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Review on the Application of Agricultural Waste Resources

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Abstract

Globally, the positive effects of aerobic fermentation industry on the resource utilization of agricultural waste and products on the agricultural production environment have been fully proved. Therefore, it is of great and far-reaching significance to improve the development level of agricultural waste aerobic fermentation industry. In this paper, the current situation of agricultural waste in China, the requirements of aerobic fermentation raw materials and the process were reviewed in order to provide scientific basis for the study of aerobic fermentation of agricultural waste.

Keywords

Livestock Manure; Crop Straw; Stacked Aerobic Fermentation; Reactor Aerobic Fermentation.

1. Introduction

Since China's reform and opening up, the amount of livestock and poultry breeding has increased step by step, and the problem of environmental pollution caused by a large amount of livestock and poultry manure has also been highlighted. Livestock manure is easy to breed and carry a large number of pathogenic bacteria, which not only pollutes the natural environment, but also poses a great threat to the health of livestock and human beings. In recent years, with the support of national policy dividends, the comprehensive utilization of crop straw, livestock and poultry manure and other wastes has gradually achieved scale and industrialization, but the industrialization development in some areas is basically in a state of disorderly expansion and blind development [1]. Therefore, on the basis of maximizing the environmental acceptability and economic affordability, how to reduce, harmless and recycle livestock manure, crop straw and other agricultural wastes will be the ideal goal pursued by people at this stage.

2. Livestock Manure, Crop Straw and Other Agricultural Wastes Production and Environmental Pollution

2.1. Livestock Manure Production and Environmental Pollution

Animal husbandry and poultry industry provide more than one-third of the protein demand for human beings. Its production accounts for almost half of the global agricultural economy and is the main livelihood provider for almost all developing countries. According to Zhu [2], the amount of manure resources produced by pigs, cattle, sheep, poultry, livestock and other animals was estimated. In 1980, 1985, 1990, 1995, 2000, 2005, 2010 and 2011, China produced

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14.80×108 t, 20.64×108 t, 22.42×108 t, 22.55×108 t, 23.95×108 t, 22.63×108 t, 22.82×108 t and 21.21×108 t, respectively. From 1980 to 2011, there was a total increase of 6.41×108 t of livestock and poultry manure.

Livestock manure generally causes the following types of harm: (1) Air pollution. Livestock and poultry breeding will produce a large number of odorous gases, including toxic and harmful gases such as ammonia, carbon dioxide, methane, sulfur-containing compounds, etc., which lead to heavy air pollution, affect air quality, and easily cause respiratory diseases in some people and animals. (2) Water and soil pollution. Untreated pig manure will breed mosquitoes and flies, producing stench, long. The accumulation of time will cause water pollution, resulting in an increase in the concentration of groundwater. (3) Spread of bacteria. Microorganisms in livestock and poultry are mainly excreted through the digestive tract, and feces are the main microorganisms. A variety of bacteria and parasite eggs, such as Escherichia coli, Salmonella, Staphylococcus aureus, avian influenza virus, Marek's virus, roundworm eggs and coccidia eggs, are excreted from diseased or diseased livestock with feces. If the manure is not handled in time, it will breed a large number of mosquitoes and flies to become a dangerous source of infection, causing the spread of disease, not only affecting the health of livestock and poultry, and even some pathogens will also affect human health [3, 4].

2.2. Crop Straw Wastes Production and Environmental Pollution

Among China 's agricultural biomass resources, energy crops with high sugar content such as wood tomb, sweet sorghum and sweet sorghum are mostly used to produce fuel ethanol. Oil crops such as rape, jatropha, and Pistacia chinensis are suitable for biodiesel production. Their raw material components are mainly starch or oil. Agricultural waste resources (rice straw, livestock and poultry manure, etc.) are mostly used for the production of solid and gaseous biomass products due to their complex composition and rich lignocellulose, including feed, fuel, energy, fertilizer, base material of straw, energy and fertilizer of livestock and poultry manure [5]. According to the latest statistical results, in 2015, China's crop rice straw was 1.04 billion tons, and the collection capacity was about 900 million tons. The output of agricultural waste is huge. If it is not treated in time, it will affect agricultural production and cause non-point source pollution.

