DETERMINING THE WATER PRESSURE INFLUENCES OF THE ICON GOLD GRAVITY CONCENTRATOR

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ABSTRACT

The iCon Gold Recovery Concentrator is a Centrifugal gravity concentrator that is designed to recover free gold without the use of chemicals. The performance of the concentrator can be affected by several operational parameters. The water pressure is one of the most important parameter which influences the operation of a Centrifugal Concentrator.

With this project the influence of the water pressure on a centrifugal concentrator was determined by comparing the result of 2 different water pressures on a centrifugal concentrator. The pressures used for this research were 10 PSI and 14 PSI. But to accomplish this research, samples of Grassalco N.V. and tailing samples from two Small Scale Gold Mines were used. For all these samples the particle size distribution test was done at the different water pressures.

This research revealed that the water pressure indeed has a great influence on the performance of the iCon Concentrator. The results proved that high recovery for fine material, (smaller than 0.25 mm) occurs at a water pressure of 10 PSI. and that for coarser material, (larger than 0.25 mm) a higher water pressure such as 14 PSI yields a higher recovery. It can also be concluded that the solid content and the composition of the material has influence on efficiency of the concentrator. Depending on the composition of the material, the ideal water pressure can be chosen.

KEYWORDS: gravity concentration; icon centrifugal concentrator; concentration; tailing of small scale gold mines.
1. Introduction

The Icon Gold Recovery Concentrator, is an enhanced gravity concentrator consisting of a spinning bowl. The bowl consist of a migration zone and a retention zone, which is immediately above the migration zone. The retention zone contains horizontal riffles welded along the inside wall, each riffle create his own ring inside the bowl. The bowl rotate at a fixed speed to create a centrifugal force. The bowl is fed with slurrified material (within the size range of 2000 µm – 20 µm) through the central vertical pipe, and accelerated by the impeller into the rotating bowl. Due to the rotation of the bowl, part of the transported material (high specific or any target particles) retains inside the retention zone and the other part (the low specific particles) are carried away by the flowing water into the tailing discharge ports (www.iconconcentrator.com).

Different mechanism and operational parameters have been identified as playing significant role in the separation taking place inside the bowl, such as particle size differential settling, density, shape, water pressure, cycle time etc. (Will, et al 2006, Koppalkar, 2009, Laplante, Huang and Mejiab, 2005).

This study focuses on the water pressure of the iCon Gold Recovery Concentrator, which operates within the range 5-15PSI (www.iconconcentrator.com). The purpose of this study is to get more knowledge about this equipment and how the water pressure contributes to its efficiency in order to achieve good separation of minerals, high recovery, good grade, effectively as well as efficiently.

2. Methods and Technologies

In order to determine the water pressure influences on the performance of the iCon Concentrator, two water pressure tests were carried out with three different types of material, which includes: Material from Grassalco N.V at Maripaston, tailing material from two Small Scale Gold Mines. The first iCon test was carried out at 10 PSI and the second test was carried out at 14 PSI. The iCon circuit with a capacity of 2t/h includes a 2 mm iscreen, an ipump and the i150 concentrator with a concentrate and tailing discharge. (Figure 1).

When feeding the iCon plant, the material was first classified by the 2 mm screen of the iCon Plant, where the material larger than 2 mm (oversize material) passed over the screen to the tailing launder and material less than 2 mm (undersize material) passed through the screen, down to the slurry pump. The ipump moved the fine material up and into the concentrator as shown in figure 1. There must be constant feeding of the iCon plant and there must also be a consistent flow of the material through the pump before the sampling of the Concentrator could be done. The sampling procedure of each sample was taken 3 times during one test. Both the feed and the tailing were sampled using bucket of 12 L or 20 L. After the operation, the concentrates was flushed out into a bucket of 12 L. These samples (feed, tailing and concentrate) used to calculate the mass flow, solid percentage and solid density and to perform a particle size distribution test. For the particle size and gold distribution test, representative samples of 1 kg were
used. The particle size analysis was executed by sieving these homogenous samples. For this test only wet sieve analysis was performed by the following 2000 µm, 1000 µm, 500 µm, 250 µm, 125 µm, and 63 µm.

