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Current situation and development of kitchen waste treatment in China

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Abstract

More than 30 million tons of kitchen wastes (KW) are produced in China every year. Approximately 80% of the collected KW has been directly utilized as feedstuff in pig farms in China, which is facing strict restrictions by China's Ministry of Agriculture due to concerns of foot and mouth disease, and raw materials for illegal extraction of hogwash oil, which is unsanitary and can cause serious illness. In addition, the universal concern on environmental protection, resource utilization and food safety has brought increasing research on KW processing technology. According to the policy perspective on promoting the recycling application and resource saving of KW, developing resource-saving and environment-friendly society as well as circular economy and protecting the ecological environment in both China (FAGAIHUANZI [2010] No. 1020) and other countries, it is required especially in China that the construction of pilot projects should be conducted overall planning and combinational optimization to enhance resource-oriented utilization and harmless treatment of three phases in KW, including oil, solid and liquid phase (FAGAIHUANZI [2010] No. 1020). Because of policy encouragement, environmental concern and economic incentives by local and central governments in China, more diverse methods after thermal pretreatment should be developed as the amount of KW production increases rapidly. Besides, basing on the increasing universal concern on safety, energy and environmental preservation, finding proper disposal methods of KW for energy production, enhancing biogas production and reducing the amount of final residue is extremely important. In this regard, this paper aims at a comprehensive study on current treatment situations of KW in China and suggests several solutions to China's KW treatment.

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1. Introduction

The production of kitchen waste (KW) significantly increases along with the development of the restaurant industry as well as the increase in consumption in China. Approximately 80% of the collected KW has been utilized as feedstuff in pig farms. However, the direct use of KW as feedstuff is facing strict restrictions by China's Ministry of Agriculture due to concerns of foot and mouth disease[1]. Owning to their high moisture and salt content, there are two potential problems on the incineration of KW, including extra energy consumption, and generation and release of toxic pollutants to the environment, such as dioxins.

Three main reutilization methods for KW collected from formal channels include animal feed via sterilization, fertilizer via composting and bioenergy via anaerobic digestion (AD). KW could be applied to compost and anaerobic process due to their high organic matter content and comprehensive nutrition element. However, the high content of moisture, oil and salt in KW does not favour the compost process, thus restricts their application in fertilizer utilization. Anaerobic digestion, an effective technology that can convert KW to green energy, has been widely used for the treatment of municipal biomass waste in recent years. When KW is treated anaerobically, common problems would appear during conventional AD because of their high oil content and the presence of macromolecular compounds, including the accumulation of lactic acid at an early stage of the digestion process resulting in a sudden pH drop and inhibitory levels of ammonia, sulphide and long-chain fatty acids due to the high protein and fat content[2]. These factors usually impede digestion stability, thus restricting the application of anaerobic digestion. In addition, the lack of efficient technology for disposal of biogas residues, the secondary pollutant during anaerobic digestion, also limits the application of anaerobic digestion in the recycling of KW.

In addition, numerous pre-treatment methods, such as mechanical (e.g. sonication), chemical (e.g. alkali or acid), osmotic (e.g. NaCl treatment, freezing), oxidative (e.g. ozone), thermal and biological (e.g. enzyme) has been proposed to improve the physical and chemical properties of KW to enhance the solubilisation of organic particulates, sterilization effects and promote the subsequent reutilization, such as promote biogas production[3, 4].

Due to the concern on environmental protection, resource utilization and food safety, domestic and foreign governments have placed increasingly stringent restrictions on KW management, and since 2002, the European Union (EU) has enforced a ban on feeding these mixtures to animals due to the formation of harmful compounds during frying and their return back into the food chain through the animal meat. Recently, Chinese government has promulgated a series of laws and regulations for the disposal and recycling of KW to guarantee the effect of disinfection sterilization, avoid the premise of exogenous pollution and improve the recovery rate of useful resource such as nutrients and lipids.

Moreover, Chinese government has published the animal husbandry law for prohibiting the direct utilize of KW as feedstuff in pig farms, and three ministries in China including the Supreme People's Court, Ministry of Public Security and The Supreme People's Procuratorate co-issued the notification about severe punishment by the law on criminal activities of waste cooking oil. Meanwhile, since 2011, four ministries in China including National Development and Reform Commission, Ministry of Housing and Urban-Rural Development and Ministry of Environmental Protection and Ministry of Agriculture co-issued the notification of carrying out the pilot projects on resource utilization and innocuity treatment of KW. Till now, 100 pilot projects have been nominated and approximately 80% choose anaerobic digestion as the main disposal technique.

Among these treatment methods for KW, Each approach has its own characteristic including benefits and drawbacks. In this regard, this paper aims at a comprehensive study on the characteristics of treatment methods of KW in China. In addition, the performance and characteristics of the corresponding products of foreign countries are analyzed in detail. Some key techniques which are adopted in these products are discussed.