A New Way of Mine Geothermal Resources Circulation Utilization

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***Abstract*—It was widespread concerned that develop low-carbon economy and reducing carbon emissions around the world. Biogas is a kind of renewable biomass energy .But, rural biogas mostly ferment in normal temperature, low temperature restricts the biogas production severely. In order to find an economy-saving heating source, analysised of the feasibility and value of using mine geothermal energy, brought up a new method of using geothermal energy, and designed a digester heating test system and it took mine underground heat water as heating resource. The results showed that biogas production increased significantly. The new method has good economic benefits and environmental benefits.**

***Index Terms*—Mine, Geothermal energy, Gas production, Heat transfer**

I. Introduction

With the increase of mining depth, mining will enter the deep well operation. Mine is more deep, geothermal energy appears more obvious, geothermal energy dissipation as heat rock, water gushing ect, affect the underground working environment [1-2]. On the one hand geothermal led to deep well heat damage, on the other hand, mine geothermal energy is a kind of precious green energy, a lot of countries and regions of geothermal resource rich, at the expensive cost of acting geothermal energy exploitation, if can reasonable use heat resources when mine working naturally occurring, it will save expensive geothermal exploitation cost, waste to treasure.

II. Analysis of Mine Geothermal Water as Heating Resource

The digester's temperature is the most important factors which decided the production of gases. Generally, biogas ferment in normal temperature, so the rate of gases' production is low. Temperature is the important external conditions of biogas' fermentation. Temperature is appropriate, the bacteria multiplication is exuberant, and the bacteria vigor is high, anaerobic decomposition and generation of biogas can be fast, the production of gases increased [3-4]. In this sense, temperature is the key to the production of gases.

The geothermic water is not only water but also a clean energy, comparing with traditional non-renewable energy, the geothermic water not only has high heat energy, but it also has economic and social benefits as the water resource which can't be neglected. Mining geothermic water is very enough, making up for the conventional heat stable disadvantages, using geothermal energy to promote the biomass, achieving energy circular promotion.

III. Geothermal Heating Test

A. The design of heating test system

The author redesigned the spiral pipe heating digester test-bed on the basis of the formal achievements [5-8]. Took advantage of mining geothermic water to do the digester heating test by a self-made digester test bench.

Put the hot water from the mine into the helix pipe which is in the methane-generating pit to cyclical heating, and the average temperature is 600C. The spiral heat exchanger has many advantages, such as the spiral structure make it avoiding temperature stress caused by temperature changes, and has a good applicability [9]. Hot water is leaded to the spiral pipe to be heated, and it can heat the digester material liquid through the spiral pipe. We also setting up an RXDC in the biogas' pipeline and it will be useful for the real-time display and storage on the temperature and flow system. All the dates that were collected for all 1Hz frequency in this experiment, spiral pipe heating schemes diagram can be found from Fig. 1.

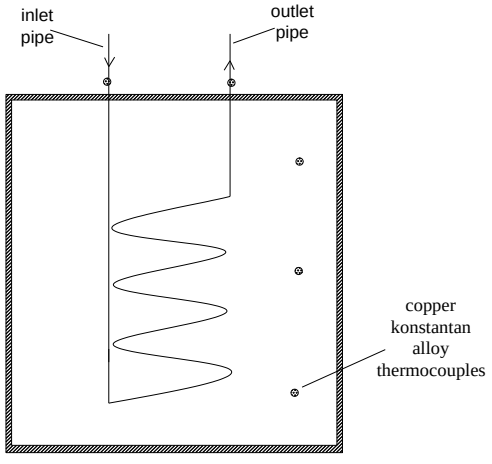

Figure 1. Spiral pipe heating schemes diagram

B. Research on spiral pipe's heating transfer

According to the law of conservation of energy, quantity of heat which was given off by spiral pipe is equal to the absorption heat because of the temperature of liquid materials in the pool, and spiral pipe's heating transfer coefficient can be dissolved as follows[10].

The total quantity of heat that the hot water transmission gives to spiral pipe is that:

$$Q = cm\Delta t = cm(t_1 - t_2) \quad (1)$$

Material liquid' absorption of heat is that:

TABLE I
SPIRAL PIPE HEATING EXPERIMENTAL DATA

Serial number	heating time min	inlet water temperature ^0C	outlet temperasure ^0C	heat transfer coefficient $W \cdot m^{-2}{}^0C^{-1}$
1	60	65	52.9-56.9	300-400
2	120	65	49.9-56.6	350-450
3	180	65	50.5-57	350-500

From the experimental results we can know that the smaller the spiral pipe export water temperature difference is, the lower the heating transfer coefficient will be. The experimental results of the spiral pipe heating transfer effect and theoretical analysis are identical with each other.

C. The test effect analysis

In order to strength the comparability of heating effect in this experiment, this experiment was carried out both in the heating digester and the two pools without heating digester at the same time. This experiment was lasted about 30 days. The gas production can be found from Fig. 2.

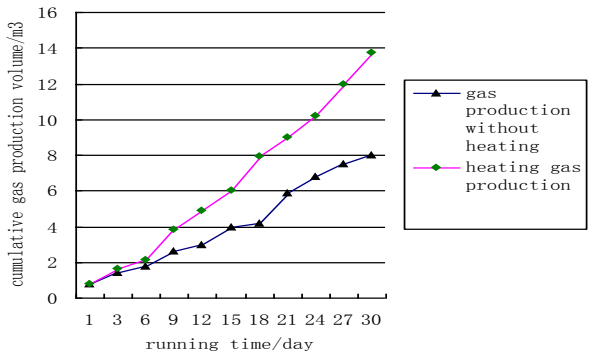

Figure 2. Contrast diagram of gas production

From the figure 2, we can know that the production of biogas was also greatly increased , and it explains that the running effects on the spiral pipe heating biogas system is very good.

SUMMARY

(1) The use of mines to heat hot water heating as a digester, the use of geothermal energy for biomass to generate economic benefits but also has significant environmental benefits, through the mine water into biogas, but also eliminates the heat underground mines harm, to a double.

(2) Digester heating system gas production compared with the case without heating has improved significantly, confirming the mine Geothermal as heating resource effectiveness.

$$Q = KA\Delta t' = KA(t_t - t_0) \quad (2)$$

Calculate the difference of temperature by logarithmic:

$$\Delta t' = \frac{\Delta t_1 - \Delta t_2}{\ln \frac{\Delta t_1}{\Delta t_2}} = \frac{(t_1 - t_a) - (t_2 - t_0)}{\ln \frac{(t_1 - t_0)}{(t_2 - t_0)}} \quad (3)$$

We can figure out the heat transfer coefficient K by leaguing these three formulas.

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