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The Effect of Minna Abattoir Waste on Surface Water Quality II

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Abstract: Discharging abattoir waste into a river or stream can have adverse effects on water quality. This study was carried out to evaluate the effects of Minna abattoir wastes on the receiving stream by analyzing the organic parameters of water samples taken at 3 different sections of the stream into which the abattoir effluent is discharged. The sections are: Upstream (US); Midstream (MS) (the point where the abattoir waste meets with the stream) a nd Downstream (DS) during the wet season of 2006. The results of the water analyses showed the various ranges of values obtained as follows: Biological Oxygen Demand (BOD) are 33.41, 23.89 and 22.50 mg L^{-1} for US, MS and DS, respectively Chemical Oxygen Demand (COD) are 2.20, 2.73 and 1.93 mg L^{-1} for US, MS and DS, respectively, while Dissolved Oxygen (DO) are 0.85, 0.80 and 0.85 mg L^{-1} for US, MS and DS in that order. The BOD and DO values are at variance with the allowable limits of the World Health Organization (WHO) for drinking water. The results showed that the abattoir effluent has lowered the quality of the receiving stream.

Key words: Abattoir waste, effluent, organic parameters, pollution, stream, surface water, wastewater

INTRODUCTION

Livestock production, which is perceived by the public to be potential food for the world's needy people, is a major pollutant of the countryside (where, the animals are raised) and cities, if processors do not manage slaughter wastes properly with dung and slurry washed into waterways. Other environmental problems include pollution of soil with dung and the atmosphere with methane (a greenhouse gas) from decomposing wastes.

An abattoir has been defined as a premise approved and registered by the controlling authority for hygienic slaughtering and inspection of animals, processing and effective preservation and storage of meat products for human consumption (Alonge, 1991). Livestock waste spills can introduce enteric pathogens and excess nutrients into surface wasters (Meadows, 1995). The wastes from Abattoir operations can be separated into solid, liquid and fat. These wastes are highly organic. The solid waste includes condensed meat, undigested ingesta, bones, horns, hairs and aborted fetuses. The liquid waste is usually composed of dissolved solids, blood, gut contents, urine and water, while fat waste consists of fat/oil.

Pollution of our water resources might lead to destruction of primary producers and this in turn leads to diminishing consumer populations in water. The direct repercussion of this is diminishing fish yield with the resultant consequence that human diet suffers. Such conditions may arise through careless discharge of dangerous slowly biodegradable and non-biodegradable wastes e.g., pesticides. The use of detergent that contains phosphorous may lead to eutrophication of inland lakes or dams. Anaerobic conditions may arise and this will make it difficult for aquatic life to flourish. Incidentally, survival of aquatic life is one very important tool for water quality monitoring. In terms of biological indication of water quality, use is made of aquatic lives (e.g., Diphniamagna), which are very sensitive to changes in pressure, pH, dissolved oxygen, toxicity and other chemical changes in water. These organisms may become disfigured or their reproductive lives impaired or are killed (Aina and Adedipe, 1991).

In essence, slaughter activities, if not properly controlled, may pose dangers to the farmers, butchers, the environment as well as the consumers. Abattoir effluent reaching streams may contribute significant levels of nitrogen, phosphorus and biochemical oxygen demand and other nutrients, thereby resulting in stream pollution. These effluents would reduce stream physical and chemical qualities, more so pathogens from cattle waste could be transmitted to humans recreating in such

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streams. These are some of the main reasons that led to the analysis of waste from Minna abattoir. Information obtained from the study can be used to design efficient end-use treatment and mitigation measures towards the impact of wastes on our environment. The study is aimed at carrying out qualitative analysis of water samples from the stream around Minna abattoir and studying the effects of the wastes on the receiving stream.

MATERIALS AND METHODS

Description of minna abattoir: Minna town, the state capital of Niger state lies on latitude 9°3'N and longitude 6°3'E. The abattoir is located in an area popularly known as Tayi Village, along Bosso Road, Minna. It is constructed in such a way to accommodate 3-4 slaughtering. The abattoir is divided into 3 main sections namely; the slaughtering section, the processing section (skin and bone removal/skin burning) and the waste dumping site.

