GLOBAL JOURNAL OF ENGINEERING RESEARCH, VOL. 1, NO. 1, 2002: 17 - 22

STUDIES ON THE USE OF BRACHYSTEGEN EURYCOMA (ACHI SEED) AS A CONDITIONER IN THE TREATMENT OF SEWAGE SLUDGE

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(Received 26 February 2001; Revision accepted 25 June 2001)

ABSTRACT

The finely ground seeds of Brachystegen Eurycoma (Achi Seed) was used in the treatment of sewage sludge. It has been found to improve sludge filterability and compare favourably with the traditional ferric chloride conditioner. The optimum dosage for each sample can be determined by drawing a tangent to the corresponding curve of each sample at the point where there is a sharp break between the straight and curvilinear portion. In this work, the optimum value for Brachystegen Eurycoma is 21.5% (0.4g/cm3) and for ferric chloride is 25% (0.5g/cm3). The foregoing results show that ferric chloride is still a better conditioner. However, during sludge filtration, cake and filtrate concentration increased with increasing dosages of the Brachystegen Eurycoma sample. This indicates that it would be useful as a conditioner if the primary product of filtration is the procurement of low filtrate concentration or high quality cake.

Key words: Brachystegen Eurycoma, Coagulation, Sewage Sludge, Filtration and Sludge Dewaterability number (SDN)

INTRODUCTION

One of the greatest problems challenging man today is the pollution of the earth's surface, resulting from rapid industrial and population growth which has given rise to diverse sources of waste water generation. These generated wastes must be treated in order to preserve a healthy environment from being polluted. Whatever treatment process chosen to treat the generated wastewater, sludges are produced (Haff, 1952). Sludge handling in waste treatment accounts for 21 to 50 percent of the total operating and maintenance cost (Carman, 1934) . The compressible nature and high water content (about 97.5%) makes sludge handling a difficult task (Ademiluyi and Eze, 1989) . In view of the high water content, sludges are usually dewatered prior to final disposal. Prior to dewatering, sludge is usually conditioned. Chemical conditioning method is usually preferred to physical methods since it can be more easily operated.

The worldwide inflationary trends have occasioned a search for a cheaper operating material having conditioning potentials. This is important, as the traditional coagulants usually used are normally imported. Some of them include ferric chloride, aluminium sulphate, polyelectrolytes etc. Thus, if local materials, which can serve as substitute to these imported coagulants, are made available for day-to-day activities in our industries, it will reduce dependence on imported materials and the demand for foreign exchange. This research is therefore intended to carry out a study on the possibility of using Brachyategen Eurycoma (Achi Seed) as a conditioner in sewage treatment. Initial chemical conditioning affects Sludge Dewaterability Number (SDN) and specific resistance (r) in similar manner (Ademiluyi and Eze, 1990). Thus, the lower the SDN and specific resistance the more filterable is the sludge (Christensen, 1983). It has also been shown that chemical conditioning affects

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filtrate and cake qualities (Ademiluyi, 1986). A high solids concentration in the cake after filtration is considered to be high quality, while a high solids concentration in the filtrate gives a low filtrate quality (Ruth, 1935). It should be noted therefore, that, if the filtrate and cake are of low quality, second stage filtration would be needed which will eventually incur extra operational cost. The aim of this work is to assess the coagulation potential of Brachystegen Eurycoma and the evaluation of its effect on filtrate and cake concentration.

METHODOLOGY

The laboratory apparatus and its experimental procedure are simple and have been exhaustively described (Ademiluyi, Egbuniwe and Agunwamba, 1987).

Brachystegen Eurycoma, trees are commonly found in forests and usually along stream banks (skerman, 1977). They can grow as high as 36.59m and about 62m in girth with widely spreading branches. Flowering is between April and May, and fruiting between September and January, The fruits are woody, conspicuous and persistent and about 12.7mm-22.9mm long by 3.81mm-6.35mm broad, thin, with parallel margins or slightly broadening towards the apex. It contains about 4-6 brown, shiny, flat seeds about1.91mm across. It is highly resistant to pest infestations, and because of its abundance in our country Nigeria, its use will be economical, if found suitable as conditioner in sewage treatment. It gives useful Yields, which can ensure continuity if, found suitable in the research work.

Finely ground Brachystegen Eurycoma seeds were used directly to condition the sludge samples filtered in this work. To assess the conditioning potential of the Brachystegen Eurycoma, sludge samples drawn from a batch digested
domestic sludge were dosed with varying amounts of the finely ground seeds. The domestic sludge was taken from the sedimentation tank of the University of Nigeria, Waste Water Treatment works at Nsukka. The domestic sludge samples were than conditioned with various dosages of the finely ground Brachystegen Eurycoma seeds and filtered. To enable comparison between the conditioning potential of the Brachystegen Eurycoma and other conditioners in use, digested sludge samples from the same batch samples above were also conditioned with various amounts of ferric chloride and filtered.

