Technological Assessment of Product Screens (137sc16/17) Performance

Noella M. Mbuyi, Antoine F. Mulaba – Bafubiandi, A. Randigwane, W. Bolha, and A. Anyimadu

Abstract— Performance of two product screens (137Sc-16/17) constantly flooding at UG2 plant were assessed. Root causes for the flooding were investigated as well as a benchmarking with the performance of non-flooding screens performance. Samples for the screens 137Sc-16/17 feed and oversize were collected for three days, and prepared according to plant standards for sample preparations in order to obtain the particle size distribution (PSD). The first PSD results of the feed were given to Barcandyle which is mechanical engineering experts for screen sizing and their findings were used in this project for optimization purposes. The PSDs of the screens undersize, oversize and feed were used to draw cumulative percent passing and these graphs were used with the effective formula in order to determine screen performances. It was observed that 137SC-17 was more efficient than 137SC-16 and also that the major cause of flooding was due to the woodchips blinding the screen panels. From these findings the aperture size of 137SC-16 was changed from 0.63mm to 0.8mm. The screens still flood during spikes time due insufficient picking points for wood at UG2 plant.

Keywords—Benchmarking, Optimization, Performance, Screens.

I. INTRODUCTION

SCREENING is an industrial process that splits material at a specific cut size into one fraction of particles larger than the cut size and another fraction of particles smaller than the cut size. Particles are vibrated to increase the probability of them being accurately classified and to move the oversize particles off the screening surface [1].

There are a variety of factors affecting screen performances, such as feed rate and density, etc. For example feed rate,

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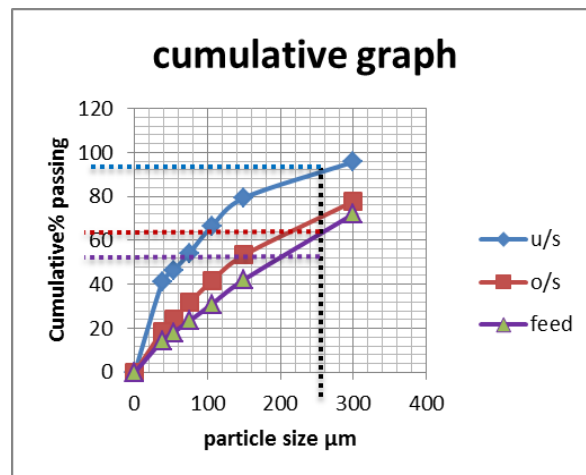
usually expressed as dry mass rate (tons per hour), is one of the most critical factors affecting screen performance. Exceeding capacity or over feeding a screen will result in the misreporting of undersize particles and fluid to the oversize stream as well as a reduction in screen surface life. The other major factor is feed density, as understood, undersize particles are transported through the screen aperture by the fluid and therefore, the volume fraction of fluid will affect screen efficiency as the screening efficiency is inversely proportional to pulp density [2]. Before a screen can be optimized, a technique is required to determine the efficiency of the screen first. There have not been any universally accepted method of assessing screens performance/ efficiency and as such many methods are used. The method adapted in this project is the Leonard method [3], this method define screen efficiency in terms of the amount of total material misplaced (fines in oversize and coarse in undersize), this method is used to overcome most of the problems faced with by using other efficiencies equations which utilize laboratory measured data using square mesh sieves, these equations are meant for square mesh industrial screens and are not strictly applicable to rectangular mesh. This equation uses the cumulative percent passing of the feed, oversize and undersize particles with known aperture size. For example a product screen in the plant with an aperture of 250µm, in order to determine the efficiency theoretically a line is drawn through the cumulative curve of the over-size, undersize and feed materials at an equivalent aperture size as the one used in the plant, these values are then which substituted in the efficiency formula to obtain the actual efficiency (Fig. 1).

Fig. **1** Cumulative percent graph as obtained using the Leonard method [3].

II. METHODOLOGY

Samples were collected at the feed and oversize sections of the vibrating screens in the primary milling circuit of plant A in order to provide PSD data needed in the drawing the cumulative curves. The procedures followed during this project are outlined as follow:

A. Sampling survey

The sampling survey took place on three consecutive days of which A, B, and C samples were collected in the feed sump, and oversize area. During sampling one person was required to be in the control room noting the survey conditions and data such as the throughput, density, make-up water, and flow rates were noted and also the density were measured in place as samples were collected. Due to safety reasons no samples were collected for undersize analysis as the area was unsafe for operation, in this instant plant "A" provided data which were limited by their laboratory screen sizes as this will be more visual by looking at the cumulative curves. The feed rate and density intervals of 340tph and 370tph, $1.4t/m^3$ to $1.55t/m^3$ respectively were taken and about 48 samples were prepared.

