



# The Mineral Flotation Overall Performance Increase by the Improvement of Recycling

By A. Alouani, A. Arbaoui & K. Benkhouja

*University Chouaib Doukkali*

**Introduction-** The use of flotation process for the mineral enrichment is increasing to satisfy the client and to match his evolving requirements. The consumption mode of reagent and energies greatly impacts the global cost of mineral enrichment by flotation, and is a determinant factor in the overall performance.

To improve the quality of products, we developed new wash and flotation processes of minerals. Their enrichment knows a big development and arouses a particular interest, which is motivated by the increasing product's demand and by the need to handle the enrichment of minerals that cannot be done by the conventional treatment processes.

The use of these processes on an industrial scale and its integration in the installations and the factories achieved within the framework of mining industries allowed to:

- Rationalize the mineral deposits exploitation and to increase their durations
- Value all the minerals
- Improve the productivity
- Extend the deposits life expectancy in exploitation
- Produce marketable and diverted qualities of minerals
- Ensure the integration of the various mineral deposits exploitation in the mining industries development project based on the sustainable development.

*GJRE-J Classification: FOR Code: 091599*



*Strictly as per the compliance and regulations of:*



# The Mineral Flotation Overall Performance Increase by the Improvement of Recycling

A. Alouani <sup>α</sup>, A. Arbaoui <sup>σ</sup> & K. Benkhouja <sup>ρ</sup>

## I. INTRODUCTION

The use of flotation process for the mineral enrichment is increasing to satisfy the client and to match his evolving requirements. The consumption mode of reagent and energies greatly impacts the global cost of mineral enrichment by flotation, and is a determinant factor in the overall performance.

To improve the quality of products, we developed new wash and flotation processes of minerals. Their enrichment knows a big development and arouses a particular interest, which is motivated by the increasing product's demand and by the need to handle the enrichment of minerals that cannot be done by the conventional treatment processes.

The use of these processes on an industrial scale and its integration in the installations and the factories achieved within the framework of mining industries allowed to:

- Rationalize the mineral deposits exploitation and to increase their durations
- Value all the minerals
- Improve the productivity
- Extend the deposits life expectancy in exploitation
- Produce marketable and diverted qualities of minerals
- Ensure the integration of the various mineral deposits exploitation in the mining industries development project based on the sustainable development.

Ores valorization during all the value chain follows an integrated industrial process since the extraction of the rock, beneficiation, and transportation until the industrial valorization.

The results obtained on the industrial scale are conclusive, viable and confirm the results obtained in laboratories and on pilots scale.

Using these new processes leads to:

- Very low grade beneficiation
- Improvement of mineral recovery
- Production of high ores quality

- Experience is capitalized and integrated in the mining industries projects under the sustainable development framework

In order to improve the flotation process overall performance, several flow recycling case studies were considered. The reduction of the recycling ratio increases the specific consumption of Flotation reagents, however its progressive increment reduces the need for reagents up to an optimal level. Moreover, any increase results in an accumulation of fine particles in the circuits, which causes saturation and a reduction of the production capacity in the Flotation unit.

According to the "AA" curve below, the industrial optimization led to a remarkable reduction of the specific consumptions for the same raw product profile and for the same level of the production capacity.

*Author α: OCP Khouribga, Morocco, University Chouaib Doukkali, Faculty of Sciences, EL Jadida, Morocco.*

*e-mail: A.ALOUANI@ocpgroup.ma*

*Author σ ρ: University Chouaib Doukkali, Faculty of Sciences, EL Jadida, Morocco.*

