ASSESSMENT OF UNDERGROUND WATER QUALITY PARAMETERS OF AN ABANDONED ABATTOIR

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ABSTRACT
The problem of getting quality water for domestic purposes is increasing as untreated effluents are discharged on ground surface and percolate into underground water. The impact of effluent from Mokwa abattoir in Mokwa, Niger State on the physical and chemical parameters of groundwater qualities was investigated. Samples were collected at different periods of time of the day and analysed using the AOAC analytical method. The assessment of ground water parameters shows that electrical conductivity was 120, 450 and 450 µs/cm; total dissolved solids were 110, 225, and 225mg/l; temperature was 27.2, 29.4 and 29.5 °C; suspended solids were 0, 3.0 and 0mg/l; turbidity was 0, 1.0 and 0 FTU; colour was 0, 0 and 0Pt.Co; pH was 7.2, 6.9, and 7.1; iron content (mg/L) nitrogen (mg/L), 33.44, 29.48 and 33.0; respectively; total hardness was 62, 40 and 48 mg/l; hardness as $CaCO_3$ was , 24.8, 16 and 19.2; hardness as $MgCO_3$ was 37.2, 24 and 28.8; total alkalinity was 12.4, 8.0 and 6.4 mg/l and phosphate as phosphorus was 0.06, 0.01 and 0.025 mg/l were analysed and World Health Organisation standards were used as standard for comparison of these parameters . Some of the tested parameters were within WHO recommendations while some were not.

Keywords: Abattoir, blood, horn, slaughter, water

INTRODUCTION

The problems associated with sewage disposal have become a major problem of the urban world due to increase in human population and urbanization. The commonality of sewage related problems throughout coastal areas of the world is significant since these areas are inhabited by over 60% of the human population. Consequently, domestic wastewater discharges are considered one of the most significant threats of the coastal environments worldwide (Danulat *et al.*, 2002). Environmental effects associated with domestic wastewater discharges are generally local with trans-boundary implications in some areas. Coastal waters are facing a variety of pressure affecting both the ecosystem and human health through sewage wastewater discharge and disposal practices that may lead to introduction of high nutrient loads, hazardous chemicals and pathogens causing diseases (Sangodoyin and Agbewhe, 1992). The adverse public health, environmental, socio-economic, food quality and security, and aesthetic impacts from sewage contamination in coastal areas are well documented. Pollution of the coastal water usually interferes with various water uses. Cultured bivalves are generally reared in areas that are often densely populated and are sensitive to heavy pollution from human activities. Pathogens transmitted by human faeces are most commonly involved and the discharge of sewage polluted by human and animal pathogens into the sea represents the main source of bacterial pollution. Every pathogen present in seawater may be trapped and concentrated in the tissues of the bivalves and so represents a potential health hazard (**Hughes and Thompson,** 2003).

However, the rapid growth of the abattoir industry has resulted in serious environmental problems, especially from those staying about 500 m radius of the area. Hence there is evidence to suggest that these units extract considerable quantity of ground water from the peripheral areas and discharge the effluent without adequate treatment. The discharge of effluents has caused severe pollution of both the surface and ground water in the region and has also contaminated agricultural land (Sangodoyin and Agbewhe, 1992). The disposal of untreated wastewater from abattoirs is known to affect the quality of surface water, groundwater and the soil not only in Mokwa but in downstream areas of the surrounding communities (Erin *et al*; 2001).

Groundwater contamination is the result of polluted water infiltrating through the soil and rock and eventually reaching the groundwater. This process might take many years and at a distance from where the well is located. Once the groundwater is contaminated, it is very difficult to remediate. Underground water quality in Mokwa basin varies with some factors such as influx of industrial effluent, influx of water through rainfall, soil and agricultural pattern. Thus, underground water quality can be varied qualitatively and quantitatively. It is useful to examine the above highlighted problems in an environmental economic framework in which the quantity and quality of water resources are a major concern (Geetha *et al.*, 2008).

In all countries, some form of on-the-spot slaughter either in the open or on the farm is inevitable. While the killing of animals results in significant meat supplies, a good source of protein and useful by-products such as leather, skin and bones, meat processing activities sometimes result in environmental pollution (Sangodoyin and Agbewhe, 1992). Areas of interest in this regard include the possibility of wastes from abattoirs interacting with underground water. The concern for increases in the level of pollutants in groundwater is justified since a large proportion of rural, and recently urban, dwellers in Nigeria obtain domestic water, and sometimes drinking water, from ponds, streams and shallow wells. Slaughter activities, if not properly controlled, may also pose dangers to the farmers and butchers as well as the consumers. Some basic principles to be followed to minimise dangers when locating and designing slaughter houses were highlighted by an FAO/WHO working group on slaughter hygiene, meat inspection and judgement. Abattoir effluent reaching streams may contribute significant levels of nitrogen, phosphorus and biochemical oxygen demand and other nutrients, thereby resulting in stream pollution (Sangodoyin and Agbewhe, 1992).

