5.Development of reuse technology of hydrogen sulfide gas adsorbent

TECHNOLOGY

Development of reuse technology of hydrogen sulfide gas adsorbent

Tomoko Suenaga[1], Masanori Nagata[1], Toshiki Thubot[1],
Koichi Kuramoto[2] and Humio Hayashi[3]

[1]*Kumamoto Industrial Reserch Institute*

[2]*Nihonrimonaito,Co*

[3]*Hujikinzoku,Co*

Abstract

The reproduction method for the adsorbent of hydrogen sulfide gas was examined at the iron oxide system with NaOH under solar light. The reaction with NaOH quickly proceeded when the air is blown. The β-sulfur was produced in 5 ~ 15 % NaOH in the sample after 64 days. The iron content reached in the maximum of 25 % NaOH after 34 days. That is almost 100 % regeneration rate. The adsorption of the hydrogen sulfide gas might be physical and chemical reactions.

INTRODUCTION

The hydrogen sulfide gas is toxic which generated by decomposing of proteins. Especially, it generated in sewage-treatment plants and food factory. In these facilities, the adsorbent of the iron oxide system is mainly used. Presently, saturated adsorbent deal it out as an industrial waste. However, liberated sulfur ignites are saturated on adsorbent, when the air is touched. Liberated sulfur is oxidized, and the sulfur acid gas is arised. The industrial waste disposal becomes difficult situation such as space problem. The researches of chemical removal and recycles of saturated hydrogen sulfide have been advanced. In this study it was successful to recover the initial adsorption using alkalin solution under solar light.

EXPERIMENTAL

Chemical disposal methods are used with solution of NaOH 200 ml in saturated sample of adjusted 50 g. The NaOH concentration was 5 ~ 35 % of the samples. The grain size of the sample was changed to 14 meshes from 7 meshes. The evaluation test system of absorbent was carried out by the equipment shown in Fig. 1. The 3 g sample was used under the condition of hydrogen sulfide gas to flow 40 ~ 50 ml/min. The 20 % hydrogen sulfide gas was diluted by the nitrogen. The crystal structure of sample was examined by X-ray diffraction equipment. The elementary content was examined by the fluorescence X-ray analyzer.

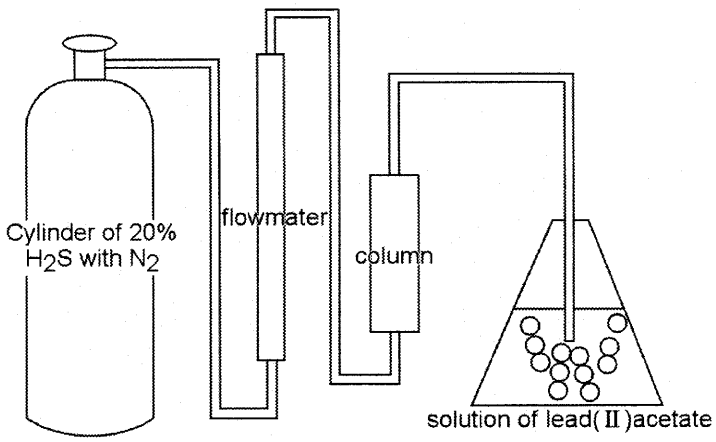

Fig. 1 Equipment of evaluation system for the absorbent of H_2S.

RESULTS AND DISCUSSION

Presently, the mixture of metal sludge and Aso Oudo were used as adsorbent of hydrogen sulfide gas. The mixture of absorbent consists of mainly α-FeO(OH) and β-FeO(OH) with traces of heavy metals are shown in Table 1.

Table 1 Chemical analysis of hydrogen sulfide gas adsorbent (%)

Fe	Ca	Zn	Ni	Cu	Al	Si	H_2O
74.10	1.90	1.46	0.22	0.30	0.24	3.78	5.62

Adsorption, elimination and reaction by the chemical processes of the hydrogen sulfide gas seem to be following equations.

Adsorption reaction	$FeO(OH)+H_2S$	⟶	$FeS(OH)+H_2O$
Desorption reaction	$2FeS(OH)+2O_2$	⟶	$2FeO(OH)+SO_2+S$
Chemical reaction	$FeS(OH)+2NaOH+3O_2$	⟶	$FeO(OH)+Na_2SO_4+H_2O$

The free sulfur to prevent carried out with liberated alkaline treatment. The oxidized sulfurous acid gas was volatilized. The sulfur was made into the solution as sodium sulfate. The reaction rate was examined under alkaline management system, for comparison of crushed sample and un-crushed sample.

