Journal of Engineering and Applied Sciences 3 (7): 607-610, 2008
ISSN: 1816-949X

Effect of Car-Wash Effluents on the Quality of Receiving Stream

[1]O. Chukwu, [2]S. Segi and [1]P.A. Adeoye
[1]Department of Agricultural and Bioresources Engineering,
Federal University of Technology, P.M.B 65, Minna, Niger State, Nigeria
[2]Niger State Water Board, Minna, Nigeria

Abstract: Car wash effluents were analyzed. The receiving stream water was also analyzed at some points (before the point of discharge and after the point of discharge). The result indicated that the effluents lowered the quality of the receiving stream water, making most of the parameters determined to be on the high side in comparison with the World Health Organization (WHO) standard. The effluents were alkaline in nature and this led to the precipitation of heavy metals. The total dissolved solids were found to be in high range, 8.1 and 118.6 mg L^{-1}. The levels of heavy metals were also high. For example, iron has a value of between 3.21 and 3.27 mg L^{-1}, which is above the recommended permissible levels for drinking water. Chromium was found to be between 0.20 and 0.27 mg L^{-1}. The Dissolved Oxygen ranges from 1.41-4.30 mg L^{-1}, while Biochemical Oxygen Demands (BOD) was between 2.18 mg L^{-1} for Upstream (US) and 4.70 mg L^{-1} at the point of the discharge (POD). Chemical Oxygen Demands (COD) was between 4.0 and 5.20 mg L^{-1} for Downstream (DS) and point of discharge, respectively. Some treatments measures were recommended to be carried out on the effluents to make the receiving stream water safe for people living at the downstream end.

Key words: Car-wash, effluents, quality, receiving stream

INTRODUCTION

Car-wash effluents refer to the wastewater resulting from the process of washing motor cars, tankers, trucks, bicycles and motorcycles. Car-wash involves the use of detergents, petrol, kerosene and diesel for cleaning. The process of car wash utilizes large volume of water either to wash the cars or as a medium for a greater attraction. In the process, large amount of wastewater is released carrying with it left over hydrocarbons and detergents. Water, which has been discharged from domestic dwellings, institutions and commercial establishments (domestic wastewater and car wash) together with discharge form manufacturing industries (known as industrial wastewater), contains a large number of potentially harmful compounds. As it is discharged directly into a watercourse, serious damage might result to the many forms of life, which inhabit this water. In addition, watercourses utilize by man, either as a source of potable water or for washing or bathing would present potential risks of the transmission of a large number of water related diseases. Over the years, man has polluted water in various ways, surface water has been polluted with industrial wastes, wash off from farm lands and even domestic sewage (Ogedengbe and Elutade, 2003).

The sources of surface water pollution are very many and vary in both strength and volume. It may be discharged from either raw or treated sewage from towns and villages. Discharge from industrial and manufacturing plants, runoff from agricultural lands or leachates from solid waste disposal sites (Sangodoyin, 1992). In addition, to these continuous discharges, there is also the danger of discharge of highly toxic materials like acid, cyanides or oil. The effects of these are often immediate with the water course suffering severe long term damage. Freshly discharged domestic sewage is a grey turbid liquid with a characteristic but not with unpleasant smell. It may produce unpleasant smell if kept unaerated due to formation of hydrogen sulphides and amines .To ensure that such problems are avoided or minimized, attention should be paid to the management of our aquatic resources and also of the pollutants, which enter them. A sensible management strategy will involve analysis of the composition of wastewater and the receiving stream (Horan, 1990).

The threat to human lives and aquatic animals due to incessant discharge of untreated sewage cannot be dismissed with a wave hand. Ajayi (1996) gave a situation report as it affects the safety of our environment. For instance, in the report, it was indicated that an estimated

Corresponding Author: O. Chukwu, Department of Agricultural and Bioresources Engineering, Federal University of Technology, P.M.B 65, Minna, Niger State, Nigeria

1.2 billion of world's city dwellers breathed highly polluted air; 10% of the Worlds Rivers was heavily polluted and that chemical contamination of food had reached unacceptably dangerous levels.

It has also been reported that phosphates activity in muscle, liver and intestine of fishes in water polluted by tannery effluents decreased significantly with increasing concentration of effluents. However, an uptake of 0.02 mg L^{-1} of metal is adequate for normal growth. Therefore, the concentration of metals above this limit is toxic. Water as found in nature is not pure but contains a number of chemical compounds, some of which give characteristics to water. Water for consumption must be free from toxic materials and concentration of chemicals that may constitute hazards to human and aquatic animals' lives (Abdulsalam and Ajiboso, 2003). Chemical water pollution may lead to unpleasant taste, appearance and even death, it is thus evident that analysis of water is necessary for social and economic development. It has been stated that streams or rivers are subject to much natural pollution because they serve as a drainage channel for large areas of the countryside. In addition, rivers are capable of absorbing some man-made pollution (Phelps, 1985). Contaminated water may not be detected by mere observation with naked eyes, careful sampling and appropriate analysis are needed to know the type and quality of pollutants present in it (Sangodoyin, 1993; Elendu, 2005).

