

INVESTIGATION OF THE CONDITIONING POTENTIAL OF *CANAVALIA ENSIFORMIS* (JACK BEAN SEED)

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ABSTRACT

The finely ground seeds of *Canavalia Ensiformis* (Jack bean 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. During sludge filtration, cake and filtrate concentration increased with increasing dosages of the finely ground seed sample. This indicates that it would be useful as a conditioner if the primary product of filtration is the procurement of high quality cake.

Key words: *Canavalia Ensiformis*, coagulation, sewage sludge, Filtration, and Sludge Dewaterability Number.

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 waste water, 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 study or investigate the conditioning potentials of the finely ground seed of *Canavalia Ensiformis* 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 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 were 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 *Canavalia Ensiformis* 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). *Canavalia Ensiformis* is a new world plant and highly resistant to pest infestations. It is a robust high yielding shrubby annual plant about one metre tall though climbing varieties are also available and is the type under consideration. It can be differentiated more clearly from the closely related species, the sword bean, in that, the seed of *Canavalia Ensiformis* is white while that of sword bean is red. It has a deep root system, which allows it, once established, to draw on stored soil moisture and to survive dry conditions. It is a fast growing crop and can produce in 3 - 4 months. It produces a flat straight scimitar-shaped pod (30cm long x 3 1/2cm wide) that is among the largest of any

domesticated legumes (Skerman, 1977). It is abundant in Nigeria and gives useful yields where cow pea and common beans fail.

Finely ground *Canavalia Ensiformis* seeds were used directly to condition the sludge samples filtered in this work. To assess the conditioning potential of the seeds, 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 then conditioned with various dosages of the finely ground *Canavalia Ensiformis* seeds and filtered. To enable comparison between the conditioning potential of the finely ground *Canavalia Ensiformis* seeds 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 *Canavalia Ensiformis* on filtrate and cake quality, equal amounts of digested sludge samples drawn from a batch Sample were conditioned with various amount of finely ground *Canavalia Ensiformis* seeds (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 cockley's filtration apparatus was used (Ademiluyi, 1986)

RESULTS AND DISCUSSION

The experimental results are graphically displayed in Figs. 1, 2, and 3
Figure 1, shows the effect of *Canavalia Ensiformis* and ferric chloride on sludge dewaterability number (SDN).

At initial conditioning, SDN decreases with increasing dosages of all the conditioners (Ademiluyi, Egbeniwe and Agunwamba, 1987). This shows that *canavalia ensiformis* can be used as conditioners to improve sludge filterability. As can be seen from Fig.1, the conditioning behaviour of *canavalia ensiformis* 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 portion of the curve and the curvilinear portion (Ademiluyi, Anazodo, and Egbuniwe, 1983). The slope of this tangent also gives the relative sensitivity of the sludge tested at initial conditioning. The slopes of the tangents are 1.095 ($2.190\text{g}/\text{cm}^3$) for ferric chloride and 0.632 ($1.264\text{g}/\text{cm}^3$) for *Canavalia Ensiformis* respectively. It is therefore evident from the results that the domestic sludge tested is more sensitive to ferric chloride conditioning than the *Canavalia Ensiformis*. The optimum value for *Canavalia Ensiformis* is 19.50% ($0.39\text{g}/\text{cm}^3$). For ferric chloride, the optimum value is 25% ($0.5\text{g}/\text{cm}^3$). This therefore shows that ferric chloride has the highest conditioning potential than *Canavalia Ensiformis* at all dosages tested.

Canavalia Ensiformis is therefore a less effective conditioner at all the dosages tested. 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.

