Available Online at http://www.journalajst.com

ASIAN JOURNAL
ISSN: 0976-3376

ASIAN JOURNAL OF
SCIENCE AND TECHNOLOGY

Asian Journal of Science and Technology
Vol. 4, Issue 04, pp.017-021, April, 2013

RESEARCH ARTICLE

DETERMINATION OF HEAVY METALS FOUND IN DIFFERENT SIZES OF TUBE WELLS OF DISTRICT PISHIN BALOCHISTAN, PAKISTAN

***Afrasiab Khan Tareen, Imrana Niaz Sultan, Mohammad Waseem Khan and Dr. Ashraf Khan**

Department of Environmental Management and Policy, Department of Biotechnology and Bioinformatics Balochistan University of Information Technology, Engineering and Management Sciences, Quetta, Pakistan

Received 15th January, 2013; Received in Revised from; 25h February, 2013; Accepted 07th March, 2013; Published online 15th April, 2013

ABSTRACT

This study was designed to determine the quantities of heavy metals such as (Cobalt, Chromium, Sodium, Calcium and Iron) in water samples obtained from tube wells having different depths in district Pishin, Baluchistan, Pakistan. A total of 50 fresh water samples were collected and different parameters such as depth of tube well, location of tube well, age of tube well, pH, electrical conductivity, population burden and use of fertilizers in the vicinity of tube wells were correlated with the quantities of heavy metals. The study findings shows that age of tube well had no impact on quantities of studied heavy metals. It was found that depth of tube wells had significant impact on quantities of heavy metals, when compared with heavy metals such as Iron and Chromium the values were found to be higher in quantities in tube wells of lower depth and as the depth of tube wells increased the contents of theses metals decreased significantly. Chromium, Cobalt and Iron was found in higher concentration than standard recommended values. The presence of chromium may be attributed to the use of chemical fertilizers and pesticides in the vicinity of tube wells. In general it is concluded that the quantities of heavy metals such as Iron, Chromium and Cobalt were found in higher than recommended level which is an alarming indication for the drinking water for public use. pH and conductivity were found higher in shallow depths of tube wells.

Key words: Heavy metals, Conductivity, Fertilizers.

INTRODUCTION

Area description

District Pishin is located in the north west of Balochistan province of Pakistan near the border with Afghanistan. Surrounding areas of Pishin are Yaro, Saranan, Nowabad, Milkyar and Barshore. Pishin district lies between 30-04 to 31-17 north latitudes and 66-13 to 67-50 east longitudes. Its length from north to south is about 68 km and its width from east to west ranges from 8 to 38 km. A census was conducted in 2005 in district Pishin and it was estimated that the population of district Pishin is more than 600,000. Pishin is situated at an elevation of 1555 meters (5104 feet) above sea level. Pishin district is famous for its agriculture products, most notably fruit orchards including apples, grapes, some crops and vegetables. The artificial irrigation channels in the area, made by boring holes into rocks to bring water to the surface for agricultural use and human consumption. Karez and modern agricultural methods have done wonders in the area. The ground water resources of district Pishin mostly depends on tube wells, rivers and Karez system. The climate of this region is cold and dry, minimum temperature in winter reaches below freezing point while in summer it can reach as high as $40^{0.}$

Water and Heavy metals

Water (H_2O) is the elixir of life and it is necessary for the survival of all living things. Water makes up more than two thirds of the weight of the human body; Water is second to oxygen as being essential for life and without it we could die in few days. The human brain is made up of 95% water, where as blood and lungs contain 82% and 90% water respectively (Fine Water, 2006). Drinking water is an important aspect for people's health, that's why it must be satisfactory as well as ecstatically pleasant in exit from, but at the point of delivery to the user also. In order to ensure health care and to avoid health damage of the people, it is recommended to use only the approved water sources. In thousands of villages across the globe unsafe water from heavy metals contaminated is causing death and fetal diseases (Khan *et al.*, 2000).

