

Optimal Solution for Copper Purification in Copper-Mine

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Abstract:- Ministry of Mine leads to copper purification of KyiSin Taung & Sabe Taung which is one of the treasures of Myanmar. In copper purification, there are two methods, Pyrometallurgy and Hydrometallurgy (Electrolysis). When we make a comparison above these methods, optimal method is required for the most economical and the best way to give the most purified copper. We propose the system in which mainly presents optimal solution about copper purification in copper-mine and calculates the amount of copper by using Analytical Hierarchy Process in Decision Support System. It is implemented by using Microsoft Visual Studio 2013 programming.

Keywords:- Analytical Hierarchy Process (AHP), Decision Support System (DSS).

I. INTRODUCTION

Copper the coinage metal is one of the oldest metals known to man and is used for thousands of years to make coins, tools, utensils and weapons. Copper is element 29 and its electronic structure is $1s^1, 2s^2, 3s^2 3p^6, 3d^{10}, 4s^1$. It is a soft and touch metal with a high conductivity for heat and electricity.[4]

The main aim of this paper is to implement the software that represented the copper purification. This study is about finding optimal solution for copper purification in copper mine which provides the users to know the purification process of copper, to calculate the optimal solution of purification, and to give knowledge of the technique of copper purification using database information system.

In the system, the main ores of copper in KyiSinTaung & SaBeTaung area are used such as Chalcocite (Cu_2S) and Chalcopyrite ($CuFeS_2$). For the purification of copper, the Pyrometallurgy and Hydrometallurgy are mainly used. In Pyrometallurgy method, It uses high temperature to transformed metals and their Ores. These transformations may produce pure metals or intermediate minerals or alloys, suitable as feed for other refining or commercial application. Hydrometallurgical methods can recover copper from oxide ores or from ores which is low in grade for treatment in a concentrator. In the process copper is dissolved by sulphuric acid from which it is recovered in elemental form, and the stripped leach solution is recycled for further leaching, ore can be leached

in situ, collected in piles and leached (heap leaching) or leached in large concrete tanks called vats.

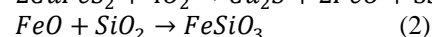
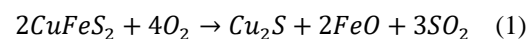
We analyse two different procedures for generating a group decision with the Analytic Hierarchy Process (AHP). Analytical Hierarchy Process (AHP) is an approach to decision making that involves structuring multiple choice criteria into a hierarchy, assessing the relative importance of these criteria, comparing alternatives for each criterion, and determining an overall ranking of the alternatives", as defined by DSS Resources. [2]

This paper is organized as follows. In Section II, the processes of our system using AHP with analysis based on the two copper purification methods are described. We explain the copper purification rates and analysed facts of Pyrometallurgy and Hydrometallurgy in Section III and the conclusion of the system is presented in Section IV.

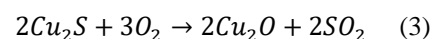
II. SYSTEM IMPLEMENTATION

In manufacturing of copper by Pyrometallurgy, concentration of the ore is carried out in first stage.

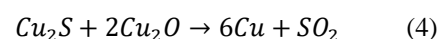
The second stage goes to a smelter where roasting, smelting and conversion are accomplished.



The third stage, conversion consists of the oxidation of the iron copper sulphide matte to blister copper by blowing air through the molten material.

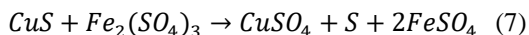
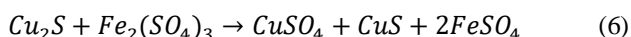
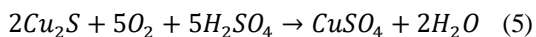


And the last stage, refining is accomplished electrolytically or pyrometallurgically. Gold, Silver, Nickel, Selenium, and tellurium are not removed pyrometallurgically, so the product is often further refined electrolytically

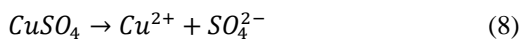


In Hydrometallurgical methods, it can recover copper from oxide ores or from ores which is low in grade for treatment in a concentrator. In the process copper is dissolved by sulphuric acid from which it is recovered in elemental form, and the stripped leach solution is recycled for further leaching, ore can be leached in situ, collected in

piles and leached (heap leaching) or leached in large concrete tanks called vats.[4].



