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Study on the Removal of the Unpleasant Odor from the Coal Briquette

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ကျောက်မီးသွေးလောင်စာတောင့်ကို အနံ့ချွတ်ရန်လေ့လာခြင်း

ဒေါ်ခင်မေလွင်၊ B.Sc. (I.C) (Rgn), Dip. Pulp & Paper Technology (India)
လက်ထောက်သုတေသနအရာရှိ၊သစ်တောသုတေသနဌာန၊ ရေဆင်း၊
ဒေါ်ခိုင် ခိုင်ထွန်း၊ B.Sc (Hons:), M.Sc. (Chemistry) (Mawlamyine)
လက်ထောက်သုတေသန(၂)၊ သစ်တောသုတေသနဌာန၊ ရေဆင်း။

စာတမ်းအကျဉ်းချုပ်

ယခုအခါ မြန်မာနိုင်ငံတွင် ထင်းအစားအခြားလောင်စာဖြင့် အစားထိုးသုံးစွဲရန် လိုအပ်လျှက် ရှိရာ ကျောက်မီးသွေး လောင်စာ တောင့်များကို စတင်ထုတ်လုပ် သုံးစွဲလျှက် ရှိပါသည်။ သို့ရာတွင် အနံ့နံခြင်း၊ မီးမွှေးရန် ခက်ခဲခြင်းတို့ကြောင့် တွင်ကျယ်စွာ အသုံး မချနိုင်သေးပါ။ ဤစာတမ်းတွင် ဓာတ်ကြွကာဗွန်နှင့် မဂ္ဂနီစီယမ်ထရိုင်စီလီကိတ်တို့ကို အသုံးပြု၍ အထက်ဖော်ပြပါ လေ့လာ စမ်းသပ် မှုများ ပြုလုပ်ခဲ့ပါသည်။ လေ့လာစမ်းသပ်မှုများအရ ဓာတ်ကြွကာဗွန်နှင့် မဂ္ဂနီစီယမ် ထရိုင်စီလီကိတ် တို့သည် ကျောက်မီးသွေးမှ ထွက်လာသော ဆာလဖာဓာတ်ငွေ့များကို စုပ်ယူ ဖယ်ထုတ်နိုင်ကြောင်း တွေ့ရှိရပါသည်။

Study on the Removal of the Unpleasant Odor from the Coal Briquette

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Abstract

A substitute for fire-wood fuel is needed in our country nowadays. Introducing of coal briquettes made from coal dust is a good substitute. The coal briquette has high heating value and other advantages but also there are draw backs such as difficulty in starting the fire and having an unpleasant odor in burning. In this paper, an attempt has been made for removal of the unpleasant odor by using activated carbon and magnesium trisilicate. The result of the study indicated that the activated carbon and magnesium trisilicate could removed sulfur gases from the coal by absorption.

Contents

1. Introduction

Most developing countries in the world depend for a large part on bio-mass as a source of energy, not only for domestic use but also for industrial applications as well. This in particular is true in the case of Myanmar where 84% of the total amount of energy consumed is biomas based, including fuel-wood, charcoal and agricultural wastes. The remaining 16% consists of commercial sources of energy like oil, gas and electricity.

With about 50% of its land area being still under forest cover, Myanmar can still be considered to be in a good condition in terms of forest resources. However, due to the continued heavy reliance on wood as a source of energy, the wood fuel situation has become critical in several areas. Various surveys and studies on the fuel wood situation in Myanmar have indicated that, out of 14 states and divisions, two states and six divisions can be regarded as fuel deficient areas.

In this situation, the use of firewood substitutes fuel becomes an impending requirement for the country. There is an urgent need for extensive production of substitute fuel to prevent depletion of our valuable forests. The year 1995 was designated as the wood based fuel substitution year and the committees to oversee the fuel substitution programme were formed at the national, state and division, district and township levels. Consequently revival of briquetting, fuel efficient stoves and wood fuel substitution measured have been undertaken.