![iCon Circuit](image1.png)

**Figure 1: iCon Circuit**

### 3. Results and Discussion

The measured values of the samples such as the calculated solid data, namely the solid mass flow and the solid percentage of the different tests are presented in Table 1. Also the water pressure used for the tests are showing in this table.
From Table 1 can be observed that the solid mass flow of some of the feeds are higher than their tailing an some of them shows the opposite. The difference in values can be caused by:

- Systematic errors such as the amount of material flowing through the unit at that specific sampling moment. The amount of slurry flowing through the unit is not the same at every point in time, due to the sampling time difference, different amounts are sampled.

- Another cause for the value fluctuations of the mass flow values is the amount of material sprayed through the feed hopper, that amount is not consistent which results in different amounts of material flowing through the unit at different times.

Also can be observed that the solid percentages of the Feeds are higher than the Tailings. This could be, due to the added water in the concentrator. Because of the addition of water the amount of solids in the tailing become less compared to the pulp material, this can be seen in the results.

Figure 2 shows the compare plotted passing of the concentrates of one of the samples. from this figure can be seen that between the interval of 0.063 mm and 0.50 mm the plotted passing of the concentrate at 10 PSI (red curve) consist of more finer material than that of the plotted passing at 14 PSI (yellow curve). Also can be seen that between the interval 0.50 mm and 2.00 mm, the opposite of the plotted passing’s can be observed. The plotted passing at 10 PSI seems to have coarser material in that interval and the plotted passing at 14 PSI, finer material. According to Koppalkar S, 2009. high flow rate especially with coarser particles has a negative impact on the recovery, whereas low flow rate with fine particles has a higher recovery.
Figure 2: Concentrate iCon sample of the material of Grassalco N.V. at Maripaston.

Figure 3 shows another plotted passing of a Concentrate sample. From the figure can be seen that between the interval of 0.10 mm and 0.50 mm the plotted passing of the concentrate at 10 PSI has finer material that the plotted passing at 14 PSI. Also can be observed that the water pressures have no influences on the particles between the interval of 0.063 mm and 0.10 mm and between the interval of 0.50 mm and 2.00 mm that the plotted passing’s of these interval are almost the same.

Figure 4 also shows another concentrate sample of 10 PSI and 14 PSI from another material. From the figure can be seen that the water pressures have little influences on
the particles in the size ranges 0.50mm and 0.063mm. Between the interval of 0.50 mm and 0.25 mm, the plotted passing of the concentrate at 10 PSI seems to be finer than the plotted passing of the concentrate at 14 PSI. And between the interval 0.25 mm and 0.063 mm, the plotted passing of the concentrate at 10 PSI is coarser than the plotted passing of the concentrate at 14 PSI. Also can be observed that for particles larger than 0.50mm and for particles smaller 0.063 mm, the plotted passing lines of the concentrates are the same. The water pressures have no influences on these particles.

![Figure 4: Concentrate iCon sample of the tailing material from a Hammer Mill Sluice box operation at Brokopondo](image)

In Figure 5, the plotted passing of the different concentrates at the water pressure of 10 PSI and 14 PSI can be seen. Out of the figure (left), can be seen that the test 6 sample contained of more coarser material in the concentrate and the test 2 sample contained more fine material in the concentrate at the same water pressure. Out of the figure (right), can be seen that all the samples almost have the same plotted line for material smaller than 0.25mm. for material larger than 0.25mm, the test 6 sample contains more coarser material than the test2 and test 4 sample.
4. Conclusion
From the results of this research can be concluded that: The largest concentration of particles are in the fraction smaller than 1.00 mm and 0.250 mm. By comparing the two water pressure with each other, the water pressure of 10 PSI, has more fine minerals in the concentrate than a water pressure of 14 PSI. The water pressure at 14 PSI contained of more coarser materials. The water pressure of 10 PSI works best in treating fine particle smaller than 0.25 mm. And a water pressure of 14 PSI works best in treating coarser particles. The solid content and the type of material also has influences on the concentrator’s efficiency. Depending on the type of material, the physical composition of the material, the ideal water pressure can be chosen for an operation.

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6. REFERENCES

