E CONF SERIES

International Conference on Scientific Research in Natural and Social Sciences
Hosted online from New York, USA
Website: econfseries.com 2nd September, 2025

# STUDY OF THE INFLUENCE OF ULTRASONIC TREATMENT ON FLOTATION PROCESSES

Sattarova Shakhlo Gayvillo qizi
Azimov Oybek Akhmadovich
Navoi State Mining and Technology University
E-mail: Sattarova.shaxlo@mail.ru

## Abstract

This article examines the influence of ultrasonic treatment (UST) on the efficiency of flotation enrichment of gold from refractory ores. Experimental data showed that ultrasound improves gold liberation, destroys gangue minerals, and enhances gold recovery efficiency. Ultrasonic treatment of the pulp (Ultrasound 40 kHz) for 5 minutes after the second stage of grinding, just before the first main flotation, increased gold recovery into the combined concentrate by 4.21% (from 81.08% to 85.29%) and reduced the gold content in tailings from 0.37 g/t to 0.28 g/t. This opens new opportunities for more efficient processing of low-grade ores and tailings.

## Introduction

Currently, global depletion of easily processed ores leads to increased processing of complex polymetallic gold-bearing ores. Enhancing gold recovery and efficient utilization of raw materials are key objectives in the processing industry. To improve gold extraction and reduce the complexity of ore processing, the development and implementation of high-efficiency technologies using innovative methods is crucial. One promising direction is the application of ultrasonic treatment (UST) at various stages of processing. This study aims to explore the impact of ultrasound on the efficiency of flotation processes in gold extraction. The article demonstrates the effect of ultrasonic waves on mineral particles in complex gold-bearing ores. Modern analytical methods were used to obtain results, including atomic absorption analysis, SEM-EDS analysis, Rietveld analysis, etc.

The study investigated the effect of high-frequency ultrasonic waves (40 kHz) on the structural and physical characteristics of gold-bearing materials, particularly on gold liberation, disintegration of aggregates, and changes in mineral surface

properties. Experiments were conducted on refractory materials (45% -0.074 mm), characterized by fine gold dissemination and high clay and sulfide content (Daugiztau GMZ-3 deposit).

Results showed that preliminary ultrasonic treatment increased gold recovery into the combined concentrate by 4.21% (from 81.08% to 85.29%) and helped destroy gold encapsulation in gangue minerals. This led to improved flotation enrichment efficiency. The tables below illustrate how UST influenced the flotation process.

**Table 1. Flotation Results Without UST**

| Product Name | Yield, % | Au Content, g/t | Ag Content, g/t | Au Recovery, % | Ag Recovery, % |
|---|---|---|---|---|---|
| Combined Concentrate | 11.60 | 12.09 | 7.74 | 81.08 | 62.88 |
| Tailings | 88.40 | 0.37 | 0.60 | 18.92 | 37.12 |
| Ore | 100.00 | 1.73 | 1.43 | 100.00 | 100.00 |

**Table 2. Flotation Results with UST (5 min before inter-cycle flotation)**

| Product Name | Yield, % | Au Content, g/t | Ag Content, g/t | Au Recovery, % | Ag Recovery, % |
|---|---|---|---|---|---|
| Combined Concentrate | 12.60 | 11.46 | 7.42 | 81.70 | 64.06 |
| Tailings | 87.40 | 0.37 | 0.60 | 18.30 | 35.94 |

**Table 3. Flotation Results with UST (10 min before inter-cycle flotation)**

| Product Name | Yield, % | Au Content, g/t | Ag Content, g/t | Au Recovery, % | Ag Recovery, % |
|---|---|---|---|---|---|
| Combined Concentrate | 12.50 | 12.43 | 7.82 | 81.62 | 66.23 |
| Tailings | 87.50 | 0.40 | 0.57 | 18.38 | 33.77 |

## Conclusion

The findings confirm the feasibility of using ultrasonic treatment as one of the stages in ore preparation for flotation enrichment. This approach may be particularly effective when processing industrial raw materials, tailings, and low-grade ores.

Furthermore, shifting ultrasonic treatment to the stage following fine grinding—right before main flotation—produced significantly positive results. This approach increased gold recovery in the concentrate by 4.21% and, notably, reduced the valuable component content in waste tailings by nearly one-fourth. This indicates that the intensification mechanism is linked to the effective cleaning and activation of freshly exposed mineral surfaces before interaction with collector reagents. The results demonstrate the promising potential of targeted ultrasonic application to intensify the enrichment of refractory gold-bearing ores.

## References

1. Abramov, A. A. (2005). *Technology of Processing and Beneficiation of Non-Ferrous Metal Ores*. Moscow: MGGU Publishing House.
2. Özkan, Ş. G., & Kuyumcu, H. Z. (2019). The effect of ultrasonic pre-treatment on the flotation of a complex sulfide ore. *Minerals Engineering*, 134, 12–20.
3. Chanturia, E. L., & Dvoychenkova, G. P. (2017). Application of ultrasonic treatment to improve flotation efficiency of refractory gold-copper-arsenic ores. *Mining Journal*, (11), 81–85.
4. Ivanov, G. V., Miroshnikov, A. M., Azarova, T. I., & Ushakova, N. N. Improvement of flotation process efficiency for fine coal slimes. UDC 622.765.
5. Kharlampenko, Y. A., Shilyaev, A. V., & Patrakov, Y. F. (2015). The influence of ultrasonic treatment on the results of coal pulp flotation. UDC 622.7.017.2. *Bulletin of Technical and Physical-Mathematical Sciences*, 2015/3.
6. Kirillov, O. D. (1957). On the possibility of using ultrasound in the processes of mineral beneficiation. *Physics and Physico-Chemical Analysis: Proceedings of MICMIZ*, No. 30, Issue 1.