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Image analysis technique as a tool for extracting features from the copper surface froth in the flotation process

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Abstract: The froth can be adopted as an indicator of the performance of flotation processes. The study of froth image structure would enable us to establish a number of parameters from which could convey the froth characteristics. To monitor the operating performance of the floatation cell by machine vision system, it is crucial to identify and extract those features that are descriptive of the surface froth. Consequently, it can provide interdependency between the froth characteristics with the operating conditions on one hand (e.g., aeration rate, froth depth, chemical compound and pH variation) and the cell parameters performance on the other hand, as well (e.g., copper grade, recovery and solid contents). The aim of the present study is to examine the copper froth characteristics, by adopting an image analysis technique and hence evaluating froth features such as the average bubble size, bubbles distribution, bubble shape features, bubble elongation factor, image average color and the color distribution. Owing to the intricacy aspect of the froth structure and in order to match properly between the real froth and the segmentation images, this algorithm adopts features similar to proper filters in the pre-processing stage, edge detection functions, threshold functions and different mathematical morphology models. The findings of this work reveal that the size and shape of the froth bubbles plays an important role in classifying the froth. Hence, it is possible to incorporate such features for either evaluating the flotation cell performance or adopting it for the automatic on-line control of the flotation process. The findings of this research could also be implemented towards the training of the operators.

Keywords: Image Analysis, Copper Grade, Flotation, Froth Color, Bubble Size, Bubble Distribution

1. Introduction

In the flotation cell, the performance of the cell is highly dependent on the morphology of the surface froth. Consequently, to control the metallurgical performance of the cell (i.e., copper grade, concentrate recovery and mass flow rate), continuous observation of the froth features (i.e., texture and color froth) by an operator is crucial. To enhance the performance of the cell, the operator must respond according to the visual appearance of the froth. Complex texture of the froth and different operating parameter interactions, make this type of evaluation not an efficient means. In recent years, a number of achievements have been made in the field of machine vision system for enhancement of the performance of the floatation cell. Their objective were initially to achieve a replacement for the visual observation of the operator and finally to associate the froth texture characteristics with the cell performance. To adopt this system for controlling the floatation process, the analysis of the froth texture was of prime concern. Therefore, feature extraction method and identification of the type of froth were essential through the geometric features. In the Sarcheshmeh Copper Plant (located in South-East of Iran near the city of Kerman), a relationship between the froth texture and performance of the cell was founded by the authors and hence modeled (Saghatoleslami et al., 2002) as are illustrated in Figure 1 [1]. Network decision making back propagation algorithm with multilayer perception structure adopted by Saghatoleslami et al., 2002 for modeling and characterization of flotation froth color and texture for assessing the flotation performance in a copper plant are shown in Figure 2 [1]. In this work, the test was carried out in a continuous flotation test rig with a rougher cell of approximately 40 liters in volume. Pictures were taken by a handy cam under suitable light intensity. The operating conditions and the materials which were used in the test are exhibited in Table 1.