

# SYS-FLTN

## FLOTATION CIRCUITS CONTROL SYSTEM

(Copper and Molybdenum Mining)



**SYS-FLTN** is part of the **BAGGI SenseEvolution® System** series.

The SenseEvolution System® product line has been developed for providing turn-key systems for industrial process analysis and control in the more varied application fields.

They are the result of combining the latest state-of-the-art-technology with over 60 years of industry experience.

This real time analyser and controller is designed for stabilizing the flotation levels (froth depth) in the flotation circuits used in the mining industry. This goal is achieved by controlling the aeration rate and the reagents addition. Furthermore the temperature of the reagents is stabilized. The system is also in charge of monitoring all the physical quantities and to raise alarms, when necessary.

Due to its modularity, the system can integrate any additional sensors when required by the application (e.g. a radio-isotopic type density analyser).

An embedded computer implements the closed-loop control algorithms; the software package is tailored according to the Customer's specific requirements.

A typical application is in the Copper and Molybdenum mining industry.

**BAGGI SenseEvolution®** offers solutions in the following fields.

SenseEvolution Shelf®: Cabinets and Shelters

SenseEvolution Mobi®: Portable instruments

SenseEvolution Sample®: Sampling and Sample conditioning

SenseEvolution Base®: Industrial Measurement and Analysis

SenseEvolution System®: Turn-key Systems

SenseEvolution Plant®: Oil & Gas plants (desalters, phase separators)

SenseEvolution Service®: Service All Over the World

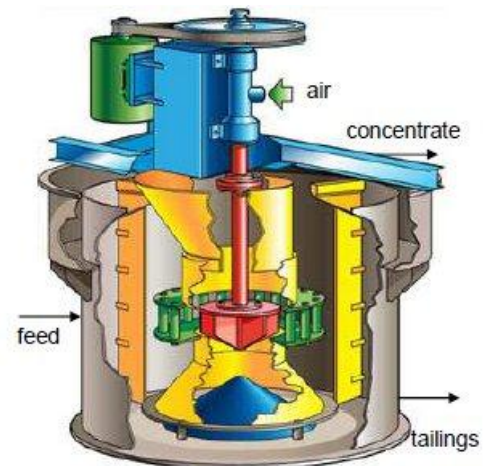


# 1 Introduction

The **FLOTATION PLANTS** are used in the mining industry to separate valuable minerals from gangue. The ore is extracted from the mine, ground in a mill and mixed with water and chemical reagents forming the pulp. Here the desired mineral particles are *hydrophobic* and the gangue particles are *hydrophilic*. The pulp is introduced in a *flotation cell* (see the figure) for separating the hydrophobic (desired mineral) and the hydrophilic (gangue) particles.

In a flotation cell:

- a feed port provides incoming pulp
- an impeller mixes the pulp
- air is blown into the cell and dispersed
- hydrophobic particles attach to the air
- air bubbles float and form *froth* on the concentrate surface
- the froth (mineral concentrate) is collected from the top of the cell
- the tailing (residual pulp) is collected from the bottom of the cell
- several flotation cells are connected in series and form a *flotation circuit*

