

## MODULE ORE-DRESSING PLANTS

*K.Fedotov, A. Potyomkin, V.Beloborodov*

Irkutsk State Technical University – Lermontov street, 83, Irkutsk, Russia, 664074  
oms@istu.irk.ru

### ABSTRACT

In the present work the results of commercial operation of modular semi-mobile concentrating plants meant for gold recovery from gold-bearing quartz ores have been given. The main peculiarity of these plants is that the whole cycle of recovery to concentrate passes in centrifugal concentrators. A principle of designing a technological flowsheet of separation has been described based on laboratory investigations and mathematic modelling, the results of commercial operation of gold recovery plants in Russia have been given in this work.

### INTRODUCTION

Rather great reduction of prices for ounce of gold, happened on the world market over the last years, forced many gold mining enterprises not only to reduce mining but also fully stop the production. In this situation development of new technologies allowing to reduce cost of gold recovery from ore becomes topical.

It is well known that mobile and semi-mobile concentrating plants can be effectually applied on small gold reserves deposits [1]. In Russia where there are a lot of such deposits, usage of module, semi-mobile plants which don't require great capital outlays, is very efficient.

In the world practice of ores separation within the last years an essential interest to mobile and semi-mobile modular systems is observed. A great experience of their commercial operation in South Africa, Australia and South America is gained.

One of the first producers of modular plants became a Sweden company Sala International, which presently is included in industrial group Svedala [2]. The first system «Caravan Mill» was produced in 1970 and meant for operation as a pilot system. Later such systems became to operate as industrial highly economical plants of small output [3].

Use of the last investigations in the field of gold recovery from ores with the help of hydrodynamic modelling of pulp flow in centrifugal concentrator allowed the authors of the present work to design and put into operation several modular semi-mobile gold recovery plants [4].

### EXPERIMENTAL

One of the gold ore deposits where modular semi-mobile plant operates is situated in the East Siberia. The ore of the given deposit contains 92,5% of quartz, the overall sulfides grade is not over 0,5%. The main sulfide minerals are pyrite, arsenopyrite, sphalerite, galenite. Average gold grade in the ore reporting to the plant is 6,5gpt silver grade – 70 gpt. Free gold amount in the ore is in the range of 60-70%, gold associated with sulfides is 10-15%. Size of free gold particles achieves 0,5mm, average size of gold particles is 0,1mm. Liberation of the gold takes place at grinding till 0,074mm.

Investigations on gold recovery to concentrate of the ore of the present deposit were conducted based on four schemes:

- gravity (jig)
- gravity (jig) + flotation
- gravity (jig) +cyanidation (coal in pulp)
- direct cyanidation of the ore (coal in pulp)

In all flowsheets size of the ore reported to separation accounted to 90% of –0,074mm class. In the first case gold recovery to concentrate came to 62%, in the second one – 94%, in the third one – 96%, in the fourth one – 95%.

A peculiarity of the present deposit is the fact that it is situated in the region with high environment requirements to any type of production. Therefore, appliance of technologies with use of chemical reagents was impossible.

Taking into account the fact that there is a lot of fine gold in the ore, part of which is associated with sulfides, its recovery with the aid of jig is considered to be a problem.

The next stage of experiments was suggested to make separation of the ore using centrifugal concentrators.

Being concerned with mathematical modeling of separation process of mineral raw material in centrifugal field, the whole process with the help of computers was made on the first stage. Having obtained positive results the real experiment was started.

Ore preparation for separation was the same as in the previous flowsheets. Experiments on gold recovery were conducted in centrifugal Knelson concentrator 3".

Tests on studies for dressability of the present ore allowed to obtain amount of gold recovery to concentrate in the range of 86-88%. Pilot ore studies allowed to obtain gold recovery 88%.

After laboratory and pilot studies conducted a decision to design technological flowsheet was accepted.

## RESULTS

Several perspective decisions were laid in foundation of technological flowsheet of separation and system's design:

- fine (size -5mm) three stage crushing of primary ore using Barmac rotary crusher;
- staged classification in vibrating screen of wet fine screening and battery hydrocyclones;
- two staged gold recovery in Knelson Concentrators;
- limitation of maximum module dimensions 2.3x2.3x5.6m (dimensions of standard 20' container) and weight of components till 6 tons.

Main technical features of the plant:

- output on ore to 15tph;
- achievable rate of ore grinding - 90% of -0,074mm class;
- recovery of liberated gold of medium classes - 90%;

-energy consumption - 400kwph;

-technological water consumption - 60-80m.3/h;

-installation and plant operation don't require reinforced concrete fundament;

-assembly period - 8 days.

The plant consists of the following main modules.

Coarse crushing module includes feed hopper, two jaw crushers, screen and belt conveyors. Size reduction of ore piece from minus 350mm till minus 35mm is achieved in this module.

Fine crushing module includes BARMAC rotary crusher, screen and belt conveyors. This module allows to get crushed product with size -5mm. Crushing modules can be installed on stationary platforms or mobile trailers.

Grinding module consists of roller ball mill 2.1x3.6m (Svedala's production), installed on pre-fabricated metal frame fundament. Pre-fabricated fundament is meant for giving toughness to construction of all concentrating system. It consists of four metal platforms connected with steel studs and additional layer of bond beams between themselves

Classification module includes vibrating screen Derrick K48-96MS, providing fine screening, polyurethane hydrocyclone with diameter 250mm and Mozley hydrocyclones battery with diameter 127mm.

Separation module consists of two concentrators Knelson KC-CD30 and KC-MD30.