By using electrolysis, the above equations are transformed into [6]



For the last stage, the copper high solution is again shifted to the electro-winning house for producing high

grade copper cathode (99.99% Cu) by using Solvent Extraction and Electro - winning (SX/EW) process.[5]

The above two methods are analysed by using AHP to make the decision. The Analytic Hierarchy Process relies on three fundamental assumptions [2]:

- Preferences for different alternatives depend on separate criteria which can be reasoned about independently and given numerical scores.
- The score for a given criteria can be calculated from sub-criteria. That is, the criteria can be arranged in a hierarchy, and the score at each level of the hierarchy can be calculated as a weighted sum of the lower level scores.
- At a given level, suitable scores can be calculated from only pair-wise comparisons. [2]

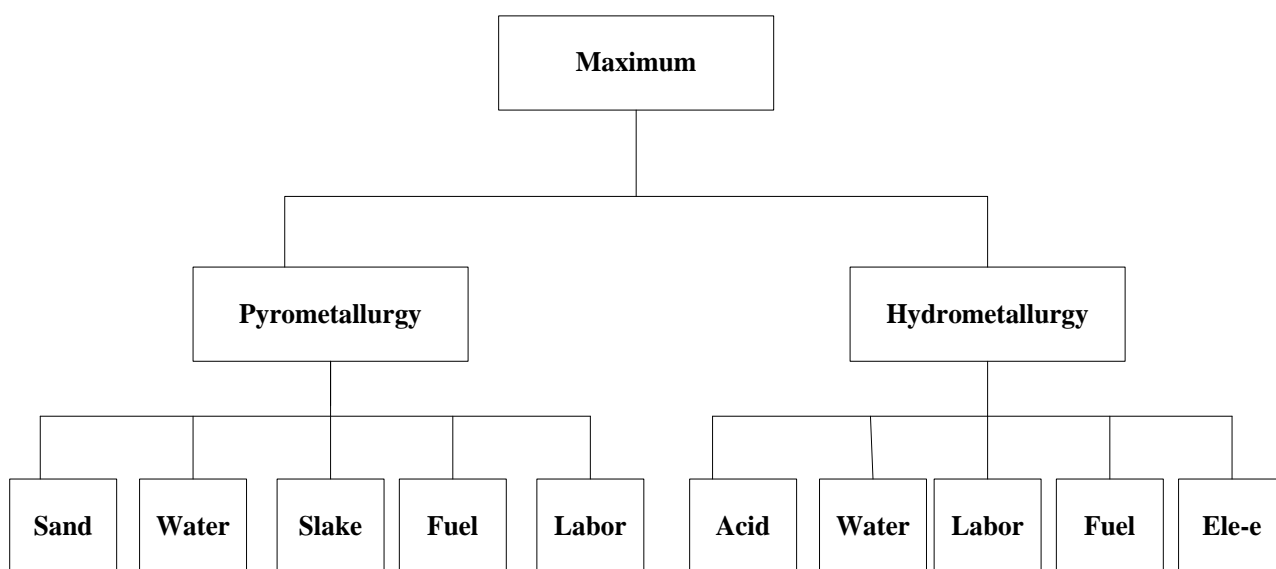


Fig. 1:- Hierarchical Process of Pyro and Hydro Methods.

Navigating through the hierarchy from top to bottom, the AHP structure comprises goals (systematic branches and nodes), criteria (evaluation parameters) and alternative ratings (measuring the ad equation of the solution for the criterion) as shown in Fig. 1.

A. System Design of the Proposed System

There are two basic functions of this system. These functions are

- Inputting the data and new record can be stored and
- Stored Information which is produced as a result.

In the inputting section, there are five major functions. They are

- Adding new records
- Editing existing record
- Retrieving data records from existing files
- Updating data records in existing files
- Deleting data records from existing files.[3]

The system flow diagram of the system is shown in Fig. 2.

