Biogas Analysis Caused by the Action of Microorganisms as Using Gangue Packed for Mine

Mem. Muroran Inst. Tech., 59（2009）77～80

Biogas Analysis Caused by the Action of Microorganisms as Using Gangue Packed for Mine

Yinsheng DENG*, Rui OU **, Min TANG * and Xiangfeng LI ***

(Received 27 May 2009, Accepted 20 November 2009)

This text measures the quantities of gas and the contents of methane in the coking coal, gangue, mine water of Pingmei Twelve Mine and by adding inoculum. Photo shoot fluorescence microscope measurement have confirmed the existence of gas in the methane gas; the CH_4's carbon isotope value in the experiment is similar to the gangue's, that is to say gangue is involved in the microbial role, the quantity of inoculum is directly related to the quantities of gas and the contents of methane. In the further research for obtaining and using the biogas, we must consider using the mining of coal and non coal mining residual layer of coal resources.

Keywords: Gangue, Anaerobic fermentation, Biogas

1　INTRODUCTION

Coal gangue is formed in the process of coal formation. The ash of gangue is usually greater than 50% and heat of it is within 3.5 ~ 8.3MJ/kg in general within the scope of a carbonaceous rocks [(1)]. It includes coal mine tunnel boring project from the roof, floor and mezzanine of the gangue in mining. According to incomplete statistics, China's coal gangue is up to a total storage of 5000 million tons, with an area of about 25 million mu, with a growing rate of 300 million tons annual emissions. Large number of these gangue storage not only use up a lot of land, impact on landscape, water, air and ecological environment, but also to have an impact on the effectiveness of mining.

At present, the way of comprehensive utilization of coal gangue is the use of coal gangue in power generation, construction materials and engineering preparation of backfill for underground fill [(2)]. Filled gangue will provide an anaerobic favorable moisture, temperature and nutritional mine waste for micro-organisms. These anaerobic microorganisms in the gangue may biodegrade organic matter. This articleis based on the concept that micro-organisms can biodegrade gangue to generated gas, and under appropriate conditions generate gas-rich biogas methane. This can not only make full use of coal gangue, but also to alleviate the current situation of China's scarce resources.

*　Henan Polytechnic University,Jiaozuo454003,China
**　Jiaozuo Chemical advanced technical schools
***　Tire plant project, Aeolus Tyre Co, Ltd. Jiaozuo

2　EXPERIMENT SCHEME DESIGN

In confined humid environment, the role of anaerobic micro-organisms will account for a dominant role. Microorganism decomposes organic matter into methane, carbon dioxide and hydrogen sulfide and other gases. Abandoned coal mine in the residue will be filled with the gangue in the coal mine under the influence of water, if there will be the role of micro-organisms is to explore this one of the purposes of the pilot. To the anaerobic microbial degradation of

simulation for the principle. In order to shorten the test time, we added inoculum and the used the largest gas production temperature (35 ºC). The coal gangue and coal in the ratio[2], inoculum volume considerations (Table 1) to study the role of microorganisms in the anaerobic degradation of the gas produced and the content of components, which is the main purpose of this article.

Tab. 1 The designs of the experiment

Formula		Waste rock: coal	Solid content (%)	Inoculum concentration (%)	Total mass of fermentation (g)	Soaking time	Temperature
A	A0	8 : 2	25	0	2000	30d	35ºC
	A1		20	20	2500		
	A2		17.5	30	2857		
B	B0	7 : 3	25	8	1800		
	B1		20	20	2500		
	B2		17.5	30	2857		

Steps of test [3] are summarized as follows:

Mine and coal gangue was socked in Pingmei Twelve Mine's mine water for 30 days; The mine water was acclimatized with inoculum for 7 days; Inoculum was fermented in the sealed fermentor, temperature was control throughout the trial process at 35 ºC, the situation of a total of aerogenes observation last 63 days (see Figure 1 test); after the end of the trial, Agilent 6890 gas chromatograph was used to detect methane gas, and gas chromatograph (GC-9A) for gas components, MAT 251 isotope mass spectrometry was used to analysis of carbon isotope of methane; NIKON TE-2000S-PH inverted fluorescence microscope was used to generate methane gas and camera components.

Fig. 1 The set of the experiment

The results shown in Table 2-4 and Figure 2-5, from which the following conclusions can be drawn.

(1) Comparing the gas production data in Tables 1 and 2, with the same amount of inoculums, A and B group is not the same as gas production, a larger proportion of gangue produced more gases. This shows that the gangue is degraded by the anaerobic microbial. An appropriate amount of gangue does not hinder the microbial activity.

