Removal of hydrogen sulfide (H_2S) from biogas for the community in the province of Maha Sarakham

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Abstract. Biogas produced from the fermentation in the province of Maha Sarakham of excreta from cow dung, fattening pigs and buffalo dung in small scale farms contained hydrogen sulfide (H_2S) at 764, 926 and 1,103 ppm, respectively. This gas has offensive smell and is corrosive to motor and metal stove of farmers, thus needs to be eliminated. The adsorbent granules soaking in $FeCl_3$ and NaOH made from grey cement mixed with diatomaceous earth or fine sand. The experiment cow dung, fattening pigs and buffalo dung farms revealed that the adsorbent granules made from fine sand mixed with grey cement had better efficiency in reducing H_2S than diatomaceous earth plus grey cement or scrap iron (97.1-91.4 vs. 86.0-64.3 and 77.9-89.4% , $P<0.01$) . The reduction of H_2S increased with the increasing weight of the adsorbent tanks, made from fine sand mixed with grey cement, from 2 to 4 and 6 kg (84.1-89.2 to 92.7-98.0 and100-99.1% , respectively). Adsorbent set of 6 kg weight can be reduced H_2S in biogas from 3,141 to 0 ppm in the first day and to 6 ppm on day 25 of using period, during which the colour of adsorbent granules changed from red brown to dark brown.

Keywords: biogas, Hydrogen sulfide, adsorbents

1. Introduction

Mahasarakam Province is the province with the majority of population engaged in agriculture and livestock farming. All waste generated from agriculture and the pet, which does not yet have a waste management system. All waste generated from agriculture and domestic animal, which does not yet have a waste management system. This result have an effect on environmental pollution in the community, such as water pollution, flies, and contagions. Therefore, there should be a waste management system and suitable methods should be used to reduce the pollution problem mentioned above. The removal of dung and urine from animals with biogas is an appropriate and widely used method. In addition, after the treatment, methane (CH_4) is a by- product of heating, which can be used as cooking energy. However, some of the biogas produced exceeds the demand. For some of the animal husbandry in the orchard, which is far away from home, with the need to be used locally and intended to replace the motorcycle fuel. But there is a problem with unwanted gas. For example,

hydrogen sulfide (H_2S) is contaminated by (1-4%v/v) which has the ability to corrode metal made the occurrence rusted the stove and engine wear. Therefore, if the H_2S adsorption medium can be developed, it will be more efficient to use the biogas in the community. Ferric hydroxide is adsorption substances as following

$$2Fe(OH_3) + H_2S \longrightarrow 2Fe(OH_2) + 2H_2O1 + 8S_8 \quad (1)$$

and $$F(OH_2) + H_2S \longrightarrow FeS + 2H_2O \quad (2)$$

balance the equation from FeS to Ferric hydroxide

$$2FeS + 3/2\ O_2 + 3H_2O \longrightarrow 2Fe(OH_3) + ¼\ S_8 \quad (3)$$

and $$FeS + H_2O_2S \longrightarrow Fe(HO_2) \quad (4)$$

The pellet Ferric hydroxide using sand cores to catch the sand in a solution **1**M $FeCl_3$ dried and then put in a solution of **3**M NH_4OH dry again and then be packed in a pipe diameter of **5** cm long and **35** cm can be**.** Ferric hydroxide is added to the sand that coated **600** cm^3 that can filter out bacteria in the water, and **%9.99**reported that the use of diatomite from Lampang province coated with Ferric hydroxide can absorb heavy metals **(**zinc, copper, and cadmium**)** up to **.%92**In this study aimed to produce an effective coating Ferric hydroxide to absorb H_2S**.**

2. Procedure

Produce a filter kit, which will contain the pellets as shown in Figure .1 Ferric hydroxide that uses light soil sand mixed with cement in different ratios to find the right level. It was then tested for H_2S adsorption from the 16-8 m^3 .Biogas ponds in the Mahasarakam community that constructed ponds, compared with the same size. Once the appropriate type of filter was applied, the H_2S adsorption was performed in a biological pond filled with three animal species: ponds filled with pig manure, ponds filled with buffaloes and pond with cow dung to test the adsorption and recovery efficiency of absorbers.

