IMPROVEMENT OF ENVIRONMENTAL SAFETY AND ECONOMIC EFFICIENCY OF GOLD EXTRACTION INDUSTRY

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Introduction. This project was devoted to reach two aims: (i) to optimize the gold leaching process based on ammonia thiosulfate and catalyzed by copper as a novel leaching agent, and (ii) to develop the cyanide recycling technology. Alternative technologies such as Acidification-Volatilization-Reneutralization (AVR), Sulphidization, Acidification, Recycling and Thickening (SART) and Gas Membrane technologies were compared and considered for further development.

Materials and methods. Ore samples originate from VasGold operation. Leaching was conducted by the solution of 0.2 M $Na_2S_2O_3$ and 0.01 M Cu_2SO_4 at 80°C, pH 10, for 3 hours. Gold and other metal cations content was determined in the filtrate and solid residue using atomic absorption spectrometry. Cyanide recycling process was investigated at ambient temperature for 1 hour, with carrier gas flow rate of 1.2 L/min. Initial basic solution of CN^- was acidified with concentrated H_2SO_4. Air was circulated via a closed loop through 100 mL of 1M sodium hydroxide. Concentration of CN^- was measured using the automatic potentiometric titrator, Titrando-905.

Results and discussion. Figure 1a shows electrochemical characteristics of Au-containing solution. It can be seen that at -0.85 V the peaks are separate and represent concentration of Au, from which might be concluded that Au content can be successfully determined by cyclic voltammetry (CV) method using glass carbon electrode. Figure 1b shows CV profile of leaching agents for comparison.

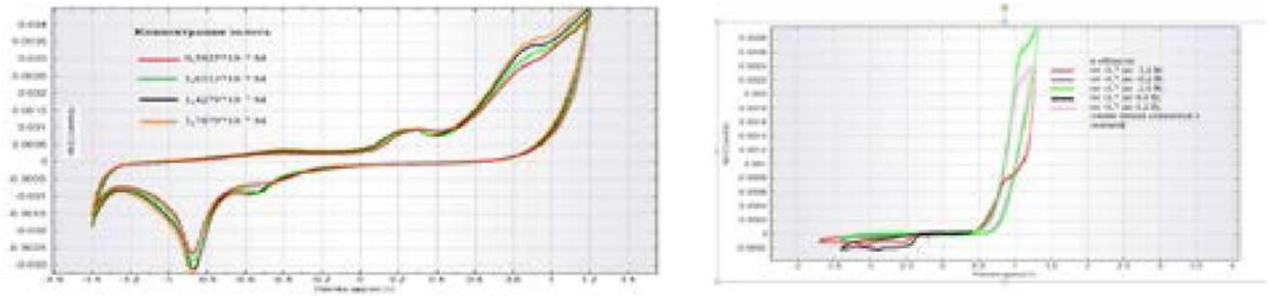

Figure 1. a) Cyclic voltammogram of Au-containing solution, b) CV-curves of different leaching agents

A gas membrane can be used to recover cyanide from acidified clear solutions. A hydrophobic gas membrane, e.g. polypropylene (PP) or polytetrafluoroethylene (PTFE), is used to separate two aqueous streams - the cyanide containing stream and the cyanide stripping stream (e.g. NaOH). The membrane pores remain air-filled for as long as the pressure difference between these two aqueous phases is lower than the breakthrough pressure. Upon acidification of the cyanide containing stream, dissolved HCN is volatilized to gaseous HCN at the membrane and HCN (g) diffuses across the gas strip solution where it reacts with NaOH to form NaCN.

Conclusions. Environmental implications of gold extraction operations regarding cyanide toxicity have led to increased research on improvement of current technology. Although some research has shown positive results on alternative lixiviants, such as thiosulfate, the economic factors are still incomparable with those of the cyanidation process. It was shown that cyanide recycling techniques could be applied in the technology currently employed. This will decrease the environmental impact caused by CN^- production, transportation and consumption and improve the economic efficiency in the gold extraction industry. The recovery factor of >95% for CN^- can be obtained.