3. Common Raw Materials for Aerobic Fermentation

Agricultural waste is the main raw material of aerobic fermentation industry in China. Among them, livestock and poultry manure mainly provides nitrogen source for microbial utilization in aerobic fermentation process. In addition to providing carbon source, crop straw can also regulate composting environment, such as regulating water, increasing porosity, shortening aerobic fermentation time, improving reactor temperature, and reducing pathogens, weed seeds and nitrogen loss in livestock and poultry manure to produce high-quality fertilizers. According to the data of the Agricultural Ecology and Resource Protection Station of the Ministry of Agriculture and Rural Affairs, the amount of crop straw used as fertilizer in 2016 was 388.731 million tons, accounting for 37.28% of the total theoretical resources [6].

Agricultural waste is mainly composed of three types of polymers, namely lignin, cellulose and hemicellulose. Lignocellulose is degraded through a complex multi-step process involving the synergy of various microorganisms (mainly fungi), producing a variety of cellulose-decomposing enzymes, hemicellulose-decomposing enzymes and lignin-decomposing enzymes that specifically and synergistically degrade lignocellulose. In lignocellulosic biomass resources, their organic components are usually very different, lignin (5%~35%), cellulose (9%~80%), hemicellulose (10% ~50%), which will directly affect their biodegradability. It will also significantly affect the type of microorganisms in the aerobic fermentation process [7]. Corn straw and rice straw are composed of about 70% cellulose and hemicellulose and 15% to 20%

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lignin. Due to the stubbornness of biomass, the structural components of corn straw and rice straw are difficult to be converted into monosaccharides, oligosaccharides, biofuels and biomaterials through biochemical and biological processes, but can be used as good aerobic fermentation materials.

4. Aerobic Fermentation Process of Agricultural Waste

At present, aerobic fermentation is a mainstream technology for the conversion of agricultural waste resources. Aerobic fermentation is aerobic microorganisms such as bacteria, actinomycetes and fungi through their own life activities, such as oxidation, reduction and synthesis, part of the organic matter is oxidized into inorganic matter, providing energy for microbial growth; part of the organic matter is converted into nutrients for microbial synthesis of new cells. At present, the most commonly used aerobic fermentation process modes in China include stacking aerobic fermentation, trough aerobic fermentation and reactor aerobic fermentation [8].

4.1. Stacked Aerobic Fermentation

Stacked aerobic fermentation is a typical open aerobic fermentation, which has almost no control over gas emissions, but its operation is simple and only suitable for livestock and poultry farms with abundant land and far away from residential areas.

4.2. Reactor Aerobic Fermentation

The aerobic fermentation of the reactor is a composting process in which organic waste is placed in a closed reactor for aerobic fermentation, which integrates feeding and discharging, aeration, stirring and deodorization. Although it can accurately control the temperature, oxygen concentration and system odor, its single processing capacity is small and the energy consumption is large. It is not suitable for large-scale treatment of livestock and poultry manure. It is only suitable for small and medium-sized farms with small land area, high environmental protection requirements and in-situ treatment.

4.3. Trough Aerobic Fermentation

Trough aerobic fermentation is generally carried out in a long and narrow channel called 'trough'. A track is laid above the wall of the trough and a dumper is installed on the track. The bottom of the aeration tank is laid with an aeration pipe to ventilate and aerate the stockpile. It is an aerobic fermentation system that combines forced ventilation with regular turning, which can control temperature and oxygen content, and collect and control odor. Through the comparison of technology, economy and environment, trough aerobic fermentation is a better choice, but on the basis of controlling various parameters, it is necessary to increase the research on its forced aeration process.

5. Conclusion

At present, the disposal methods of agricultural waste are still relatively extensive, which has brought serious 'three-dimensional pollution' to the environment, including water environment pollution, soil environment pollution and atmospheric environment pollution, which seriously hinders the green development of agriculture and rural areas in China. Actively promoting the effective transformation and optimal regeneration of agricultural waste, promoting industrialization and large-scale development, and realizing the resource value of agricultural waste are the inherent requirements for the construction of ecological civilization. The development of agricultural waste aerobic fermentation industry is to apply the concept of circular economy to the process of agricultural waste recycling. By extending the modern agricultural industry chain, the agricultural waste, which has no resource characteristics, can

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be transformed into commercial products. It can achieve a virtuous cycle of agricultural ecosystem and market economy system, and realize the organic combination of environmental, economic and social benefits.

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