Mineral beneficiation by flotation

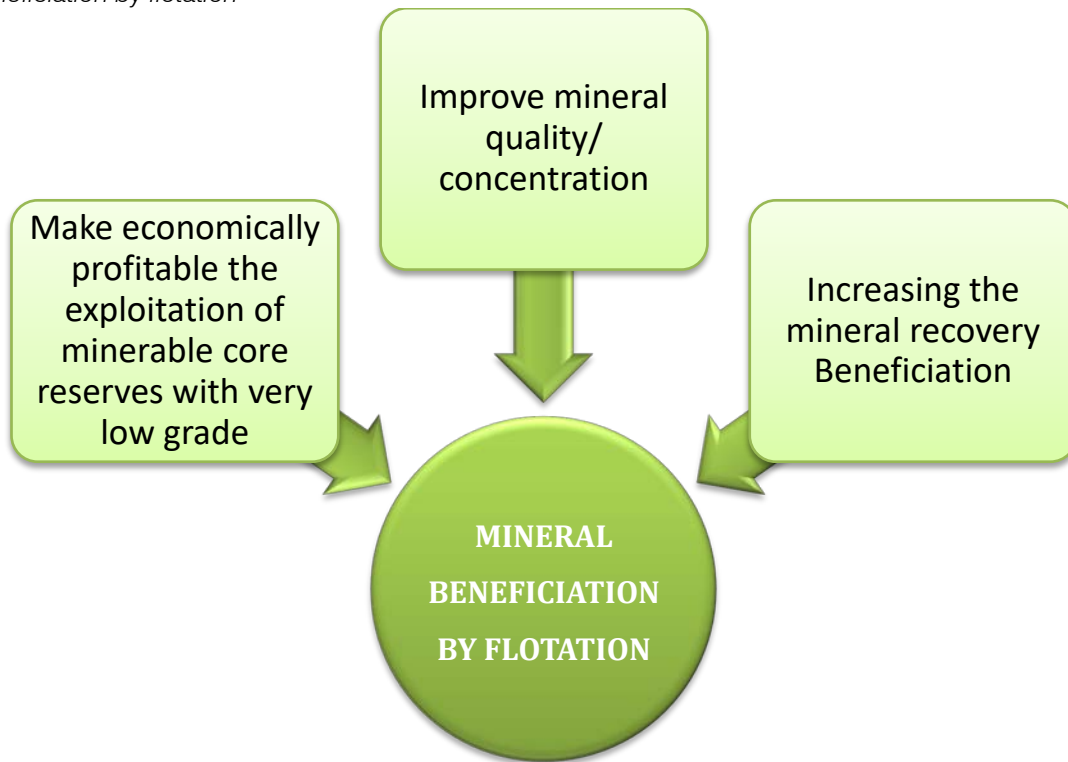


Fig. 1: Mineral beneficiation by flotation

Steps to develop new flotation process

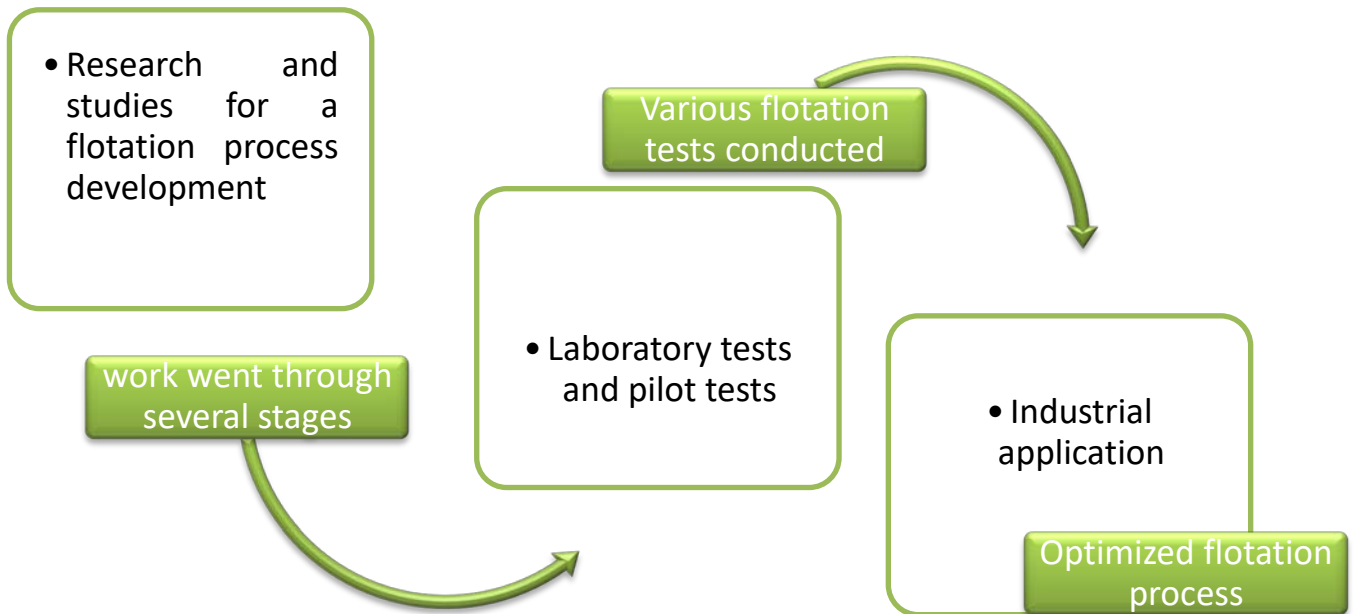


Fig. 2: Steps to develop new flotation process

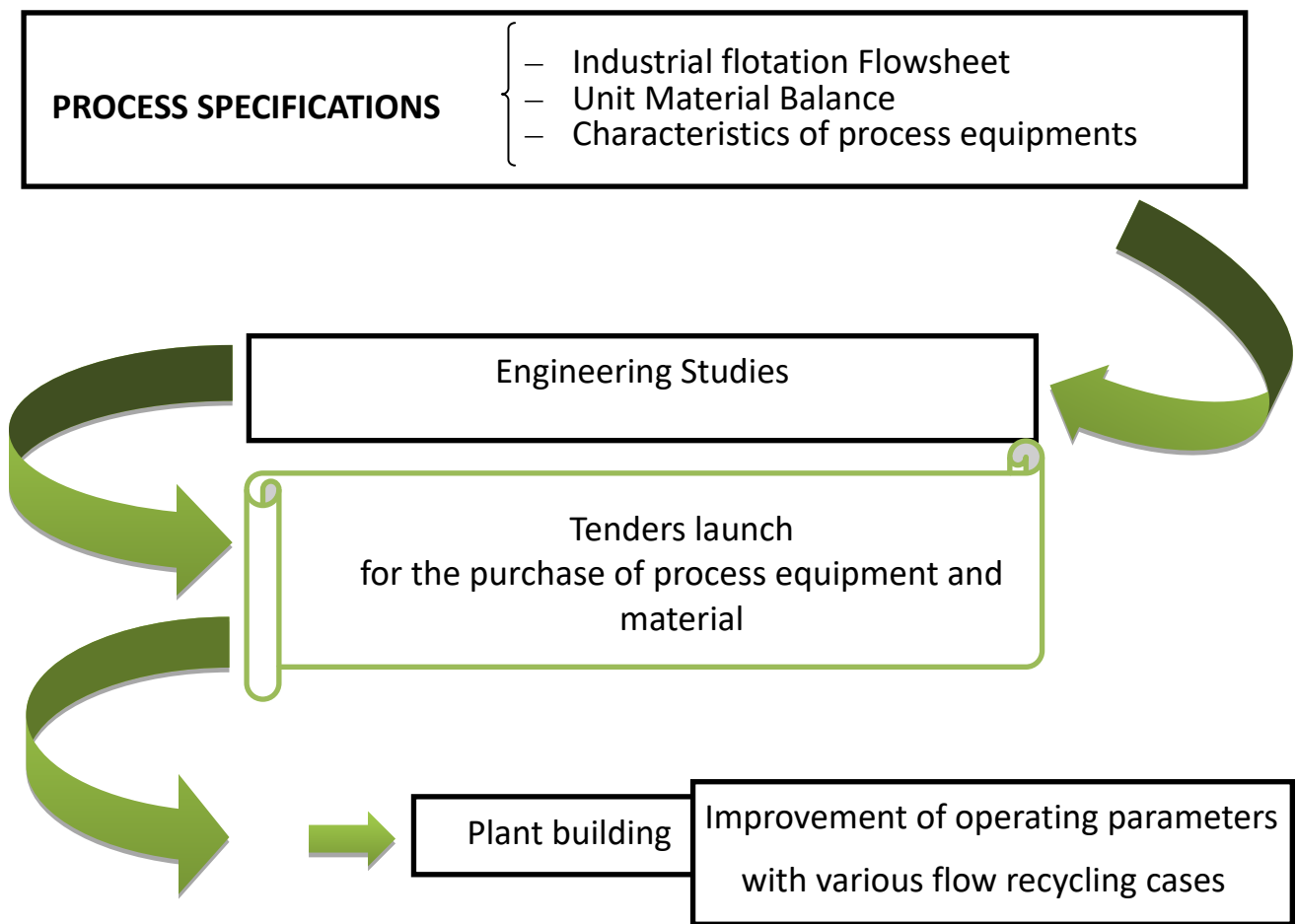
- Laboratory tests are carried out in small flotation with minimal unit capacity.
- The tests are focused on the determination of operating parameters and the choice of flotation reagents.
- Adjust the order of reagents concentration.
- Determine the stay time of different process phases.



