

International Journal of Innovative Research in Science, Engineering and Technology

(A High Impact Factor, Monthly, Peer Reviewed Journal)

Visit: www.ijirset.com

Vol. 6, Issue 10, October 2017

Art of Flowsheet Development in Mineral Processing Industry

Anand V.Kulkarni,

Manager-Geology, Hospet Steel Limited, Koppal, Karnataka, India

ABSTRACT: Mineral dressing is the art of treating crude crust of the earth to produce consumer derivatives. The operation involves separation of valuables from the undesired constituents. Mineral dressing is adopted because it permits one to make a profit out of mineral exploration venture. In this paper, it is analysed in brief, about the philosophy of mineral processing flowsheet development

KEYWORDS:flowsheet, beneficiation, mineral processing/dressing, flotation,

I. INTRODUCTION

Any organisation owning a mineral deposit is hopeful that, it might be developed into a promising project one day. Consultants, normally economic geologists, are expected to give their opinion. In that case, it is essential to have the geologist working in close association with a mineral dressing laboratory.

In order to prevent any misunderstanding, flowsheet process development and investigations should start with the cooperation of a mineral dressing expert. Incorporation of mineral dressing man, into the team along with geology and mining engineer from the start of the exploration program can be of help in orienting the exploration towards mineralized zones of greater interest on account of ore beneficiation.

II. FLOWSHEET DEVELOPMENT

The essential elements of flow sheet must be such as to take advantage of the differences in physical and/or chemical properties of the constituents of the crude. The correct method has to be determined by the yardstick of optimum profit. While doing so, no pet process or fashionable method should be adopted. The flowsheet has to be designed to include principal equipments only, in qualitative manner and finally auxiliary equipment in quantitative manner.

A. SAMPLING

Natural ores are highly heterogeneous mixtures of solid minerals varying in quality, properties, texture etc. The sample collected for flowsheet development should represent the average of the ore deposit with respect to chemical and mineralogical properties. For the geologist, the sampling of mineral deposit provides data for estimating Ore reserves including grade and tonnage. Whereas, the mineral dressing engineers concern is feed to the mill or furnace. Hence, a mineral dressing engineer has to be very careful about the true representatives of the sample corresponding to the mining reserves, taking into account the mining methods also.

By adequate testing of initial samples, expensive drilling programs can be avoided. Thus, mineral processing engineer is recommended to keep a direct control of the whole sampling operation. Because, it is commonly found that, in order to save a geologists fees, tests are conducted on any kind of grab sample, and plants are built without any ore testing at all.

International Journal of Innovative Research in Science, Engineering and Technology

(A High Impact Factor, Monthly, Peer Reviewed Journal)

Visit: www.ijirset.com

Vol. 6, Issue 10, October 2017

B. TEST WORK

Ore testing is an art that comes naturally to one who is thoroughly familiar with mineral dressing processes and practice. Knowing the elemental analysis of the feed, complete process flow sheet can be developed without any test work. But, it is essential to perform laboratory testing. Because, the mineral processing is dependent on the mode of occurrence of valuable elements, using physical and or chemical methods of separation.

Client might define the objective of the test based on his requirements. But, it is essential to have orientation tests to determine physical, chemical and metallurgical properties of the ore. This would expose some other characters of the ore of economic value, which client might not be aware of. Tests are necessary on several composite samples, rather than on the large average sample. Then mineral processing expert has to find out a flow sheet which is most suitable to fit all the cases.

C. APPROACH OF A DETECTIVE

Mineral processing flowsheet development work presents many similarities with a detective business.

1. It requires an acute sense of observation.
2. Thorough knowledge of all the parameters.
3. Industrial perception of the problem.
4. Technical aspects like knowledge of mineralogical analysis, chemical analysis composition and physical separation.
5. Marketing aspects.
6. Safety and environmental regulations and
7. Capital and operating costs

Thorough knowledge of all the parameters will have a positive effect on the actual operation test results. The steps involved are:

- 1 Collecting feed sample for analysis, which we have discussed.
 2. Determination of minerals present and elements to be analysed and associated gangue elements like Alumina, silica etc.,
 3. Quantitative mineralogical composition has to be found out.
 4. Detailed size analysis is required.
 5. Response of the ore to the corresponding separations should be analysed.
 6. Ascertaining the grinding characteristics and possible segregation of mineral constituents in various size ranges.
- All these observations recorded will help to establish experimental conditions of subsequent texts.

C. APPROACH OF A DETECTIVE

Mineral processing flowsheet development work presents many similarities with a detective business.

1. It requires an acute sense of observation.
2. Thorough knowledge of all the parameters.
3. Industrial perception of the problem.
4. Technical aspects like knowledge of mineralogical analysis, chemical analysis composition and physical separation.
5. Marketing aspects.
6. Safety and environmental regulations and
7. Capital and operating costs.

Thorough knowledge of all the parameters will have a positive effect on the actual operation test results. The steps involved are:

- 1 Collecting feed sample for analysis, which we have discussed.
 2. Determination of minerals present and elements to be analysed and associated gangue elements like Alumina, silica etc.,
 3. Quantitative mineralogical composition has to be found out.
 4. Detailed size analysis is required.
 5. Response of the ore to the corresponding separations should be analysed.
 6. Ascertaining the grinding characteristics and possible segregation of mineral constituents in various size ranges.
- All these observations recorded will help to establish experimental conditions of subsequent texts.

