

# Introducing Process Efficiency Improvements and Cyanide Recycling at Akbakai Gold Mine



**Transferable Solution**

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**Project Title:** Process Efficiency Improvements and Cyanide Recycling at Akbakai Gold Mine

**Project Leader:** JSC Altynalmas, Almaty, Kazakhstan

**Project Partner:** EnviroNet Management Systems, LLC, Arlington, VA USA

**Location of Project:** Akbakai, Kazakhstan

**Project Duration:** October 2000 - September 2001

**EcoLinks Project Contribution:** Total Project Investment : \$83,758; EcoLinks Grant Support: \$49,101; Project Team Contribution: \$34,657.

## Best Practice: Transferable Solutions

As is common in many gold processing operations, cyanide is used to leach gold from the ore at Akbakai mine facilities. Prior to implementation of this EcoLinks funded project, about 20-30% more cyanide was being used at Akbakai mine facilities as compared to similar processing facilities world-wide. Furthermore, gold extraction resulting from cyanide leaching at Akbakai was about 15% lower than at other facilities.

The project "Process Efficiency Improvements and Cyanide Recycling at Akbakai Gold Mine" is an EcoLinks Best Practice. Building on technologies and processing techniques already proven in the US, the Project Team developed a pre-feasibility study to assess the potential for optimizing the efficiency of the cyanide leach plant and of the ore dressing plant. The pre-feasibility study showed that the mine can undertake measures not only to significantly reduce the amount of cyanide required for gold processing at Akbakai (through improved efficiency and partial cyanide recycling), it can also extract a larger percentage of gold from the ore, thus bringing additional revenue to the mine. The recommendations and approach developed through this EcoLinks funded project are transferable to other gold mines and non-ferrous metals producers using cyanide in processing in the CEE/NIS regions.

# Project Summary

The Altynalmas Gold Mine and Ore Processing Facility, located in Akbakai, Kazakhstan, uses cyanide as a leaching agent in gold processing. Cyanide is one of the most toxic substances known; even small quantities have the potential to contaminate large volumes of surface water or ground water for extended periods of time. Prior to project implementation, used cyanide was first partially neutralized with hypochloride sodium and then discharged into a tailings pond near the plant. Despite the hypochloride sodium neutralization process, however, wastewater from gold processing at Abakai released into tailing ponds still contained significant amounts of cyanide.

In addition to the environmental concerns associated with the cyanide leaching at Akbakai, Altynalmas faced serious economic concerns as well. First, cyanide is not produced in Kazakhstan, which means that it must be shipped in from abroad (usually from China or Georgia), an import which cost the mine about \$200,000/year. An initial pre-project assessment of the facilitates showed that cyanide usage at Akbakai was approximately 20-30% higher than at other facilities. In addition, about 800 tons of hypochloride sodium had to be purchased each year to neutralize the used cyanide. Second, the percentage of gold extracted Akbakai was approximately 15% lower than at other, similar facilitates using cyanide leaching.

The goal of this project was to develop a pre-feasibility study to assess the potential for efficiency improvements in the gold leaching plant and ore dressing plant. The pre-feasibility study also assessed the potential for implementing a cyanide recovery and recycling system.

## Project Activities

The main goal of this project was to develop a pre-feasibility study to assess the potential for efficiency upgrades to improve the environmental and economic performance of gold processing at Akbakai. Project activities included the following:

### **1. Establish Mass Balance -- Assessment of Processing Efficiency of Mine**

Action: The Project Team developed a protocol for data collection on engineering parameters at the gold processing facility. Working with Altynalmas staff, information was gathered and a database was created on (1) material inflows; (2) ore geo-chemical characteristics; (3) current gold processing methods and efficiency; (4) chemical make up of waste streams; (5) reagent use; and (6) energy use. Technical schema of the treated ore dressing factory and cyanide leaching plant were developed.

Product(s): 1) A mass balance of gold processing at the mine was established.

### **2. Characterize Performance and Technical Alternatives**

Action: Based on data gathered under Activity #1 (above) the Project Team identified the following technical aspects as priority for further consideration: (1) the current gold processing facilities and potential for improved gold extraction; (2) introduction of Cyabisorb cyanide recovery/recycling; (3) introduction of Kazahstani-developed cyanide

recovery/recycling process; (4) introduction of other cyanide recovery options, such as tailings washing and high density thickening. Initial technical characteristics were gathered on each of these points.

Product(s): 1) Technical characteristics of potential alternatives were collected.

### **3. Develop Technical and Economic Assessment of Options**

Action: The economic costs and benefits of each of the four variants listed in Activity #2 (above) were considered for the Akbakai facilities. Within the scope of this EcoLinks project, Altynalmas management decided to focus the economical and technical assessment on cyanide recovery/recycling options (Options (2) and (3) ). An initial assessment of Options (1) and (4) was also conducted and Altynalmas management plans to develop pre-feasibility studies on these options in the future.