The briquette made by coal dust compounded with other elements has a high heating value and many other advantages but the draw back is the difficulty to kindle it and the unpleasant odor emitting from it.

The main objective of this paper is to find ways for removal of unpleasant odor from the coal briquette.

2. Literature Review

Coal is a natural solid combustible material consisting chiefly of amorphous element carbon with low percentages of hydrocarbons, complex organic compounds and inorganic materials. Coal was formed from prehistoric plant life and occurs in layers of veins in sedimentary rocks. It contains a high sulfur content which may affect on pollution depending on how it is used.

Coal is most frequently specified in terms of proximate analysis, giving the percentages of moisture, volatile combustible matter, fixed carbon and ash. An ultimate analysis give the percentages of various elements present (C, H, O, N and S). Hard coal consists of 90% carbon, 5% oxygen and 5% hydrogen.

Sulfur is a nonmetallic element found in coal and fuel oil. When these fuel are burned, sulfur joins with oxygen in the air to form gaseous sulfur, including sulfur dioxide (SO_2) and sulfur trioxide (SO_3).

$$S + O_2 = SO_2 \text{ (gas)}$$

Once in the air, SO_2 can be oxidized to SO_3 in the presence of oxygen.

$$2SO_2 + O_2 = 2SO_3$$

Sulfuric acid is formed when SO_3 reacts with the moisture in the air.

$$SO_3 + H_2O = H_2SO_4$$

Sulfurous acid is formed when SO_2 reacts with the moisture in the air.

$$SO_2 + H_2O = H_2SO_3$$

(A.Lan Sherman; Sharon J. Sherman)

In certain situation; carbon monoxide may be produced.

Sulfur dioxide is a colorless gas with a sharp pungent odor, soluble in water alcohol and ether.

It is toxic when inhaled. It can become a dangerous containment and an irritant to eyes and mucous membranes, especially under pressure.

Sulfur trioxide occurs in three solid modifications; alpha m.p. 62 c, beta, m.p. 32.5C; gamma, m.p. 16.8C.

It is highly toxic, and a strong irritant to tissue. It is an oxidizing agent and can become a fire risk in contact with organic materials.

The carbon dioxide is colorless, odorless gas and non toxic. However, it is an asphyxiant gas.

Carbon monoxide is colourless and odorless but can be highly toxic when inhaled. It is highly flammable and has an effinity for blood hemoglobin over 200 times that of oxygen. It is also a major air pollutant.

Thus when using coal, means and ways should be found in which its adverse affects could be lessened or completely removed through research and experiments.

3. Materials and Methods

3.1 Materials

Briquette samples are obtained from the briquette factory of the Institute of Forestry.

Activated carbon is made in the Wood Chemistry Lab: room, Wood Utilization Division, Forest Research Institute.

The gas and vapor adsorbent carbon (activated carbon) are obtained by carbonizing coconut shells treated with 10% zinc chloride solution.

The container used for activated carbon making are old oil drums with a volume of 200 liters. These drums are very much appropriate for use as they do not easily rust if stored for a long time. Furthermore, they are inexpensive, easy to obtain and can be easily moved to the source of raw materials.

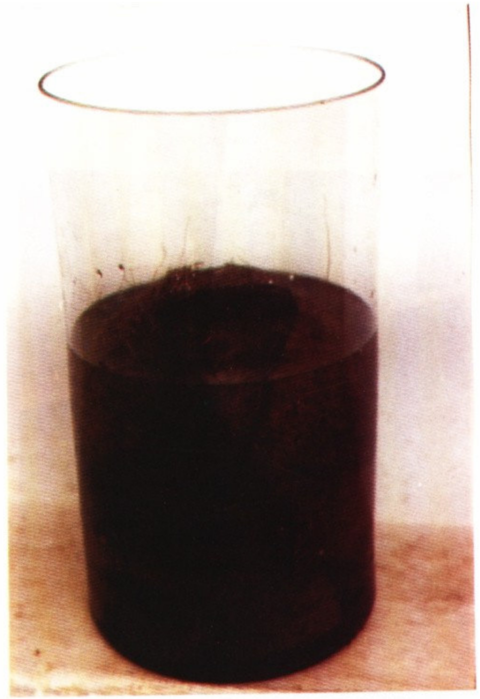
Each drum is prepared as shown in the figure (4). The drum is placed an flat ground. Loading of raw material (zinc chloride treated coconut shell) is done from the top of the drum. Initial fire is spread through from the bottom hole (e). The hole (b), (c) and (D)are closed when fired.