The liberated NaOH concentration takes in the part of the liquid process (Fig. 2). Phenolphthalein is used as indicator adding HCl solution. After 30 hours the reaction

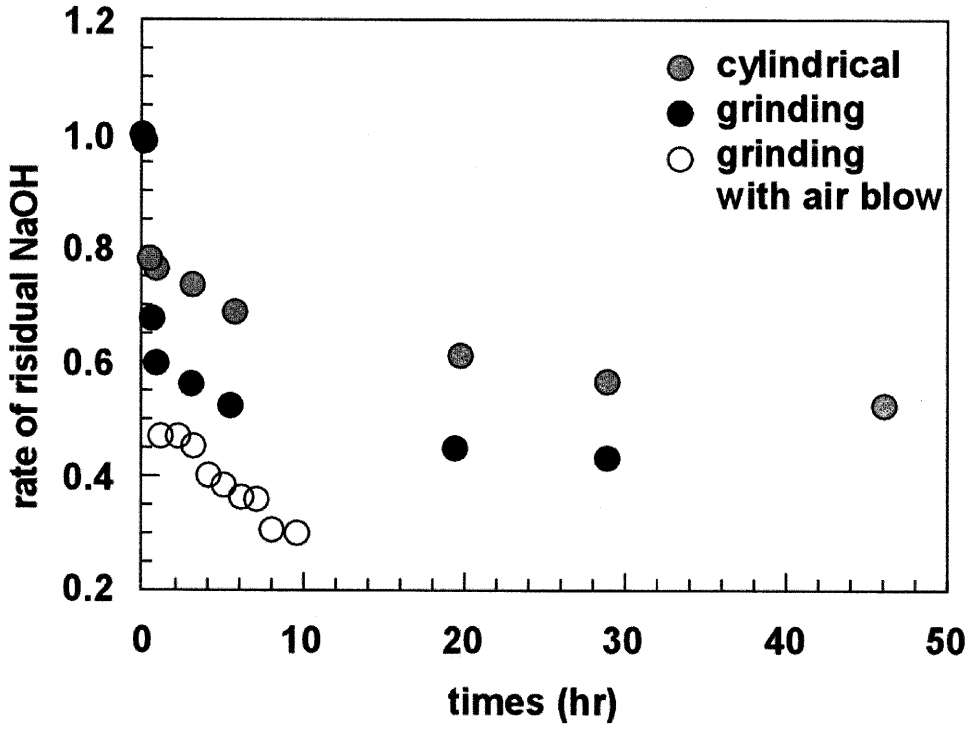

Fig. 2 Relationship between grain size, progressing times and rate of risidual NaOH in 25 % NaOH solution.

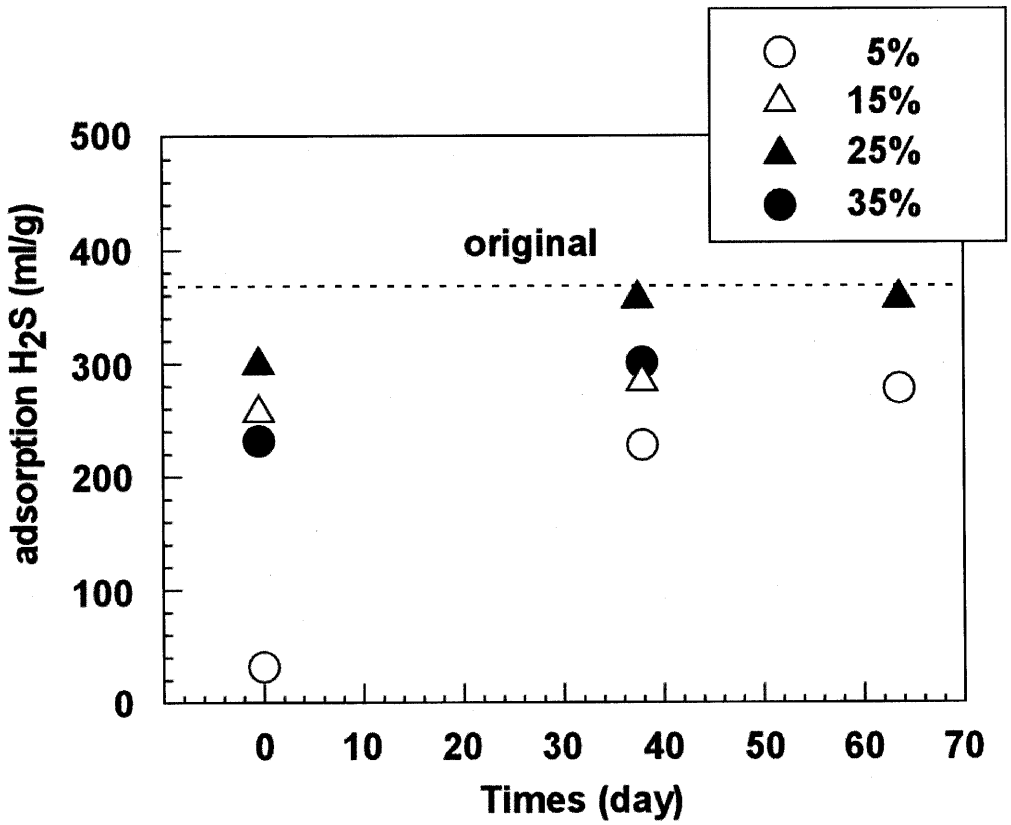

Fig. 3 Relationship between additional rate of NaOH, absorption H_2S and aging time. The samples were dried under atmospheric condition.

