ENVIRONMENTAL ISSUE IN COPPER ORE FLOTATION BY XANTHATES

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Abstract: *This paper presents some investigation results about potassium ethyl xanthate (PEX) stability in water solution at higher pH and in presence of mineral chalcopyrite, related to flotation of copper minerals from copper ore. It is well known that ions of nonferrous metals have a catalytic effect on PEX decomposition forming the simple compounds as: related alcohol, related alkali and carbon disulphide. These investigation were focused on PEX decomposition in presence of mineral chalcopyrite at higher pH, above 10 which has the same catalytic effect like copper ions in solution. The most dangerous product of that decomposition is carbon disulphide with its toxic action on humans in working environment. These effects have occurred at higher pH values and rapidly increase towards pH 12. On the other hand, the copper minerals flotation has occurred at those pH values in practice. The concentrations of Xanthate ion and* CS_2 *were determined by UV Vis spectroscopy. Some results from extended investigation were given in this paper.*
Keywords: *Potassium ethylxanthate, carbon disulphide, chalcopyrite, environmental problems.*

Introduction

Dithiocarbonates are widely applied in practice in the flotation process of sulphide minerals of non-ferrous metals in previous years. Now, they are largely replaced by other substances on the basis of phosphorus chemistry and ethoxy compounds. But their application is still present in some plants for flotation concentration of sulphide minerals in Serbia and abroad. The reason for their application lies mainly in the low cost and satisfactory efficiency in the given process. Dithiocarbonates or well known as xanthates are very unstable in acidic media below pH 4 and also in higher basic conditions in the presence of non-ferrous metal ions they decompose to their simple compounds as: related alcohol, related alkali and carbon disulphide. Here, non-ferrous metal ions play a catalytic role on xanthate decomposition process [1].

Xanthates as surface active substances detrimental to human health so it needs to take special safety measures when handling with them. Addition of carbon disulfide in xanthate decomposition process is even more toxic effects on the working environment in relation to the xanthates itself. NICANAS (National Industrial Chemicals Notification and Assessment Scheme) from Australia was pointed out in detail the dangers of using xanthate [2].

Carbon disulphide affects the central nervous system, cardiovascular system, eyes, kidneys, liver, and skin. It may be absorbed through the skin as a vapor or liquid, inhaled or ingested. The probable oral lethal dose for a human is between 0.5 and 5 g/kg for a 70 kg person. In chronic exposures, the central nervous system is damaged and results in the disturbance of vision and sensory changes as the most common early symptoms. Lowest lethal dose for humans has been reported at 14 mg/kg or 0.98 grams for a 70 kg person. Alcoholics and those suffering from neuropsychic trouble are at special risk. [3]. Some physical properties of carbon disulphide are (3): Boiling point at 46 °C (lit.), density 1.266 g/mL at 25 °C, vapor density is 2.67 (vs air), vapor pressure is 5.83 psi (20 °C) (40.21 kPa).

The process of flotation of copper minerals in the alkali media and especially in the refining cycle of flotation concentrate where the pH rises to 11.8, there is an intensive decomposition of xanthate with carbon disulfide is released as a highly toxic component.

There are a number of published papers on the stability of the xanthate in aqueous solutions depending on pH and with and without the presence of foreign ions in solution. It also found that non-ferrous metal ions have a catalytic effect on decomposition of xanthate in alkaline aqueous solutions [2].

The works [4, 5] have shown that the presence of copper sulphide minerals affects the decomposition of xanthates in high alkali conditions at pH above the 11. This paper presents some research results concerning the identification of decomposition of potassium ethyl xanthate in the presence of mineral chalcopyrite. Any changes in the solution were monitored by UV Vis spectrophotometer, which has registered the presence of xanthate and carbon disulfide solutions of the appropriate characteristics. In Figure 1, is shown the UV Vis spectra for: ethyl xanthate (ETX- 301nm and 226nm) and carbon disulfide (CS_2 206 nm), in fresh stae and after 2 days exposed ti air.

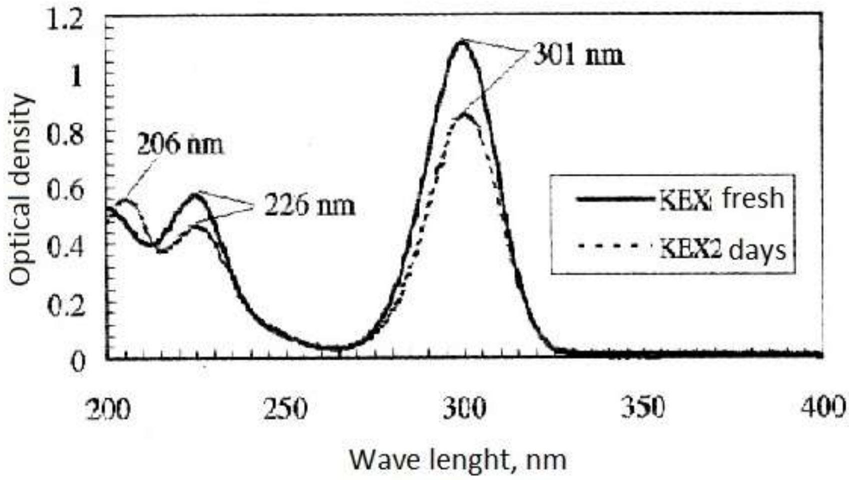

Figure 1, is shown the UV Vis spectra for: ethyl xanthate (ETX-) and carbon disulfide C

EXPERIMENTS AND RESULTS

Reagents and material

- Potassium ethyl xanthate of technical grade underwent to double purification by dissolving in acethone and recrystallization in petrol ether under vacuum.
- Regulator was calcium hydroxide p.a. grade.
- Chalcopyrite sample from Bor copper mine, fraction (-74 + 38) µm.