Close attention must be paid to the carbonization process and firing continued till the smoke attain the blue color.

To stop firing, every hole and the chimney must be closed. The drum is left over night for cooling.

Magnesium trisilicate (talc) is obtained from the market.

The ceramic paper are made by pasting 5g talc and 5g calcium oxide on the iron sieve.



Fig(1) Coconut shells are treated with $ZnCl_2$ sloution

Fig (2) Drying the treated coconut shells

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Fig (3) Production of activated carbon by using old oil drum.

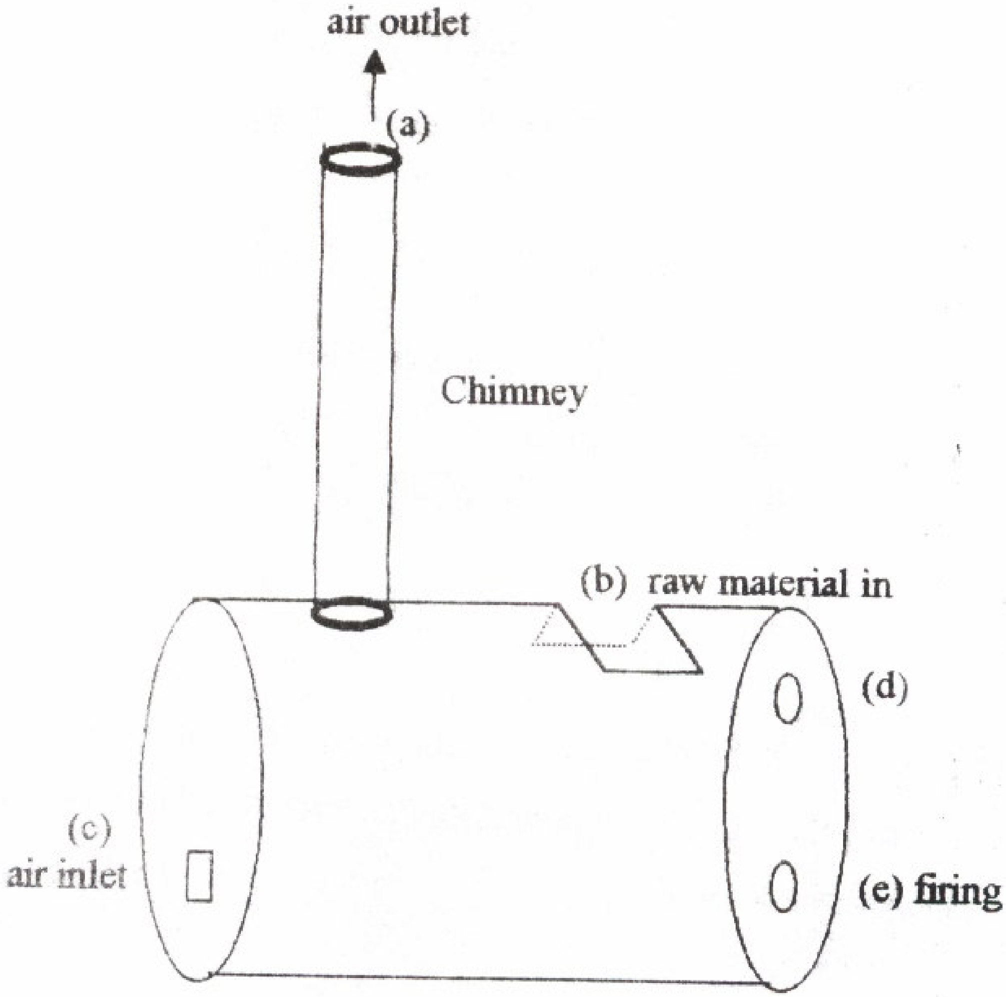

Fig (4) Coconut charcoal drum kiln.