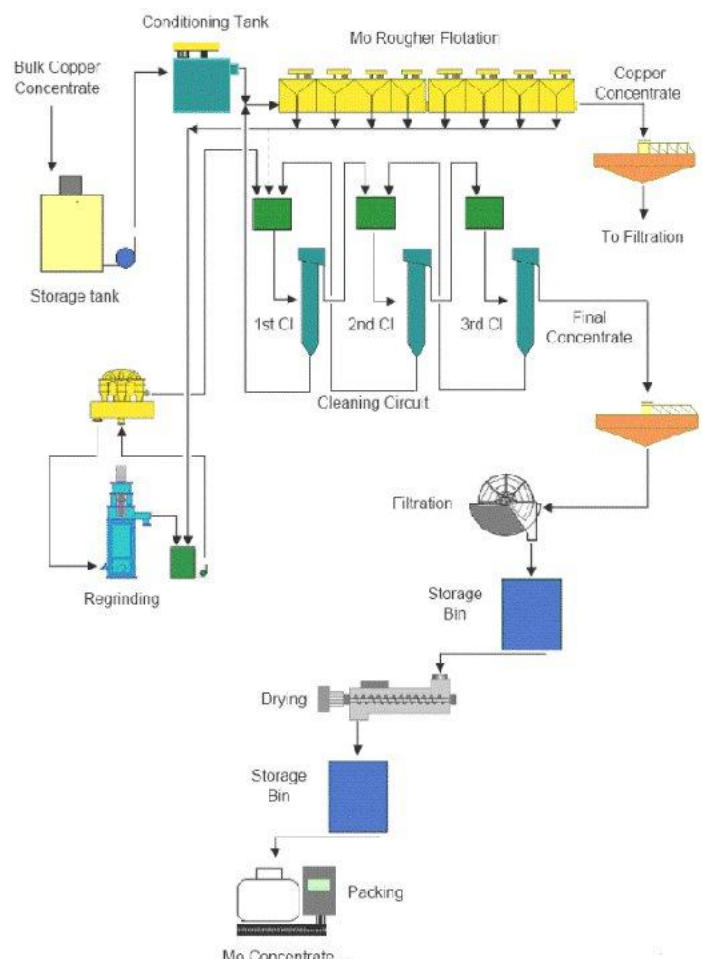


In the case of Molybdenum mining processing, a significant amount of moly is recovered as copper mine by-product. Molybdenite ( $\text{MoS}_2$ ) is the predominant molybdenum mineral. While it is naturally very hydrophobic, addition of *fuel oil* enhances its floatability and recovery. The figure gives an overview of the processing flow.

Separation of the  $\text{MoS}_2$  from the bulk copper-molybdenite concentrate is generally accomplished by selective molybdenite flotation following copper and iron sulphide depression. Standard depressant schemes include addition of *sodium hydrosulphide* and *sodium cyanide*. The reagents depend upon the type of ore to be recovered.

To obtain the maximum recovery, the milling and flotation process are repeated a second time. During the molybdenum upgrading process, often the cleaner concentrate is roasted to drive residual reagents off all the minerals in the Cu-Mo bulk concentrate to make a selective separation easier.

The entire process depends on balancing the correct reagent dosing and aeration rates with consistent froth depth.



## 2 SENSEEVOLUTION SYSTEM PRODUCTS

The **SENSEEVOLUTION SYSTEM**<sup>®</sup> product line has been developed for providing turn-key systems for industrial process measurement, analysis and control in the more varied application fields. They are the result of combining the latest state-of-the-art-technology with over 60 years of industry experience. Each system is made from the following components:

- An embedded computer that controls the overall system and interfaces any higher level O&M node (Modbus, Profibus, Ethernet)
- A software package specialized according to the specific application, with PLC capabilities
- One or more sensors, e.g. spectrophotometer, photo-ionization detector, flame-ionization detector, microwaves absorption, level, temperature, pressure, density and viscosity sensors...
- Data acquisition and logging subsystem: it handles typically analog signals (0/4...20 mA), digital I/O, thermocouple inputs, RTD inputs, resistance up to 15 K $\Omega$ , strain gauge input
- A sampling system: either a direct insertion into the process pipe/vessel or a fast loop derivation with any required pump
- A sample conditioning subsystem, according to the application: line heaters, filters, bubblers, dehumidifiers, pressure regulators, flow controllers
- Auxiliary devices like calibration cylinders and cleaning circuits.
- Cabinets and Shelters: from the shelter providing an internal controlled climate to the cabinet providing ATEX protection in potentially explosive atmospheres (hazardous areas Zone 1-2), type of protection: "Ex d", "Ex e", "Ex pz" and "Ex px". They come with a full range of accessories, according to the requirements: heating/cooling systems, ventilation, exhaust, electric installation, lighting, intrusion detector, electromagnetic shielding, cable and pipe connections, fire protection, mounting system.
- Service: it can be considered an integral part of the **SYSTEM**<sup>®</sup> product line. Training, spares handling, on site programmed and spot maintenance, tuning and calibration, remote technical support, worldwide expedited shipments are all available



If the system is already in operation and needs only to be updated with off-the-shelf instrumentation, the following radio-isotope based instruments are proposed, because they are well suited for monitoring a flotation plant:

- Density measurement
- Mass flow measurement
- Level measurement

BAGGI provides all the necessary piping and the power and signals connections.

### 3 The SYS-FLTN Solution

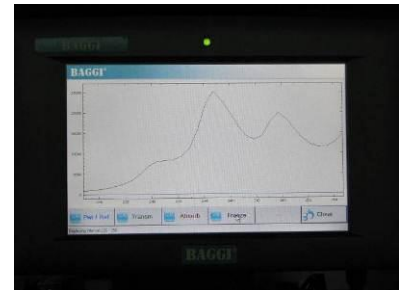
The SYS-FLTN is a threefold device. It acts as:

#### 1. Programmable Logic Controller (PLC).

An embedded microcomputer runs the application software for monitoring the system status and applying the closed control loop algorithms.