After the laboratory tests, come the tests on pilot scale phase. These ones are needed to confirm the results obtained in the laboratory and assess the extrapolation effects parameters on pilot scale. This

leads to the determination of stabilization and process optimization parameters and several recycling flow cases.

*Preparation of process tender*



*Fig. 3:* Preparation of process tender

The optimization is based on the process model of mineral enrichment by washing flotation with a calibration on the experimental results and the industrial units' returns of experiments.

Vigilance points are to observe, especially the recycling impact on the accumulation of fine particles and circuits' saturation, which leads to an optimal point of recycling flows.

The optimization of these recycling flows leads to the following results:

- Reduction of fresh water consumption and therefore a sustainable water resources management.
- Decreased wastewater volumes.
- Maximum recovery of unused reagents retained in the industrial unit wastewater.

Starting from a simplified flow sheet of the elaborated process

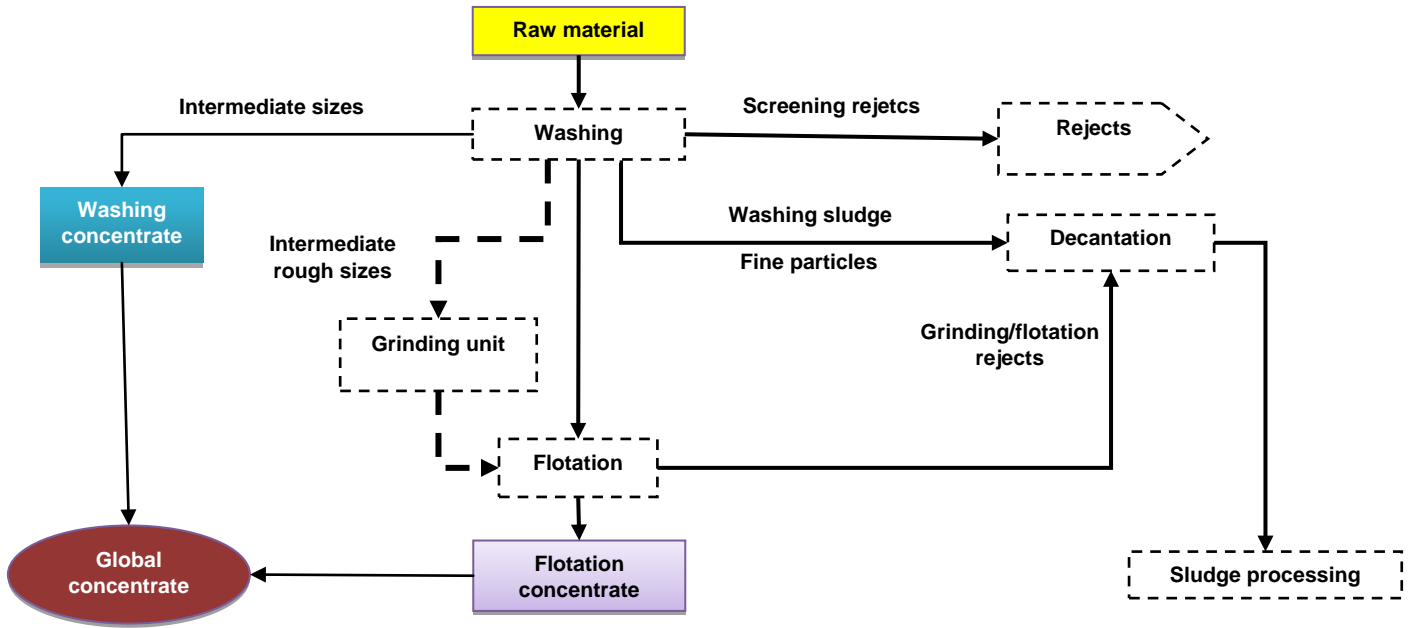


Fig. 4: Simplified flow sheet of mineral washing flotation

The optimization is based on the identified influence parameters

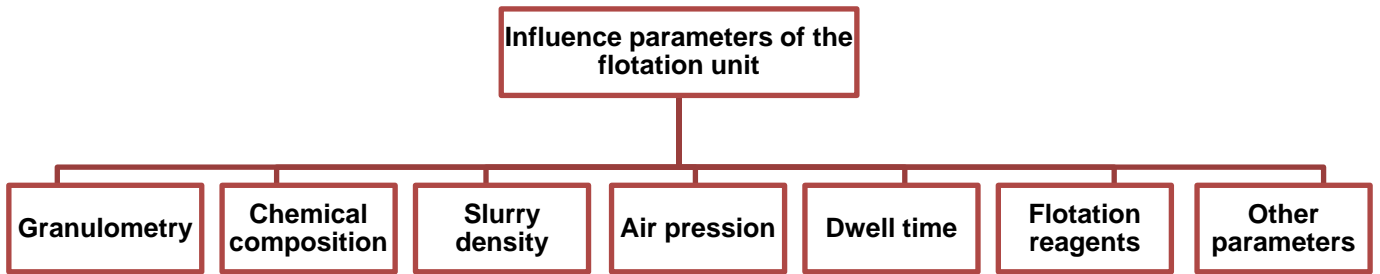


Fig. 5: Influence parameters of the flotation unit

Flotation process phases

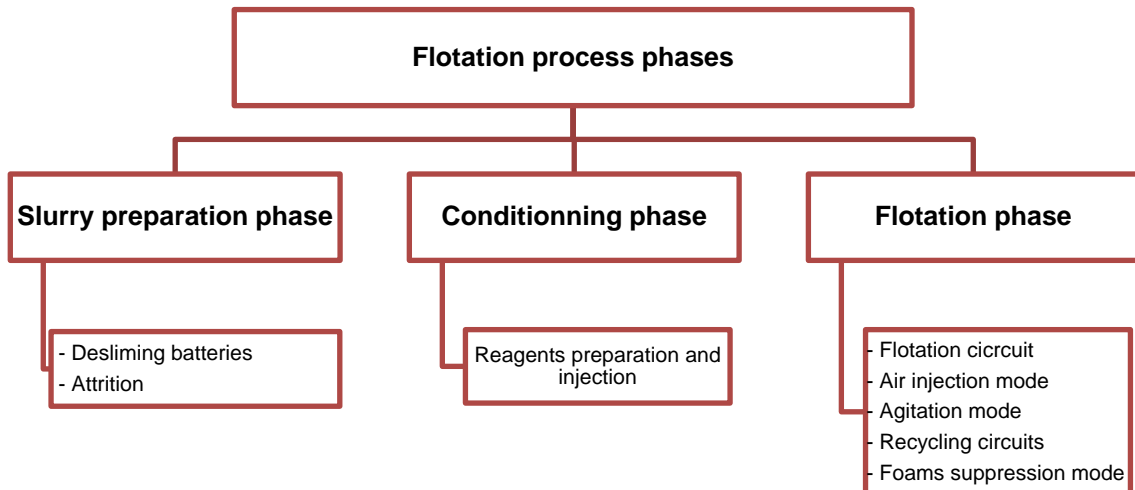


Fig. 6: Flotation process phases