The slaughtering section: The animals are first checked by a Veterinary Doctor for any infections. If the animals are certified free of any infection they are kept in a place called the waiting site after which it will be brought into the slaughtering section for slaughtering. The animals are slaughtered on the floor by a staff. The blood with any other liquid that comes out of the animal passes through a channel which leads to a reservoir outside the building. As of the time of this research, the reservoir constructed with concrete has been destroyed; thus, the wastes from the building are channeled directly into the Tayi stream.

The processing and dumping sections: The processing section is where the slaughtered animals are skinned or sometimes the skin is burnt, bones and internal parts of the animals are removed, washed and chopped into portions. The blood with any other liquid that comes out during the slaughtering as well as faecal waste from the animal intestines passes through the centralized channel which leads to Tayi stream. These are liquid and suspended solid wastes. The bones which are solid waste are usually dumped into the dumping section and burnt before they are sold.

Collection of water samples and method of analysis: Samples of water from Tayi stream in the vicinity of Minna abattoir were taken at 3 different points using three thoroughly washed 0.50 L plastic containers. The plastic bottles were well covered to protect them from contamination and were immediately taken to the laboratory for analysis. The collected samples were designated as follows:

- Upstream (US) sample collected 60 m before the point where the abattoir waste meets the stream.
- PS-sample collected at the point where the abattoir waste meets with the stream.
- Downstream (DS) sample collected 60 m away from the point where the abattoir waste meets with the stream.

Standard laboratory reagents and apparatuses were used to analyze the water samples into physical, chemical and organic parameters. The method and procedure of the analysis were those described by the APHA (1995, 2000).

RESULTS AND DISCUSSION

The organic parameters of the water samples analysed are presented in Table 1.

Biological Oxygen Demand (BOD) and Chemical Oxygen Demand (COD): Biological oxygen demand is the most commonly used index in water quality management. It represents the amount of oxygen required for the biological decomposition of organic matter under aerobic condition at a standardized temperature (20°C) and time of incubation (usually 5 days). It is an expression of how much oxygen is needed for microbes to oxidize a given quantity of organic matter. However, organic matter will undergo chemical oxidization even in the absence of decomposers. The amount of oxygen needed to achieve this is called the chemical oxygen demand.

The biological oxygen demand of the effluent varies between 22.50 mg L^{-1} for DS and 33.41 mg L^{-1} for US. The value of BOD for the PS section is 23.89 mg L^{-1} for the 3 sections; the values are at variance with the WHO (2004), permissible limit of 0.0 mg L^{-1} for drinking water. This implies that it is dangerous to discharge the effluent directly into water without aeration, as this would deplete the water of dissolved oxygen that is needed by aquatic animals for respiration. This is because high BOD leads to less dissolved oxygen, which is detrimental to aquatic lives. The high BOD of the effluents could be attributed to only partial or non-treatment of the effluents by the abattoir before releasing them into Tayi stream. Poor self-purification of the receiving stream could also be a contributing factor. When compared to FEPA allowable

Table 1: Organic parameters of the samples

Parameter (mg L^{-1})	US	PS	DS	FEPA*	WHO+
Biological Oxygen Demand (BOD)	33.41	23.89	22.50	30	0
Chemical Oxygen Demand (COD)	2.20	2.73	1.98	80	N/A
Dissolved Oxygen (DO)	0.85	0.80	0.85	30	5

*Maximum allowable level (FEPA, 1991) + Maximum allowable level (WHO, 2004); N/A = Not available limit of 30 mg L^{-1} for water used for irrigation, the value at the US section could not used for both drinking and agricultural purposes.

The chemical oxygen demand of the effluent ranges between 1.98 mg L^{-1} for DS section and 2.73 mg L^{-1} for PS section. At the US section the value was 2.20 mg L^{-1}. This means that the COD for the 3 sections satisfy the standard recommended by FEPA which is 80 mg L^{-1}.

