Evaluation of Ceramic Media Wear Characteristics on the M100 Isa Mill

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***Abstract*—** Since the installation of Isa-Mills, major improvements/studies have been made to make it more efficient. In 2006, ceramic media were introduced in the market to identify the cost effective type. This was achieved by the quality studies on different type of media both at the laboratory and pilot plant scale. In this present study, a 100 hours test was carried out in order to evaluate the wear characteristics of ceramic media branded candidate media and was compared to the standard media using the M100 Isa mill at the pilot plant. The evaluation was in the basis of comparing the relative performance of the candidate media and standard media in terms of wear rate, energy consumption and the finest of grind, whereby the following results were generated. A seasoned charge graph of both media at d80 µm vs. running time (hr) was generated and clearly highlighted the points of reaching seasoned charge for both media however, this didn't help much in terms of finding the difference between the media because one cannot confirm the points of reaching seasoned charge by just looking at the graph but this can be confirmed by the actual size analysis of the media beads. A further comparison was made by comparing the finest of grinds from the Isa-Mill discharge and it does not necessarily gives a clear view of which media is better compared to the other. The media wear rate and energy consumption of both media were compared and the standard media showed a big variance from the candidate media in terms of wear and energy. The standard media stood out to be the cost-effective type compared to the candidate media. Its utilization in the plant will then be suggested.

***Keywords*—** M100 Isa-Mill, ceramic media.

I. INTRODUCTION

TSA Mills were introduced back in 2003 in the Anglo Platinum production plants to enhance grinding and improve recovery. Back then silica sand of 5mm was utilized as the grinding media in the UFG application. In 2006 Ceramic media was introduced therefore different types were in the market. The challenge was to identify the cost effective type; hence DML started doing quality studies on different types of media both at the laboratory and pilot plant.

A 100 hour test was carried out in order to evaluate the wear characteristics of ceramic media branded candidate using the M100 MIG Isa Mill at the pilot plant. From this test work, the relative performance of the media was to be determined. Comparison of the candidate media with the standard media was done to determine the cost effective type. Consistent evaluation procedure applied to both media was produced From the data that was collected and the evaluation of the wear on the Isa Mill grinding discs and the discharge screen apertures a detailed wear analysis was done on the media.

It was envisage that the significance of media in the Isa Mills should enhance grinding therefore improve recovery. The cost effective media hence, media wear rate, energy consumption, life span of internals of the Isa Mill and the media costs was considered prior proposed for operations.

II. METHODOLOGY

The following assumptions were made and applied to all the experiments carried out [1]:

a) The test ran over a period of 100 hours continuously.

b) MIG M100 Isa Mill was utilized for all the tests.

c) The plant operated under normal stabilized conditions.

d) Only UG2 ore was used for all the tests.

e) The plant throughput was maintained constant at 1.4 t/hr.

f) The Isa Mill media load was maintained to a constant filling degree of 1kg batches to stabilize the power.

g) Hydro-cyclone classification targeted 80% passing 75µm before feeding the Isa Mill was maintained.

A. Circuit description

Primary Mill [2]

a) The mill feed set point was kept constant at 1.4t/h.

b) It operates in a closed circuit with the screen whose sieve separates up to 800µm.

c) The mill inlet and Mill dilution water was maintained at a flow rate of 0.016-0.018 m^3/h to give discharge slurry density of 1.35 t/h.

Re-grind Mill

a) The primary mill product, which is the screen undersize

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pumped to the re-grind for secondary grinding which;

b) Operates in a closed circuit with the Hydro-Cyclone.

Hydro-Cyclone

a) It is a classification device which target 80% passing 75µm.

b) The Hydro-Cyclone overflow which is the Isa Mill feed sampled manually before entering the M100 Isa Mill.

M100 Isa Mill

a) Targets 90% passing 75µm

b) Initial media feed depends on its bulk density.

B. Sample preparation

Sample preparation was done at the DML pilot plant and the final stage was done at the DML laboratory. The sample preparation was done as per Anglo Platinum standard and procedures which includes filtration, drying, weighing, coarse screening and splitting and packaging for Malvern. At sampling points, samples were collected manually using pelican hand sample cutter at the Isa Mill feed and Isa Mill discharge. Isa Mill feed was taken at 8 h shift as composite in 1 bucket, while Isa Mill discharge was taken hourly for the first 16 hours in the ice cream containers to see a point of reaching seasoning charge. This was followed shift composite samples throughout 100 h.

All the packaged samples were taken to the DML laboratory for PSD analysis using the Malvern.

III. Result And Discussions

A. Data capture

All data used in the evaluation of media wear were collected during the 100 h test runs. After sample packaging they were all sent to DML laboratory for Malvern PSD analysis. Current media being used is represented as candidate media compared to the standard media.