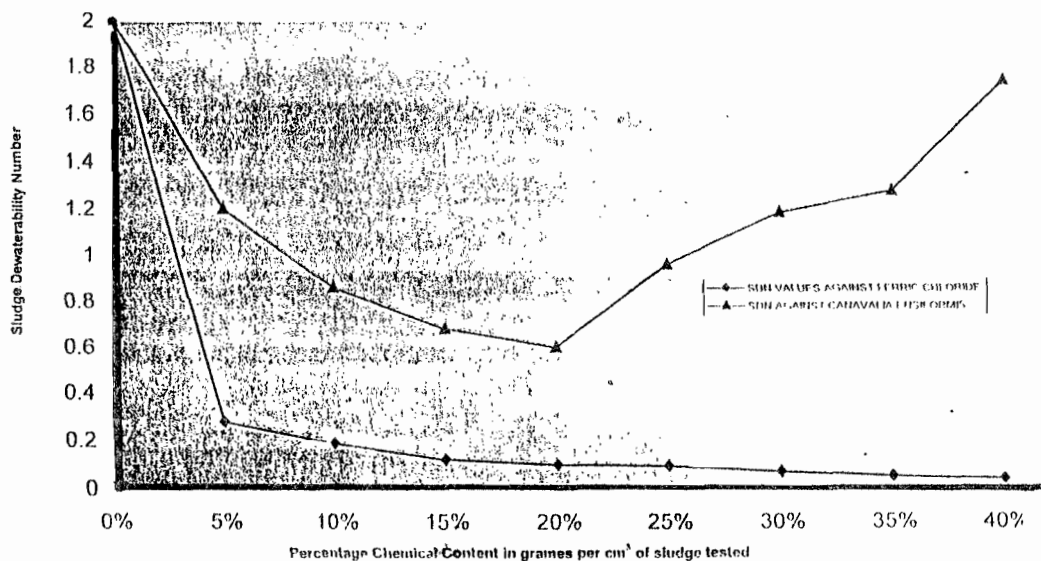


FIG.1 EFFECT OF CHEMICAL CONDITIONING ON SDN OF THE DOMESTIC SLUDGE TESTED

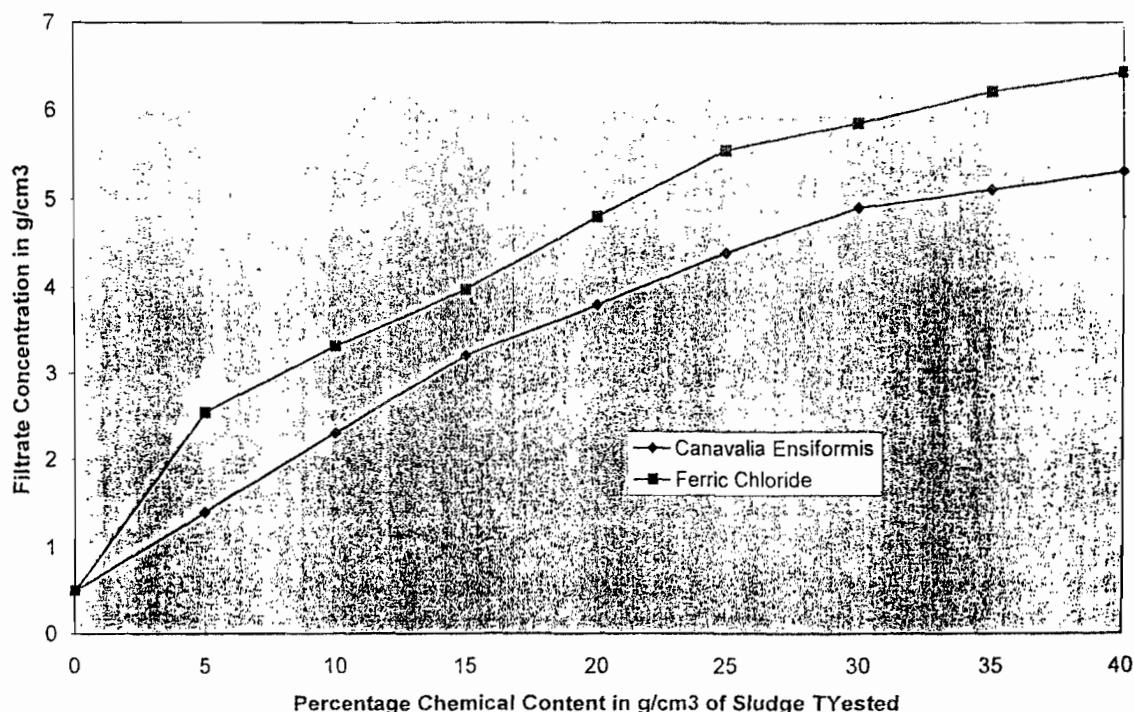


FIG.2 EFFECT OF CONDITIONERS ON FILTRATE CONCENTRATION OF DOMESTIC SLUDGE TESTED

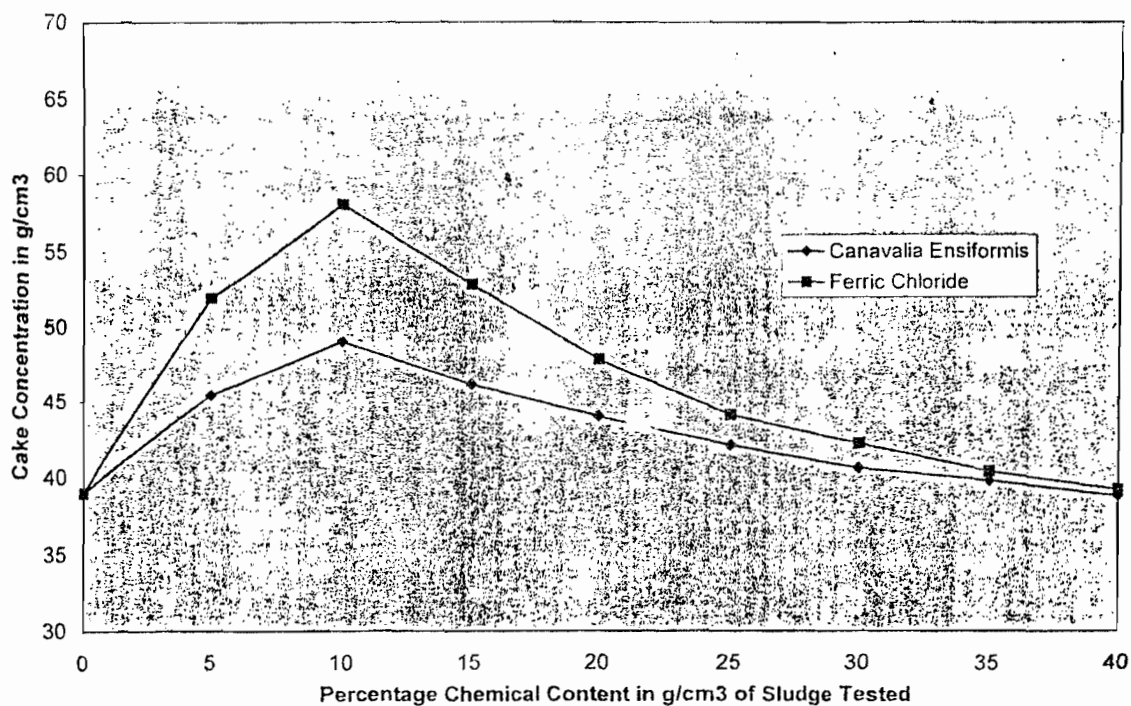


FIG.3 EFFECT OF CONDITIONERS ON FILTRATE CONCENTRATION OF DOMESTIC SLUDGE TESTED

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 Canavalia

Ensiformis. 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 Canavalia Ensiformis would be preferred to ferric chloride.

Fig.3, shows the experimental results on the effect of conditioners on cake concentration. Canavalia

Ensiformis shows a sharp initial increase in cake concentration until 10.5g/l dosage, after which, the rate of increase of cake concentration with conditioning becomes gradual but not as rapid and as pronounced as the initial increase. Canavalia Ensiformis shows an increase in the cake concentration at the initial dosage but not as rapidly as that of ferric chloride. Its optimum conditioning dosage is reached at 10.5g/l after which, the cake concentration decreases gradually till the last dosage applied. 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, Canavalia Ensiformis 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 Canavalia Ensiformis 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. Canavalia Ensiformis is edible with little processing to remove its acidic content. Thus, its use in waste treatment works where sludge filtration is expedient may not pose any serious problem

Conclusion

Canavalia Ensiformis has been found to have some conditioning effect on sludge. The optimum dosages for conditioning the digested sludge for Canavalia Ensiformis is 0.39g/cm³ (19.5%). 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, the finely ground seeds of Canavalia Ensiformis would be useful as conditioner. It is noticed that within the range of conditioner dosage tested, higher solids concentration in the cake are produced with Canavalia Ensiformis seed particles and are highly comparable to that of ferric chloride. This means that its particles produced lower filtrate concentration. Finally, the chemical constituents of the Canavalia Ensiformis need to be identified, so that, any inhibitor to sludge dewatering found in them can be extracted.

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