The software is designed by BAGGI closely with the Customer. The programs are written in a high level object oriented language. An easy-to-use graphical interface is available for man-machine communication. The system parameters that can be acted upon by the control algorithms are:

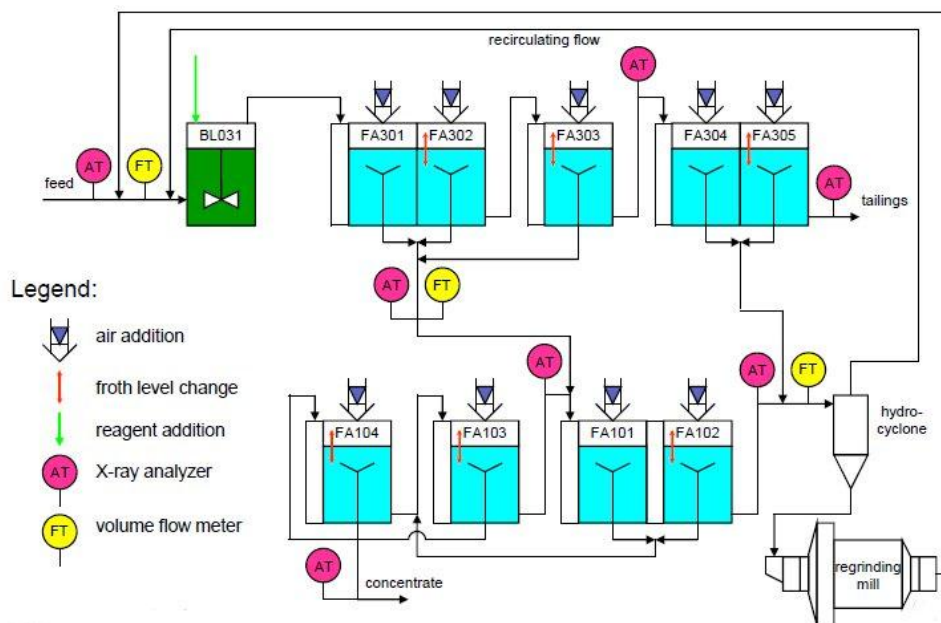
- the dosage of the reagents (taking into account that the reagents used in the flotation process are expensive)
- the air addition rate
- the pulp flow rate (feedstock and exit flow)



#### 2. Control loop sensor/actuator devices.

A complete set of sensors and actuators is delivered as a component of the solution and is controlled by the PLC.

A typical configuration is depicted in the example figure below



The measurement of the froth depth is very important.

The depth of the froth is a key indicator to the performance of a flotation cell. In simple terms, the thicker the froth, the more concentrate is entrained within. A consistent froth depth is recommended to maximize ore extraction while ensuring that it does not reach a point where it collapses on itself. The control of the parameters such as reagents dosing rates, air addition rate and the pulp flow rate are all used to optimise froth depth and ultimately mineral recovery rate.

All the instruments (pulp flow meters, reagents Coriolis flow sensors, air pressure transmitters, level sensors...) are available in both analog and Profibus compatible versions.

### 3. Centralized Operation and Maintenance

The embedded computer presents an easy to use Graphical User Interface (GUI).

This menu driven interface allows the operator to know at a glance the whole status of the system.

The measurements and the control data are logged for a configurable time interval and are archived/exported in CSV format. They can be retrieved in tabular or graphical format according to filtering criteria.

The Alarms package allows to associate filters and alarm thresholds to each of the quantities and to activate a related output signal.

Remote operation is also possible due to the WAN connectivity of the Ethernet and WiFi ports.

This facilitates the easy updating and upgrading of the software that operates and controls the whole system.



## 4 Benefits

The SYS-FLTN offers the following benefits:

- Maximization of plant output
- Observance of minimum concentrate grade
- Reduction of chemical reagent use
- Prevention of costly unplanned plant stops by respecting operating range of plant
- Easy operation and maintenance of the overall flotation plant
- Modularity allowing the later addition of instruments (e.g. radio-isotopic analysis)
- Technical support, training, spares, on-site maintenance and tuning guaranteed by **BAGGI<sup>®</sup> SERVICE**