The curve “AA” below is based on the optimization test result which helps determine the optimum recycling point (optimal operating point). This resolves the dilemma of “increasing the recycling flow in order to recuperate a bigger quantity of reagents. This process will ultimately lead to a bigger saturation of the circuits which can lead to a capacity decrease”.

This is more efficient with the use of foam flotation because the generation of abundant foam is generally quite a challenge spread in the mining industry.

There are many ways of foam flotation, here are some identified:

- Breaking foams by high pressure water
- Additional mechanical breaking by pumping
- Optimization of flow and breaking circuits recycling
- Hydrocycloning and storage foams in intermediary basins before evacuation

## II. CONCLUSION

- The results obtained are aligned with the ones from the AA curve
- The results obtained on the industrial scale are conclusive, viable and confirm the results obtained in laboratories and pilots scale
- Using these new processes leads to:
  - Very low grade beneficiation
  - Improvement of mineral recovery
  - Production of high quality mineral
  - Reduction in the reagents consumption

Reduction of the recycling ratio increases the specific consumption of Flotation reagents, how ever its progressive increment reduces the need for reagents up to an optimal level. Moreover, any increase results in an accumulation of fine particles in the circuits, which causes saturation and a reduction of the production capacity in the Flotation unit.

According to the “AA” curve above, the industrial optimization led to a remarkable reduction of the specific consumptions for the same raw product profile and for the same level of the production capacity.