rate of crushed sample increases in the 25 % NaOH solution. The air blowing sample after smash, the reaction proceed quickly after 10 hours with NaOH solution (Fig. 3). In addition, the aging variation and absorbed hydrogen sulfide gas are shown in Fig. 3.

Initial absorbed amount of 5 % NaOH is 40 ml, and it regenerated the rate of 10 %. However, the 220 ml initial rate become to 15 %, and it reproduced over 60 %. In addition, decreased adsorption of 25 % NaOH recovered after 34 days. The absorbed rate was from 25 % NaOH to 35 % NaOH is shown in Fig. 4. After dried for 34 days, the content of sulfur was lower at 5 % NaOH than 15 ~ 35 % NaOH, this result agreed with the regeneration rate. The Na content increased a little at 35 %. The Na chemical compound adhered to the sample surface by high-dense NaOH. An iron is maximum content with 25 % NaOH and that is also maximum adsorption quantity of sulfide hydrogen gas. The X-ray patterns of the samples which were dried for 7 days under solar light (Fig. 5). In 5 ~ 15 % NaOH, there is a peak of β-S, and the intensity is also

high. However, 25 ~ 35 % NaOH could not observe the peak of β-S. There was an uncertain peak at 29.5° suggesting originated sodium compound. The iron is main components of α-FeO(OH) and β-FeO(OH). Only β-FeO(OH) chemically changes by the NaOH treatment.

The adsorption of the hydrogen sulfide gas is generated on this fact by the chemisorption and the physical adsorption. The α-FeO(OH) is physical adsorption, whereas β-FeO(OH) is chemical adsorption.