Environmental problems have increased in geometric proportion over the last decades with improper management practices being largely responsible for the gross pollution of the aquatic environment with concomitant increase in water - borne diseases especially typhoid, diarrhoea and dysentery. Abattoirs are generally known all over the world to pollute the environment either directly or indirectly from their various processes (Adelegan, 2002). In Nigeria, many abattoirs dispose their effluent directly into surrounding streams and rivers without any form of treatment. Slaughtered meat from such abattoirs is washed using the same water (Adelegan, 2002). Recent studies on abattoir as reported by Laukova *et al.* (2002) and Amusu *et al.* (2003) show that some of the consequences of man-made pollution are transmission of diseases by water-borne pathogens, eutrophication of natural water bodies, accumulation of toxic or recalcitrant chemicals in the soil, destabilization of ecological balance and negative effects on human health.

The continuous drive to increase meat production to meet the protein needs of the ever increasing world population has some pollution problems attached. In many countries pollution arise from activities in meat production as a result of failure in adhering to good management and hygiene practices. Much consideration is given during animals transport to the abattoirs most especially concerning their safety, during dressing of hooves and content of alimentary tract and during evisceration. The negative impact on the environment includes microbes in the soil surface and ground water (Laukava *et al.*, 2002; Amusu *et al.*, 2003).

The objective of this study is to the effect of an abandoned abattoir effluent on groundwater.

METHODOLOGY

Mokwa in Mokwa Local Government Area of

Niger State houses one of the most modern abattoir facilities in the country. The long southern border of the LGA is formed by the Niger River from Lake Jebba in the west beyond the confluence of the Kaduna River in the east. Kwara and Kogi States are across the Niger from the LGA which is located on the coordinates of 9° 12N and 5° 29E.

Some samples water were collected from a borehole in the abattoir premises in the morning by 6:30am and in the evening by 6:30pm while other samples were collected from the community well (Mokwa) by 6:30am of the following day with the containers clearly labelled. The first sample taken by 6:30am from the borehole in the abattoir was marked AB while the second sample taken at 6:30pm at the same borehole was marked C. The final sample taken from the community well by 6:30 am of the following day was marked as A. The analyses were conducted based on the methods described by AOAC (2005) in the Niger State Water Board.

RESULTS AND DISCUSSSION

From the results presented in Table 1, it is clear that abattoir effluent generated affects groundwater resources in Mokwa after it has been abandoned for four years. Generally, analysis of groundwater resources in Mokwa shows a marked difference in quality depending on the location of the source. From the results obtained, the groundwater samples collected were clear, tasteless and odourless, especially those collected from the deep well in community . It was also observed to contain low amount of solids owing to filtration through the various layers of soil and soft rocks which sometimes are alkaline in nature and reacts with water to form highly mineralized water in such wells.

Table 1 shows the physico-chemical properties of underground water supply for some selected wells in Mokwa Local Government Area.

	PARAMETERS	TOWN WELL WATER "A"	Abattoir Bore-hole "B"	Abattoir Borehole "C"	WHO
1	Electrical conductivity (μs/cm)	220	450	450	1000
2	Total dissolved solids (mg/l)	110	225	225	500
3	Temperature in the Lab (°C)	27..2	29.4	29.5	N/S
4	Suspended solids (mg/l)	0	3.0	0	25
5	Turbidity (FTU)	0	1.0	0	5.0
6	Colour (Pt.Co)	0	0	0	15
7	pH	7.2	6.9	7.1	6.8-8.5
8	Iron content (mg/l)	0.39	0.15	0.23	0.30
9	Sulphate (mg/l)	9.0	20	20	250
10	Nitrate as Nitrogen (mg/l)	7.6	6.7	7.5	10
11	Nitrate (mg/l)	33.44	29.48	33.0	50
12	Total Hardness ($CaCO_3$) (mg/l)	62	40	48	100
13	Hardness as ($MgCO_3$) (mg/l)	24.8	16	19.2	N/S
14	Hardness as $MgCO_3$ (mg/l)	37.2	24	28.8	N/S
15	Total Alkalinity (mg/l)	12.4	8.0	6.4	100
16	Phosphate as Phosphorus (mg/l)	0.06	0.01	0.025	N/S