3.2 Methods

F.R.I 9-3 stoves are used for all experiments. All experiments were conducted to test the odor. Replication was made five times for each method.

3.3 Method I

Sixty mesh powder activated carbon of content 0.05g, 0.25g, 0.5g, 1.0g is sprinkled over the briquette after burning. The odor are tested by using acidic potassium dichromate paper and litmus paper.

3.4 Method II

The briquettes are made by a combination of the different ratios of activated carbon powder 0.05g, 0.25g, 0.5g and 1.0g in each briquette. The briquette are burned and odor is tested by using acidic potassium dichromate and litmus paper.

3.5 Method III

The briquettes are made by combination of the equal ratio of talc and calcium oxide. 05g, .50g and 1.0g in each briquette. The briquette are burned for the determination of odor test by using acidic potassium dichromate and litmus paper.

3.6 Method IV

After burning, the talc powder 0.05g, 0.25g, 0.50g and 1.0g is sprinkled over the briquette. The odor are tested by using acidic potassium dichromate and litmus paper.

3.7 Method V

After burning the briquette, a special asbestos-free ceramic paper is placed on the stove. The odors are tested by using acidic potassium dichromate and litmus paper.

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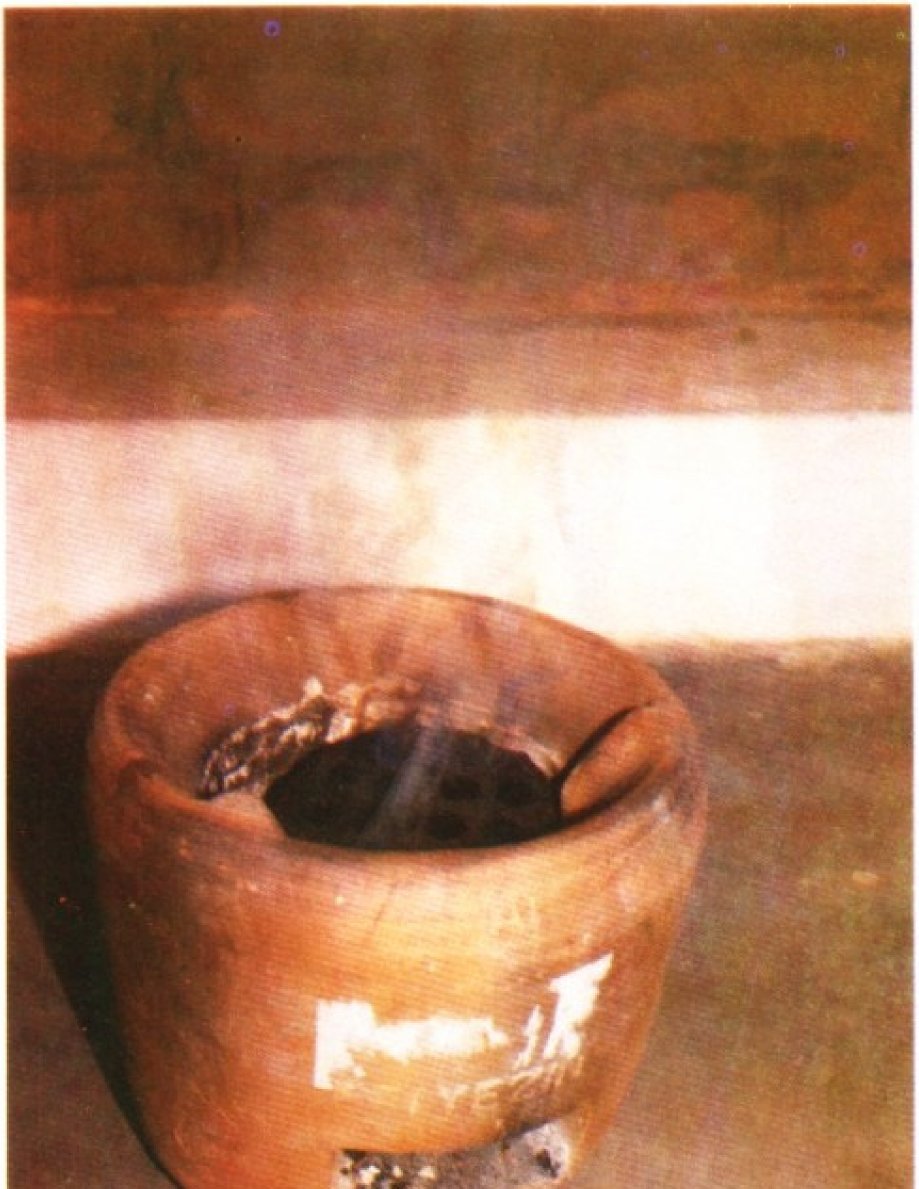