Product(s): 1) Initial economic and technical assessment of options.

### **4. Development of Pre-feasibility Study**

Action: Using data gathered by Cleaner Production Laboratory, the American Partner EnviroNet developed a pre-feasibility study which considered introduction of Cyabisorb cyanide recovery/recycling vs. other options, such as tailings washing and high density thickening. Advantages of the Cyabisorb cyanide recovery system as compared with other options are the superior recovery rate (up to 90% of cyanide can be recovered and re-used) and that the Cyanisorb system has a proven track record at mines in the USA, New Zealand, Argentina and Peru. While investment for a Cyabisorb cyanide recovery plant can be significant (the pre-feasibility study estimates approximately \$200,000 in capital costs for the Akbakai facility), cyanide can generally be recovered for about \$0.70 - \$1.50 per kg. Since Akbakai currently purchases cyanide at about \$2.00-\$2.20 per kg., this method of cyanide recovery seems to be an economically attractive alternative to the mine's current practice of cyanide neutralization and disposal.

The project pre-feasibility study also makes an initial assessment of improving gold extraction at Akbakai through pressure oxidation.

Results of this pre-feasibility study show that both Cyabisorb cyanide recovery/recycling and pressure oxidation are economically attractive options at Akbaikai.

In addition to the pre-feasibility study developed by EnviroNet, the Local Partner, Cleaner Production Laboratory, conducted a technical and economic assessment of a cyanide recovery system developed in Kazakhstan in the 1980's and previously tested on a pilot basis. Because this system had previously only been tested in pilot project conditions, it was necessary to run tests using actual tailings from Akbakai to estimate efficiency of a full-scale system. Tests showed that about 60% of cyanide can theoretically be recovered using the Kazakhstani system. Approximate cost of installing the system at Akbakai is \$130,000.

Product(s): 1) Pre-feasibility study on introduction of Cyabisorb cyanide recovery/recycling vs. other options, such as tailings washing and high density thickening. 2) Technical and economic assessment of Kazakhstani cyanide recovery system.

# Project Benefits

This project draws on technologies and processing techniques already proven at gold processing facilities that use cyanide leaching in the USA, New Zealand, Argentina and Peru. The project built the Project Leader's capacity by involving Altynalmas staff directly in conducting the mass balance and a technical and economic assessment of options. Potential economic and environmental benefits, as outlined in the pre-feasibility study, include up to a 90% reduction in the amount of cyanide needed to process gold at Akbakai and 10% increase in the percent of gold extracted from the ore.

## Capacity Building Benefits

This project resulted in several capacity building benefits. First, project activities built the Project Leader's capacity by involving Altynalmas directly in conducting the mass balance and in the technical and economic assessment of options. Second, through this project, Altynalmas Mine management was introduced to technologies and processing techniques to reduce cyanide needed in the gold leaching process already proven in the USA. Through the involvement of Altynalmas staff in this project, mine management was able to observe firsthand the cost of cyanide neutralization and disposal at Altynalmas.

## Environmental Benefits

Implementation of recommendations in the pre-feasibility study concerning cyanide recovery will have significant environmental benefits. These include:

- ◆ Cyanide recovery will make the current high cyanide concentration solution ponds unnecessary, reducing the risk to wildlife and ground water in the area.
- ◆ Reduced cyanide in tailings will allow for quicker, cleaner and easier mine closure and reclamation.
- ◆ Recovery and recycling of cyanide will greatly reduce the need to purchase and transport cyanide from abroad, and therefore will likewise greatly reduce the risk of accidental spillage or release during transport. (In 1998, such an accident took place in neighboring Kyrgyzstan, when a tanker transporting cyanide to Kumtor Mine tipped over and two tons of sodium cyanide leaked into the Barskoon River).

## Economic Benefits

Capital costs for construction of a cyanide recovery plant at Akbakai are estimated at \$200,000. Cash flow costs for this plant show a positive income of approximately \$60,000 annually (avoided cyanide purchase costs). Thus, the simple pay back period of a cyanide recovery plant is about 3.3 years.

However, if costs of cyanide neutralization and disposal are also considered (currently approximately \$50,000 per year at Akbakai facilitates), then an annual savings of \$50,000 can be added to the cashflow benefits of the plant, bringing the simple pay back period down to under two years.

The pre-feasibility study also included an initial assessment of using a processing technique called 'pressure oxidation' to increase the amount of gold extracted from the ore as something Altynalmas may want to consider in the future. Findings of the study indicate that such a process would be economically attractive at Altynalmas and could increase the amount of gold extracted from the ore by approximately 10%.

## **Lessons Learned**

Lessons learned from this project include the following:

- Critical to the project's success was that mine staff was directly involved in the assessment of gold processing efficiency (Activity #1) and evaluating technical options (Activity #3). Through their involvement in these activities, the mine's management was able to observe firsthand how much current practices of cyanide neutralization and disposal actually cost the mine, and that there are proven alternatives available.

## **Contact Information**

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