B. Sample collection

The samples were collected at the screens (137Sc-16/17) feed and oversize using a hand-held sample cutter, density measurements were conducted using a densitometer as demonstrated in Fig. 2, and this was done for every run.

Density scale   1L Beaker
Fig. 2: Pictures of sample cutter and densitometer as used in sampling campaign.

1) Density measurement

The density measurements were done by suspending the densitometer onto the beaker; tearing off the mass of the beaker before measuring slurry density. The scale was tore so that a zero reading would show initially. The corresponding density was noted for each run after filling up the beaker with slurry until it overflown.

C. Sample preparation

After sampling, the buckets were carried down to the metallurgical laboratory area. The samples were weighed to get the wet mass. Once the wet mass was known, the samples were then filtered and dried in the oven at 90°C after drying weighing of the sample took place again to determine the dry masses.

1) Coarse screening

Coarse screening was done by transferring the dry sample onto a 600µm sieve and making sure that sieve as well as the roller was clean and in good condition. The roller was used to break the lumps which were formed while a plastic bag was used to avoid spillage (Fig. 3).

Fig. 3: Coarse screening in order to break lumps of dried samples using 600µm sieve

2) Sample Splitting

The main objective for sample splitting was to obtain a small portion of the sample that is a representative of the bulk. This was accomplished by making sure that the splitter and its cups were clean to avoid contaminations, the sample was then transferred into the funnel of the splitter by switching on the splitter and ensuring that the turntable was switched on first and then the vibrating feeder and allowing splitting time. Two opposite cups were taken to weigh the masses. The above procedures were repeated until a mass of approximately 100g was obtained. Fig. 4 shows the equipment used.

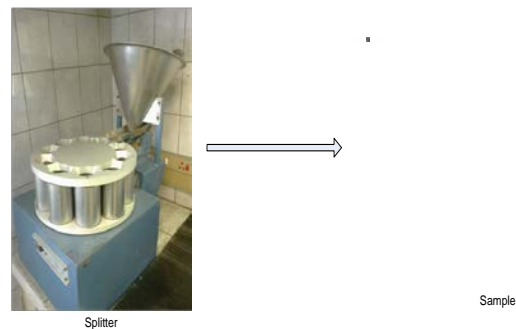
Splitter   Sample
Fig. 4: Equipment used for splitting techniques in sample preparation.

3) Wet Screening And Infra-Red Drying

100g of dry sample from the splitter were taken and transferred into a pan. Wet screening of the sample was conducted on a screen with an aperture size of 38µm, this was done until the water coming out of the bottom of the sieve was clear enough as this was an indication that all the particles smaller than 38µm were being removed (Fig. 5), after wet screening the sample were transferred on a dry pan and kept under infrared dryer for heating and drying.

4) Grading/ Particle size Distribution

Grading/ Particle size distribution was achieved by arranging stack of screens from smallest aperture size to the

largest 38-850 µm in that order (the root 2 series). Fig 6 shows how a sieve shaker looks like. Particle size analysis was conducted by weighing each size fraction from the sieve and recording the respective masses.

Wet screening

Sample under heaters

Fig. 5: Wet screening techniques and drying under infra red of samples before grading analysis.

Fig. 6: Vibrating shaker used for particle size analysis

III. RESULTS AND DISCUSSIONS

During this study, pictures were taken at the plant for comparison as part of visual observations. Fig. 6 and Fig. 7, show holes in the screens bed as well as aperture and tremendous amount of woodchips blinding the screens aperture panels. Since the primary mill of the plant is operated on closed circuit, the woodchips have the ability of causing a higher re-circulating load thus increasing the volume of the feed. This in return causes a coarser grind which leads to an even higher circulating load in the circuit. Due to the reduced residence time in the mill caused by high circulating load, the mill discharge correspondingly becomes coarser thus the size distribution of the circuit product changes.

The data and graphs presented in Fig. 8-10 are the averages of all the three runs performed at the same conditions to ensure accuracy in the findings obtained.