Although the water from these tube wells is poisonous but the people have no choice other than to continue drinking the water from these tube wells and fall victim to diseases, including skin cancer and many other fatal diseases such as reduced growth and development, cancer, organ damage, nervous system damage, and in extreme cases, death. Exposure to some metals, such as mercury and lead, may also cause development of autoimmunity, in which a person's immune system attacks its own cells. This may lead to joint diseases such as rheumatoid arthritis, and diseases of the kidney, circulatory system and nervous system (Neville, 2001). The infants and younger population are more prone to the toxic effects of heavy metals, as the rapidly developing body systems in the fetus, infants and young children are far more sensitive (Johnson and Hallberg, 2005). Childhood exposure to some metals can result in learning difficulties,

***Corresponding author:** afrasiabkhan2004@hotmail.com

memory impairment, damage to the nervous system, and behavioral problems such as aggressiveness and hyperactivity (Rajendran *et al.,* 2003). At higher doses, heavy metals can cause irreversible brain damage. Children may receive higher doses of metals from food than adults, since they consume more food for their body weight than adults. The reason for this hydrological scourge is the presence of alarming levels of heavy metal arsenic in groundwater in several villages of the globe (Dogan *et al.,* 2005).

Rural poor communities in developing countries of the world use their own initiatives to acquire drinking water from either surface water sources (rivers, dams etc) or ground water sources such as tube wells, hand pumps etc. For surface water, water is fetched by the use of buckets. For the ground water sources, shallow holes are dug, in which water is fetched by the use of buckets tied to ropes. A hole drilled in the ground for the purpose of extracting ground water (Karavoltsos *et al.*, 2008). Water tube wells are those that penetrate into aquifers in which the water is not confined by an overlying impermeable layer. The level at which the soil is saturated is the water table. Pumping the well lowers the water table near it. These wells are particularly sensitive to seasonal changes and may dwindle during dry periods (Moody, 1996). Heavy metals in the form of arsenic and arsenical compounds are exceptionally toxic and harmful to human health. They are found in effluents and leaches from metallurgic industries, glassware and ceramic industries dye, pesticide and fertilizer manufacturing industries, petroleum refining and other chemical industries. Some part of the world arsenic occurs naturally in the soil from where it reaches to the ground water (Choudhury *et al.,* 2009).

Objectives

This study was aimed to achieve the following objectives.

- To assess the presence of Toxic heavy metals and metals (Antimony, Cobalt, Arsenic, Chromium, Sodium, Calcium, Lead, Aluminum, and Iron) in drinking water.
- To relate parameters such as (depth of tube well, location of tube well, age of tube well, pH, electrical conductivity, population burden and use of fertilizers) of water with heavy metals.

METERIALS AND METHODS

This study carried out for the determination of heavy metals in drinking water from tube wells of different depths, age of tube well, location, population burden, pH and conductivity of district Pishin, Balochistan, Pakistan. The purpose of this study was to evaluate the concentration of heavy metals in ground water from tube wells and to analyze if, parameters such as depth of tube well, location of tube well, age of tube well, sample pH, sample conductivity, population burden and use of fertilizers, pesticides and insecticides has an impact on presence of heavy metal contents and heavy metal concentration. The area selected for research study was district Pishin, district of province Balochistan, Pakistan.

Sample collection

Fifty (50) water samples from different tube wells of twelve (12) different villages of district pishin namely (Main Pishin city, Malakyar, Chaman Malakyar, Manzaki, Ismailzai, Bagarzai, Dab khanzai, mian Khanzai, Sir Khanzai, Killi Nawabad, Batazai and Tora Shah) were obtained. To avoid possibility of contamination the empty polythene bottles were used for the collection of water samples and were labeled accurately. Two samples were collected from each and every tube well in which one samples of 50 ml was mixed with 4 ml of HNO_3 (Nitric acid) for sample preservation (Michael, 1982 and APHA, *et al.,* 1992).

Sample analysis

The pH of all samples was measured by pH meter (JENWAY MODEL No.3520) and electric conductivity was measured with the help of conductive meter (JENWAY MODEL NO.470). The concentrations of heavy metals were analyzed in all the 50 samples of water using (SOLAAR AA SERIES S4 SYSTEM ATOMIC ABSORPTION SPECTROSCOPY (AAS) by Flame method with the help of nitrous oxide/Acetylene gases as described by (Michael, 1982).