(2) The addition of inoculum indeed increased the rate of methane gas production, gas production and the greater the higher the methane content. Table 2 and Figure 2 show that the largest gas production is A2, the smallest is the B2, A1 and B1 is similar in the gas production. Gas production are the fastest phase of the fundamental within the first month; in A, B group circumstances under which the amount of inoculum with the increase in gas production is increasing rapidly before slowing down again. The content of methane is positively correlated with the amount of inoculums (A1 <A2, B0 <B1). Generally speaking, the greater the gas production, the greater the concentration of methane (A1 <A2, B0 <B1) is. The exception to the B2 may be soaking time (30 days) and the amount of inoculum (30%) lack of coordination between these two factors, or with the conduct of decomposition, the ratio of materials is not suitable for microbial activity. Therefore, considering gas production and methane content, the ideal ratio is A2, that is, gangue: coal for the 8:2, the amount of inoculum was 30%. Blank group is not product gas may be related with the immersion time is short. As a result of the hard coal gangue biodegradable, even if the water has yet to allow a 30-day micro-organisms "chew on" action.

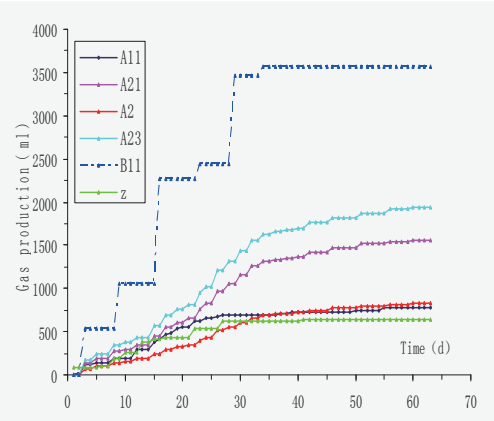

Fig.2 The gas productions of groups (ml)

Note: The map of the curve Z said gas biogas situation.

Tab.2 The total quantities of gas (ml) and the contents of methane(%)

Formula	Total gas production	Biogas minus gas production after	Methane content	Formula	Total gas production	Biogas minus gas production after	Methane content
A0	0	——	0	B0	731.41	89.23	6.84
A1	1165.86	523.68	9.98	B1	1191.84	549.66	10.90
A2	1492.16	849.98	29.86	B2	383.67	——	2.32
Biogas	642.18	——	3.3				

Note: The biogas, which did not add the test of coal and gangue, gas production from its point of view, about 1g of organic matter produced gas 0.599ml.

(3) The components of the gas from A2 and B1 were tested. Only methane, carbon dioxide, nitrogen and oxygen were detected, and hydrogen, ethane and propane were not detected. The drainage method used to collect gas, carbon dioxide and hydrogen sulfide had slight impact on the determination. At the same time, the existence of carbon dioxide, the course of the experiment confirmed the existence of the anaerobic microbial degradation (see Table 3).

Tab.3 The gas components (%)

Item	Nitrogen	Methane	Carbon dioxide	The proportion of non-air	With air sampling
A2	18. 31	35.83	18. 28	0.92	27.31
B1	54.47	13.08	15.50	0.80	21.17

Tab.4 The carbon isotope values (‰)

Name	Gangue	Coal	Gas	A2	B1
Carbon isotope	-25.0	-25.7	-49.3	-32.6	-35.8

(4) The majority of researchers in accordance with the biogas used in the lower limit of carbon isotopes of methane (-55 ‰) [4-7] to see, whether it is gas or A2 and B1, they have a heavier carbon isotope of methane. The pilot biogas from digesters Jiaozuo a small farm, A2 and B1 to test the gas collected in the course, as the test temperature is always controlled at 35 ℃, so they can not be the hot gas. At the same time, biogas as a result of the geological environment in the ancient form, and this test is in the modern environment within a short span of three months to complete, so with the geological division of biogas some differences. Resulting in different geological periods of geological product of the existence of methane carbon isotope may be quite different.

On the other hand, carbon isotopes of methane gas to -49.3 ‰, and A2, B1 of the methane carbon isotope of -32.6 ‰, -35.8 ‰, combined with the carbon isotope of coal (-25.7 ‰) and the gangue of the carbon isotope (-25.0 ‰), note the high degree of coal metamorphism can be microbial degradation indeed, involved in the micro-organisms at the same time the role of coal gangue; otherwise, if simply in response to the inoculum, then A2, B1 of the methane carbon isotope of methane should be is consistent (see Table 4).

(5) From the liquid fermentation broth, and the natural dry smear, and then placed in the inverted fluorescence microscope (model NIKON TE-2000S-PH) were observed (magnification times 100,200,400, respectively), and Figure 3-5 a camera. As the methane bacteria can be issued under the fluorescence microscope in the blue-green fluorescence, photographs confirmed the anaerobic microbial fermentation process does contain the gases produced by methane gas.

