The three-dimensional structure of lignite humic acid fermentation temperature based on matlab

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Key words: organic fertilizer, lignite, fermentation, temperature, three-dimensional

Abstract

The temperature is one of the most important factors in the traditional fermentation. Wireless temperature monitoring system is used for real-time monitoring on the three lignite fermentation heap temperature of YUNNAN GREENTECH CO.,LTD. in this experiment, lignite humic acid content, organic matter content and pH are tracked and detected. It reflect directly internal temperature changes of the fermentation heap through three-dimensional structure of the fermentation heap temperature mapping, especially of every lignite layers at certain point. More fermentation heap monitoring points, other indicators of organic fertilizer assessment besides humic acid content, organic matter content and pH can be selected to be monitored in further study. A more scientific and comprehensive lignite fermentation law can be explored to guide production practices better, and improve production quality and yield.

Introduction

Fertilizer is one of the most important factors to promote the development of agricultural production, and also an important material foundation for the establishment of sustainable agriculture. With China's large-scale cultivation of field crops, fertilizer pollution has been worsening in the past two decades, and the urban and rural people's concerning for environmental quality, people are on increasing desires for the commercialization of organic fertilizer. The domestic fertilizer industry and some related companies began to invest in the commercialization of organic fertilizer since the late 1980s. The wireless temperature monitoring system is used to monitor the three lignite fermentation heap in YUNNAN GREENTECH CO.,LTD. in this experiment. MATLAB software is used to draw the measured data for three-dimensional mapping at a certain time, analyze the internal fermentation reaction from the view of the three-dimensional structure, and obtain the internal regulation of the product temperature variation[1-2].

Materials and methods

1 Test Materials

Three lignite humic acid fermentation heap in YUNNAN GREENTECH CO.,LTD.(Fig.1)

2 Apparatus and equipment

Wireless temperature monitoring system (Mechanical Organization Chart is shown in Fig.2) and typical chemical laboratory equipments.

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Fig.1 **Lignite fermentation heap**

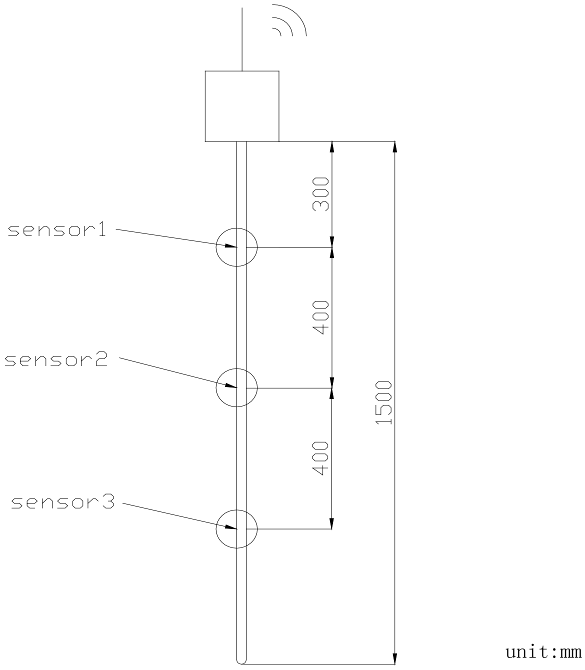

Fig.2 Mechanical organization Chart of wireless temperature monitoring system

3 Methods

3.1 Temperature measurement method: Select three lignite fermentation heap (Natural heap of fermentation, 1 day at interval). The temperature probe is used to measure the upper layer (40cm from the top of the fermentation heap), middle layer (80cm from the top of the fermentation heap) and lower layer (120cm from the top of the fermentation heap) of the central region and surrounding areas (About 20cm away from the fermentation heap wall) of the fermentation heap from the first day to the time when put the heap into production to end detection[3].

3.2 Detection of humic acid: Detection process complies with the Ministry of Agriculture standard (NY525-2002).

3.3 Detection of organic matter: Detection process complies with the Ministry of Agriculture standard (NY525-2002).

3.4 Detection of pH: (GB188877-2009)

Weigh the sample 10.0g in 100ml beaker, add 50ml of carbon dioxide-free water, shake 1 min and stand for 30min, detect it with pH acidimeter.

Data Processing

Matlab software is used for Three-dimensional mapping. This paper only list fermentation temperature of three-dimensional map analysis of the 1st fermentation heap due to the paper length limitations.