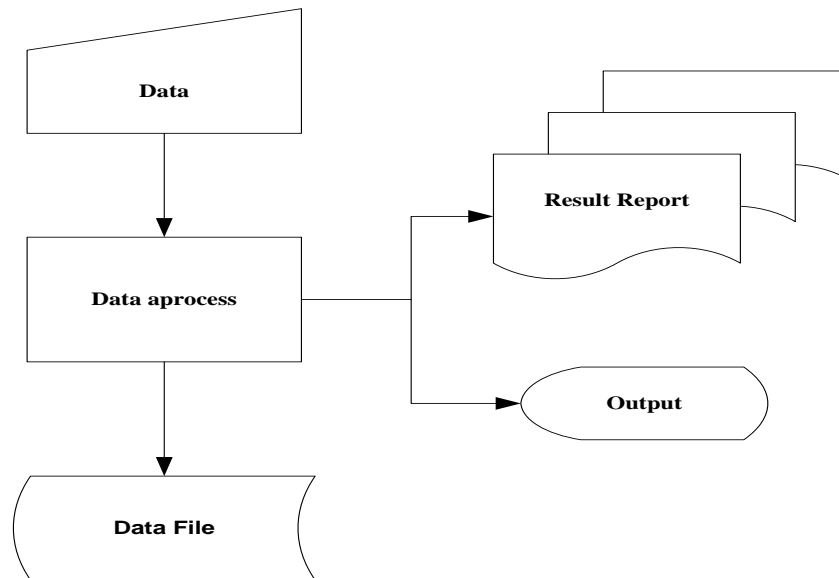


Fig. 2:- System Flow Diagram.

In this system, Manager calculates copper for using Hydrometallurgy method and Pyrometallurgy method. Hydrometallurgy method calculates total cost, product, and profit for one ton of ore. And also Pyrometallurgy calculates total cost, product, and profit for one of ore. By

comparing these two methods and then optimal result is calculated by using Analytical Hierarchy Process of Decision Support System.