To investigate the effect of conditioning with Brachystegen Eurycoma on filtrate and cake quality, equal amounts of digested sludge samples drawn from a batch sample were conditioned with various amounts of Brachystegen Eurycoma (Eze, 1997) . After filtration, the filtrate and cake concentrations were evaluated in accordance with the standard methods (APHA, AWWA, and WPCF, 1971). In all the filtration experiments, a modified form of coackley's filtration apparatus was used(Ademiluyi,1986)

RESULTS AND DISCUSSION

The experimental results are graphically displayed in Figs. 1, 2, and 3 Figure1, shows the effect of Brachystegen Eurycoma and ferric chloride on sludge dewaterability number (SDN). At initial conditioning, SDN decreases with increasing dosages of all the conditioners (Adewuluyi, Egbeniwe and Agunwamba, 1987).. This shows that Brachystegen Eurycoma seeds can be used as conditioners to improve sludge filterability. As can be seen from fFg.1, the conditioning behaviour of Brachystegen Eurycoma compares favourably with that of ferric chloride, which has been established as an effective conditioner. At the initial dosage, each of these two conditioners produces a more filterable sludge until some optimum values are reached. The optimum dosage for each curve can be determined by drawing a tangent to the curve at the point where there is a sharp break between the straight and the curvilinear portion of the curve (Ademiluyi, Anazodo, and Egbuniwe, 1983). The slope of this tangent also gives the relative sensitivity of the sludge tested