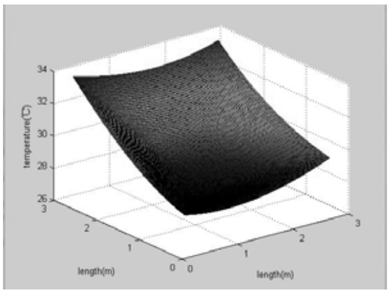

Fig.3 Temperature of the upper layer on the 1st day

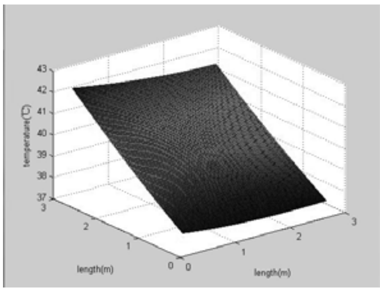

Fig.4 Temperature of the upper layer on the 5th day

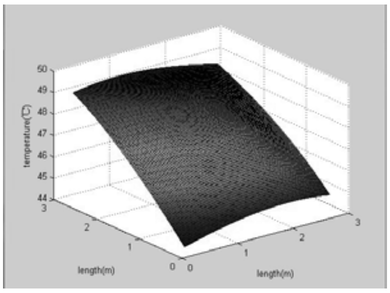

Fig.5 Temperature of the upper layer on the 10th day

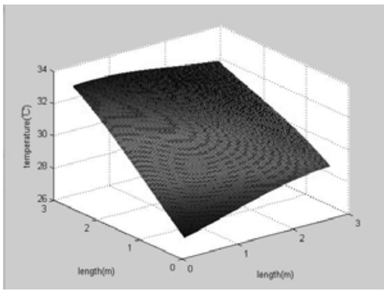

Fig.6 Temperature of the middle layer on the 1st day

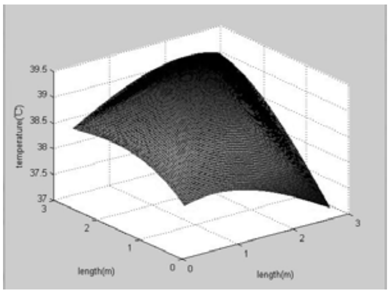

Fig.7 Temperature of the middle layer on the 5th day

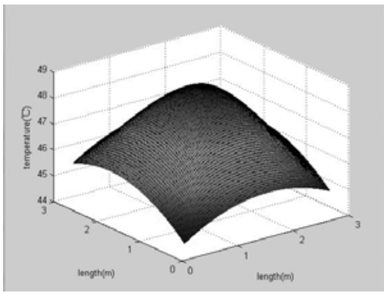

Fig.8 Temperature of the middle layer on the 10th day

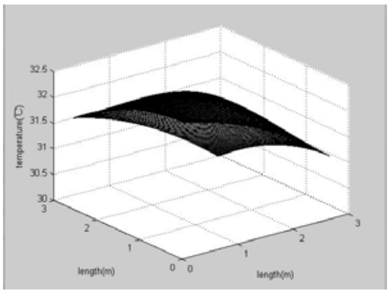

Fig.9 Temperature of the lower layer on the 1st day

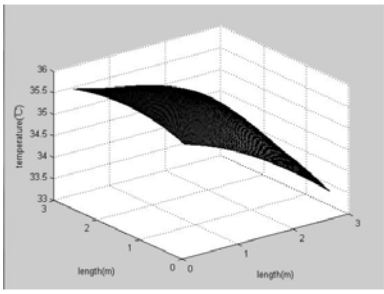

Fig.10 Temperature of the lower layer on the 5th day

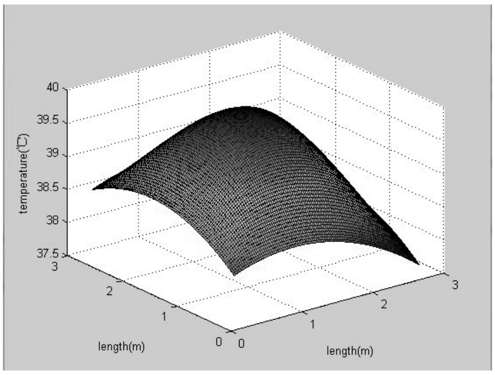

Fig.11 Temperature of the lower layer on the 10th day

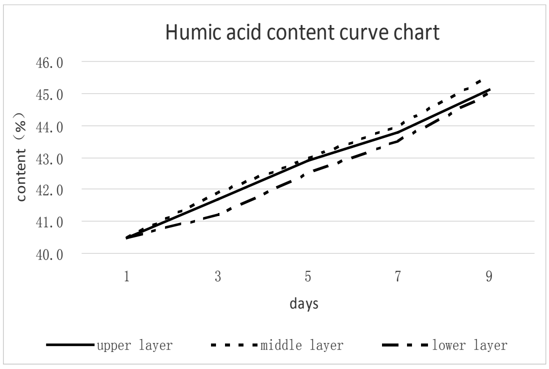

Fig.12 Humic acid content change

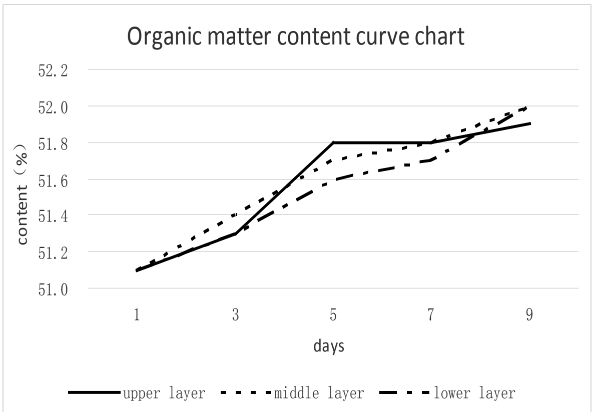

Fig.13 Organic matter content change

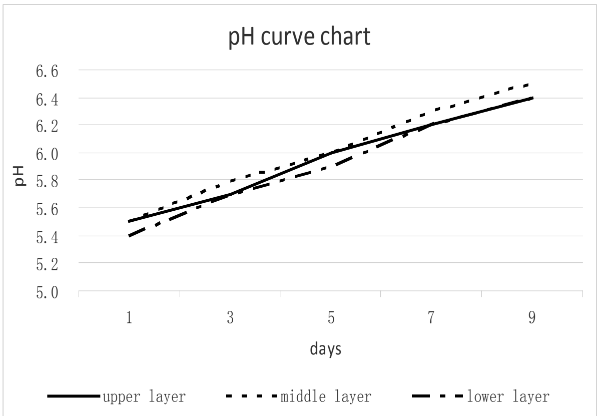

Fig.14 pH change

Fig.3~Fig.11 show temperature three-dimensional map of upper, middle and lower layer on the first day, the fifth day and the tenth day of the fermentation heap. The X-axis, Y-axis length and width at the bottom of three-dimensional map are both equate to 3m of the fermentation tank. Enumerate the 1st fermentation reactor center position, middle and lower layer of humic acid content, organic matter content and pH analysis.

Test results and analysis

1 Discussion

Fig.3, Fig.6, Fig.9 show the internal temperature of the fermentation heap on the first day. As is the way of outdoor natural accumulation of fermentation, half of the fermentation heap exposed to direct sunlight. As it can be seen, the temperature of the fermentation heap is significantly higher than on the upper and middle layer in the other side.Fig.3~Fig.5 show temperature three-dimensional map of upper layer on the first day, the fifth day and the tenth day of the fermentation heap. The three-dimensional map shape essentially unchanged, temperature rise steadily with the passage of time, parts exposed to sunlight the temperature was higher than other parts of the heap significantly. Fig.6~Fig.8 show temperature three-dimensional map of middle layer on the first day, the fifth day and the tenth day of the fermentation heap. Middle layer temperature raise significantly, and the temperature increase in the central areas is more apparent. The central temperature of the fermentation heap reaches the highest on the tenth day.Fig.9~Fig.11 show temperature three-dimensional map of lower layer on the first day, the fifth day and the tenth day of the fermentation heap. The temperature of lower