High level of COD indicates the presence of chemical oxidants in the effluent and low COD indicates otherwise. High COD could likely cause nutrient fixation in the soil resulting to reduced rate of nutrient availability to plants. In addition, chemical oxidation affects water treatment plants by causing rapid development of rust. This would reduce the service life of the plant. Disposal of such waste into water could reduce the level of oxygen thereby threatening aquatic lives. Dissolved-oxygen conditions have attracted the concern of sanitary engineers and river mangers for many years and great efforts have been made to conserve the oxygen reserves of streams. Organic wastes such as biodegradable industrial wastes can be treated to reduce their oxygen demand by a set of processes that are often referred to as primary, secondary and tertiary treatment (Chukwu, 2005).

Primary treatment involves the settling of suspended mineral and organic solids. The process may be accelerated by the addition of chemicals to flocculate or precipitate solids. Such, treatment removes 40-90% of the suspended solids and 25-85% of the 5 day BOD (Fair *et al*., 1968). The settled waste must then be disposed off by dumping in a large body of water or in a landfill and the liquor it contains must be removed, disposed off, or treated separately. The rest of the effluent passes directly to the receiving water or undergoes further treatment. Secondary treatment involves a biologic form of processing in a trickling filter. It involves spraying wastewater onto columns of crushed stone. The wastewater flows in thin films over biologic growths covering the substrate. The organisms, which include bacteria, fungi and protozoa and insects, which graze on them, absorb and break down the dissolved organic substances in the wastewater. Some of the breakdown products such as carbon dioxide escape to the atmosphere; others such as nitrate remain in solution, while others are absorbed into cells of the biologic growths, which eventually slough off to be carried to settling tanks by the wastewater stream. The process removes between 50-95% of the remaining settleable solids and 50-95% of the BOD. The tertiary treatment includes such practices as using a strong oxidizing agent like ozone to remove the final vestiges of BOD, odour taste and the addition of alum to precipitate phosphates, which are not removed efficiently by the other treatment processes (Chukwu, 2005).

Dissolved Oxygen (DO): The dissolved oxygen in the effluent was found to vary between 0.80 mg L^{-1} for the PS section and 0.85 mg L^{-1} for both the US and DS sections. These are within FEPA's allowable limit of 30.0 mg L^{-1}. Most game fish require at least 4-5 mg L^{-1} level of DO to thrive (Corson, 1990). It therefore, means that discharging the abattoir effluent into Tayi stream would discourage the breeding of fish. Complete absence of DO results to anaerobic condition, putrefaction and the development of foul odour. DO in liquids provides a source of oxygen needed for the oxidation of organic matter when the concentration is high and lack of it in acute cases may cause the water body to become dead or devoid of aquatic life. Another, important factor is the temperature of the effluent. This is because cold water holds more oxygen in solution than warm water. Thus, since, the effluent is always warm at point of discharge, the DO is low. This situation could lead to depletion of life organism in the effluent sink. The relationship of biodegradable wastes to the amount of dissolved oxygen in stream water, therefore, is fundamental to the maintenance of environmental quality along streams that are used for waste disposal. Moderately high dissolved oxygen content is necessary for the maintenance of healthy aquatic ecosystems and particularly for the most prized game fish such as salmon and trout (Chukwu *et al*., 2007).

CONCLUSION

The aim of evaluating the effect of abattoir waste on surface water was achieved by analyzing organic parameters of water samples at various locations within and around the abattoir. Also, The dissolved oxygen content in the streams are less than the 5 ppm minimum value required to sustain normal life in aquatic environment and the water is, therefore said to be polluted. Using FEPA and WHO recommended limits as bases for comparison, it therefore, implies that Minna abattoir effluent has lowered the quality of receiving stream and that they contain several pollutants, which are above the allowable limits. It was then recommended that further discharge of the abattoir effluent into Tayi stream should be stopped.

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