Fig(5) Start burning for a briquette.

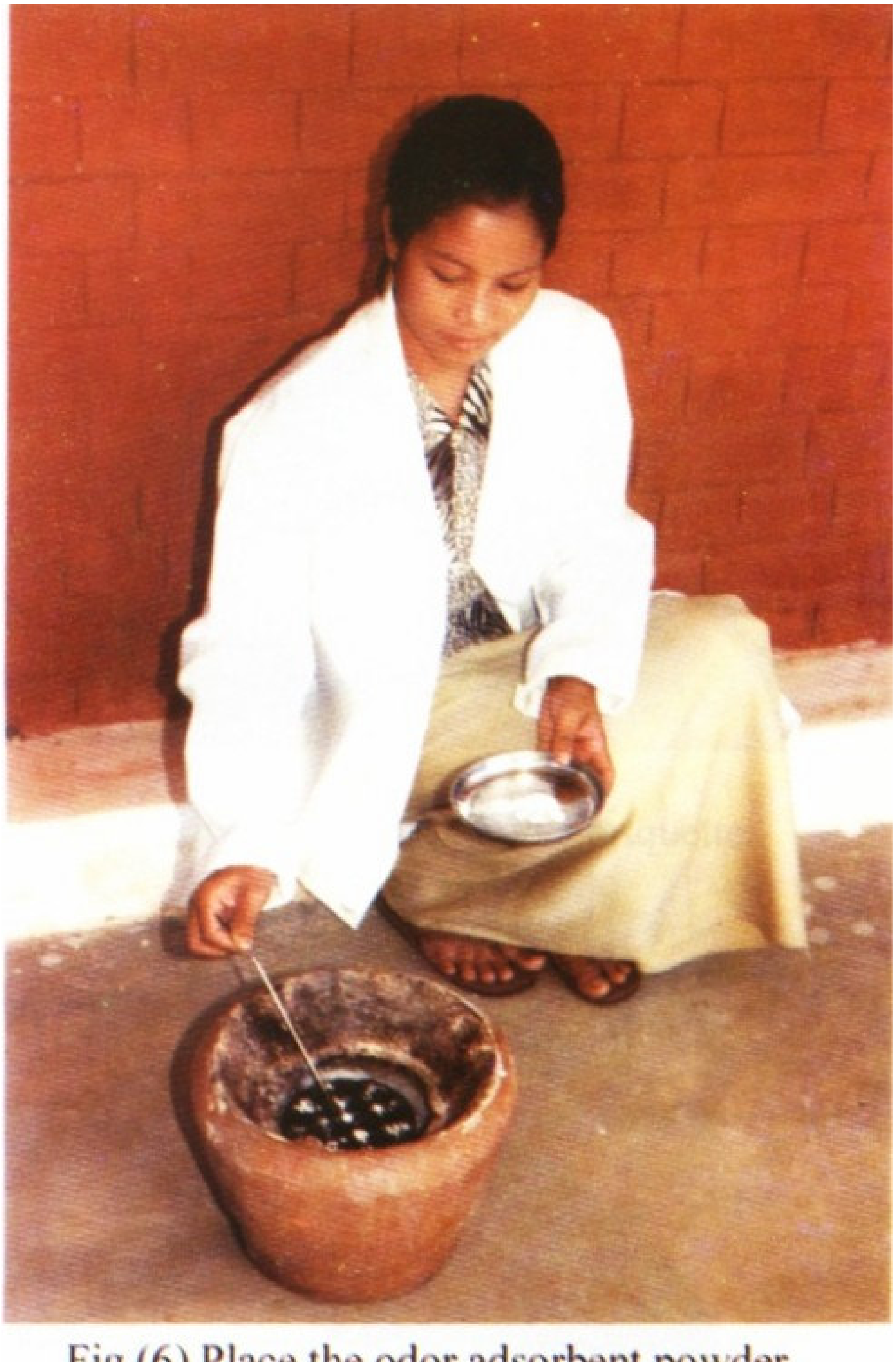

Fig (6) Place the odor adsorbent powder