RESULTS AND DISCUSSION

Water samples collected from different areas of district Pishin were analyzed for presence of heavy metal contents. The presence of heavy metals such as iron (Fe), sodium (Na), cobalt (Co),calcium (Ca) and chromium (Cr), were analyzed for their presence and compared with different parameters such depth of tube well, age of tube well, location of tube well, sample pH, sample conductivity, population burden, use of insecticides, pesticides and The aesthetic and physical parameters were determined which provided general information about water quality in qualitative terms and include water quality parameters like color, physical appearance, transparency, Electrical conductivity, odors, pH, taste and turbidity. The overall average pH of all the collected samples were 8.38 with the minimum and maximum values of 7.9 - 8.86 respectively. The average pH of all samples was 8.38. Most of the sampling areas were having the normal pH value except Nawabad having the average pH of 8.69. The electrical conductivity (EC) provides a rapid and convenient means for estimating the concentration of electrolytes and gives quick information about all minerals. The EC values of all the water samples were in the normal range of 50-500 uS/cm. The age of tube wells were also assessed with the presence of heavy metals in water. The average ages of all the tube wells were approximately 04 years. While the average depth of the wells were recorded as 157 meters (509 feet).

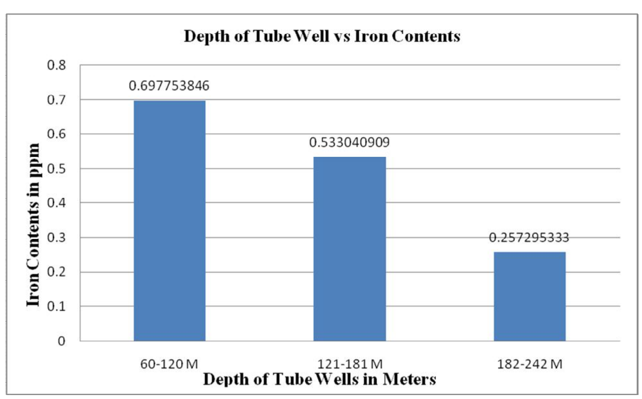

Figure 1. Depth of Tube Wells vs. Iron Contents

Iron Contents were compared with the depth of tube wells and it was found that on average in every sample iron contents were present and they were significantly above the recommended value. The Iron contents of collected samples ranged from 0.0022 mg/l to 4.1058 mg/l. Iron contents were found in higher amount in tube wells of lower depth and the value of iron contents was significantly lower in tube wells of higher depth. Iron mostly occurs in anaerobic underground water in the form of (ferrous) which is soluble and it becomes as an insoluble (ferric) when it comes in contact with air, presence of iron in water changes the characteristics of fresh water alters color of water as well as taste of water. It was also found that the average tube well size in these areas were below average (Of lower depth) in general than others.

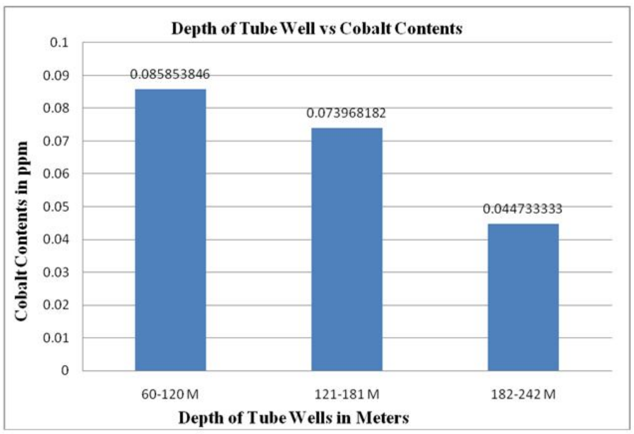

Figure 2. Depth of Tube Wells vs. Cobalt Contents

Cobalt contents were compared with the depth of the tube wells and it was found that in every sample cobalt contents were present and they were significantly above the recommended value. The cobalt contents of collected sample were ranged in 0.0414 mg/l to 0.104 mg/l. This study shows that the Cobalt contents had a significant change when compared with the depth of tube wells.

