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Collector Ability of Potassium Ethylxanthate Synthesized with Caustic Potash of *Elaeis guineensis* on Sulphide Minerals

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Abstract: The ash of burnt inflorescence of *Elaeis guineensis* (oil palm tree) was found to contain 99% potassium hydroxide (caustic potash). The crystals of the caustic potash were used to synthesize potassium ethylxanthate (KEX) at optimum temperature of about 45°C. The flotation tests carried out showed that over 200% recovery was achieved during the concentration of galena mineral. Physical characterisation and ultraviolet spectroscopic analysis showed the presence of an alkali xanthate as the collector specie.

Key words: *Elaeis guineensis*, adsorption, potassium ethylxanthate (KEX), recovery, galena, collector

INTRODUCTION

A collector is heteropolar surface-active agent used in flotation to render certain selected minerals hydrophobic. Hydrophobicity is imparted to minerals by adsorption of collector ions or molecules onto mineral surfaces. Xanthates as collectors are very powerful and selective in the flotation of sulphide minerals (Wills, 1981). Xanthates are the most effective collector for the flotation of sulphide minerals such as galena and sphalerite. Xanthates belong to the group of collectors called sulphydyl collectors. The inflorescence of *Elaeis guineensis* are usually waste matter left after palm fruits have been removed for palm oil production. The ash of the inflorescence has been utilized in the production of local soaps and as food emulsifiers. Many workers has shown that other soaps from locally available oils can be used in flotation (Ajayi, 2005; Onyemaobi, 1990). Researchers have produced sodium amyl and sodium hexylxanthates using analar grades of chemicals. Because of high cost of xanthates due to importation tariffs, the objectives of this work are to harness the abundance of the potassium hydroxide (caustic potash) found in the palm bunch to synthesize the collector-potassium ethyl xanthate (KEX). The economic value of the otherwise waste ash of these palm bunches can thus be enhanced in the solid mineral industry.

MATERIALS AND METHODS

The waste palm bunch chaffs were collected from Adapalm Oil Mills, Ohaji. The chaffs were sun dried and burnt in an oven at 220°C until only the ash remained. Five g of the ash were digested with aqua regia (10 mL). The solution was made up to 200 mL with distilled water and filtered. Elemental analysis was done using Atomic Absorption spectrophotometer Buck 205 model.

Preparation of the KEX: The burnt ash of *Elaeis guineensis* was weighed and stored in a dessicator. One hundred and thirty two gram of the palm ash was leached with 300 mL of distilled water for 72 h. The leached solution was filtered and the filtrate collected. The filtrate was heated to dryness on a water bath to obtain crystals of the caustic potash. Equimolar quantities of the caustic potash crystal and 98% alcohol were taken together and the mixture stirred and heated to 30°C for 10 min. Tewelve mililiters of Petroleum ether was added as diluents to the mixture while stirring continued for 1hour at same temperature until slurry was formed. At this point, 9.8 mL of carbondisulphide of 67% purity was introduced to the mixture, which led to the formation of thick slurry. More Petroleum ether was added to the mixture then separated by filtration leaving behind a yellow residue as the KEX. The KEX so obtained was dried in a desiccator. The same procedure was repeated at temperatures of 35, 40, 45, 50 and 60°C while other conditions of time was constant.

Flotation test on galena (PbS): Five hundred gram of the ore as collected from the mining site at Ozalla in Ishiagu of Ebonyi State was crushed and reduced to 300 μm using the blarke jaw crusher. Two hundred g of the-300 μm ore sample was put in a 2 L Denver laboratory flotation cell. The sieve used was the BSS model. Water was run into the cell to achieve the desired dilution. The resulting pulp was conditioned by stirring for 20 min The pulp

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natural pH was 4.6. 3 g of the prepared potassium ethylxanthate of *Elaeis guineensis* as collector were added and conditioned for 5 min. Three drops of C_3-C_5 alcohols were used as frothers and conditioned for another 5 min. The ore was then floated for 3 min by opening the air jet. The concentrate was collected, dried in an oven at 110°C and weighed. Chemical analysis was performed on the concentrate to assay the quantities of metal sulphide present.