on to a burning briquette.

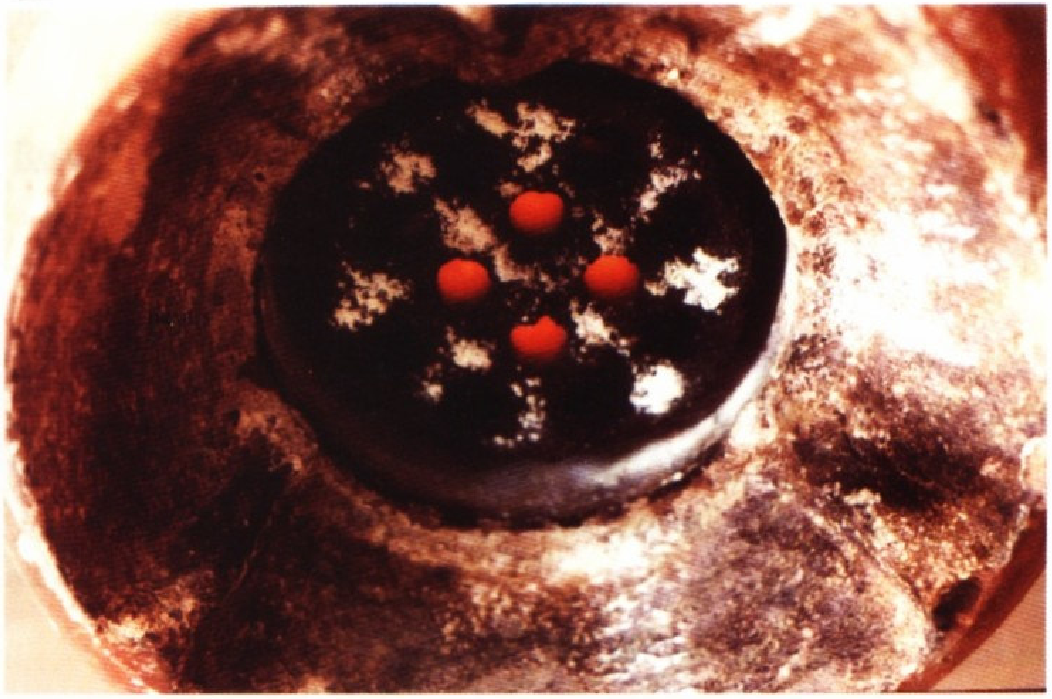

Fig (7) Odor adsorbent powder are placed on a briquette.