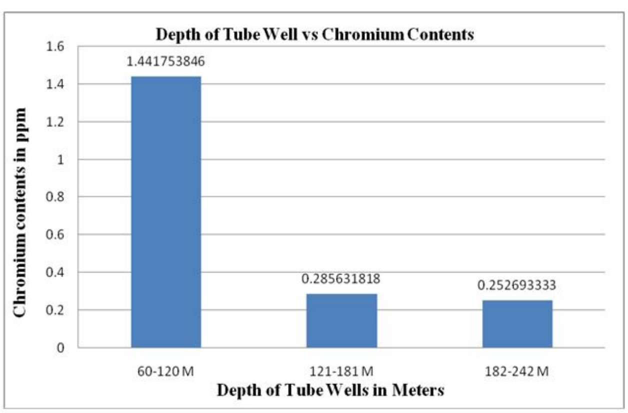

Figure 3. Depth of Tube Wells vs. Chromium Contents

The Chromium Contents were compared with the depth of the tube wells and it was found that on average in every sample chromium contents were present and they were significantly above the recommended value.

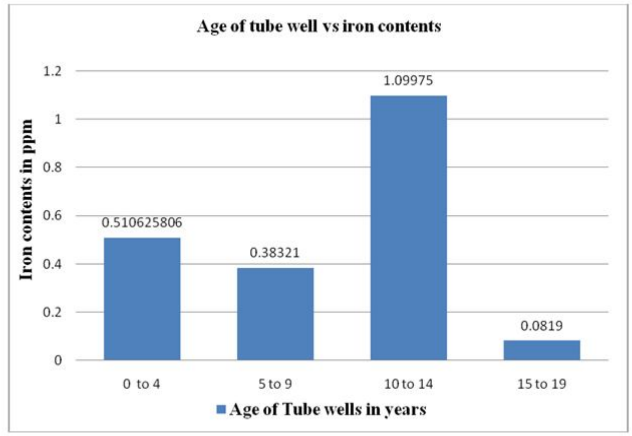

Figure 4. Age of Tube Wells vs. Iron Contents

The age of tube wells were studied and its impact was compared on iron contents. The graph shows that tube wells of long and short age have iron contents in mix proportion. Some tube wells of short age have higher iron contents while some tube wells of long age have higher iron contents vice versa. Literally it depicts true picture that age has no impact on proportion of iron contents.

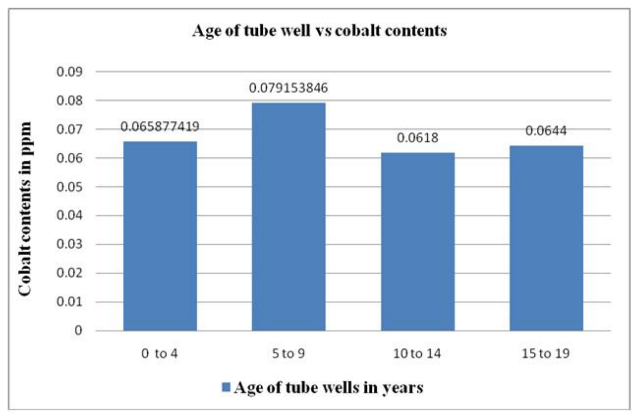

Figure 5. Age of Tube Wells vs. Cobalt contents

The age of tube wells were studied and its impact was compared on cobalt contents. It was seen that cobalt contents were in equal proportion regardless of tube well age.

