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DETERMINATION OF PERMANENT, ELECTROMAGNETIC FIELD INFLUENCE ON SEWAGE SLUDGES CONDITIONING

In the paper, some investigations of sewage sludges' conditioning before their dewatering were presented. Sludges were subjected to action of permanent electromagnetic field of magnetic induction equal to 0.04 T, and then treated with polyelectrolytes. Time of electromagnetic field action was: 10, 20, 30, 40, 50 and 60 seconds. Sludges were subjected to two different systems of magnetic poles: (N_S) and (S_N). The efficiency of this method was tested not only for the sludges prepared in such a way, but also for the sludges treated using physicochemical method.

In the chemical process of sewage sludges' conditioning, the optimal doses of polyelectrolytes (Zetag 92 and Praestol 644 BC) were applied. They were determined in the capillary suction time (CST) test. Conditioned sludges were dewatered in vacuum filtration process. Basic characteristic parameters of this process, i.e. resistivity, capillary suction time, final hydration and zeta potential, were established.

1. INTRODUCTION

Sludges make up about 5% of sewage volume being treated. It is estimated that the amount of sewage sludges produced in Poland will be about 0.5 million tons of dry matter per year after the full implementation of sewage treatment plants building programme, and now this amount approaches 0.25 million tons of dry matter [1]. The problem of disposal of sewage sludges is mainly overcome by their storage, combustion and natural management. There exist also another possibilities of utilization of sewage sludges, but they are not used widely [2].

However it seems very important to resolve the problem of sewage sludge management in such a way as to consider the sludge as a useful product, not as a ballast [3].

Taking account of the volume of sludges and the problem of their final utilisation, the sludge dewatering is of the prime importance. Therefore reliable methods of sewage sludge treatment and management should be implemented [4]. And just for this

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reason the methods enhancing the effectiveness of polyelectrolyte action are remarkably efficacious.

One of the trends of investigations, which have been conducted at the Institute of Environmental Engineering of Technical University of Częstochowa, is conditioning of sewage sludges before their dewatering in electromagnetic field. The results obtained encourage the authors to further research [5], [6]. The effect of electromagnetic field on such basic parameters of sewage sludges as CST, resistivity, final hydration and zeta potential was tested in laboratory.

2. EXPERIMENTAL

The tests were conducted on sludges taken after their aerobic digestion in the SUPERBOS-1000 sewage treatment plant. General characteristic of the sludge was as follows: brown colour; insensible odour; pH = 8.18; dry matter content (d.m.) of 19.66 g/dm³ (organic dry matter, 5.95 g/dm³; mineral dry matter, 13.71 g/dm³); zeta potential of -12.50 mV; capillary suction time of 198.0 seconds; initial hydration of 97.8%; final hydration of 84.9% and resistivity of 2.1·10¹³ m/kg. The samples of sludges were subjected to the action of electromagnetic field of magnetic induction equal to 0.04 T. Exposition of sludges lasted 10, 20, 30, 40, 50 and 60 seconds. Zetag 92 and Praestol 644 BC were used as chemical reagents. The optimum polyelectrolyte doses and the most proper time of an electromagnetic action were determined on the basis of the capillary suction time (CST).

3. RESULTS

In the case of sludges treated with polyelectrolyte Zetag 92 in the optimum dose of 3.5 mg/g d.m. and then subjected to an action of electromagnetic field, the changes in the values of the parameters tested were observed (figure 1 and figure 2).

The results of laboratory tests with polyelectrolyte Zetag 92 in the dose of 3.5 mg/g d.m. revealed that the (^S_N) system of magnetic poles was favourable. The values of all parameters investigated were lower than their initial values in the range of 10–20 seconds. On the other hand, the values of final hydration and resistivity were minimal for the longest time of the electromagnetic field action equal to 60 seconds (figure 1). For the system presented in figure 2, the decrease in the CST values, final hydration and resistivity was observed, but the results obtained were more advantageous for the (^S_N) system. For the sludges subjected to action of electromagnetic field and treated with Praestol 644 BC in the dose of 3.5 mg/g d.m. the dewatering results were worse compared with the results obtained for the sludges treated with polyelectrolyte Zetag 92 (of 3.5 mg/g d.m.). Only the values of final hydration were different; for

example, 20–40 seconds of the sludge exposition to the electromagnetic field in the (S_N) system of magnetic poles were in this case the most favourable (figure 3).