PHYSICAL ANALYSIS

The average Electrical conductivity (μs/cm) for the three wells were 220, 450 and 450 which were found to be lower than the world health organization (WHO, 2007) limit. This may be as a result of the movement of water through the various soil layers before finally entering into the well. The average total dissolved solids (mg/l) of the samples were 110, 225 and 228 for the three samples collected which is lower than maximum permissible limit of 500 mg/l. Therefore, the TDS found in the samples were generally satisfactory for domestic use and many industrial purposes. The average laboratory Temperature (°C) for the three samples was 27.2, 29.4 and 29.5. The maximum permissible limit for temperature is not stated by World Health Organization (WHO, 2007) as it depends on the environmental condition at the time of the collection and testing of the samples The average values of the suspended solids (mg/l) were 0, 3.0 and 0 for the all samples analysed which were lower than the maximum permissible limit of World Health Organization (WHO, 2007). This was observed because of the screening process that took place while the waterbody was travelling through the various soil layers/particles, thus purifying the water that is entering the well for domestic use. The average turbidity (FTU) values were 0, 1.0 and 0 for the three samples analysed. On comparing these values with the maximum permissible limit of WHO (2007), it was discovered that they were lower and thus can be recommended for drinking and industrial works. The average Colours (Pt. Co) values for the samples analysed were 0, 0 and 0. They were found to be lower than the WHO standard which is 15. Therefore by WHO standard, it is clear that the groundwater is good for domestic activities. The pH values for three samples analysed were 7.2, 6.9 and 7.1 which are within the maximum permissible limits of world health organization (6.5 – 8.5). It is therefore recommended for drinking and other domestic uses.

CHEMICAL ANALYSIS

The average value of iron content for sample A (community well) is 0.39 mg/l which is not compatible with drinking but it can be used for other domestic activities while obtained for samples B and C are compatible with drinking because the respective values were found to be lower than the maximum permissible limit of the World Health Organisation limits (0.3mg/l). The iron content present in water usually reacts with plumbing materials/fixtures and causes the water to stain clothes during laundering, incrusts well screen and clogs pipes (Deutsch, 2003). The average sulphate (mg/l) values for samples A, B and C were found to be 9.0, 20 and 20, respectively. When the results obtained from the analysis were compared with the WHO standard of 250 mg/l, it was observed that the values were far lower which makes it within the maximum permissible limit, while nitrate as nitrogen (mg/l) were found to be 7.6, 6.7 and 7.5 for samples A, B and C, respectively. They are lower than the WHO standard (10mg/l). The average nitrate (mg/l) values for the three samples were 33.44, 29.48 and 33.0 which are lower than the WHO standard. This may be due to deepness, screening and filtration process taking place within the soil matrix and it can be recommended for both industrial and domestic uses and for agricultural practices. The average value of hardness (Ca) as $CaCO_3$ were found to be 24.8, 16 and 19.2 mg/l, respectively for samples A, B and C; while the average values for hardness (Mg/l) as $MgCO_3$ were 87.2, 24 and 28.8 for human consumption respectively. The average total alkalinity (mg/l) values were found to be 12.4, 8.0 and 6.4 for human consumption which are lower than the WHO standard of 100 mg/l. The low values of the results were due to depth of the community well and boreholes of the abandoned abattoirs. It can therefore be concluded that the groundwater is still good for domestic, agricultural and industrial uses. The average values of Phosphates as phosphorus were

0.06, 0.01 and 0.025 mg/l, respectively.

Conclusion

The results obtained show that the water extracted from the various wells and borehole are within the maximum permissible limit of WHO. It was concluded that the water extracted in Mokwa abattoir environment is fit for domestic, agricultural and industrial uses. **Recommendation**

The following recommendations have been made.

- Effluent should be recycled instead of discharging them without treatment into the surrounding environment. When the abattoir restarts work, proper waste collection and management system should be put in place by the relevant ministries.
- The State should enact a law which would prevent the abattoir area from being more congested as to minimize the environmental pollution due to effluent discharge.
- More surveys of this nature should be commissioned in order to fully assess measures necessary to prevent groundwater pollution.
- The solid waste from the abandoned abattoir should be recycled and restoration of damaged resources or environment. People within the environment should be forced to use waste bins and other facilities provided by waste managers for disposing of their waste.

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