The objective of this research is therefore to determine whether the quality of the receiving stream is being affected by car wash effluents and if yes to determine the concentration of the elements in the receiving stream water using DR 2000.

MATERIALS AND METHODS

The study site is broadcasting station, Minna, Niger State, Nigeria. Minna is located in the Northern Guinea Savanna belt within longitude 06°E 33[1] and latitude 09°N3[1] with average annual rainfall of 110 mm. A car wash factory is located close to a perennial stream and the effluents from the carwash are being drained untreated into the stream. The stream is being used at the downstream end by small holding farmers for irrigation purposes and also, Minna residents use it for washing vegetables, melon, fruits and other food items.

Reagents and sampling techniques: Car wash effluents obtained from HACH DR/2000 spectrophotometer and Handbook of DR/2000 spectrophotometer containing approved procedures of water analysis were used. High quality distilled water and all solutions were stored in clean plastic containers and kept in the refrigerator until needed. Samples were taken at mid-depth. A tightly stoppered clean plastic container of 4.5 L capacity was dipped into the car-wash effluents with the stopper on and the stopper was removed at mid-depth, while the container was filled to the point of overflowing. The stopper was immediately replaced and the sample refrigerated. The samples were taken at intervals of 100 m from the Point of Discharge (POD), Upstream (US) and Downstream (DS). This gives a span of 1000 m or 1 km.

The samples were designated as:

A_{US} : 100 m before the point of effluent.
B_{US} : 200 m before the point of effluent.
C_{US} : 300 m before the point of effluent.
D_{US} : 500 m before the point of effluent.
E_{US} : 200 m before the point of effluent.
POD : Point of discharge into the stream.
A_{DS} : 100 m after the point of discharge.
B_{DS} : 100 m after the point of discharge.
C_{DS} : 100 m after the point of discharge.
D_{DS} : 100 m after the point of discharge.
E_{DS} : 100 m after the point of discharge.

The samples were analyzed using standard analytical technique developed by American Public Health Association (APHA) and World Health Organization (WHO).

RESULTS AND DISCUSSION

The level of zinc in the effluents at POD and DS is within the World Health Organization's standards that permit 5.0 mg L^{-1} drinking water. Toxicity of this parameter could occur over periods of time because the receiving stream is being used for irrigation of sugarcane plot in the dry season. Iron content for the effluents is between 3.21 and 3.27 mg L^{-1} for the POD and DS. This is above the WHO guidelines that allow 1.0 mg L^{-1} of iron for drinking water. This may be attributed to the washing of corroded car parts. Excessive high amount of iron is known to interfere with the oxygen-carrying capacity of the body (Table 1).

The chromium contents of the effluent at POD and DS lie between 0.24 and 0.2 mg L^{-1} which are higher than the control US value that ranges from 0.20-0.23 mg L^{-1}. This might be due to car colours that contain chromium compounds. Chromium toxicity is considered to be mutagenic and carcinogenic. High value of sodium in humans as present in the effluents can also result in muscular twitching and rigidity (Bell and Paterson, 1986) (Table 2).

Table 1: Chemical parameters of car wash effluents

Parameters	E_{US}	D_{US}	C_{US}	B_{US}	A_{US}	POD	A_{DS}	B_{DS}	C_{DS}	D_{DS}	E_{DS}
Total alkalinity (mg L^{-1})	35.0	35.0	35.0	36.0	36.0	43.0	42.3	41.0	41.0	39.5	39.5
Total hardness (mg L^{-1})	1.34	1.34	1.34	1.39	1.39	1.69	1.67	1.67	1.65	1.65	1.66
Chloride (mg L^{-1})	0.36	0.36	0.36	0.37	0.37	0.43	0.43	0.41	0.41	0.43	0.41
Sulphate (mg L^{-1})	66.0	65.00	67.00	67.00	69.00	75.00	75.0	72.0	72.0	71.0	72.0
Magnesium (mg L^{-1})	0.08	0.08	0.10	0.10	0.11	0.14	0.14	0.13	0.13	0.13	0.13
Calcium (mg L^{-1})	0.32	0.32	0.32	0.32	0.38	0.45	0.44	0.44	0.42	0.42	0.42
Zinc (mg L^{-1})	0.22	0.22	0.22	0.25	0.28	0.36	0.36	0.34	0.33	0.32	0.32
Iron (mg L^{-1})	1.94	1.94	2.00	2.01	2.01	3.27	3.24	3.24	3.21	3.22	3.21
Chromium (mg L^{-1})	0.20	0.20	0.20	0.23	0.23	0.27	0.27	0.24	0.24	0.25	0.24
Copper (mg L^{-1})	1.40	1.42	1.42	1.43	1.42	1.59	1.55	1.55	1.51	1.51	1.51
Potassium (ppm)	22.20	22.20	25.10	25.4	25.4	34.2	34.2	33.2	30.1	30.1	30.1
Sodium (ppm)	12.10	12.10	12.60	12.7	12.9	13.50	13.5	12.4	12.3	12.3	12.3