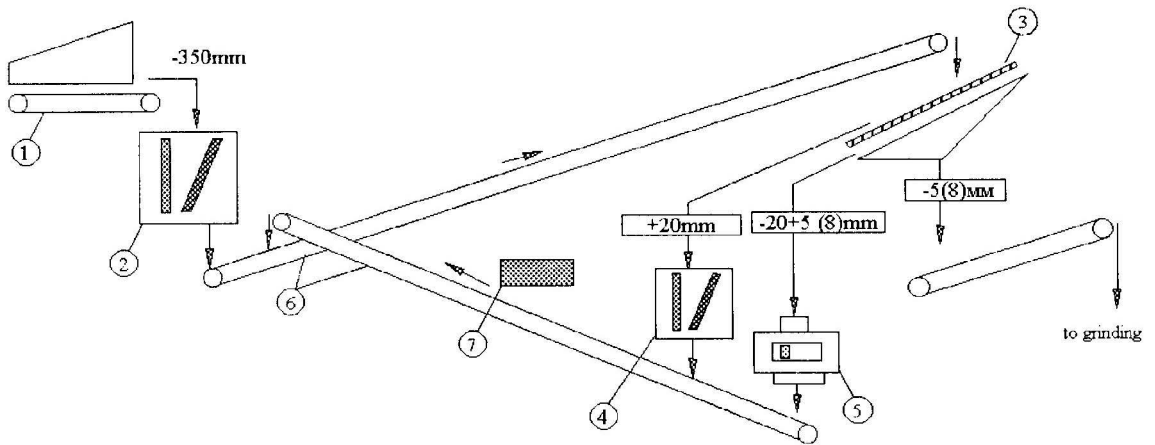
Pump station is made in view of separate module with three sumps and three horizontal pumps VASA 334-100.

Module of stair span with platforms is meant for service of technological equipment.

Division of technological flows is carried out with the use of flexible rubber-cord highly wear-resistant pipes with detachable flanges Trelex providing rapidity of assembly and possibility of its changing in the course of system operation. The system is protected with a shed from rain and snow.

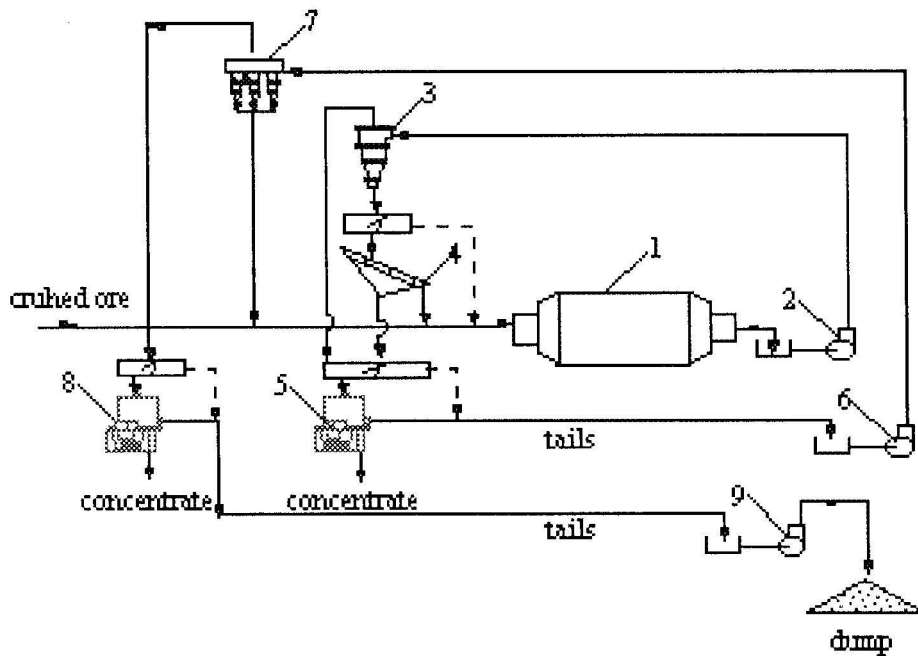
Power and water supply can be as either centralized or done by separate diesel stations and pump stations.

Scheme of modular plant apparatus chain is shown on the pictures 1 and 2.



Picture 1 – Apparatus scheme of crushing complex of MODULE PLANT

- 1.Feed hopper;
- 2-.Jaw crushers;
- 3-Screen;
- 4-Crushers; 5
- Rotary crusher;
- 6-Conveyors\*;
- 7-Magnetic collector.



Picture 2. Apparatus scheme of grinding, classification and separation modules

- 1 – ball mill;
- 2, 4, 9 – pumps,
- 3 – stub hydrocyclone;
- 4 - vibrating screen;
- 5, 8 – Knelson concentrators;
- 7 – hydrocyclones battery

On the base of technology worked out by the authors four modular plants were produced and successfully introduced in commercial operation on rock gold bearing deposits in Magadan region, Sakha(Yakutia) and Buryat Republics. At all four plants a technological cycle of gold recovery is realized only with the help of centrifugal concentrators. Gold recovery to concentrate on all deposits is in the range of 86-94%.

Presently, new modifications of modular concentrating plants have been developed and supplied to Sakha (Yakutia) Republic.

## REFERENCES

1. Brewis T. Modular Processing Plants // Mining Magazine. – 1992. – July.
2. Product & Process News// Mining Magazine. – 1991. – October.
3. World Mining Equipment, 1997. – June. Vol. 21. - #5.
4. Recovery of fine gold using efficient gravity separators / K.V. Fedotov, V.I. Beloborodov, S.B. Leonov, C.H. Iestra // Proceeding of the XX International Mineral Processing Congress. - Aachen, Germany, September 21-26, 1997, Vol.2