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TREATMENT OF SOME TEXTILE INDUSTRIAL EFFLUENTS USING DRY CORN STALK

V. O. AJIBOLA and T. O. IJABOR

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Abstract

Corn stalk ground to various mesh sizes was used to treat textile effluents obtained from three different industries. These effluents were first pretreated with alum and then charcoal; passing the water through a column, (20cm long and 5cm diameter) containing the ground corn stalk of size diameters of 300µm, 355µm 425µm followed this treatment. Results show that better quality effluent was obtained after treatment with the ground corn stalk. The corn stalk ground to a size of 425µm gave the best effluent quality.

Keywords: Textile effluent, Treatment, Corn stalk.

Introduction

There are a variety of processes available for the treatment of wastewaters from industrial sources (Walter, 1981). The exact choice of processes will depend on the nature of the industry, the regulations governing the discharge of the effluents and the availability and economics of the water supply (Liddell, 1992). Physical and chemical processes are used in the treatment of effluents (Walter, 1981; Borne, 1981). Physical processes are used mainly for the removal of suspended solids from the water; chemical processes are used mainly for the removal of dissolved solids. Biological processes are also used (Holdich, 1981).These treatments do not really solve environmental pollution problems, rather the effluents after treatment attain a degree of purity, where the water could be re-used where lower quality water is adequate or safe enough to be discharged into the environment. In many ways these treatments help to reduce ionic concentration, pH, total solid contents, alkalinity, of the effluent. Some success has been recorded in the recovery of some textile inputs, however, this involves a process which may be considered in terms of it economics, because being a physical method it may require high energy input (Ajibola, 2001).

Most firms will only wish to install a minimum plant for effluent treatment; provision of a complete effluent treatment plant is expensive and expert staffs are required to operate it. Thus using processes involving the use of readily available by-products as corn stalks from farms to treat textile effluents to a level in which it could be reused or discharged is described.

Experimental

Collection of Effluent Samples

Effluents of two textile industries as typical were collected. The samples were collected at the various points of discharge into the River Kaduna. The samples were taken in 4-litre plastic bottles with air-tight-screw-capped covers and stored in a refrigerator at about 5°C. The pH and conductivity measurements were taken for the untreated samples at the point of collection. The time interval between sample collection and determination of other parameters was 24 hours.

Preparation of Corn Stalk

Dry corn stalks were collected from a farm around Zaria and ground to powder using a ceramic mortar. The particles were separated into three-size particle diameters i.e. 425µm, 355µm and 300µm using the appropriate sieves. The ground stalk was then treated with 0.01M HCl for about 2hours and dried in a ventilated oven at about 50°C until a constant weight was attained.

Procedures used for determination of the various parameters

All the methods used for the determination of the various parameters are those recommended by the American Public Health Association (APHA).

V. O. AJIBOLA, Department of Chemistry, Ahmadu Bello University, Zaria, Nigeria
T. O. IJABOR, Department of Chemistry, Ahmadu Bello University, Zaria, Nigeria

Table I: Results of Chemical Analysis for Textile Effluent A

S/N	Nature of treatment	Suspended solids (mg/L)	Dissolved Solids (mg/L)	Total Solids (mg/L)	Conductivity (uhmos)	pH	Sulphides (mg/L)	Total Alkalinity (mg/L)	Hardness Ca (mg/L)	Hardness Mg (mg/L)	Colour (Hazen units)
1.	untreated	820 ±12	2180 ±20	3000 ± 35	6250 ± 10	9.5 ± 0.2	240 ± 20	1000 ±15	-	-	100 ±15
2.	Treated*	220 ± 5	1380 ± 23	1600 ± 22	5700 ±12	6.5 ± 0.1	90 ± 10	120 ± 3	-	-	20 ± 2
3.	Treated**	180 ± 10	1040 ±19	1220 ± 23	5200 ± 8	6.5 ± 0.1	70 ±12	42 ±6	585.2 ±13	345.3 ±18	15 ± 2
4.	425µm	130 ±15	908 ± 14	1038 ± 18	3450 ±20	6.7 ± 0.2	30 ±5	50 ±10	140.2 ± 9	85.4 ±15	5.0 ±0
5.	355µm	180 ±11	1029 ± 20	1200 ± 10	4400 ±15	8.8 ± 0.1	50 ±9	50 ±5	192.3 ±10	116.7 ±10	5.0 ±0
6.	300µm	100 ±15	1500 ± 18	1600 ±13	3500 ±10	8.8± 0.2	30 ±4	50 ±9	513 ±10	311.3 ±9	10 ± 2