UV Analyses

Analysis of aqueous solutions of potassium ethyl xanthate after contact with chalcopyrite at the certain conditions, was determined by UV Vis spectrometer 9200 type UV Rayleigh.

UV measurements

In these experiments the variables were: pH, concentration and contact time of KEX solution with chalcopyrite. The concentration of carbon disulfide in the resulting solution was monitored by the wavelength of 206 nm at a concentration of ethyl xanthate over the wavelength of 301nm. Table 1 shows the changes in these concentrations as a function of contact time and pH value of solution at the initial KEX concentration of 1 × 10-5 mol / l.

Table 1 Absorbance of degradation KEX products (carbon disulphide - 206 nm and ethylxanthate ion-301 nm) in a solution concentration of 1 × 10-5 mol/dm-3 at pH = (10, 11 and 12), a function of time

Time min	pH 10		pH 11		pH 12	
	206.5 nm	301 nm	206.5 nm	301 nm	206.5 nm	301 nm
20	0.14284	0.03938	0.14181	0.05121	0.19804	0.06151
40	0.12368	0.03667	0.14681	0.04865	0.19306	0.06213
60	0.11914	0.02511	0.14361	0.04787	0.17773	0.05566
1440	0.12221	0.02076	0.13698	0.04276	0.16515	0.03887

In Figure 2, is given the graphical representation of the concentration of CS2 in solution as a function of pH and contact time with the mineral chalcopyrite. A in Figure 3, presents the changes in concentrations of KEX function of pH and contact time with chalcopyrite.

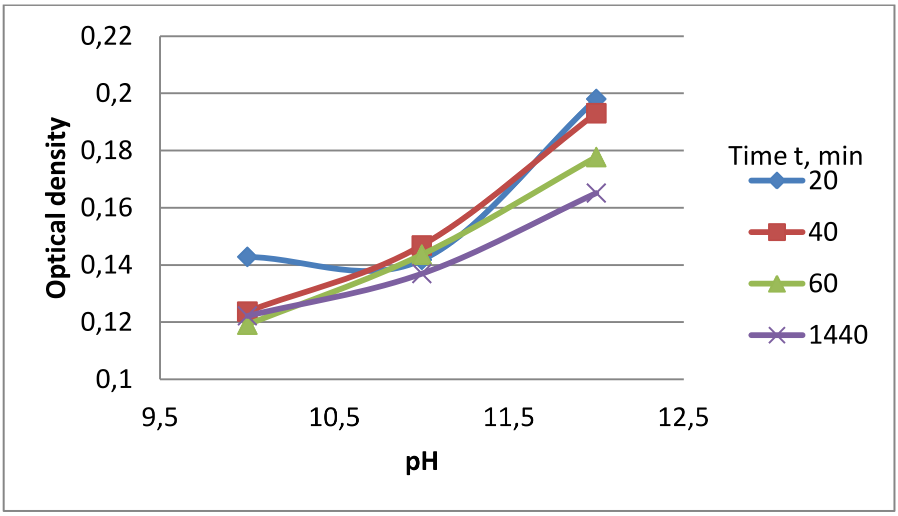

Figure 2. The graphical representation of the concentration of CS2 in solution as a function of pH and contact time with the mineral chalcopyrite

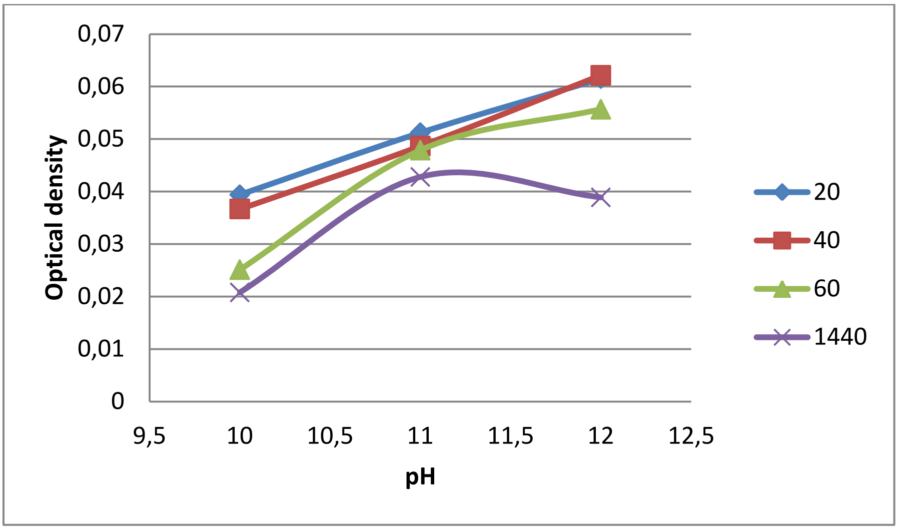

Figure 3. The changes in concentrations of KEX in function of pH and contact time with chalcopyrite

Based on previous research the decomposition reaction of KEX at higher pH in the presence of minerals chalcopyrite, the chemical equation was suggested as:

$$C_2H_5OCSSK + H_2O \rightarrow C_2H_5OH + KOH + CS_2$$

The reaction products are ethyl alcochol, potassium hydroxide and carbon disulphide.

Conclusion

According to above presented, there is no doubt that Potassium ethylxanthate has a great negative impact on working area in the closed flotation plants.

There are two main negative effects by using the xanthates in copper minerals flotation process. One is related to working environment due the faster decomposition of KEX on pH 11.8 and releasing the carbon dioxide, very toxic gas in the working area. Second is the great losses of reagent xanthates in the flotation cleaning prosess which occurs at the pH of 11.8. Loosing the xanthates it effects on technological results in copper mineral flotation.

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