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Editorial

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Research subjects suggested to young scientists in mineral processing to tackle future challenges of mining and minerals processing

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Mineral processing is the process of separating commercially valuable minerals from their ores. Generally, mineral deposits close to civilized areas are prioritized for development due to low production costs and high economic benefits. However, with resource exhaustion and technical development, the mineral deposits in undeveloped regions have attracted attention and become major mining areas, including arid regions, alpine regions, and the deep crust. Arid regions, especially deserts, cover a large area of the Earth's land surface. Due to harsh weather conditions, such as high temperatures and water scarcity, mineral resources in these regions are rarely explored and exploited. For instance, the Atacama Desert in Chile is considered the oldest nonpolar desert on Earth, rich in copper, boron, lithium and potassium[1]. Furthermore, high-altitude regions are characterized by low temperature and low atmospheric oxygen levels. Such a harsh environment poses serious challenges to mining operations. Additionally, deep underground mineral resources are more difficult to exploit compared with surface deposits. Therefore, given the high transportation costs, establishing the concentration plant on site could be a good idea (i.e. in the mining pits under more than 2000 meters). Nevertheless, such a plant will face significant challenges due to the depth, narrowness of the mine workings, and high temperature.

Overall, while it is inevitable that these regions are abundant in mineral resources, particularly high-grade, the lack of simple mineralogical characterization and appropriate mineral processing technologies severely restrict mineral exploration and exploitation. Therefore, in order to utilize the mineral resources, many new mineral processing technologies need to be developed. Among them, smart technology, flotation in high salinity water, flotation at high solid concentration, mineral concentration in air and compact concentration plant are particularly important.

SMART TECHNOLOGY

Most of the undeveloped mineral deposits are located in hostile environments, making it difficult for workers to complete mining operations on site. Therefore, smart technology is necessary to replace manual tasks. The application of monitoring systems such as image recognition of flotation foams will free workers from manual work in the field. In addition, the online analyses for various parameters, such as grade, solid concentration, and particle size distribution, will produce smart production systems which are more efficient. When there were some malfunctions in concentration equipment, the smart technology could quickly find the root cause and then adjust the parameters to restore optimal operation. As a result, the operators could be kept away from harsh environments via 5G communication while improving the processing efficiency of concentration plants.

FLOTATION IN HIGH SALINITY WATER

Some mineral resources in arid regions are located near the sea, where there is a large amount of water with high salinity. Mineral flotation using seawater is significantly different from fresh water, and the chemical strategies are not applicable[2]. Therefore, new chemical schemes and reactors for mineral flotation in seawater or high salinity water are desperately needed. Some reports on this subject had recently been published, while effective chemical schemes and reactors had not yet been developed. Therefore, much more efforts from scientists and engineers in mineral processing are necessary in the near future.

FLOTATION AT HIGH SOLID CONCENTRATION

Conventional flotation is generally carried out at a solid concentration of 10% to 30%, depending on the processed ores. It means that the flotations require 2.33-9 tonnes of water for each tonne of processed ores. If the solid concentration could be doubled, the water required would be reduced to 0.67-4 tonnes. Therefore, new technologies for mineral flotation at high solid concentrations are extremely important in order to reduce water consumption in arid and alpine regions. Of course, the technologies are also welcomed in other regions due to their water efficiency.

MINERAL CONCENTRATION IN AIR

Mineral concentration in air or dry mineral concentration is suitable for arid and alpine regions. In many cases of commercial mineral processing, dry magnetic separation, air cyclones, and electrostatic separation have been employed[3]. In addition, mineral sorting based on image recognition is recently used to separate coarse and dry mineral particles. The advantages of the mineral concentration in the air are no water usage and no dewatering and heating requirements, while the disadvantages are poor separation efficiency and low production capacity. Therefore, new and efficient dry concentration technologies with high capacity are required for mineral resource exploration in arid and alpine regions soon.

COMPACT CONCENTRATION PLANTS

Compact concentration plants have appeared in the form of gold dredgers, in which many separators and auxiliary facilities are equipped. Regarding the plants in the deep crust, many new technologies and

equipment, as well as intelligent technology, are needed to build compact concentration plants.

In summary, many new opportunities are emerging in undeveloped regions rich in mineral deposits. More young scientists are encouraged to devote themselves to research in the frontiers of mineral processing, and great success will come soon.

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