Results are the average determinations obtained from biweekly sampling over a period of three months
Treated* – effluent was treated with alum only
Treated** – effluent was treated with alum and charcoal

Table II: Results for Chemical Analysis of Textile Effluent B

S/N	Nature of treatment	Suspended solids (mg/L)	Dissolved Solids (mg/L)	Total Solids (mg/L)	Conduct-ivity (uhmos)	pH	Sulphides (mg/L)	Total Alkalinity (mg/L)	Hardness Ca (mg/L)	Hardness Mg (mg/L)	Colour (Hazen units)
1.	untreated	1200 ±31	4890 ±37	6090 ±33	9000 ±67	11.5 ±0.4	100 ±17	1200 ±12	-	-	300 ±9
2.	Treated*	590 ±12	2480 ±21	3080 ±17	8000 ±43	9.5 ±0.2	40 ±8	280 ±21	-	-	240 ±5
3.	Treated**	400 ±10	2000 ±17	2400 ±13	7500 ±59	8.5 ±0.3	40 ±5	137 ±10	440.9 ±16	267.1 ±10	20 ±0
4.	425µm	320 ± 10	1650 ±12	1970 ±12	6000 ± 33	7.4 ±0.2	30 ±5	125 ± 8	254.5 ±10	154.4 ± 7	20 ±0
5.	355µm	200 ± 12	1800 ±19	2000 ±18	6000 ± 61	8.0 ±0.3	30 ±9	50 ±4	300.6 ± 9	182.4 ± 13	25 ± 2
6.	300µm	200 ± 15	3150 ±10	3350 ± 12	7000 ±72	8.3 ±0.4	40 ±5	50 ±7	350.7 ±10	157.9 ±12	15 ±5

Results are the average determinations obtained from biweekly sampling over a period of three months
Treated* – effluent was treated with alum only
Treated** – effluent was treated with alum and charcoal

Alkalinity: 25cm^3 of the sample was titrated with 0.1M HCl using methyl orange indicator. The total alkalinity was determined as $CaCO_3$.

Colour: 2cm^3 of the sample was measured into graduated plastic curvet and placed in the hollow column of a Lovibond Comparator. The colour was measured in Hazen units. Dilution of sample was carried out where necessary.

Conductivity: The conductivity was determined using a portable conductivity bridge, type MC 3E/L equipped with a cell unit.

Hardness: 10cm^3 of the sample was buffered with ammonia-ammonium chloride at pH 10 and titrated with 0.01M EDTA solution using Eriochrome Black T as indicator.

Solid particles: Suspended solid was determined by taking 100cm^3 of the sample and filtered using Whatman filter paper (No. 40). The filter paper was dried in an oven set at 50°C and weighed until constant weight was attained. The dissolved solid was determined by taking 100cm^3 of the sample in a beaker and heating it to dryness. The weight of the residue was determined appropriately.