Table 2: Physical parameters of car wash effluents

Parameters	E_{US}	D_{US}	C_{US}	B_{US}	A_{US}	POD	A_{DS}	B_{DS}	C_{DS}	D_{DS}	E_{DS}
Turbidity (FTU)	290	290	290	294	320	461	452	451	451	450	450
Temperature (°C)	24.1	24.0	24.1	25.0	25.0	28.4	27.5	27.5	27.4	27.0	27.0
Odour	Free	Free	Free	Slight odour	Slight odur	Offensive	Slight odour	Slight odour	Free	Free	Free
Colour (PtCo)	271	270	271	271	278	550	542	501	501	501	497
Conductivity (ms cm^{-1})	0.21	0.22	0.21	0.23	0.23	0.30	0.26	0.25	0.25	0.25	0.24
Total dissolved solids (mg L^{-1})	82.2	82.1	82.2	82.8	82.8	118.6	103.0	103.0	102.0	102.0	100.0
Suspended solids (mg L^{-1})	218	219	218	218	220	300	298	298	290	291	290
pH	8.4	8.5	8.4	8.5	8.9	9.4	9.4	9.3	9.0	8.9	8.9

Table 3: Organic parameters of car-wash effluents

Parameters	E_{US}	D_{US}	C_{US}	B_{US}	A_{US}	POD	A_{DS}	B_{DS}	C_{DS}	D_{DS}	E_{DS}
Dissolved oxygen (mg L^{-1})	4.30	4.20	4.20	3.40	2.80	1.41	1.42	1.45	1.62	2.41	2.42
Biochemical oxygen demand (mg L^{-1})	2.30	2.32	2.32	2.18	3.91	4.70	4.62	3.95	3.82	3.70	3.71
Chemical oxygen demand (mg L^{-1})	0.97	0.98	0.98	1.02	4.39	5.20	5.12	4.41	4.22	4.11	4.01

The samples also recorded high value of potassium. The values of dissolved oxygen for the effluents at POD and DS range from 1.41-2.42 mg L^{-1}. These are lower than the minimum of 5 mg L^{-1} value required to sustain normal life in aquatic environment and the water is said to be polluted (Sangodoyin, 1993). Water samples with Biochemical Oxygen Demand (BOD) higher than 5 mg L^{-1} are said to be fairly polluted. Drinking water is expected to have a BOD less than 1 mg L^{-1} and water is considered fairly pure with BOD of 3 mg L^{-1}. Chemical Oxygen Demand (COD) on the other hand was between 4.01 and 5.20 mg L^{-1} for the effluents at DS and POD respectively compared to the control which falls between 0.97 and 4.39 mg L^{-1} (Table 3).

CONCLUSION

From the analysis, it was evident that the water samples from receiving stream contains physical, chemical and biological chemical parameters higher than the acceptable limit imposed by various health agencies. It can then be concluded that the effluents from car wash have lowered the quality of the stream. The effluents parameters can be improved upon by having a sedimentation tank that will improve the physical properties of the effluents. This can be followed by aerated lagoon treatment to improve its biological parameters and then use methods like oxidation, precipitation or adsorption to reduce the chemical parameters to permissible level. Government can also establish a layout for car wash workers if treatment will be too expensive for them and channeled their effluents to sewage treatment plant to avoid its usage for domestic and irrigation purposes.

REFERENCES

Abdulsalam, W.A. and O.O. Ajiboso, 2003. Environmental impact assessment of bida abattoir on receiving stream. Nig. J. Eng. Appro. Technol., 1 (1): 15-18.

Ajayi, B., 1996. Industrial pollution control. Wemabod's Giant Stride. Tell Mag., pp: 23-24.

Bell, G.H. and C.R. Paterson, 1986. Comprehensive Text on Physiology. 10th Edn. Mc Graw Hill Publishers, pp: 32-34.

Elendu, N.O., 2005. Effects of refuse disposal on groundwater quality in aba metropolis, Abia State. Proceedings of the 7th International Conference and 28th Annual General Meeting of the Nigerian Institution of Agricultural Engineers (NIAE), held at Ahmadu Bello University, Samaru-Zaria, Kaduna State, 28: 154-159.

Horan, N.J., 1990. Biological Wastewater Treatment Systems. Theory and Operation. 3rd Edn. John Wiley and Sons, Chisheter, pp: 1-2.

Ogedengbe, K. and O.O. Elutade, 2003. Effects of irrigation on soil nutrients status and surface water quality. J. Agric. Eng. Technol., 11: 45-50.

Phelps, B., 1985. Environmental Engineering, Wastewater Collection. Treatment and Disposal. 4th Edn. McGraw-Hill Company, New York, pp: 680-700.

Sangodoyin, A.Y., 1992. Environmental study on surface and groundwater pollutants from abattoir effluents. J. Bioresour. Technol., 41: 193-200.

Sangodoyin, A.Y., 1993. Consideration on contamination of groundwater by waste disposal systems in Nigeria. J. Environ. Technol., 14: 957-964.