B. Structure of the Proposed System

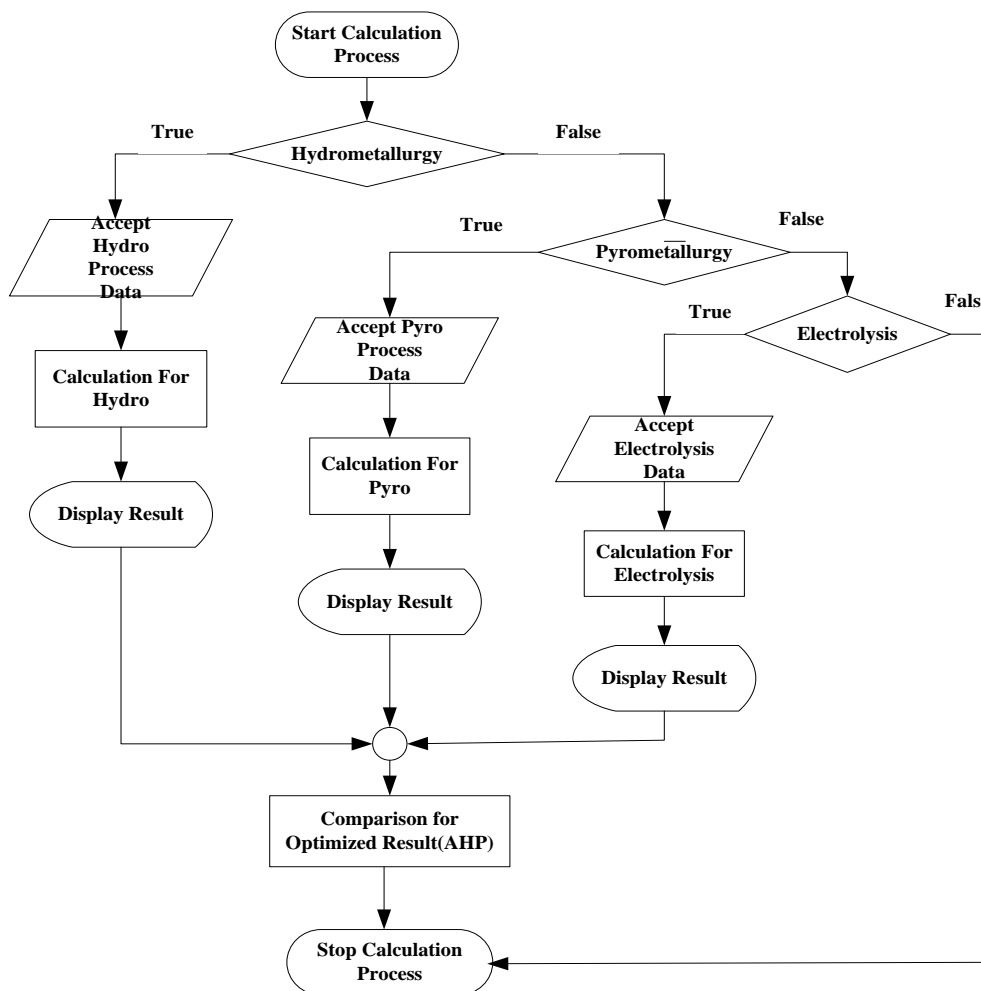


Fig. 3. The Flow Chart for User to Preview the Calculation Process.

For implementation of the system, the following database tables are used on the SQL server [1]. These are mining, leaching, agglomeration, solvent, extraction, electro-winning, hydrometallurgy, and pyrometallurgy tables. The user can calculate the optimized result of total cost, product, and profit in copper purification on both methods. The calculation process for user preview is shown in above Fig. 3.

To calculate the optimal result of copper mining, the proposed algorithm is described in TABLE I.

<p>Begin</p> <p>Accept User Name & Password</p> <p>If user Name & Password cannot contain in database</p> <p>Display error message</p> <p>Else process selection</p> <p>Select case (user choice)</p> <p>Case1: Information Entry</p> <p>Open Database</p> <p style="padding-left: 40px;">Open Information table</p> <p style="padding-left: 40px;">Accept Information data</p> <p>Case 2: Information Retrieval</p> <p style="padding-left: 40px;">Display details information of copper</p> <p>Mining</p> <p>Case 3: Mining Process Module</p> <p style="padding-left: 40px;">Open Database add new record</p> <p style="padding-left: 40px;">Update the database</p> <p>Case 4: Calculation process module</p> <p style="padding-left: 40px;">Open database</p> <p style="padding-left: 40px;">Accept Hydrometallurgy process data</p> <p style="padding-left: 40px;">Accept Pyrometallurgy process data</p> <p style="padding-left: 40px;">Display results for comparison optimized</p> <p>Case 5: Report Module</p> <p style="padding-left: 40px;">Open database.</p> <p style="padding-left: 40px;">Accept the user specified conditions.</p> <p>After the user has accepted data to retrieve from database and display information.</p> <p>Case 6: Exit</p> <p>End;</p>
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Table 1:- Algorithm For Main System

For calculation process module (Case 4), the AHP that is described in the TABLE II is used.

<p>Begin</p> <p style="padding-left: 40px;">Accept cost of two alternatives</p> <p>Begin</p> <p style="padding-left: 80px;">For (i=1; i<=; i++)</p> <p style="padding-left: 80px;">For (j=1; j<=5; j++)</p> <p style="padding-left: 120px;">If i=j, aij =1</p> <p>Else aij=1/aij</p> <p style="padding-left: 40px;">Normalize it</p> <p>Calculate λmax (Eigen Value)</p> <p>Calculate CI (Consistency Index)</p> <p>Accept RI (Redundancy Index)</p> <p>Calculate CR (Consistency Ratio)</p> <p style="padding-left: 40px;">If CR>=0 &&CR <=0.1</p> <p style="padding-left: 80px;">Display Accepted Value</p> <p style="padding-left: 40px;">Else Display Not Acceptable</p> <p>End.</p> <p>Calculate alternatives scores</p> <p>Calculate overall score</p> <p>Compare alternatives</p> <p>Calculate the best one</p> <p>End.</p>

Table 2:- Algorithm For Result Calculation

In the system, the user can choose any information among of the daily record, price, hydro, and pyro and then calculates the optimal solution.