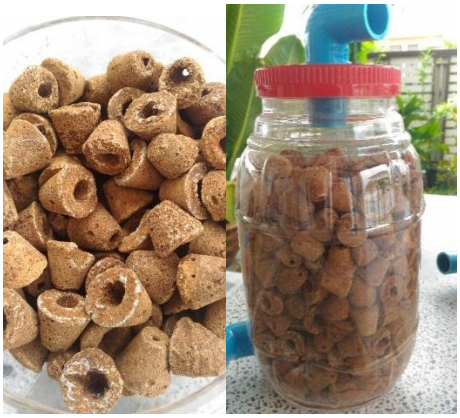

Figure 1. Ferric hydroxide

3. Result and discussion

3.1 Production of light soil with cement

Use light soil as an intermediary. By using grey cement compared with white cement as a handle. Mix light soil with mortar in a ratio of .25.0 :1Mold into tablets and dry at room temperature. Then, the water-solubility test was found to be slightly fragmented. Or other examples that put the proportion of mortar increased no crack. Mixing with grey cement has a cracking of the granules rather than white cement. Increasing the cement content will improve the durability of the cement. Therefore, choose grey cement for further study.

3.2 Finding the optimum ratio of sand and cement

Use fine sand as an intermediary mixed with grey cement, which is used to grind the granules in ratio of mortar to sand 1 :1, 2 :1and 3 :1and then mold into tablets of 5.1-0.1cm in diameter, dried at room temperature. When tested for dissolution in 3 M NaOH solution for 12 hours, it was found that the

media were broken up by increasing the proportion of sand. Using more than 2times more sand than cement, the granules is less durable, which is unsuitable for further use.

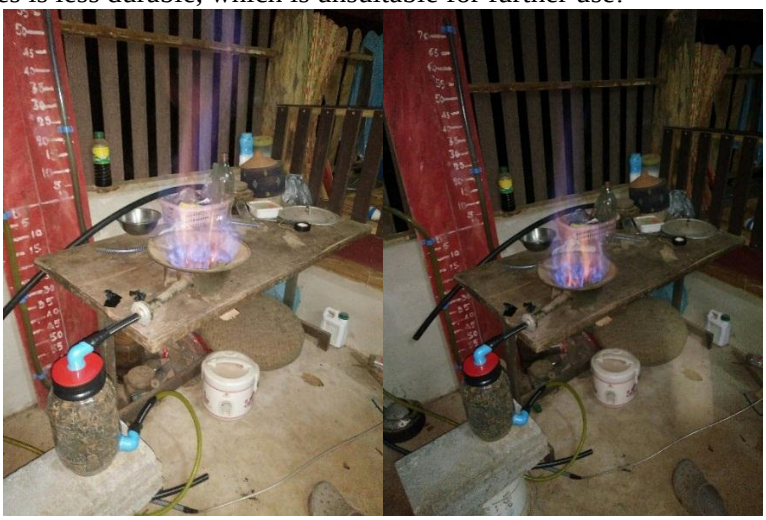

Figure 2. Installation Ferric hydroxide

3.3 Colour of adsorbents testing

By bringing light soil mixed with white cement and grey cement in various ratios. Then dried at room temperature. To produce $Fe(OH)_3$ adsorbent, the cement mixed with sand at a ratio of 1:75.0was dark red brown.