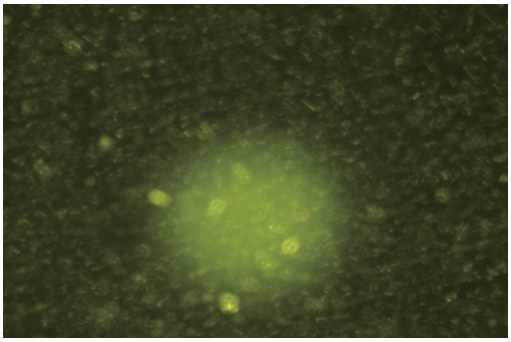

Fig.3 100-fold amplification of the microbial sample

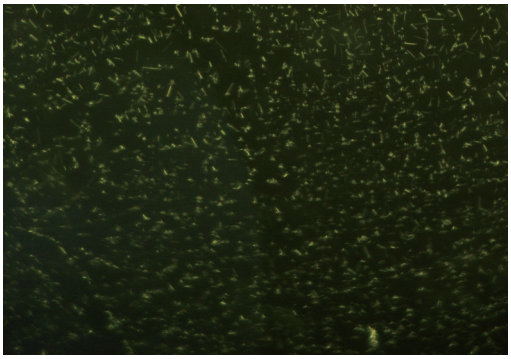

Fig.4 200-fold amplification of the microbial sample

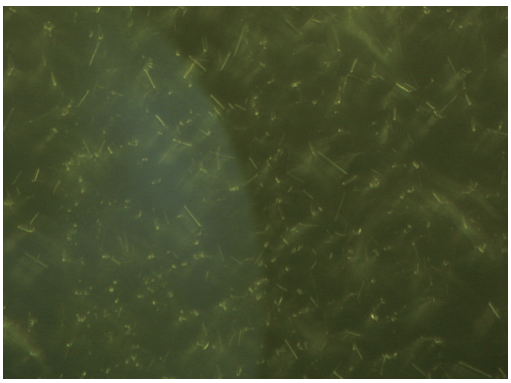

Fig.5 400-fold amplification of the microbial sample

3 CONCIUSION AND OUTLOOK

In the present work the coal - gangue - mine water system added inoculum (biogas) was studied to produce combustible gas containing methane. Although this gas in the geological materials of the products (coal and coal waste rock), but it is not generated in the geological and geological causes of order in connection with the distinction between biogas, will be named in the non-geological causes of biogas. This biogas is not a long geological process, mainly coal gangue, coal mining and mine water residue, as the role of micro-organisms, in a very short period of time the process gas can be completed, it is not only

faster than gas, but also so that the use of coal resources. At present, results of the decomposition of organic matter are not sufficient.

Mine will be filled with a large number of coal gangue, from security considerations, in about three months time, do not add the inoculum, no significant role in micro-organisms, nor have an impact on the environment; the use of solid waste from coal point of view, when gangue and coal, representing a ratio of 8:2, the amount of inoculum was 30%, we can be relatively large concentrations of methane. In this regard, however if the use of coal gangue, we have to consider more factors in order to enhance gas production and methane content of gas.

Mining of coal and residual coal seam can not be a higher degree of metamorphism of coal, bio-degradation is difficult, if these resources can be fully utilized, it will be the focus of future research.

REFERENCES

(1) Bingxin Bian, Qiang Xie, Youcai Zhao, et al. Coal technology of solid waste resources [M]. Chemical Industry Press .2005.5:5.
(2) Yunsheng Yan,Fengchen Zhang. Gangue and its utilization. 2005.2:56-58 Energy.
(3) Guoping Wang, Chuanmin Sun. Gangue of the main way of resources. .2004.13 China Mining (3) :40-43.
(4) Mascaro I.,Benvenuti B.,et al., Mine wastes at the polymetallic deposit of Fenice Capanne (southern Tuscany, Italy) and environmental impact. Environmental Geology,（2001）41：417－429.
(5) Fernandes H.M.,Franklin M.R. : Assessment of acid rock drainage pollutants release in the uranium mining site of Pocos de Csldas－Brazil.Journal of environmental Radioactivity，54（2001）：5－25.
(6) Dalway J. Swaine : Why trace elements are important.Fuel processing technology，65（2000）：21－33.
(7) Garcia-Gil S, Vilas F, Garcia –Garcia A. Shallow gas feature in incised-valley fills(Ria de Vigo, NW Spain): A case study[J]. Continental Shelf Research,2002，22（16）：2303-2315.
(8) Fuling Zhao, Yinsheng Deng. Gangue mine to fill the role of the process of microbial impact on the environment [J]. Coal Journal, 2008,33 (9) :1045-1048.
(9) Fuling Zhao, Yinsheng Deng, Rui Ou, Min Tang. Gangue mine to fill the role of process gas study of micro-organisms [J]. Clean Coal Technology, 2008,14 (3) :88-90.
(10) Yinsheng Deng, Xueling Xing, et al. coal use and disposal of solid waste [M]. Beijing: China Environmental Science Press, 2008.