III. RESULTS AND DISCUSSION

The results are analyzed based on different features in both methods. In pyro method, to calculate the copper price, the user add the appropriate facts concerned with pyroproduct, sand, water, slakelime, fuel, and labors. For hydro method, the facts such as hydroproduct, acid, water, labour, current, and fuel are considered. After the calculation using these facts, the user can compare the total cost, product cost and profit of copper mining.

A. Comparison Results of Two Methods

The optimization result of two methods in terms of the profit is described with the bar chart in Fig. 4.

IV. CONCLUSION

In many application areas, information systems are widely used. Using this system, it can reduce the time and cost that are faced in manual systems. In this system, it involves the information system of copper from copper ore. It can provide the required information about the detailed descriptions of copper purification with step approach from raw to goods. The optimal result can also be calculated for users. This system is implemented only for stand-alone personal computer, and therefore, it will be implemented as the web site for copper mining process in our country.

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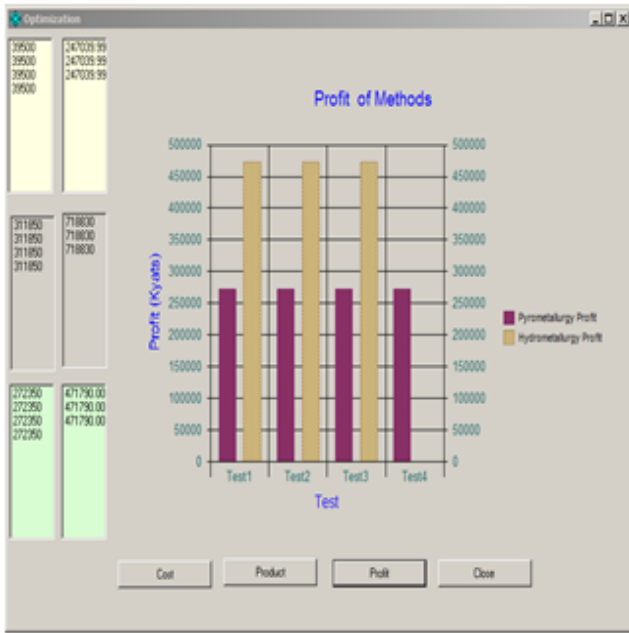


Fig. 4:- Profit of Two Methods.

The compared results based on three factors are described in Fig. 5.

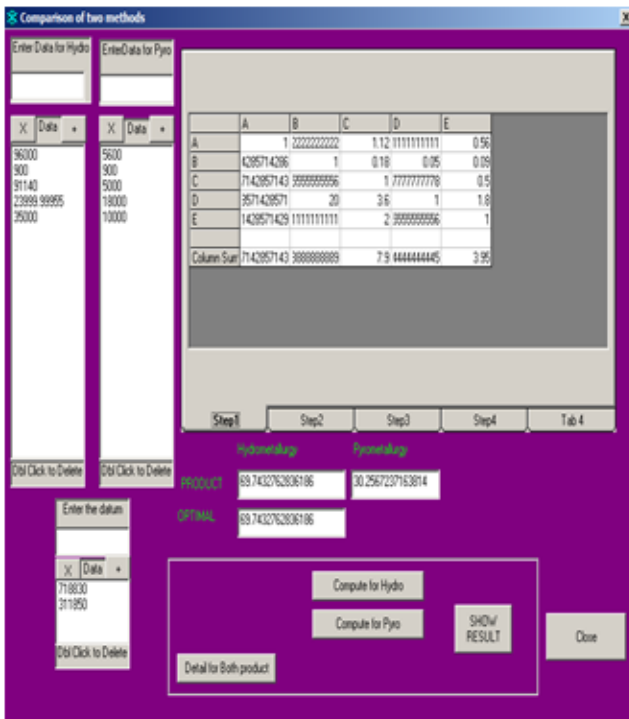


Fig. 5:- Comparison Result of Two Methods

According to the results, the hydrometallurgical method’s result is better than the Pyrometallurgy method in all of three factors.