layer increases steadily and the central temperature is higher than surrounding areas.Fig.12~Fig.14 show that lignite humic acid content as the temperature increases gradually improving, while organic matter content is relatively stable with slight changes. In the accumulation of fermentation process, lignite develops from the acidic to neutral, suitable for most crops which usually grow well in such neutral or slightly acidic soil.

2 The reasons for different temperatures in different regions during the fermentation. Initially, the upper and middle layer temperatures of one side of fermentation heap are significantly higher than the other side due to direct sunlight. The temperature on both sides increase steadily based on the temperature of the first day. It

produces a lot of heat accumulation in the central region during fermentation process, then the central area and its adjacent areas gradually reach equilibrium due to the heat transfer. The temperature of lower layer of fermentation heap is relatively low, since the ground reduces the temperature of the area around the fermentation[4-5].

3 Research Problems

3.1 Because the selected test points are less, it is not comprehensive, detailed and true picture of the internal temperature situation throughout the fermentation heap. More detection points should be selected for test in further studies. Since natural outdoor stacking mode is used in the production of fermentation in YUNNAN GREENTECH CO.,LTD., there is greater impact on the outside world, for example, solar radiation causes fermentation heap at temperatures significantly higher than other locations. In addition, the test did not consider season, outside temperature, humidity and other factors influencing the fermentation process due to limitations.

3.2 Chemical tests detect only the humic acid content, organic matter content and pH. The lignite, the basic structural units of humic acid and oxygen-containing functional group content changes in the relationship among the changes in temperature can be explored in further study.

Conclusion

Real-time monitoring for temperature changes of lignite heap fermentation process can be able to guide the production practices better, help enterprises improve production technology, improve product quality and yield. We can design more sophisticated chemical testing programs, select more monitoring points, establish a complete internal temperature of the dynamic three-dimensional map. The lignite, the basic structural units of humic acid and oxygen-containing functional group content and Ascaris mortality and humic acid properties of E. coli and other important indicators can be explored in further studies.

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