For the sake of fair comparison the following were compared of the two media

a) Point of reaching season charge

b) Feed

c) Discharge

d) Power draw vs. wear rate

B. Season charge

The media that reaches a point of seasoned charge earlier could be the one that has a higher wear rate compared to the other one. Fig. 1 illustrates the media stability and variance between 40 and 50 µm, similarly the candidate media reach season charge after 12 h. In order to be able to compare the discharge PSD's for the two media the PSD data was averaged after reaching the seasoned charge.

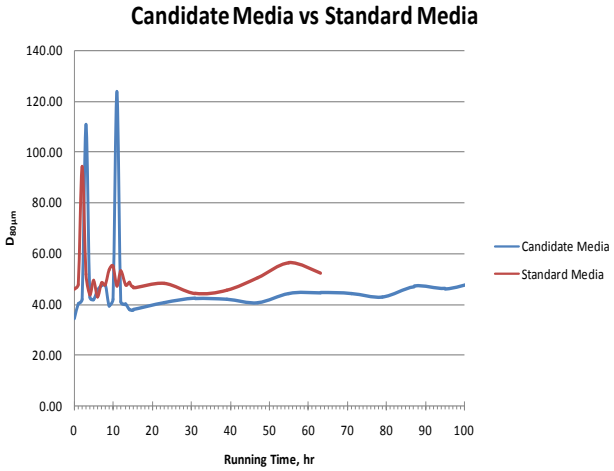

Fig. 1 Illustrating point of reaching seasoned charge of both media.

B. Feed

Isa mill is fed with similar grind so to yield fair media results. Fig. 2 illustrates that the feed during the candidate media test was slightly finer than the feed during the standard media test; this was as a result of a slight change of water balance in the regrind Mill. Also the average of D80 showed the candidate feed had slightly finer particles than the standard feed.

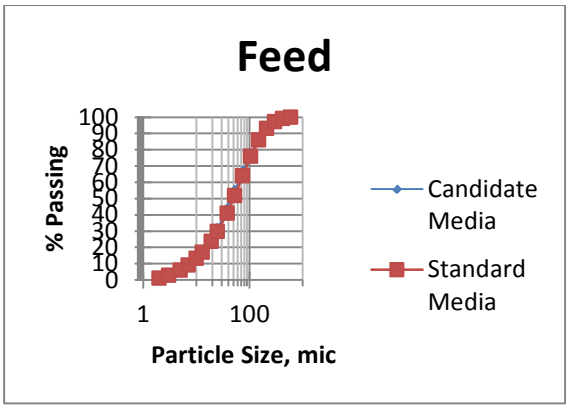

Fig. 2 Illustration on the Feed of both media.

C. Discharge

Fig. 4 compares PSD of the Isa Mill discharge during the candidate media and standard media test which shows candidate media to have slightly finer particles than the standard media. The reduction ratio of candidate media and standard media (2.58:1 and 2.46:1) respectively shows the Isa Mill efficiency. Since this ratios are very tight by basing comparison on the discharge could be little unfair so it would be better to compare the wear rate of both media.

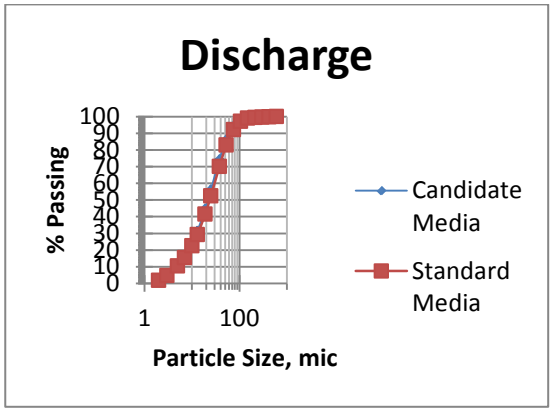

Fig. 3 Illustration on the discharge of both media

D. Media consumption rate and energy consumption

The most convenient way of comparing media is by evaluating their relative performance (wear rate and energy consumption) of each type.

After calculating the media consumption rate of the two media it was found that the candidate media used more beads in grams per power hour compared to standard media. From these results, it was clear that the higher wear of media calls for more media top-ups in the mill, in order to keep the power stabilized. In this case of comparison the standard media standout to be the favorable in terms of wears rate and energy consumption. Standard media was found to be much better than the candidate media and can be recommended for production sites.

TABLE I
ILLUSTRATE MEDIA CONSUMPTION RATE AND ENERGY CONSUMPTION OF BOTH MEDIA

Media Type	Media Consumption Rate (g/KWhr)	Energy Consumption (KW)
Candidate Media	*27.7*	*2058.9*
Standard Media	*3.6*	*2490.2*

IV. CONCLUSION

A clear comparison came by when compared the media wear rate and energy consumption of both medias, whereby the standard media showed a big variance from the Candidate media in terms of wear and energy. The Standard media standout to be the cost-efficient type compared to the candidate media so will be proposed for operations.

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