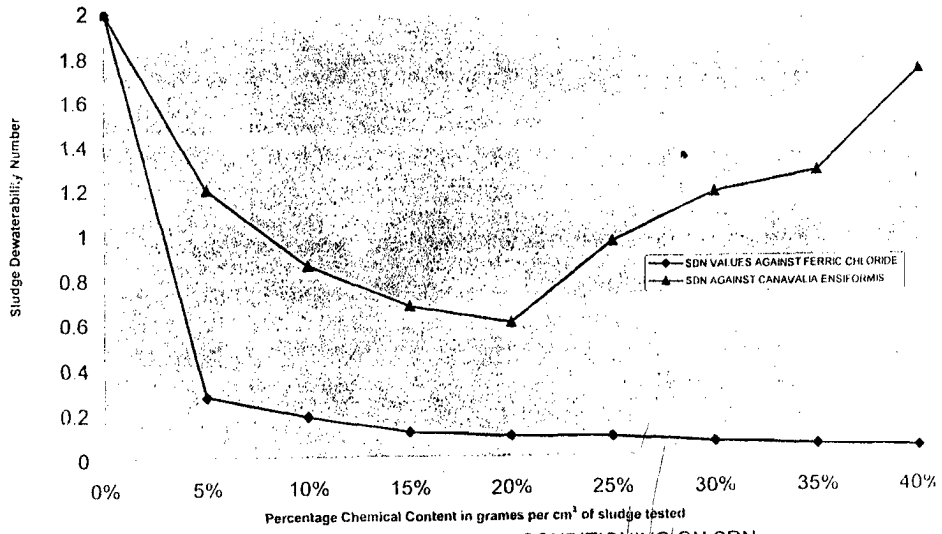

FIG.1 EFFECT OF CHEMICAL CONDITIONING ON SDN OF THE DOMESTIC SLUDGE TESTED

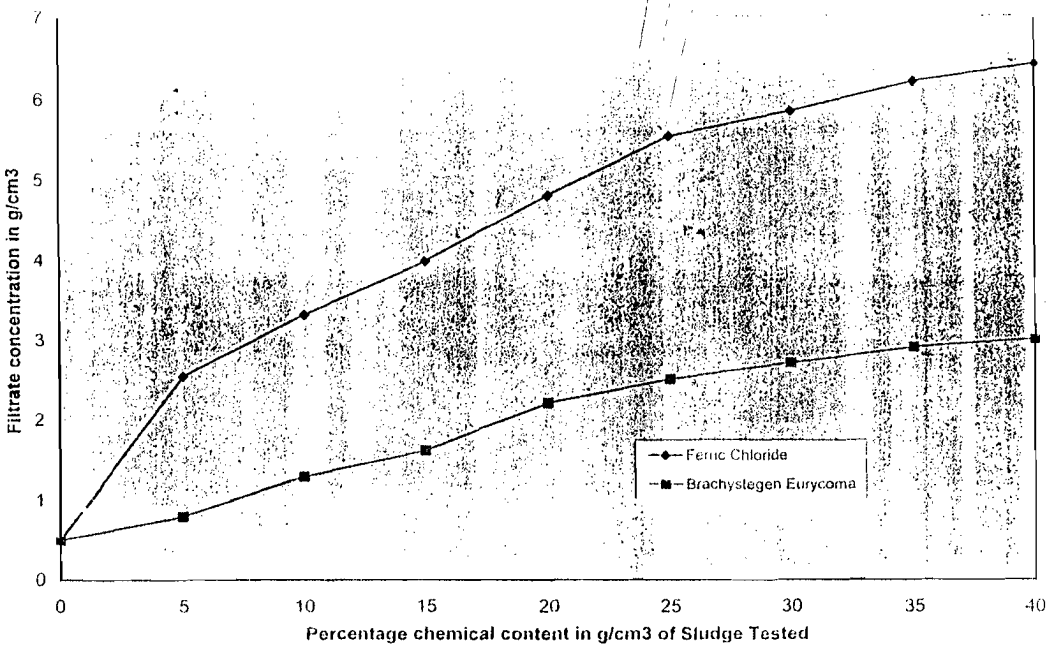

FIG.2 EFFECT OF CONDITIONERS ON FILTRATE CONCENTRATION OF DOMESTIC SLUDGE TESTED

at initial conditioning. The slopes of the tangents are 1.095(2.190g/cm3) for ferric chloride, and 0.60 (1.20g/cm3) for Brachystegen Eurycoma respectively. It is therefore evident from the results that the domestic sludge tested is more sensitive to ferric chloride conditioning than the Brachystegen Eurycoma. The optimum value for Brachystegen Eurycoma is 21.5% (0.43gcm3).

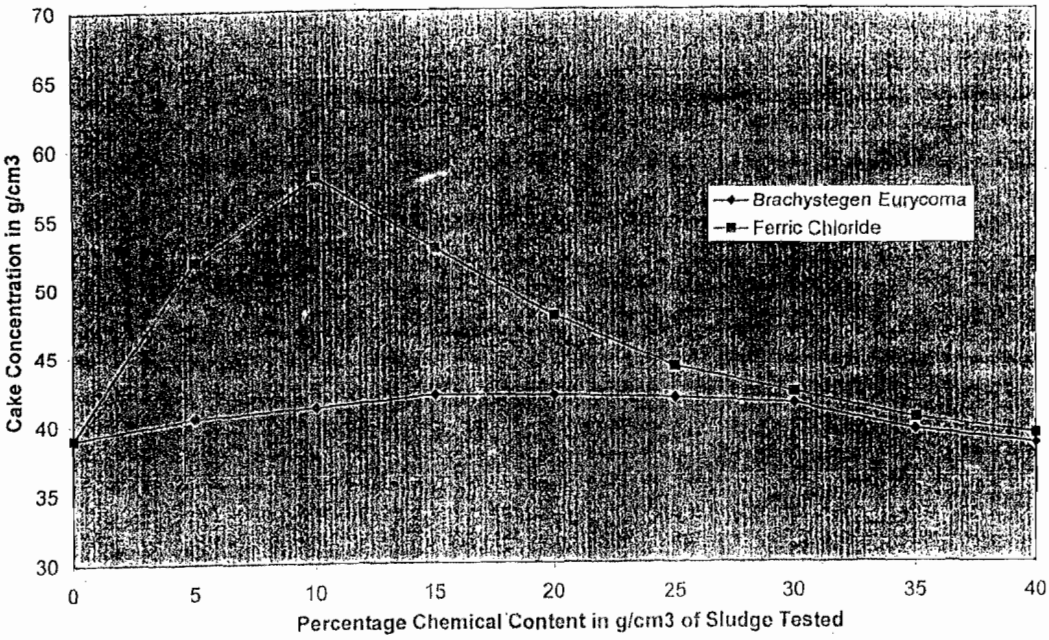

FIG.3 EFFECT OF CONDITIONERS ON FILTRATE CONCENTRATION OF DOMESTIC SLUDGE TESTED

For ferric chloride, the optimum value is 25% (0.5g/cm3). This therefore shows that, ferric chloride has the highest conditioning potential than Brachystegen Eurycoma at all dosages tested.

Brachystegen Eurycoma is therefore a less effective conditioner. However, it has the advantage of not costing much to procure since it is locally grown. It is also a known fact that oil generally inhibits sludge filtration (Dick, 1974). Extraction of oil from it may then increase its conditioning potential. Its ability to lower sludge dewaterability number indicates that it is effective in the coagulation of the sludge particles, which could have otherwise blocked the filter medium. The constituent materials causing coagulation in the seeds are yet to be documented in the literature. Therefore, indepth study is needed to further identify the actual compounds in the seeds, and verify whether any such compounds would have any adverse effects on the resulting product of any dewaterability endeavour.