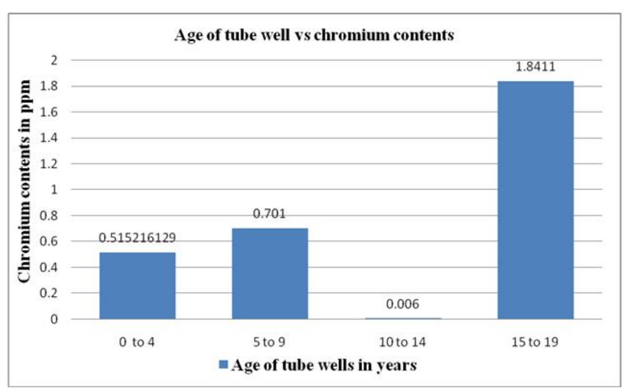

Figure 6. Age of Tube Wells vs. Chromium Contents

The age of tube wells were studied and its impact was compared on Chromium contents. The graph shows that tube wells of long and short age have chromium contents in mix proportion.

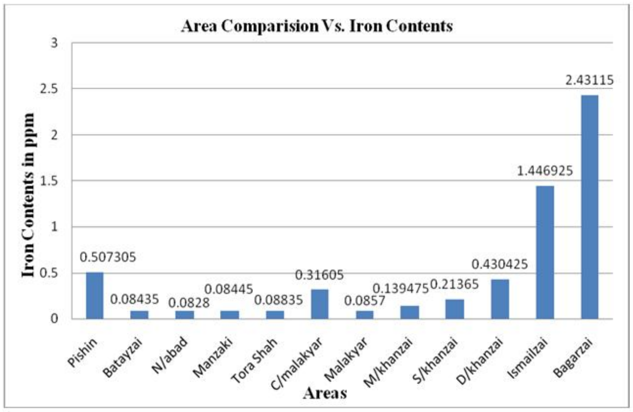

Figure 7. Area Comparison vs. Iron (Fe) Contents

When Iron contents were compared with studied areas, it was initiated that iron contents were found in every area water sample collected from tube wells. However in some areas including Ismailzai and Bagarzai the iron contents were found significantly higher than other studied areas. It was assumed that the increase in iron contents in those areas might be due to water turbidity and muddy soil in nature found in these areas.

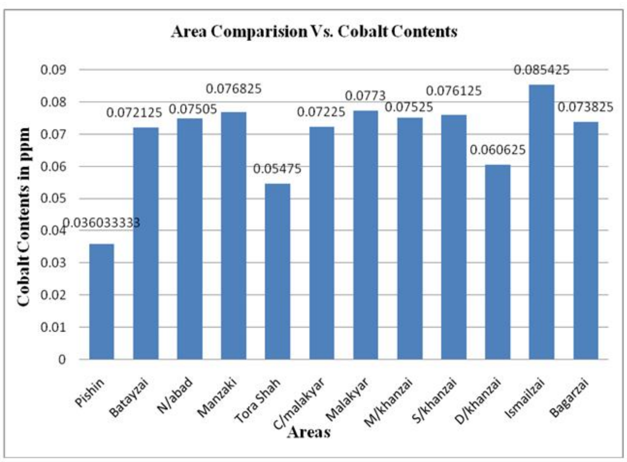

Figure 8. Area comparison vs. Cobalt (Co) contents

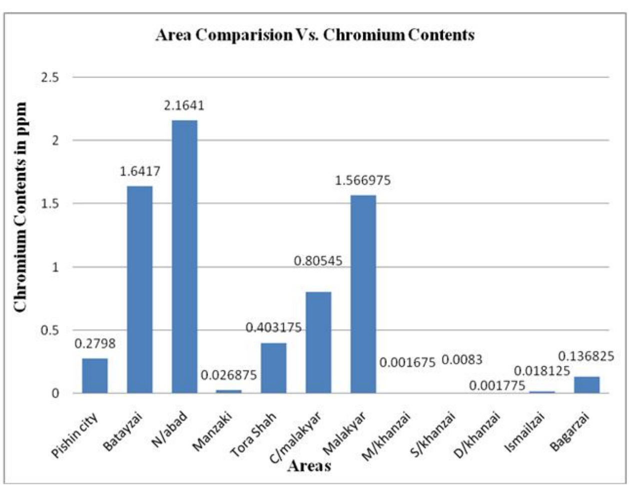

Figure 9. Area Comparison vs. Chromium (Cr) Contents

Cobalt contents were compared with different studied areas. It was found that cobalt contents were found in every area water sample collected from tube wells. Cobalt contents had almost equal amount in all studied areas and no significant change was found. It might be due to dust, soil erosion and Human activity. (Barceloux, 1999) also stated that sources of cobalt are both natural and anthropogenic, natural sources Include erosion (wind-blown continental dusts), weathering of rocks and soil, where as anthropogenic sources includes sludge or phosphate fertilizers in soil, the disposal of cobalt containing waste, and atmospheric deposition from activities such as the burning of fossil fuels.

