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RESEARCH ARTICLE

A STUDY ON DEWATERABILITY IMPROVEMENT OF SEWAGESLUDGE BY MIXING WITH WOOD WASTE USING ULTRASOUND TREATMENT

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ABSTRACT

Considered the possibility of the improvement in dewaterability of sewage sludge by treating ultrasonic waves to sludge with waste wood. The sludge used in this study was collected directly from the sewage treatment plant. It is mixed with 5% waste woodwith holding the pH and temperature, and then treated by ultrasound at different treatment times. The study found that the CST values of sludge with wood waste that did not treated by ultrasound decreased compared to single sludge. Andthe CST values tended to decrease after 5min of ultrasound treatment but it was measured to increase gradually as time of treatment was increase.

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INTRODUCTION

Marine dumping, which accounted for the largest share of sewage sludge treatment in Korea, has been completely prohibited since 2012 by the London Convention. And RPS (Renewable Portfolio Standard, RPS) and CDM (Clean Development Mechanism, CDM) has been activated In the same year. Therefore, there is a need to develop more continuous and stable sludge treatment and utilization technologies. In case of sewage sludge, it is judged that it is highly likely to be used as a powerful fuel source due to high organic content, but the pretreatment of sludge cost a lot because of high moisture content and low dehydration. This accounts for the largest portion of the cost used for overall sewage treatment (Cho, 1985). In addition, we are using coagulations and filter aids to improve the dehydration of sludge, but there is a concern of secondary environmental pollution. Various technologies such as ozone treatment, freeze treatment has been studied to solve this problem (Wang, 2001), and Research on ultrasound treatment, one of the environmentally physical treatments without secondary environmental pollution, is also underway.

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The mechanism of ultrasonic treatment of sludge is to induce changes in the physical and chemical properties of sludge using the energy of the breakdown of fine bubbles generated by ultrasonic waves (Muller, 2003). The effects of this have been demonstrated through various studies. In this study, to consider the possibility of improving the dehydration of sludge, waste wood, one of the waste biomass, is applied as a filter aid.[4)] Then, the sludge with waste wood is treated by ultrasound. To consider changes in dehydration, sludge was collected directly from the sewage treatment plant in Incheon and lab-scale ultrasonic treatment reactor was used.

MATERIALS AND METHODS

Material: The sludge was collected at a sewage treatment plant in Incheon andused within two days under refrigeration. Waste wood was collected at a landfill in same city and then, broke it into small pieces. And used the mixture that mixed waste wood 700g into sewage sludge 14L (5%) as specimen. The result of the proximate analysis and solid analysis are shown in (Table.1), (Table. 2)

CST (Capillary suction time) test: To evaluate sludge dehydration, the CST(Capillary suction time) test which is widely used as indirect indicator and is easy to measure was used.

Table 1. Proximate analysis of sewage sludge and waste wood

Material	Moisture (water %)	Volatile matter (water %)	Ash (water %)	Fixed Carbon (water %)
Sewage Sludge	97.63±0.31	1.02±0.10	1.14±0.16	0.21±0.05
Waste wood	17.59±1.31	51.37±3.46	6.17±2.65	24.86±4.98

Table 2. Solid analysis of sewasgesludge and waste wood

Material	TS(%)	VS/TS(%)	VS(%)	SS(mg/l)
Sewage Sludge	2.37±0.31	52.05±0.65	1.23±0.18	149181±2733
Waste wood	82.41±1.31	92.54±3.13	76.24±2.60	

Table 3. CST variation with Sonication time

Sonication time		0	5	10	20	30	60	120
CST (sec)	Sludge with waste wood	20	19.2	53.4	95.9	98.7	315.6	621.8
	`Sludge	23	-	-	-	-	-	

This is a simple experimental method of indicating value of resistance approximately. When the sludge is injected into the funnel, which has an internal diameter of 10mm, the time for moving of water in the sludge is measured through two electrodes and timers and this is called CST.[5] CST values are low for specimens which have high dewaterability. The mixture was rapidly stirred at 160rpm for 30 seconds, then stirred at 40rpm for 90 seconds, then measure the CST of the specimens after filtering with 5mm test sieve (Figure. 1) shows a diagram of the CST test device.

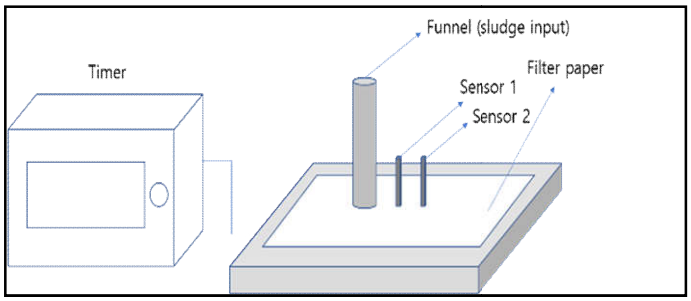

Figure 1. The diagram of the CST tester

Ultrasound treatment reactor

The ultrasound treatment reactor was made in lab-scale (15L), with an ultrasonic transducer set at 20kHz and the controller of ultrasonic power. The sludge with waste wood put into the reactor and considered changes of CST values over ultrasonic treatment time.

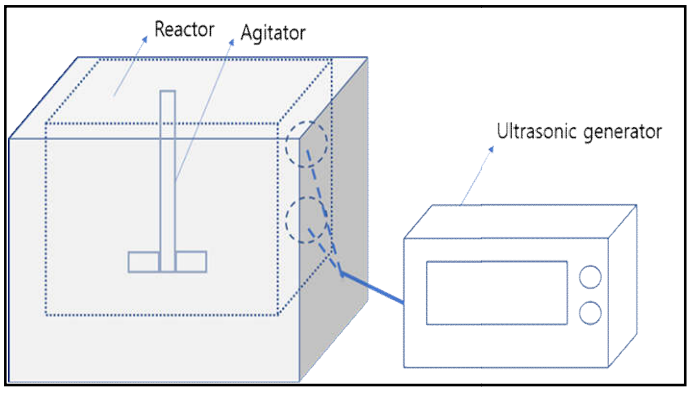

Figure 2. The diagram of the ultrasound treatment reactor

RESULTS

The changes of CST values of the mixture which mixed 700g of waste woond into 14L of sewage sludge were measured after ultrasound was applied at different time (5min, 10min, 20min, 30min, 60min, 120min) at an constant temperature (25°C) and pH (6.4). As a result (Table 3), (Figure 3), the CST value of sludge with waste wood (before ultrasound treatment) was reduced by 13% compared to single sludge. And when mixture was treated by ultrasound the CST value decreased 16.5% in case of 5min. But the CST values becomes increased as the treatment time increased. This is believed to be caused by waste wood. In detail, the improvement in dewater ability of sludge is because ultrasonic waves breaks cells of sludge and thus release bound water from cells into aqueous phase,[6] but waste wood disturbed this.

Figure 3. CST variation with Sonication time

Conclusion

In this study, waste wood, one of the waste biomass, was used as a filter aid in sewage sludge treatment, then ultrasound treatment was applied to identify the possibility of improvement in dehydration of sewage sludge. After mixing 5% of waste wood into sludge, an ultrasonic wave of 20kHz and 200W was shot in different times. As a result, the CST values of sludge with wood waste that did not treated by ultrasound decreased compared to single sludge. And the CST values tended to decrease after 5min of ultrasound treatment but it was measured to increase gradually as time of treatment was increase. The results of this study show that the mixture of sludge and waste wood and ultrasound treatment in less than five minutes can have positive effects on dewaterability of

sludge. This is expected to be useful for the continuous and stable treatment of sludge.

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