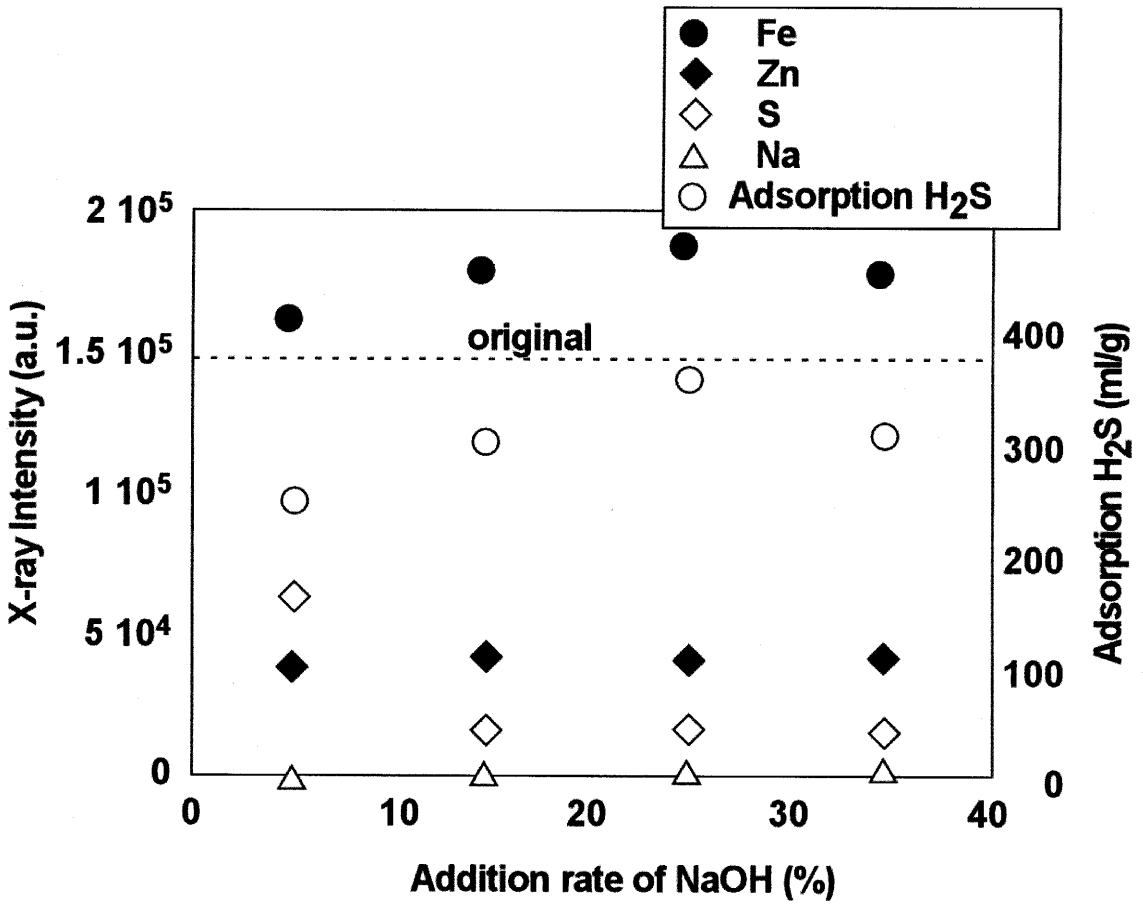

Fig. 4 Relationship between additional rate of NaOH, X-ray intensity of fluctuational elements, and adsorption of H_2S. The samples were dried for 34 days under the atmosphere.

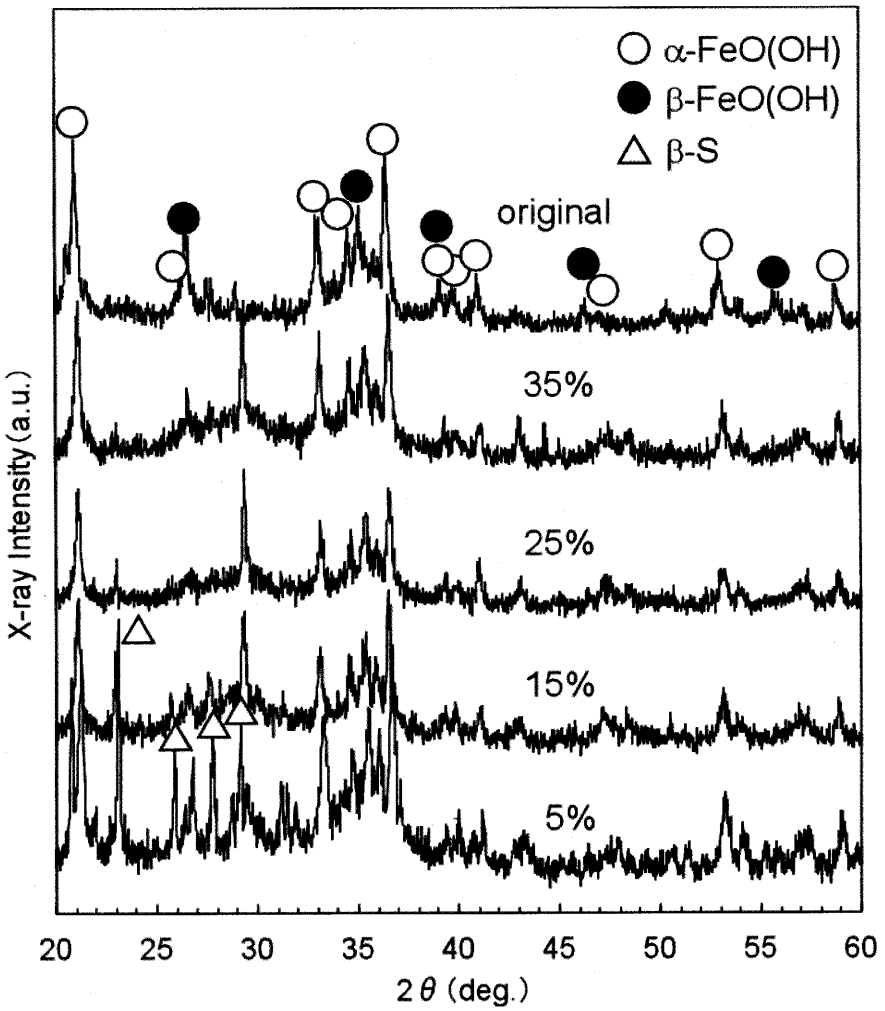

Fig. 5 XRD patterns of original sample and additional rate of NaOH. The samples were dried under atmospheric condition for 7 days.

CONCLUSION

In this study the results are summarized as follows;

(1) The reaction with NaOH was quickly proceeded when the air is blown.

(2) The β-sulfur was produced in 5 ~ 15 % NaOH in the sample after 64 days.

(3) The iron content reached in the maximum of 25 % NaOH after 34 days.

(4) α-FeO(OH) reacted on physical adsorption of hydrogen sulfide, whereas β-FeO(OH) seems to be the chemisorption.