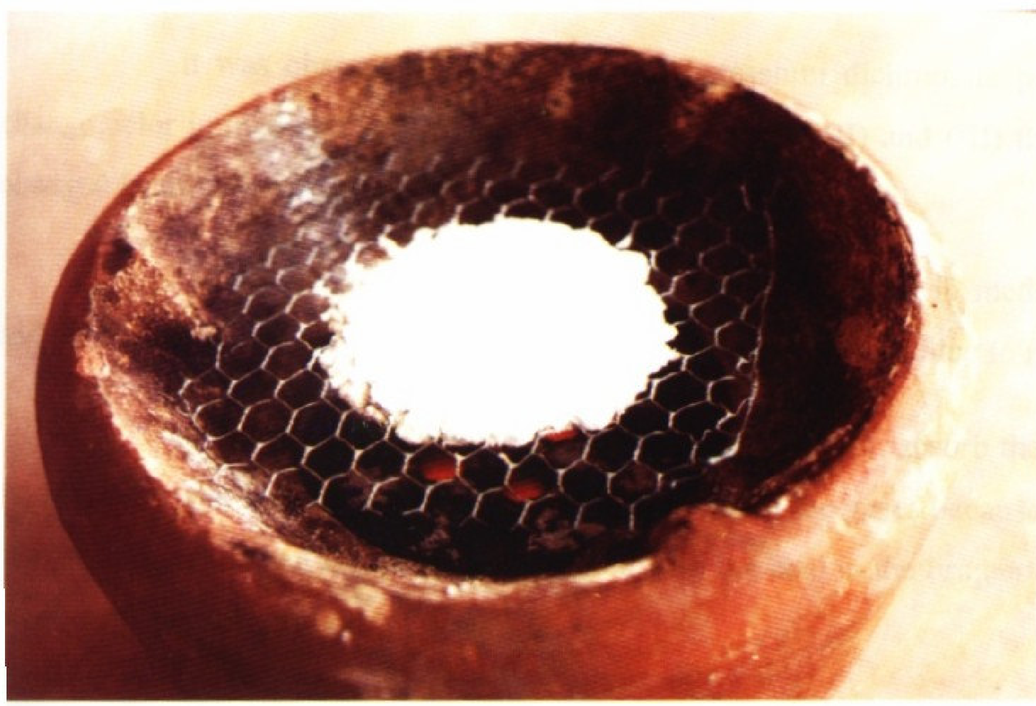

Fig (8) Odor are removed by using the ceramic materials.

4. Results and Discussion

The results of method (I), (II), (III),(IV) and (V) are summarized in table 1,2,3,4 and 5.

The comparison of method, (I), (II), (III), (IV) and (V) are shown in Table 6. Results of method (I) showed that, the gases are absorbed in .5g activated carbon.

The method (II) and (III) indicate that gases are not absorbed.

The method (IV) indicates that 0.5g of talc can absorb the unpleasant odor from the coal briquette.

Results of method (V) showed that a special asbestos-free ceramic paper could absorb the gases.

It was observed that the color of potassium dichromate paper did not change color in method (I), (IV) and (V). But in method (II) and (III) the colour are changed from yellow to green.

In the litmus paper tests, the color did not change in method (I), (IV) and (V), but in the methods (II) and (III) the colour changes from blue to red.

It was found that methods (I), (IV) and (V) could absorb the gases from the briquette. But method (II) and (III) could not absorb the gases because the surface of activated carbon and talc powder are mixed with the coal in the briquette. There are no affect for the absorption of gas.

Table 1. Results of Method I.

Amount of activated carbon	Potassium Di chromate Paper	Litmus Paper	Remarks
.05g	yellow → green	Blue → Red	no absorbed
.25g	yellow → green	Blue → Red	no absorbed
.50g	yellow → yellow	Blue → Blue	absorbed
1.00g	yellow → yellow	Blue → Blue	absorbed

Table 2. Results of Method II.