KEX analysis: Physical analysis such as colour, odour and solubility in water was performed. The KEX obtained at 45°C was chosen as the standard sample for subsequent collector test runs because it was the temperature of maximum yield observed. The KEX sample was diluted with petroleum ether and analysed using FT UNICAM-UV visible spectrophotometer.

RESULTS AND DISCUSSION

Table 1 shows the elemental analysis of the caustic potash from *Elaeis guineensis*. Table 2 presents the yield of potassium ethylxanthate from the reactants at varying temperatures. Table 3 indicates the results of the chemical analysis of the raw ore as collected from Ishiagu mines and the concentrates obtained after flotation using the KEX from Elaeis guineensis.

The p oint of maximum absorption from the UV-analysis is 420 nm. The physical characteristics showed colour as yellow, odour as unpleasant and the KEX found very soluble in water.

Table 1 shows that the burnt palm fruit bunch of *Elaeis guineensis* is predominantly potassium (99%) in the form of K_2O. Mixture of the ash and water yields potassium hydroxide (caustic potash) as shown below:

$$\underset{\text{Palm bunch}}{K} \xrightarrow[\text{ignition}]{\text{air } (O_2)} K_2O_{(s)} \xrightarrow{+H_2O} 2KOH_{(aq)}$$

The reaction of the caustic potash, alcohol and carbon disulphide in equimolar quantities gave the collector, potassium ethylxanthate. The scheme follows thus,

$$C_2H_5OH + KOH \rightarrow C_2H_5OK + H_2O \quad (1)$$

$$^{+}C(=S)(-S) + C_2H_5OK^{+} \longrightarrow C_2H_5OC(=S)-S^{-}K^{+} \quad (2)$$

Overall equation:

$$KOH + C_2H_5OH + CS_2 \rightarrow C_2H_5OCS_2K + H_2O$$

Table 1: Elemental analysis of the palm ash from *Elaeis guineensis*

Element	Phosphorus, P	Sodium, Na	Potassium, K
Conc (Mg L^{-1})	0.01	253	25,200
Percentage composition	>0.01	0.994	99.00

Table 2: Yield of KEX obtained at different temperatures at constant stirring time of 1 h

Temperature °C	Yield (g)
30	9.8
35	10.00
40	12.01
45	14.80
50	12.00
60	9.40

Table 3: Comparative elemental analysis of the ore sample and flotation concentrate recovered by using KEX as collector

Element	Ore sample % composition 1	Flotation concentrate % Composition 2
Zn	56.00	24.44
Pb	31.10	72.95
Ca	4.00	1.00
Fe	1.01	0.02
Si	2.08	0.50
Cd	2.08	0.41
Mg	2.80	0.41

Table 2 shows the effect of temperature on the yield from the combining species; as the temperature increases from 30°C the yield of KEX increases up to an optimum temperature of 45°C. Further increase in temperature leads to decrease in yield. This could be that the ethanol volume decreases by vaporization thereby reducing the reacting volume of ethanol in the system.

Table 3, column 2 indicates that the Ishiagu ore is predominantly sphalerite and galena while the concentrate obtained from the flotation of the ore using the KEX (column 3) showed an increase in the recovery of galena and a decrease in sphalerite and other trace minerals. The increase in amount of galena represents over 200% increase in recovery of galena and a decrease of about 43% in sphalerite which shows that sphalerite cannot be floated without activation by copper (Sui *et al*., 1999).

The UV spectrophotometer results show a maximum absorption at wavelength 420 nm, which is near to the absorption wavelength of samples obtained from analar grade of Crozier (1980).

CONCLUSION

In the synthesis of potassium ethylxanthate KEX, burnt ashes of *Elaeis guineensis* has proved to be a good and cheap source of natural potassium hydroxide (caustic potash). The result of the flotation test reveals that the potassium ethylxanthate synthesized from caustic potash has good collector ability on a sulphide mineral-galena. It is recommended that countries without an alkali-chlor industry but with high palm oil production

can utilize this process in order to reduce cost on importation of xanthates and also solve the environmental problem caused by the palm bunches.

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