D. RESULTS

A correct evaluation of the test results will help to establish experimental conditions up to the point that a complete flowsheet can be derived, to produce a desired final product. After completion of these determinations, whether concentrating method

International Journal of Innovative Research in Science, Engineering and Technology

(A High Impact Factor, Monthly, Peer Reviewed Journal)

Visit: www.ijirset.com

Vol. 6, Issue 10, October 2017

should be adopted can be decided viz., gravity concentration, flotation, amalgamation, magnetic separation or some other methods. Objectives of flowsheet are:

1. Determination of material balance.
2. Recoveries
3. Quality of the products.

Care should be taken while designing the flowsheet, selecting a limited number of processes only, which have been tried in the beginning. Mineral processing engineer should study the overall economics, while choosing the flowsheet process.

E. PILOT PLANT TEST WORK AND PLANT DESIGN

Whether a pilot plant testing is necessary or not is of controversy.

1. Even though it requires high tonnage of ore sample, there will be difficulties in getting a large sample. But, it produces more sample for further metallurgical testing.

2. In pilot plant tests, it is difficult to maintain stable operating conditions. But, on a whole it is possible to check the feasibility of the whole process.

3. It is possible to test recycle effects and try new type of equipments.

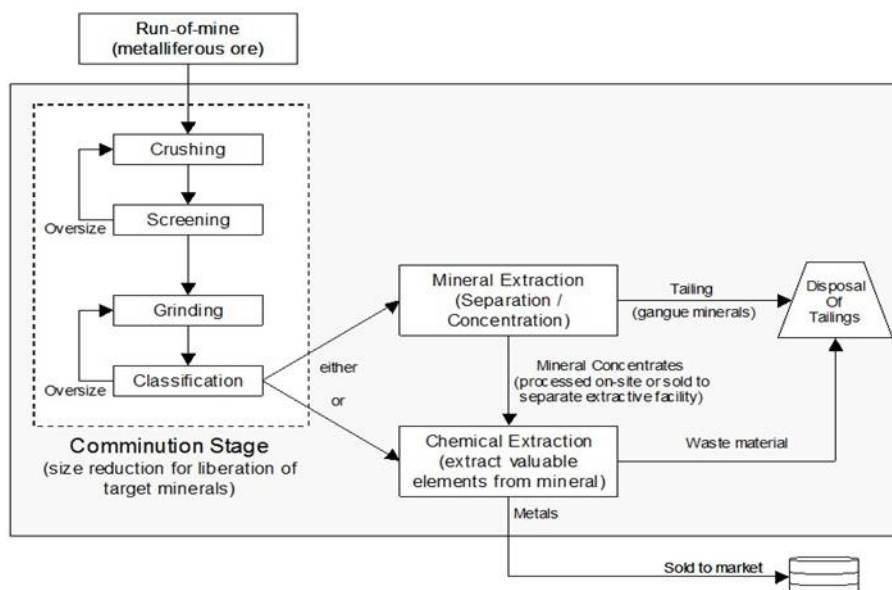
Whether processing plant is justified from an economic or commercial standpoint has to be verified. Location of Site, selection of essential and auxiliary machinery are all of great importance. Possible quality of the ore to be processed has to be ascertained. Simple and inexpensive plants can be designed to operate one shift per day. Whereas, complex and expensive plants are to be operated continuously. Preparation of qualitative flowsheet is simple, but, preparation of quantitative flowsheet is difficult.

F. MARKET

In the preparation of the product, the mineral dressing expert must keep in mind the wishes of the purchaser. In mineral dressing, as in other commercial ventures, 'The customer is always right'

Mineral processing expert must be aware of the market requirements for various categories of products, he plans to produce. The better he knows the real problems encountered by the potential customers, the more chances, he has to work out a process that would give the greatest benefit.

Fig. 1. Stages in flowsheet processes



International Journal of Innovative Research in Science, Engineering and Technology

(A High Impact Factor, Monthly, Peer Reviewed Journal)

Visit: www.ijirset.com

Vol. 6, Issue 10, October 2017

IV. CONCLUSIONS

Mineral dressing test work program is a very delicate task and it should be planned step by step in close association with the client. Involvement of people from all the fields give the most efficient solution to mineral processing flowsheet development.

REFERENCES

- [1] T. E. Marlin, A. N. Hrymak, "Real-time operations optimization of continuous processes", Proc. Chem. Process Contr. V Conf., pp. 156-164, 1996.
- [2] T. Y. Chai, J. L. Ding, "Integrated automation system for hematite ores processing and its applications", Measur. Contr, vol. 29, no. 5, pp. 140-146, 2006.
- [3] S. Engell, "Feedback control for optimal process operation", J. Process Contr., vol. 17, no. 3, pp. 203-219, 2007.
- [4] D. Hodouin, S.-L. Jamsa-Jounela, M. Carvalho, L. Bergh, "State of the art and challenges in mineral processing control", Contr. Eng. Pract., vol. 9, no. 9, pp. 995-1005, 2001.
- [5] T. Tosukhowong, J. M. Lee, J. H. Lee, J. Lu, "An introduction to a dynamic plant-wide optimization strategy for an integrated plant", Comput. Chem. Eng., vol. 29, no. 1, pp. 199-208, 2004.
- [6] B. Chachuat, B. Srinivasan, D. Bonvinc, "Adaptation strategies for real-time optimization", Comput. Chem. Eng., vol. 33, no. 10, pp. 1557-1567, 2009.
- [7] P. Bhagat, Pattern Recognition in Industry, U.K., Oxford:Elsevier Science Ltd., 2005.
- [8] Murali,B.Pitchumani,NigelN.Clark, "A settler for continuous particle shape separation", International Journal of Mineral Processing,Vol. 18, No. 3-4, Pages 237-249, 1986
- [9] Ting-ChuenPong,RobertMHaralick,JamesRCraig,Roe-HoanYoon,Woo-ZinChoi, "The application of image analysis techniques to mineral processing", Pattern Recognition Letters, Vol. 2, No. 2, , Pp. 117-123, 1983