Fig.2 shows the effect of conditioners on filtrate concentration. From the result, it is shown that the filtrate concentration increases with the increasing dosage of the conditioner tested. This increase is more pronounced in ferric chloride than in Brachystegen Eurycoma. If the main aim of filtration is to procure high cake concentration, then this effect is of no importance. However, if the primary aim of filtration is to reduce the filtrate concentration, then the effect will be of significant importance. If therefore filtrate concentration reduction were required, then Brachystegen Eurycoma would be preferred to ferric chloride.

Fig.3 shows the experimental results on the effect of conditioners on cake concentration. Brachystegen Eurycoma shows an increase in the cake concentration at initial dosage but not as rapid as that of ferric chloride. The most pronounced effect in the cake concentration value was noticed with ferric chloride at a dosage of 10g/l but after that, there is a gentle

decrease till the last dosage applied. Since in waste treatment works, the primary product of filtration is the procurement of cake, Brachystegen Eurycoma will satisfy the foregoing objective. The more the dosages, the greater the cake concentration till after a particular optimum value when the cake concentration starts to decrease. This means that if the primary aim of filtration is to procure high quality cake, these optimum values must not be exceeded (Eze, 1988) . This general trend in the behaviour of the Brachystegen Eurycoma sample tested may be attributed to an enhanced coagulation and flocculation of fine particles at a relatively low dosage. This can be of advantage in industries where materials could be used to procure high quality cake that otherwise may have needed more materials with other conditioners

The increase in the filtrate concentration after the optimum value may also be attributed to the increase in cake porosity formed thereby allowing passage of more sludge particles. Brachystegen Eurycoma is edible without any danger to human life. Thus, its use in waste treatment works where sludge filtration is expedient may not pose any serious problem.

CONCLUSION

Brachystegen Eurycoma has been found to have some conditioning effect on sludge. The optimum dosages for conditioning the digested sludge for Brachystegen Eurycoma is 0.43g/cm3 (21.5%) This compares favourably with the traditional ferric chloride conditioner in improving the sludge filterability. It has been noticed that cake and filtrate concentrations increase with increasing dosages of the seed powders during filtration. If therefore, the primary aim of filtration is the procurement of high quality cake, then, Brachystegen Eurycoma seed would be useful as conditioners. It is noticed that within the range of conditioner tested, higher solids concentration in the cake are produced with Brachystegen Eurycoma seed particles and highly comparable to that of ferric chloride. This means that its particles produced lower filtrate concentration. Finally, the chemical constituents of the seed need to be identified, so that, any inhibitor to sludge dewatering found in the seeds can be extracted

REFERENCES

Ademiluyi J.O. Amazodo, U.G.N., Egbuniwe N., 1983 Filterability and compressibility of sludges-conclusion . Effluent and water Treatment Journal 23 (1): 25-30.

Ademiluyi J.O., 1986. Filtrate and cake quality in sludge dewatering. Effluent and water Treatment Journal 26 (4): 114 - 117.

Ademiluyi J.O., Egbuniwe, N. Agunwamba, J.C., 1987. A dimensionless number as an index of sludge dewaterability: Journal of Engineering for Development, 1: 1-11.

Ademiluyi J.O. and Eze, R.M., 1989. Modification of sludge dewaterability number equation. 2nd UNIBEN - conference on Engineering and Technological Development, Benin-city, Nigeria.

Ademiluyi J.O. and Eze R.M., 1990. Improving the sludge conditioning potential of moringa seed". Environmental Management 14 (1): 125-129.

A.P.H.A., AWWA, WPCF, 1971. Standard methods for the examination of water and wastewater 13th Edition.

Carman, P.C., 1934. A study of the mechanism of filtration part II Journal of the society of chemical industry, Transactions and communication 53, (6) :159-165.

Christensen, G.L. 1983. Units of specific resistance. Journal of water Pollution control federation. 55 (4): 417-418.

Dick R.I., 1974. Sludge treatment, utilisation and disposal" Litt. Review, journal of water pollution controls Federation, 46, 1161.

Eze R. A. M., 1988. Studies in sludge filtration. Unpubl. M. Eng., Thesis , University of Nigeria, Nsukka.

Eze R.A M., 1997. Utilisation of local materials in sewage coagulation, Unpubl. Thesis, University of Benin-City Edo State

Halff. A.H., 1952. An investigation of the rotary vacuum filter cycle as tapplied to sewage sludge. Sewage and industrial wastes, 24 (8): 962-984.

Ruth, D.F., 1935. Studies in filtration 'Derivation of general filtration equation. Industrial and Engineering Chem. 25 (1): 76-82.

Skerman P. J., 1977. 'Tropical forage legumes. FAO Plant production and production series No 2. Food and agriculture organisation of the United Nations. Rome, 609pp.