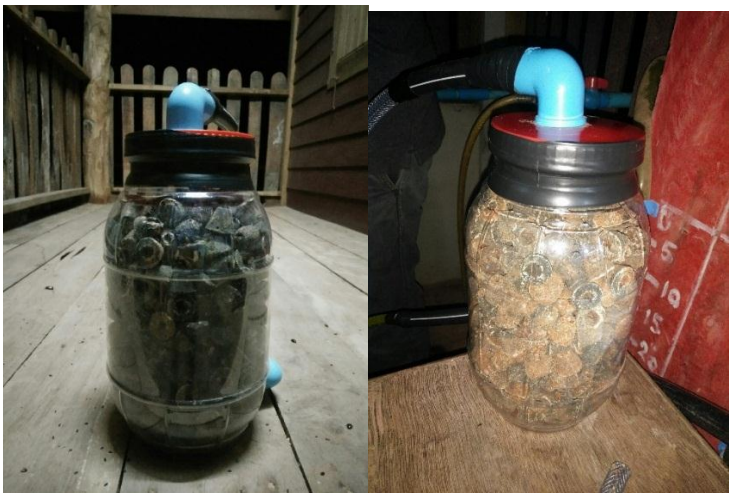

Figure 3. Ferric hydroxide colour change

3.4 Removal of H_2S in biological ponds testing

Use a 3x3 Factorial in CRD trial. Factor 1 is a type of three types of media (silt, sand, and steel) in a tank filter. Factor 2 is the type of waste in the fermentation ponds (pig dung, buffaloes dung and cow's dung). The biogas from the excreta of all three types of animals has H_2S of 3,141, 1,150 and 1,499 ppm. respectively, through intermediaries, to a mixture of sand, cement grey to reduce H_2S best ($P < 0.01$) reduced by up to %99-97, followed by intermediates used steel wool to reduce the minimum (69.50%), with the interaction. With this kind of information, that is, it absorbs H_2S from pigs manure pits had better than buffaloes dung and cows dung, respectively ($P < 0.05$) (Table 1.) The absorb can eliminate H_2S to not less than %95when the colour of the sorbent top showed a dark red brown to black, including a hole stove used for cooking clogged slow. Normally, the need to break down the burner holes every week shown that the absorbing series performs well satisfied users.

Table 1. H_2S reduction from 3 kinds of excreta by different adsorbent granules in 50 cm tank.

Type of excreta	H2S before passing through adsorbent tube (ppm) H2S reduction (%)	Grey cement mixed with fine sand	Scrap iron
Buffalo's dung	1,150.74	99.25[a]	69.44[c]
Cow dung	1,499.86	98.58[a]	62.51[d]
Dung of pig	3,141.43	97.33[a]	49.93[e]

[a-e] Means with the same letter are not significantly different (P<0.01)
Interaction between type of adsorbent and animal excreta are significant (P<0.05)

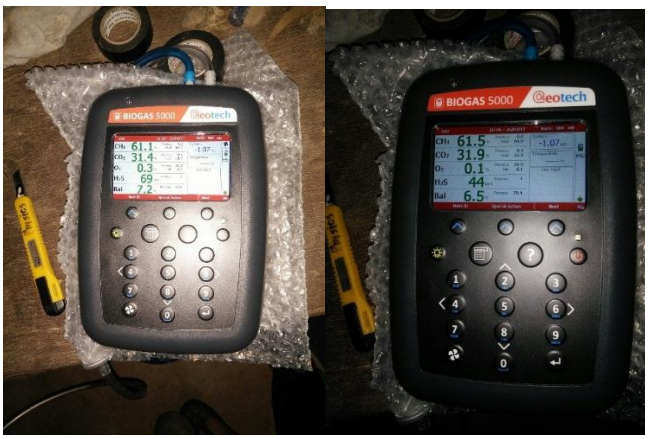

Figure 4. The amount of hydrogen sulfide is clearly reduced.

4. Conclusion

Reduction of H_2S from Biogas By using a sand-based adsorbent with the gray cement mixture is resistant to the solvents. $Fe(OH)_3$, when applied to a pipe with a length of 100 cm, can absorb H_2S better than the use of light soil and the use of steel as well by using shorter length pipes.

Acknowledgments

This study was supported generously by Research and Development Institute. Mahasarakham Rajabhat University, Mahasarakham, Thailand which supports the research for the research team and helping to edit the work with attention from start to finish.

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