

RESEARCH PROGRESS ON ANAEROBIC DIGESTION OF CELLULOSE WASTE BASED ON BIBLIOMETRIC ANALYSIS

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INTRODUCTION

Lignocellulosic waste as an important component of organic waste is more productive and more difficult to treat. Lignocellulosic waste is a huge biomass resource when disposed of rationally, so it is vital that lignocellulosic waste is disposed of in a rational way[1]. Relying on incineration and landfill for waste disposal can create secondary pollution and is not economically viable[2]. Studies have demonstrated that lignocellulosic biomass has a significant potential for biomass fuel production[3]. Anaerobic digestion of organic waste can produce clean energy and other organic products while efficiently degrading organic waste, reducing human dependence on fossil energy and greenhouse gas emissions, with environmental, economic and social benefits[4]. However, the crystalline and reticulate structure formed by the lignin, cellulose, and hemicellulose increases the difficulty of anaerobic digestion[5]. Therefore, the hydrolysis rate of cellulose waste is slow and the methane yield is low[6]. Scholars have conducted extensive research to improve the methane yield of cellulose waste. To study the progress of the anaerobic digestion of cellulose waste and the future development trend, this paper conducted a literature search and bibliometric analysis based on the Web of science database, and reviewed the current hot areas to improve the anaerobic digestion of cellulose waste.

MATERIALS AND METHODS

Information Summarized from the ISI Web of Science published by Thomson Reuters [7] and Science Citation Index Expanded (SCIE) database were the primary data source. In this study, (cellulos* waste* or fiber* waste* or fibre* waste* or garden waste* or paper* waste* or straw* waste* or agricultur* residue* or yard* waste* or lignocellulosic biomass or forests waste or grass) and (anaerob* digest* or biogas or methane) was used as a search phrase to search topics in SCIE for the period from 2002 to 2021. The 2021 Journal Citation Report (JCR) is also add in the study as a data source.

All the analysis were all count using Excel 2019, Bibliometrix(in R) and VOSviewer.

RESULT AND DISCUSSION

Fig. 1 displays the overall publications as well as the number of articles from the top 5 countries for the period 2002-2021. Research on the anaerobic digestion of cellulose waste has developed rapidly in this century, which may be related to the emphasis placed by the Food and Agriculture Organisation of the United Nations (UN) on bioenergy, agroenergy, wood energy, etc The results of a bibliometric analysis of articles published between 2002 and 2021 by countries and institutions are shown in Fig. 2 which shows that anaerobic digestion of cellulose waste has been actively explored and studied in many countries around the world.

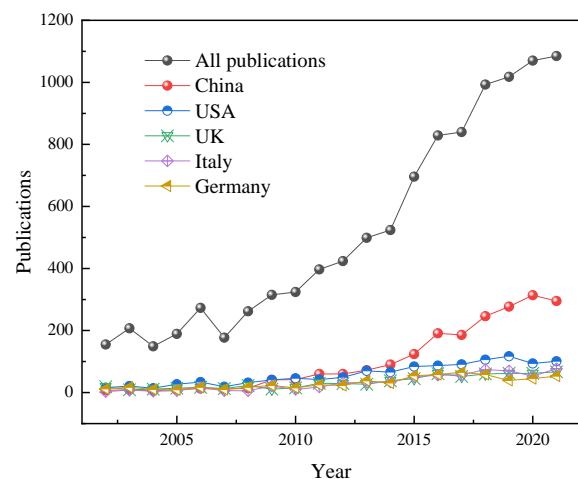


Figure 1. Number of SCI publications on -related research and trends in the top 5 countries with the highest numbers of publications in 2002-2021

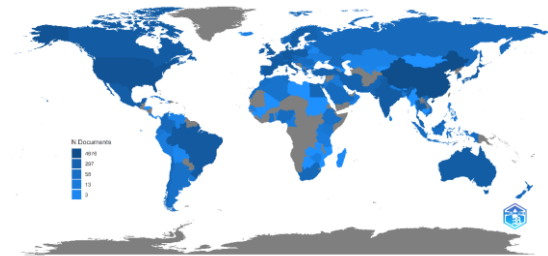


Fig. 2 Research in various countries around the world Statistical analysis is often performed on author keywords to understand the research trends and frontiers. Words with the same meaning need to be combined before processing. This result indicates that pretreatment

and co-digestion play an important role in improving the efficiency of anaerobic digestion of cellulose waste. The microbial community is valued during anaerobic digestion.

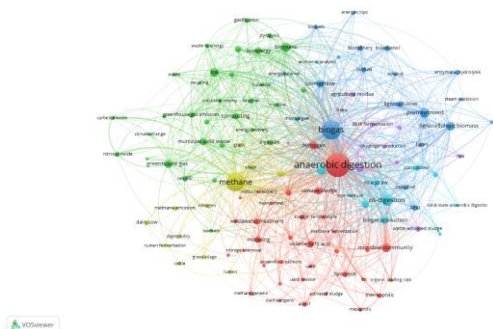


Fig. 3 Clustering analysis of author keywords occurring more than 40 times

TREATMENT TO IMPROVE THE ANAEROBIC DIGESTION EFFICIENCY

Pretreatment is an initial treatment to modify the structure of lignocellulose waste for increased efficiency before anaerobic digestion. The pretreatment is varied and the conditions are complex, so it has a wide range of effects on methane production. The improper selection of conditions may not promote increased methane production. The mechanism of physical pretreatment to enhance the methanogenic capacity of cellulose waste varies. Crushing destroys the cell wall of the plant and increases the specific surface area to enhance biodegradability. Microwave, ultrasound, electron beam and γ -ray treatments can destroy the structure of lignocellulose. Physical pretreatment may lead to the loss of components. Microwave and thermal pretreatments may produce furfural, melanoid and other substances due to the temperature rise that may inhibit the methane production process. Two main principles of chemical pretreatment to enhance anaerobic digestion exist. One is to break chemical bonds, i.e. break down esters or glucoside side chains to improve the biodegradability of waste. The other is using the substances generated from the reaction process as catalysts for 'autocatalysis' to promote anaerobic digestion. Biological pretreatment has low energy consumption and no pollution and mild operating conditions. This pretreatment needs no additional chemical substances. From the perspective of energy, biological pretreatment has certain advantages. Cellulose waste such as agricultural wastes often have a high C/N ratio, so the degradation rate is usually slow and the stability of the system is poor when anaerobic digestion is performed alone. Co-digestion can not only improve the process stability by regulating the C/N ratio but also reduce the cost of biogas purification and fermentation residue processing. The most common substrates for co-digestion are kitchen waste, livestock manure and sludge. Anaerobic digestion is a complex,

multi-process metabolic pathway carried out by various microorganisms acting together in an anaerobic environment. With the development of molecular biology technology, increasing studies on microbial community structure are being conducted. The microorganisms of the anaerobic digestion process are often divided into bacteria and archaea.

CONCLUSION

Based on the articles from SCIE, this bibliometric study provided an overview of research in anaerobic digestion of cellulose waste and identified some significant points in this field throughout the investigation period. China was the most productive country. The results show that the overall research related to the anaerobic digestion of cellulose waste is increasing. Pretreatment, co-digestion and microbial communities of cellulose waste are hotspots of research.

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