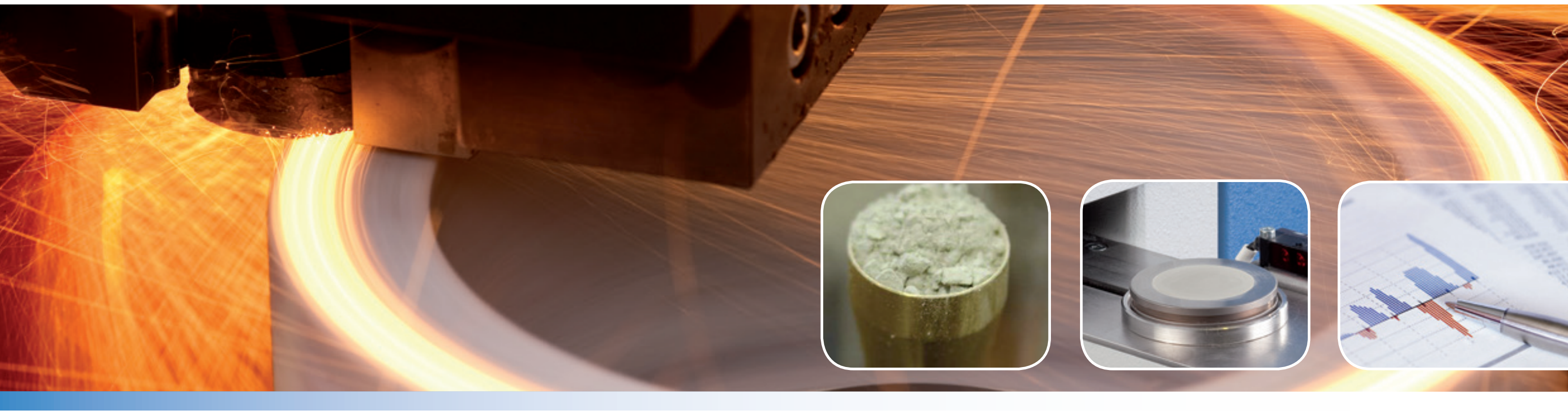

Preparation of slurry samples from flotation processes

Abstract

Froth flotation is a common industrial application for raw material beneficiation in the mining industry. Here, we report the principles of sample preparation of slurry material gathered from flotation processes. We show that the combination of drying on a belt dryer, pulverizing and pelletizing is a quick and reliable method to prepare the material for XRF analysis.

Keywords

• Iron ore • phosphate • flotation process • wet material • belt dryer • automation • automated sample preparation • Prepmaster

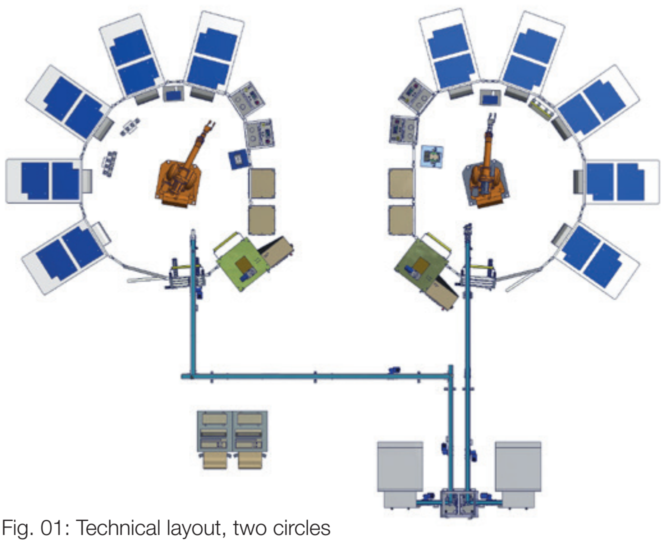

Fig. 01: Technical layout, two circles

Fig. 02: Technical layout 3D model, two circles

The following machines are necessary for the realization of this project (one circle):

1. Belt dryer HBTO, not included in the figures above
2. Sending station HR-L1, not included in the figures above
3. Receiving station HR-HSK/L
4. Robot ABB IRB 2600
5. Automatic mill HP-M
6. Automatic press HP-P
7. Transport belt and Lift

Flotation in the mining industry

In the iron ore mining industry the wanted ion has to be extracted from the raw material. Due to different iron concentration in the raw material different methods are applied in the industrial process. For lower grade iron ore froth flotation is the method of choice to gain an iron concentrate. In this process different chemicals (so called flotation reagents) are used to beneficiate a specific ion step by step. Flotation reagents like, e.g. a partially charged organic polymer, bind the target ions on their surface and the Ion-/Polymer-complex can be extracted during the following stages. In the case of iron ore the used reagent is partially negatively charged for binding the cationic Fe ions. To ensure that this industrial process is running properly, it is important to determine the concentration of the ingredients after each leaching out step. Usually, the enriched concentrate is slurry material, containing a mixture of solids and the flotation reagents diluted in water, whose solid ingredients are analyzed by means of XRF. Here, we present a fully automated system for preparation of slurry samples. It is possible to use this presented sample preparation technique to handle various slurry types, not only iron ore but also other materials like, e.g. phosphate concentrates.