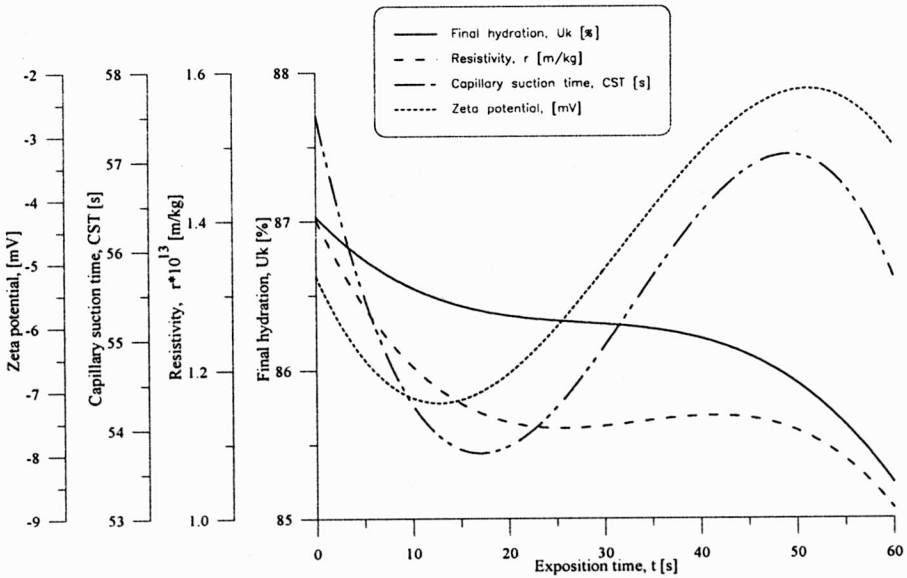


Fig. 1. Influence of the electromagnetic field on the parameters of sludges dewatered in the filtration process after conditioning with polyelectrolyte Zetag 92, the (S_N) system

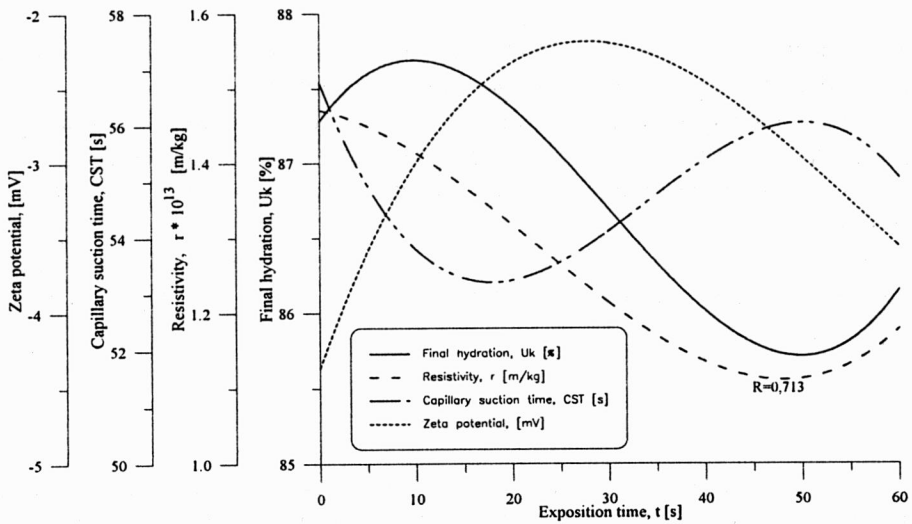


Fig. 2. Influence of the electromagnetic field on the parameters of sludges dewatered in the filtration process after conditioning with polyelectrolyte Zetag 92, the (N_S) system