Fig. 7a: Holed screen panels and surface

Fig. 7b: Woodchips on the screening surface

When comparing 137Sc-17 and 137Sc-16 screens operated at the same throughput of 340tph as well as same density of approximately 1.45t/m3, it was found from efficiency calculations using the graphs Fig. 8 and 9, that 137Sc-17 has a higher efficiency in comparison to 137Sc-16. This is also visible on the graphs by the wideness of the curve between feed and oversize for 137Sc-17.
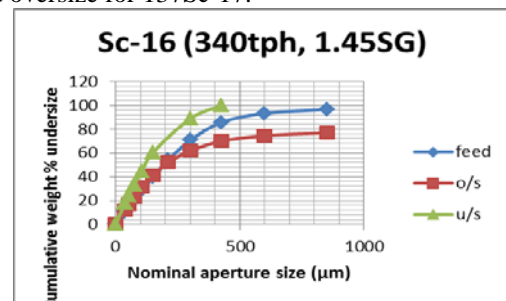

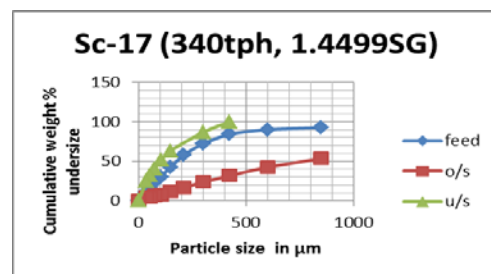Fig. 8: cumulative graph (sc-16 at 340tph and 1.45t/m^3)

Fig. **9**: Cumulative % graph (SC-17 at 340tph and 1.4499t/m^3)

In Fig. 10 and 11, the comparison was made between 137Sc-16 operating at the same feed rate of 340tph with different densities. It was observed that the efficiency increases with decreasing density, at 1.485t/m^3 the efficiency

obtained is 78.53% whereas at $1.5t/m^3$ an efficiency of 70.28% results. This is also seen by the distance between the two curves (feed and oversize) in Fig 10 being wider than in Fig. 11.
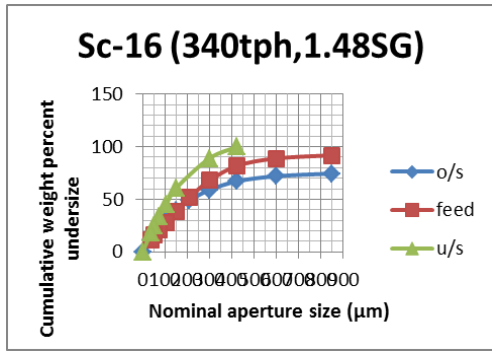

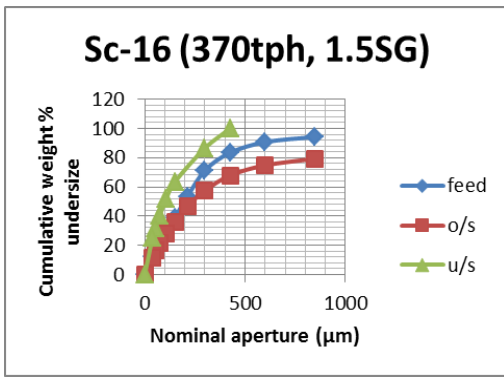Fig. 10: Cumulative % graph (SC-16 at 340tph and $1.48t/m^3$)

Fig. 11: Cumulative % graph (SC-16 at 370tph and $1.54t/m^3$)

In Fig. 12 and 13, the comparison was also made for the same screen 137Sc-17 operating at the same feed rate of 340tph with different densities. It was observed that the efficiency increased with decreasing density, at $1.375t/m^3$ the efficiency obtained is 94.82% whereas at $1.545t/m^3$ an efficiency of 92.59% results. This is also seen by the distance between the two curves (feed and oversize) in Fig. 12 been wider than in Fig 13.
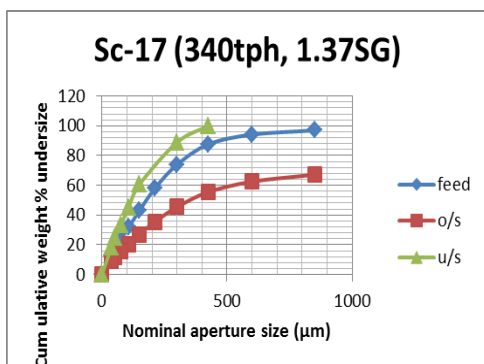
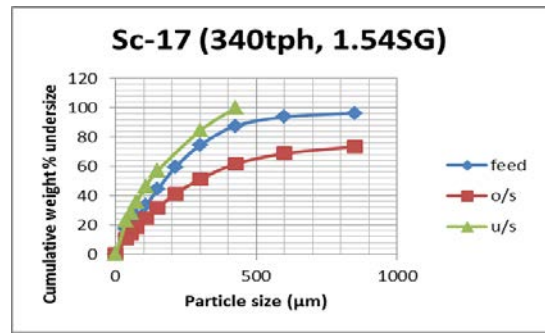