Amount of activated carbon	Potassium Di chromate Paper	Litmus Paper	Remarks
.05g	yellow → green	Blue → Red	no absorbed
.25g	yellow → green	Blue → Red	no absorbed
.50g	yellow → green	Blue → Red	no absorbed
1.00g	yellow → green	Blue → Red	no absorbed

Table 3. Results of Methods III.

Amount of talc and calcium oxide	Potassium Di chromate Paper	Litmus Paper	Remarks
.05g	yellow → green	Blue → Red	no absorbed
.50g	yellow → green	Blue → Red	no absorbed
1.00g	yellow → green	Blue → Red	no absorbed

Table 4. Results of Method IV.

Amount of talc	Potassium Di chromate Paper	Litmus Paper	Remarks
.05g	yellow → green	blue → red	no absorbed
.25g	yellow → green	blue → red	no absorbed
.50g	yellow → yellow	blue → blue	absorbed
1.00g	yellow → yellow	blue → blue	absorbed

Table 5. Results of Method V.

Material	Potassium Di chromate Paper	Litmus Paper	Remarks
Ceramic paper	yellow → yellow	blue → blue	absorbed

Table 6. Comparison of methods (I), (II), (III), (IV) and (V).

Method	Potassium Di chromate Paper	Litmus Paper	Remarks
I	yellow → yellow	blue → blue	absorbed
II	yellow → green	blue → red	no absorbed
III	yellow → green	blue → red	no absorbed
IV	yellow → yellow	blue → blue	absorbed
V	yellow → yellow	blue → blue	absorbed

Table 7. Cost estimate for the production of activated carbon by drum. (25 kg)

	First time (Kyats)	Next time (Kyats)
Empty Drum	3000	-
Welding	2500	-
Zinc chloride (3 Lbs)	2400	2400
Coconut shells (4 Bags)	500	500
Labor cost	400	400
Total	8800	3300

Table 8. Compared with the market rate.

Activated carbon	Production cost	Market Rate

1 bag (25 kg)	3330 Kyats	10000 Kyats

Cost estimate for the activated carbon to the removal of unpleasant odor from the briquette are as follow.

Number of briquette to remove the odor by using 1 bag activated carbon $= \frac{25 \times 1000 \text{ gm}}{0.5 \text{ gm}}$

$= 50000$

Cost for the activated carbon to remove the odor from the one briquette $= \frac{3300 \text{ kyats}}{50000}$
$= 0.066$ Kyats

$= 0.07$ Kyats

Cost estimate for the Magnesium Trisilicate to the removal of unpleasant odor from the briquette are as follow.

Cost for the magnesium trisilicate = 800 kyats / 500 gm
Weight of magnesium trisilicate for a briquette = 0.5 g

Number of briquette to remove the odor by using 500 g $= \frac{500 \text{ gm}}{0.5 \text{ gm}} = 1000$

Cost for the magnesium trisilicate to remove the odor from the one briquette $= \frac{800 \text{ Kyats}}{1000}$
$= 0.8$ kyats

Cost estimate for ceramic paper to the removal of unpleasant odor from the briquette are as follow.

Cost for the Chemical (talc, calcium oxide) = 10 Kyats
Cost for the iron sieve = 40 Kyats
Total cost = 50 Kyats

When compared to the cost estimate for the activated carbon, Magnesium Trisilicate and ceramic paper to the removal of unpleasant odor from the briquette, the result showed that the cost of activated carbon, (0.07 kyats) was lower than others.

5. Conclusion

The unpleasant odor of briquette resulted from the combination of sulfur dioxide and sulfur trioxide. Sulfur compounds are dangerous to health and many pollute the air when the density is great. Therefore removal of the sulfur compound should be made before burning the coal briquette in air.

From the studies conducted in the five methods, in the absorption of odor tested, it is concluded that method I and method IV are suitable for the removal of unpleasant odor from coal briquette.

For the economic point of view, method I is most suitable because it's cost is the least. By removing the noxious unpleasant odor, the adverse side affects which may injure human health and at the same time pollute the air are totally removed.

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