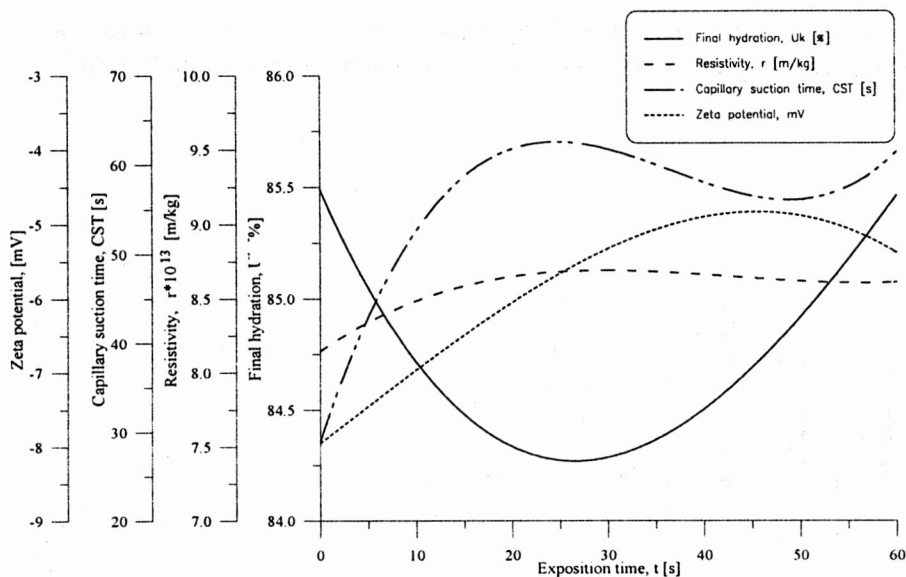


Fig. 3. Influence of the electromagnetic field on the parameters of sludges dewatered in the filtration process after conditioning with the polyelectrolyte Praestol 644 BC, the (S_N) system

4. CONCLUSIONS

- Application of physical method (electromagnetic field) before chemical conditioning proved to be justified in sewage sludge preparation.
- The reversed system of magnetic poles (S_N) better supported conditioning of unprepared sludges in the time interval from 30 to 50 seconds than the conditioning of sludges subjected to chemical preparation (Zetag 92 of the dose of 3.5 mg/g d.m. for the exposition time of 10–20 seconds).
- Final result of sludges conditioning by means of the combined method depended on the kind of polyelectrolyte used (of characteristic similar to Zetag 92) and the system of solenoid magnetic poles.

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OKREŚLENIE WPLYWU STAŁEGO POLA ELEKTROMAGNETYCZNEGO NA PROCES KONDYCYJONOWANIA OSADÓW ŚCIEKOWYCH

Przedstawiono badania dotyczące sposobu kondycjonowania osadów ściekowych przed ich odwadnianiem. Na osady działano stałym polem elektromagnetycznym o indukcji magnetycznej 0,04 T, a następnie polielektrolitami. Czas ekspozycji osadów na działanie pola elektromagnetycznego wynosił, 10, 20, 30, 40, 50, 60 sekund. Osady eksponowano w dwóch różnych układach biegunów magnetycznych: (S_N) oraz (S_N). Skuteczność tej metody badano dla osadów preparowanych nie tylko polem elektromagnetycznym, ale również metodą fizykochemiczną.

W procesie chemicznego kondycjonowania osadów ściekowych stosowano optymalne dawki polielektrolitów Zetag 92 oraz Praestol 644 BC, ustalone na podstawie testu CSK. Kondycjonowane osady odwadniano metodą filtracji próżniowej. Wyznaczono podstawowe parametry charakterystyczne dla tego procesu: opór filtracji, czas ssania kapilarnego, uwodnienie końcowe oraz potencjał elektrokinetyczny ζ .

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