Tests of centrifugal concentrator in processing of diamond-bearing sand with co-current gold recovery

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Abstract. The data are reported on the co-current gold recovery in the process for beneficiation of diamond-bearing sands from a number of deposits developed by Almazy Anabara Co. The company conducts co-current gold recovery at standard sluice facilities. The comparative data on gold recovery at Itomak centrifugal concentrator and a centrifugal-vibration concentrator (CVC), designed at IGDS SB RAS, are cited in the present paper. It is proved that CVC capacity allows as high as 92.8% gold recovery.

1. Introduction
At the concentrator owned by Almazy Anabara Co. to process the alluvial diamond-bearing sands –1.2 mm tailings of classifying complexes (including mobile module facilities in combination with heavy-medium separation) are beneficiated at shallow sluices to extract fine and very fine gold. The flowsheet to concentrate the gold-bearing materials from tailings of classifying complexes is shown in Figure 1.

Figure 1. The flowsheet to concentrate the gold-bearing material from tailings of classifying complexes: XFS—X-Ray Fluorescence Separation, DMS—Dense Medium Separation.
As it is known from the practical application of sluice technologies, the loss in beneficiation of fine and very fine gold can reach 50%. In view of this fact Almazy Anabar Co. in collaboration with IGDS SB RAS launched the research project to study feasibility to cut down the loss of fine and very fine gold in the course of co-current recovery.

2. Centrifugal concentrator test

At the initial stage the efficiency of the used flowsheet was assessed. Technological calculations under VNII-1 methodical procedure with consideration for a granulometric composition of gold fed to a shallow sluice showed the normative gold loss within 53.69%. Later the general testing of the shallow sluice was performed with the purpose to determine its operation parameters. The data on the general testing are summarized in Table 1.

| No. | Operations and products | Yield | Au content | Recovery |
|-----|------------------------|-------|------------|----------|
|     |                        | m³    | g/m³       | %        |
| Feed | Original sand          | 136.9 | 0.0571     | 100.0    |
| Total|                        | 136.9 | 0.0571     | 100.0    |
| Yield| Sluice concentrate     | 0.16  | 0.12       | 19.40    | 40.02    |
|      | Sluice tailings         | 136.7 | 0.0343     | 59.97    |
| Total|                        | 136.8 | 0.0571     | 100.0    |

As it is obvious from the Table 1, the actual gold loss with the use of a sluice exceeds the calculated values and equals to 59.97%.

Considering the test results, the researchers tested a flowsheet with the use of a centrifugal concentrator traditionally practiced to enrich fine and very fine gold as one of possible variants [1].

The tests were performed at two centrifugal concentrators operating with water fluidization of a mineral bed through holes in walls of the working body. In these tests Itomak KN-0.1 and CVC concentrators were used [2]. The shallow sluice product, sampled during the general testing, was used as the test feed. The test results on Itomak KN-0.1 and CVC concentrators are reported Tables 2 and 3, respectively. The tests were conducted at an industrial mining area.

| No. | Operations and products | Q | βAu | ε |
|-----|------------------------|---|-----|---|
|     |                        | % | g/t | % |
| Feed | Feed of Itomak KN-0.1 | 100 | 0.052 | 100 |
| Total|                        | 100 | 0.052 | 100 |
| Yield| Concentrate            | 0.37 | 6.6 | 46.11 |
|      | Tailings               | 99.63 | 0.028 | 53.89 |
| Total|                        | 100 | 0.052 | 100 |

The technical capacity of Itomak centrifugal concentrator designed for tailings of the classifying complex are restricted up to 62.5% gold recovery provided that there is an opportunity to supply the pure fluidizing water, however under industrial conditions it was managed to provide only the recycle
water rather than the pure water supply. Therefore, the recovery at the concentrator was only 46.11% being appreciably lower than expectant results.

| No. | Operations and products | Q (%) | $\beta_{Au}$ (g/t) | $\varepsilon$ (%) |
|-----|-------------------------|-------|-------------------|------------------|
| 1   | Feed:                   |       |                   |                  |
| 1   | CVC feed                | 100   | 0.052             | 100              |
|     | Total                   | 100   | 0.052             | 100              |
| 2   | Yield:                  |       |                   |                  |
| 2   | Concentrate             | 0.14  | 34.46857          | 92.8             |
| 3   | Tailings                | 99.63 | 0.003758          | 7.2              |
|     | Total                   | 100   | 0.052             | 100              |

The gold recovery at CVC substantially exceeds that for Itomak KN-01 under industrial conditions and amounts to 92.8%, so it is reasonable to prefer CVC as for the concentrate recovery is concerned. However the disadvantage of CVC concentrator lies in the technical complexity of the high-performance facility design, viz., complex driving systems and transmission of vertically-directed vibration to the working organ. Moreover, the greater are geometrical dimensions of the working organ, the more complicated is to maintain a processing mode. In view of economic efficiency the applicability of CVC concentrators is restricted in rough mineral ore processing operations where high throughput capacity is required. Serial Itomak facilities have design advantages as the minimal set of moving and wearable parts of the working organ in this concentrator allows high-volume technological flow, provided that it is feasible to supply pure recycle water.

3. Conclusions
To conclude, the findings of the present research indicate the potential possibility to upgrade performance of gold-bearing sand beneficiation owing to application of centrifugal concentrators provided that pure water supply is feasible at mining areas and the design of CVC is modified. The above problems are of prime importance for reduction in loss of fine and very fine gold and rational utilization of natural resources.

References
[1] Myazin VP Litvintseva OV and Zakieva NI 2006 Dressing technology for gold-bearing sand: Educational Aid Chita:ChitGU (in Russian)
[2] Ochosov OYu and Matveev AI 2014 RF Patent No 2535323 MPK V03V 5/32, 10.12.2014 Byull. Izobret. No 34