Fig. 12: Cumulative % of 137Sc-17 at 340tph and 1.37t/m3

Fig. 13: Cumulative % of 137Sc-17 at 340tph and 1.54t/m3

Fig. 14 and 15 are used here for comparing the performances of 137Sc-16 and 137Sc-17 when operated at the same throughput of 370tph an also approximately same density. It was found from efficiency calculations using the graphs below with the values given on the side of the graphs that 137Sc-17 has a higher efficiency even though its density is 0.01 greater than 137Sc-16. This is also visually shown on the graphs by the widest of the curve between feed and oversize for 137Sc-17.
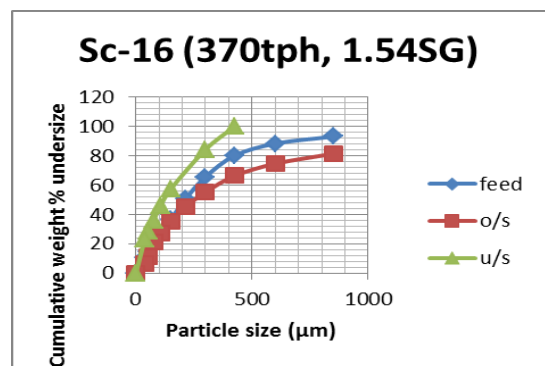

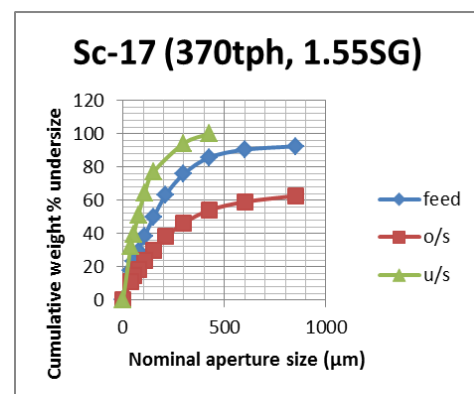Fig.14: Cumulative % graph (Sc-16 at 370tph and $1.54t/m^3$)

Fig. 15: Cumulative % graph (Sc-17 at 370tph and $1.55t/m^3$)

IV. CONCLUSION AND RECOMMENDATIONS

137Sc-17 (0.8mm × 8.8mm) screen was found to be more efficient in comparison to 137Sc-16 (0.63mm × 8.8mm) at the same conditions depicted in the results. The performance of 137Sc-16 screen was associated to the fact that it had a smaller screen aperture in the last five rows of 0.63mm where most of

flooding occurred as the apertures were easily blinded. This led to a suggestion of increasing the screen aperture to 0.8mm. Both screens were changed to 0.8mm aperture panels during optimization sections. From the plant shut-downs for maintenance it was noticed that the old panels were blinded over time by wood chips. Both screens cope well with 0.8mm aperture panels under normal operating condition (300tph and 1.445t/m^3) and flooding was observed whenever the density increased in this range 1.5-1.6 t/m^3. The plant has only one picking point for wood prior to feeding the primary mill. The screens can be operated individually only under normal conditions of density of 1.445t/m^3, but flooding will result as soon as the density spikes. It was recommended to try maintaining this condition. The amount of water added was very important to avoid high densities, as this will ensure consistent and efficient screening at all times, even during peaks and spikes.

V. RECOMMENDATION

Regular inspections on the screens are prerequisite in order to replace damaged panels. Picking points must be improved in order to avoid woodchips reporting to the primary milling circuit. More safely designed picking points for wood before feeding the ore to the primary milling circuit is a prerequisite in dealing with woodchips problems. Self-cleaning wire for screen surface panel can be used due to its potential to counter blinding problems. Self-cleaning wire is a variation on this, having wires that are crimped to form apertures but individual wires are free to vibrate and therefore have a high resistance to blinding and pegging. Screening accuracy can be close to that of conventional woven wire mesh; and they have a longer wear life, justifying their higher initial cost. The triangle and diamond weaves give a more efficient separation [1].

A multiple feed point screens with spray water installed at the feeding points can be used to maximize screen capacity and efficiency of classification. It has been shown that it is usually more beneficial to add water to the screen feed slurry than to add the same amount of water directly to the screen surfaces with spray nozzles The multiple feed point screens applications [2], have the capacity to achieve efficiencies above 90 % in numerous high tonnage applications.
Woodchips consume reagents which lead to unnecessary high production cost; a linear screen could be installed at the primary mill discharge as this screen aims at removing foreign material such as woodchips.

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