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論 文 要 旨

THESIS SUMMARY

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要旨（英文 800 語程度）
Thesis Summary (approx.800 English Words)

Antibiotic bacterial residue (ABR) is the digestion residue comes from the antibiotic production process. The antibiotics content, the high moisture content (85 wt.%) and the high protein content (30-40wt.% in dry base) make this waste hazardous and difficult to be managed. By reviewing previous studies on the hydrothermal treatment (HTT) to convert high moisture waste into solid fuels, the proposal of this study was raised to manage the ABR by HTT combined with combustion. The task of this study is to explore a feasible system for the management of ABR.

Firstly, the processing characteristic of HTT on the ABR is investigated in a batch scale autoclave reactor. The effects of the HTT operating parameters including the temperature and the holding time were discussed. The water removal performance of the ABR varied with different experimental conditions was revealed. Besides, the mass balance during HTT was obtained. The results showed that HTT could largely facilitate the centrifugation water removing from the ABR. A higher operating temperature and a longer holding time both could boost the water removal in a deeper level. The best situation showed that the HTT product could be centrifuged to obtain 26wt.% moisture content material. The needed oven drying time to get 20 wt.% moisture content material also could be shortened from 10hours to 1hour after HTT. The mass balance showed that around 50% of the solid matter was dissolved in the liquid phase during HTT. As a result, around 60-80% of nitrogen could be removed from the ABR by HTT and centrifugation. Besides, around 25-45% of the ash could be leached out during these processes. The products from various HTT operating conditions were characterized to investigate the possibility of solid fuel production from the ABR by HTT. The safety disposal of antibiotics substance in the ABR using HTT was studied using a model solution. The solid products were analyzed by the calorific oxygen bomb, the ultimate analysis, the proximate analysis, XDF, XPS and FTIR. Correspondingly, the liquid products were analyzed by the pH value meter, the COD analysis, the spectrophotometer and the LC-MS. The HHV of the dried ABR increased by about 27% after HTT. The oxygen (O) and nitrogen (N) content in the solid product gradually decreased as the HTT temperature increased. Correspondingly, the COD and the nitrogen concentration of the aqueous products were increased gradually as the HTT temperature increased. The hydrolysis of carbohydrate and protein during HTT led to the reduction of O and degraded molecules into smaller molecule so that N was dissolved into the aqueous. As a result, the HHV was increased and the N content was decreased. Alkali metal in solid fuels could also be leached out by HTT and centrifugation. As for safety disposal of the antibiotics substance in the waste, the results show that after HTT, almost all the cephalosporin C sodium could be degraded. HTT can upgrade the ABR for solid fuel production and

effectively decompose the antibiotic for safety disposal.

Furthermore, In order to get more information about HTT of the ABR for industrial application, HTT research was conducted in a 2 m^3 large scale reactor. The properties of the solid product and liquid product were analyzed respectively. Besides, the mass balance and the energy balance during HTT and the dewatering process were discussed based on the large scale experimental results. In addition, a new process was developed to reduce the energy consumption of the total system. The results showed that the solvable COD in the liquid products were ranging around 6,4000mg/L to 88000mg/L which were suitable for the methane production by digestion. The dewaterability of the mycelail residue was improved after HTT. 23.8% of the total solid energy input could be received in the solid fuel. By introducing the new HTT, the energy consumption could be reduced by around 41.4% in the 180 °C, 30min HTT.

Later on, the effect of HTT on the combustion performance of the ABR was investigated. The dried raw ABR and the solid fuel obtained from 200 °C, 30min HTT were combusted in the thermo gravimetric analyzer to reveal their combustion characteristics. In addition, the NO emission from the combustion of the samples was studied in a silica reactor under the conventional combustion mode and the air staging combustion mode. The co-combustion of coal and the ABR was also conducted under the different blending ratios. The TGA curves showed that HTT could improve the combustion reactivity of the ABR. Compared with the raw ABR, the NO emission of HTT treated one was reduced (the largest reduction was 45%) under any combustion mode or any combustion condition. Compared with conventional combustion, the air staged combustion was helpful for the reduction of the NO emission where the combustion temperature of 1000 °C showed the largest reduction by 38%. By co-combustion of coal and the ABR, the NO emission level could be well controlled.

As conclusions, an energy self-sustainable and low emission system combining HTT with combustion was established and tested to be feasible for the management of hazardous ABR. The future research should be focused on the usage of the liquid production possibly by anaerobic digestion for methane production.