Drying of slurry material

First of all the sample is dehumidified (in this project the sample has a residual moisture of approximately 33 %) and a subsample is taken. For drying the slurry the belt dryer HBTO (Figure 3) is used which is usually installed in close vicinity to the sampling point at the flotation line. A small amount of sample is poured on the belt of the HBTO, dispensed, and then dried under an infrared lamp while the belt is moving constantly forward. The speed of the belt is adjustable to ensure that the material is completely dried when it leaves the oven.
A scraper removes the dried material from the belt so that it can be collected in the transport carrier to be available for the next step.
Alternatively the slurry material can be transported to the laboratory and there it is dehumidified using a filter press system (see application note no. 02/2012, "Automated quality control in the Apatite-Staffelite ore beneficiation").

This collected material can either be transferred manually to the next sample preparation station or sent via an air tube system. In the latter case, a subsample is automatically dosed, filled into an air tube carrier and transported to the laboratory.

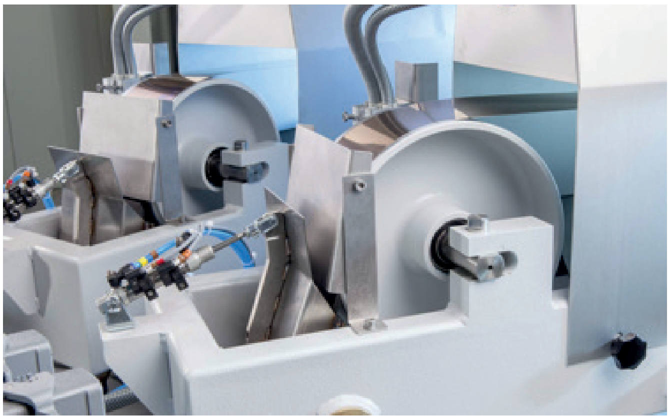

Fig. 03: Picture of belt dryer HPTO: Detail of the sampling scraper unit

Sample preparation of slurry material

In the laboratory, the final sample preparation takes place. After being ground there are two possible ways for the further processing of the sample. First, the sample can be pelletized using a pelletizing press (Figure 4). Alternatively, if a higher analytical accuracy is required, a fused bead (Figure 5) can be produced using an automatic fusion system like the HAG fusion system.

Fig. 04: Pressed pellet

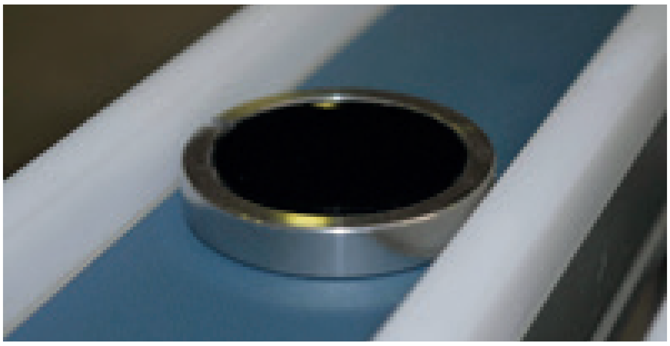

Fig. 05: fused bead

Pelletizing and fusion are common preparation techniques used for XRF analysis. Each method has its own advantages and disadvantages. In Table 1 and Table 2 the two methods are compared [1].

Advantages

Pressed pellets	Fusion beads
Short preparation time	No particle size effects
Suitable for trace elements	No mineralogical effects
Shorter overall analyzing time compared to fusion bead	Homogeneous solid
Cost effective	Less material needed (0.7 g – 1.0 g)

Table 1: Comparison of the advantages of pressed pellets and fused beads [1]

Disadvantages

Pressed pellets	Fusion beads
High amount of sample needed (approx. 15 g)	Longer preparation time
Particle size effect	More expensive, platinum ware must be used
Mineralogical matrix effects	Platinum ware has to be protected from sulphides or other ingredients that can cause damage
Analytical surface must have a mirror surface	Fusion program must be found to ensure the best possible bead
Segregation problems	
Preferential orientation	

Table 2: Comparison of the disadvantages of pressed pellets and fusion beads [1]

Robot Automation for slurry material

In the described iron ore mining project the slurry material is dried within the HBTO, transferred from the belt dryer to the air tube station and sent to a fully automatic robot laboratory (see Figure 1). Here, the material is unpacked from the air tube carrier in the receiving station and dosed in the dosing station. Following dosage the sample is forwarded to the pulverizing mill and, after grinding, to the pelletizing press. The pressed pellet is then automatically transferred to the XRF spectrometer.

The program parameter of the mill HP-MA and press HP-PA can be adjusted according to the sample material properties so that the optimal preparation conditions can be defined. The automatic addition of a grinding aid is also available to improve the stability of the pressed pellet if needed.

The automation is controlled by the Prepmaster SCADA software. The automation provides full redundancy since air tube lines, preparation cells and analyzers are completely interlinked. In case that one component is in service mode, the sample is automatically transferred to another machine or analyzer. Each equipment can also be used as a stand-alone device.

The fully automated sample preparation laboratory receives 624 samples per day and is an important component for controlling the complex flotation process.

More information:

References

[1] Nicole Krusberski,
"Exploring potential errors in XRF analysis", The Southern African Institute of Mining and Metallurgy, Analytical Challenges in Metallurgy

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