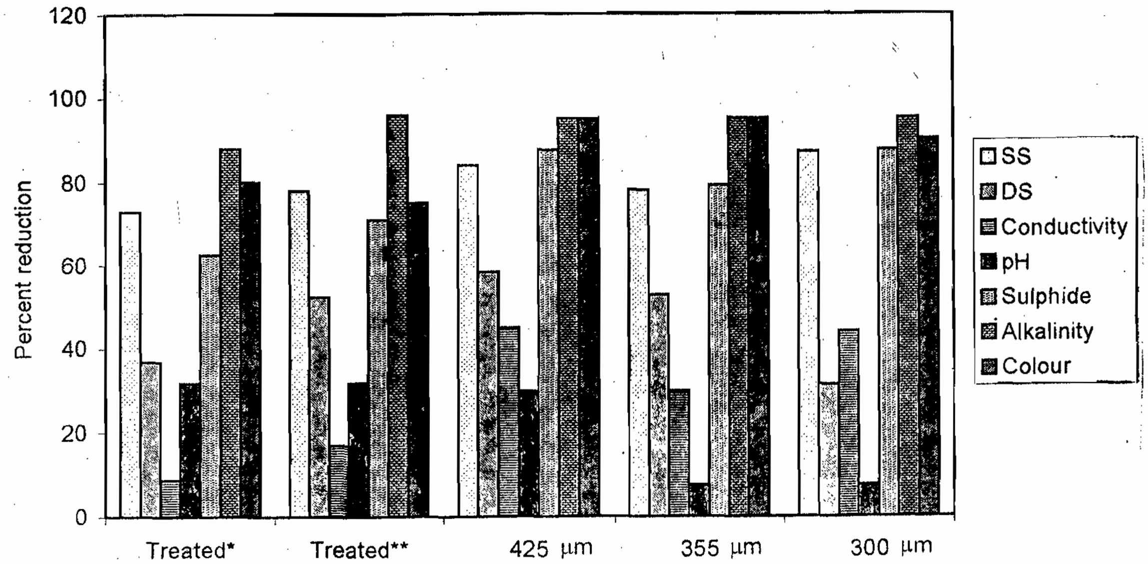

Figure I: Percentage by which different parameters measured were reduced in textile effluent A by each treatment method

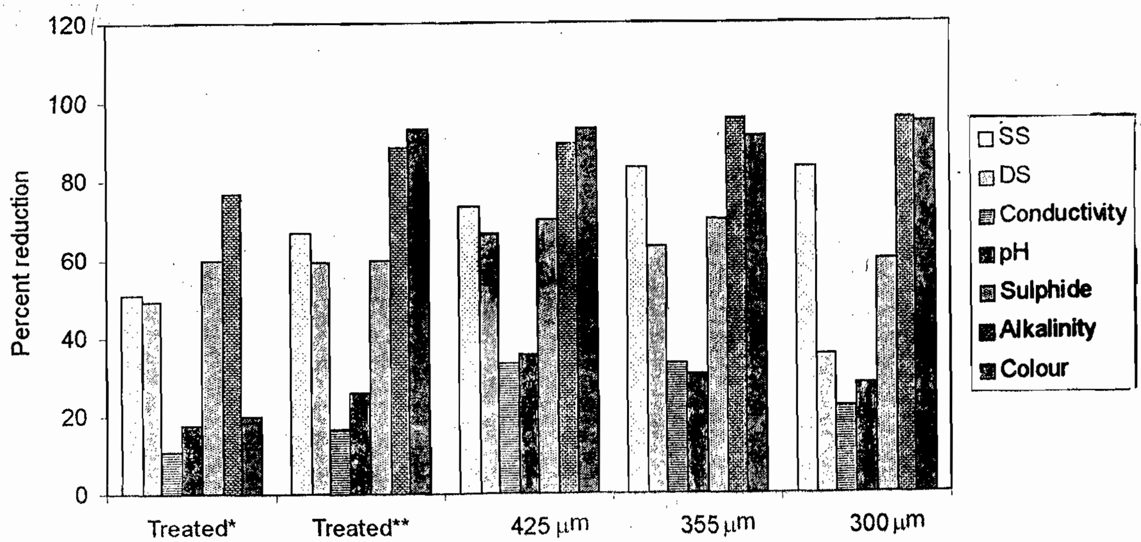

Figure II: Percentage by which different parameters measured were reduced in textile effluent B by each treatment method

Sulphide: $10cm^3$ of saturated cadmium acetate solution was added to $10cm^3$ of sample in a conical flask. The precipitate was allowed to settle and filtered. The precipitate together with the filter paper was dropped into another conical flask containing a mixture of $10cm^3$ H_2O-H_2SO_4 (1:3) and $20cm^3$ iodine solution. The solution was mixed thoroughly. Two drops of starch indicator was added and the solution was titrated with 0.025M $Na_2S_2O_3$ solution.

