in drinking water was determined and detached. To minimize the chronic diseases spread in the area in the city of Muzaffarabad and surroundIng. It was taken as a serious matter . According to [WHO, 20022], it should be in drinking water < 5 mg/l. During experiment it was found that Zn comes from soil, atmosphere, food, and water coming from rocks. The amount of Zn in drinking water [Municipal Corporation 2022] should not .> 6 mg/l. The Cu concentration was undertaken to evaluate the quality of drinking water. The concentration was 3 mg/l whereas the recommended limit was < 1 mg /l. The source of CU in water was found through copper pipes, from the rocks and soils. The spring water contains about 5 mg /l. It was detected that Cu, Zn, and iron pipes are also a big source of contamination. The CU make CUSO4 in water and other ionic compounds. The main source of contamination was hospital and domestic wastes dropped in river Neelum near filter plant. The recommended amount of Cl in water is < 250 mg/l. The Cl present in water as NaCl IS daily used. Its use is not dangerous but excess of cl from NaCl can cause heart problems. Its source was food, rocks of salts which come in the way of river. The Ca and Mg were detected in drinking water. According to [WHO 2022] it should not > 3000 mg/ l. Laboratory tests showed 5000-6000 mg/l in river and spring water. The water from treatment plant contain average of >600mg/l. Hardness of water was due to ions of Ca and Mg, the Ca [OH]2 and Na2CO3. The addition of Ca [OH]2 and CaCO3 in filtration plant increase the hardness. The addition of Mg[OH]2 which are salts deposited at the bottom of sedimentation tank and can be removed through filter method. The treatment of chlorination, fluoridation, and alum addition acidify the raw water. PH and alkalinity both decrease. The addition of H2SO4, affects the PH increases due to coupling of alum and enriched SO4 concentration. Alkalinity and PH values decreased [7. 4- 7.3 in treated water] in the summer season [Driscoll, C. T., 1975]. The addition of fluorine in the months of June to July . Probably it was due to the

decrease in H2FiS6 [Baker, J. P., and Schofield , C. L., 1982]. . The decrease in H2FiS6 resulted in decrease in DOC in winter. The concentration of DOC was increased in summer again. During the winter season inorganic Al dominates in treated water. However, low PH values due to the addition of H2SO4 and increase in AL in summer resulted in higher concentration in inorganic Al, [Driscoll, C. T., 1984]. .

TABLE-2 SHOWING LOSS OF ALKALINITY DURING WATER TREATMENT DUE TO ADDITION OF CHEMICALS

Time period	cl	F	Al	H2SO4	ALKALINITY
1/2021-1/2022	42	75	51	192	140
5/2021-5/2022	46	52	65	195	356
5/2022-5/2023	43	50	54	70	230

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The chemical equilibrium has been calculated to know the changes in inorganic carbon constituents and other products of alum along with potash Pb, Zn, Cu , CO2, K, Ca, Mg, Cl, H2SO4, CO3, and H O and H as ionic concentrations. The acidity increase in water in the treatment plant due to the addition of H2SO4 causing the treated water to become in excess of one fold in magnitude oversaturated with respect to solubility of CO2. From equilibrium calculations it seems to increase in hydroxide complexes dominant in treated water. [Table-1, 2]. [AlOH]4 is the major constituent in treated water. The addition of F, made Al-F complexes increase in treated water. AlF2 , and AlF3 were significant components Al and F observed in concentration of F less than 5% total F, associated with Al as complex [TABLE-2].

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TABLE-3 CHEMICAL ANALYSIS OF RIVER WATER

Pb	CU	Ni	Zn	Mn
3	2	3	3.1	4
5	2	4	5	5
6	3	4	3	8

ANALYSIS:

The H2SO4, Pb, Cu, Zn, Al2SO4, k, Cl, H2SO4, and other chemicals and compounds added to the treatment plant are directly removed by direct filtration. The elevated concentration of residual compounds are evident immediately after treatment through the transmission system to the reservoir. The fractions of residual compounds play an important role in chemistry of treated water.