Chromium contents were compared with different study areas. It was found that chromium contents were initiated in every area water sample collected from tube wells. However in some areas including Pishin city, Tora Shah, Chaman Malakyar, Malakyar, Batayzai, and Nawabad the chromium contents were found significantly higher than other studied areas . It was assumed that the increase in chromium contents in these areas might be due to presence of fruit orchards where different fertilizers, insecticides and pesticides are abundantly used in fruit orchards.

REFERENCES

APHA, AWWA and WEF, D.E (1992) Standard methods for the Examination of water and waste water. American public Health Association, American water work Association and Water Environmental Federation, 18th Edition, Washington, DC.

APEC, 2006. http://www.freedrinkingwater.com/water-education/ water-health.html (Last visited on 20 may 2011).

Barceloux, D.G. (1999). Cobalt. Clinical Toxicology, Vol. 37(2): pp.201–216.

Chandio, B.A. (1999). Groundwater pollution by nitrogenous Fertilizers: UNESCO case study, UNESCO report, Lahore, Pakistan.

Choudhury, R. Q., T.S. Shaikh, R Alam, R. Sen, J. Hasan, and I.A. Chowdhury, (2009). Effect of Arsenic Contaminated Irrigation Water on the Cultivation of Red Amaranth. American-Eurasian Journal of Scientific Research, Vol. 4 (1): pp.14-19.

Dogan, M., A. U. Dogan, C. Celebi, and Y.I. Baris, (2005). Indoor Built Environ, Vol.14 (6): pp.533-536.

Fine waters, 2006.http:// www.finewaterimports.com/water. imports/read/235. (last visited on 07/03/2011).

Hashmi, S. K. and S. Shahab, (1999). The Need of Water Quality Guide Lines for Pakistan. Proceeding: water resource Achievements and Issue in 20th Century and Challenges for Next Millennium.

Huda, M. K., (1995) "Ground water quality in deep aquifers of Bangladesh" Department of civil Engineering, BUET, Dhaka.

Johnson, D.B, K. B. Hallberg, (2005). Acid mine drainage remediation options: a review. Sci. Total Environ., Vol.338: pp. 3-14.

Karavoltsos, S., A. Sakellari, N. Mihopoulos, M. Dassenakis, and M. J. Scoullos, (2008). Desalination, Vol.224 (1-3): pp.317-329.

Khan, B.A., N. Abdullah and M.A. Tahir, (2000). Drinking water quality and standardization in Pakistan. Proceedings of the national workshop on quality of

Drinking water, organized by PCRWR and chemical society of Pakistan, Islamabad.

Matthew, S. (2001) Waste lands the threat of toxic fertilizer.Toxics Policy Advocate CALPIRG Charitable Trust the State PIRGs. pp.5-14.

Micheal, J. S., (1982) Physical, chemical and radiological Examination, Vol. 2(170): pp.202-210.

Moody,D.W., (1996). Sources and Extent of Ground Water Contamination. North Carolina Cooperative Extension Service No.AG-441: pp. 1.

Neville, A. (2001). Effect of Cement Paste on Drinking Water, Materials and structures, Vol. 34: pp. 367-372.

Rajendran P., J. Muthukrishnan, P. Gunasekaran, (2003). Microbes in heavy metal remediation. Indian J. Exp. Biol., Vol. 41(9): pp.935-944.

Sial, J.K. and S. Mehmood, (1999) water pollution from agriculture and Industry proceedings: water resources achievements and issues in 20th century and Challenges for Millennium. Pakistan Council of Research in Water Resources, Islamabad, Pakistan.

****