Results and Discussion

The results obtained for the untreated and treated effluents from industry A and B are given in Tables 1 and 2 respectively. The untreated effluents discharged into the river show very high values for all the parameters measured, especially that discharged by industry A. These values are well above the permissible levels for these industries (Liddell, 1992). The concentration of total solids present and the values for conductivity measurements is an indication of the severity of the pollution caused by these effluents. The consequence is eutrophication and desertification of the river, as a result of the changes in the physical and chemical characteristics of the river.

The results for the treated effluents are also given in Tables 1 and 2. The treatment of effluents from industry A (i.e. effluent A) with alum showed a decrease in all of the parameters measured, i.e. suspended solids, dissolved solids, pH, conductivity, total alkalinity and colour. A further reduction in these parameters was achieved when the effluent was treated with charcoal, especially the alkalinity. The effluent A after being treated with alum and charcoal, was passed through a column containing ground corn stalk of 425μm mesh size. The result showed a large reduction in the parameters measured. For example, conductivity, sulphide, alkalinity and hardness were reduced by an average of 50% over the water obtained when alum and charcoal were used for treatment, except for the pH that increased slightly (figure 1). The water obtained after this treatment was colourless and clear, having a value of about 5 hazens. When the effluent treated with alum and charcoal was passed through a column containing ground corn stalk of 355μm mesh size, slight increases were observed in all the parameters over that passed over the column containing the ground corn stalk of 425μm mesh size, except for the total alkalinity and the colour of the water obtained. When the treated effluent was passed through the column containing 300μm mesh size corn stalk, results showed increase in the concentration of dissolved solids in the water obtained, over that obtained when passed over columns containing 425μm and 355μm mesh sizes. The conductivity measurements and sulphide for 300μm mesh size was comparable to the 425μm mesh size and both lower than 355μm mesh size. Total alkalinity was the same for all sizes of the corn stalk, but the column containing 300μm mesh size gave water that was several times harder than the water obtained from the other mesh sizes.

Results obtained for effluent B (Table 2 and figure 2), show essentially the same trend as effluent A, except for the high pollutional load of effluent B. Comparing the efficiency of the different sizes of corn stalk used, it can be seen that the column containing the 425μm mesh size gave the best treatment for both effluents.

Conclusion

The corn stalk was found to reduce the concentration of some metal ions and anions such as sulphide quite well as shown in results obtained for total hardness and conductivity measurements. This leads to softening of the water. Such water (or effluent would not have much effect on a river and would be suitable for direct reuse as reclaimed water by the industries. The colour of the water obtained also improved significantly after passing the effluent through the column containing the ground corn stalk. The ability to remove these parameters was also found to depend on the mesh size to which the corn stalk was ground in this case 425μm mesh size.

References

Ajibola, V.O. 2001. Recovery of Indigo from a Textile Effluent in Nigeria. Journal of Scientific & Industrial research, 60: 735-737.

APHA (American Public Health Association). Standard Methods for the Examination of water and wastewater. 18th edition. Washington, D.C.: APHA, 1992.

Borne, B.J. 1981. 'Practical Considerations' in Walter, J.K. and Wint, A. (editors.). 'Industrial Effluent Treatment (Water and Solid Wastes)'. Applied Science Publishers Ltd. London, 213-242.

Holdich, D.M. 1981. 'Biological Effects' in Walter, J.K. and Wint, A. (editors.), 'Industrial Effluent Treatment (Water and Solid Wastes)'. Applied Science Publishers Ltd. London, 91-126.

Liddell J M, 1992 Biopol™ polyester: ICI's truly biodegradable polymer. *In The chemical industry – friend to the environment?* Edited by J A G Drake, Publication of the Royal Society of Chemistry (Information Services). (Redwood Press Ltd., Melksham). 10 – 25.

Walter, J.K. 1981. 'Physical and Chemical Treatment' in Walter, J.K. and Wint, A. (editors.), 'Industrial Effluent Treatment (Water and Solid Wastes)'. Applied Science Publishers Ltd. London, 127-166.