2. Results obtained indicate that in springs, in treated water in the tap and in lakes. The low concentration of complex compounds are mostly removed by direct filtration. Some of them are dissolved in water, some are as residues, and mostly deposited on the bottom of the treatment plant, the lakes and in springs. From the results and observations, the compound complexes at the plant were highly removeable at the reservoir. The most complexes are negative during study in nearby areas in water resources indicating under saturation with respect to solubility from source rocks. This study also concentrates the role of F, addition and role of Pb, , Zn, Cu, Ca, Mg, H2SO4 and CO3. At high F, PH becomes acidic. The disruption reduces alum and potash by elimination of Al-F. Residues increase DUE TO Variation in water temperature and other products like Pb Cu, Zn, CaCO3, H2SO4, Cl, [MgCO3]2, affect the purity of drinking water. Solubility increases with the addition of F. Low and high temperatures also affect PH and solubility of complex products. The alum products are soluble at low temperature at PH-7. At the PH 7.5 , the metal cations also converted to OH ions. The PH of minimum solubility decreases to 5.5 at more than 30c. At higher temperature decomplexation of Al-F and other complex products were noted. The complex products increase and decrease with change in temperature. This increase and decrease in temperature results in degassing of CO2 , increase in PH and change solubility in drinking water. [Barnes, R. B., 1975]. [table 1,2,3,4]

Table -4: Chemical analysis of river water

Ca	Mg	Na	K	HCO3	Cl2	SO4	NO3
42	14	55	1.2	336	13	44	0.65
43	15	55	1.2	336	13	44	0.40
44	14	20	1.4	226	15	46	0.85
46	15.5	17	2.3	215	13	40	0.25

CONCLUSIONS:

The water treatment at Makri plant drinking water was analyzed for Pb, Cu, Zn, Caco3, Mg,CL, F, CO3, CO2, AL, and their complexes. PH, increase and decrease in distribution system. For safe water distribution, river water, treatment plant water, spring water, tap water and lake water was analyzed. The complexes of Pb, Cu, Zn, CaCO3, H2SO4, Cl, Mg, F, CO3, CO2 at low and high temperature were studied. It was found that low and high temperatures affect the solubility of complex compounds and also affect PH of drinking water. The complex species of Pb, Cu, Zn, F, and Cl, in water showed various neurological and bone mineralization diseases in peoples of Muzaffarabad city. About 2-5% people have bone, 5% heart, 10% kidney, 3%, neurological problems were found, in addition throat, eyes, and stomach problems are common . [Data was collected from CMH, hospital Muzaffarabad].
The Pb in water should be 0.01 mg/l [WHO, 2001, 2022]. It comes from food , drinking water, atmospheric air and smoking. . concentration in blood 0.1-0.2 mg/l creates anemia, obstruction of functions in the digestive system, and nervous system. The CU should be <1 mg/l to create cirrhosis of the liver. The Zn, concentrated in skin, The skin diseases are common in the area. The Ca and Mg, in water increase hardness of water. Diarrhea was reported in many people. The presence of Cl in water should < 250 mg/l [WHO, 2022]. It comes from rocks bearing salt of Nacl, and addition of this salt to the food. Excess of it affects the heart and kidney.

So it was concluded that presence of such elements, and compound complexes are very harmful for inhabitants of the area of Muzaffarabad. This study is not sufficient and needs further research.

Concluding this research it was reported:

That the diseases burn by toxic elements, compounds and complexes were reported. Those who drink river water, stream water, and spring water, were investigated by eminent doctors having anemia, kidney, liver, pain in body, legs and arm problems. Cd was > 0.03mg/l. The Hg < 0.001mg/l is accepted . The excess of Hg in water where symptoms of inflammation, vomiting, agums, temper and shivering of fingers and mainly minamata was reported.
The Pb should be <0.01mg/l in water. The excess amount create vomiting, pain in abdomen, diarrhea decreasing blood pressure, and nervous system. The Cr be < 0.05mg/l. Access give rise to inflammation, ulcerative symptoms at the skin, liver trouble, hepatitis. Obstruction of respiratory system, liver. The Zn is not > 3 mg/l. The excess amount in water promote diseases like diarrhea stomach ache, shivering. The CU <2 mg/l, excess give high toxicity for algae, fungi and plants with seeds. The patient of Willson,s disease caused cirrhosis of liver. The Ca and Mg < 300 mg/l. cause of diarrhea, urinary calculi, hardness of water [JICA, No-2, 2001-2021].

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Note:

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Introduction

Line 4

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