# A STUDY ON THE INFLUENCE OF THE SOLID MASS PERCENTAGE ON THE I150 CONCENTRATOR

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## RESUMO

Este estudo foca na influência que o tipo de material tem sobre o desempenho do concentrador do ícone (IGR 100) ao usar diferente porcentagens de sólido (SMP) como parâmetro. O IGR 100 é uma instalação que consiste em um Grizzly de 2mm, um iPump (bomba) e no concentrador centrífugo do ícone 150. Para realizar este estudo, foram utilizados 2 tipos de material de granéis de poços em uma de mina de ouro de pequena escala. O conteúdo sólido na Grizzly de alimentação eram de 30% e 70%. No entanto, as amostras de ração do concentrador calculado tinham uma densidade sólida de aproximadamente 11,50%, enquanto o SMP 70 tem um valor calculado aproximado de 18,50%. Esta diferença ocorreu por causa da água da tela da peneira. Os resultados do estudo mostram que ambos os materiais consistem em mais de 70% das partículas menores que 63 µm. Comparando estes dois, pode-se concluir que o material X é mais grosseiro do que o material Y. A partir dos resultados pode-se concluir que um maior valor de porcentagem de sólido resulta em um concentrado mais grosseiro e vice-versa. O concentrado de material X foi mais fino comparado ao concentrado do material Y para ambos os valores de densidade.

**PALAVRAS-CHAVE:** Processamento mineral, Concentração gravitacional, Concentrador centrífugo, Pequena mineração, Mina de ouro, Concentração.

## ABSTRACT

This study focusses on the influence that the type of material has on the performance of the iCon concentrator (IGR 100) while using different solid mass percentage (SMP) as a parameter. The IGR 100 is a setup consisting of a 2mm grizzly, the iPump and the iCon 150 centrifugal concentrator. To accomplish this study, 2 types of bulks material from a mine pit of a small scale gold mine operation were used and the solid content of the screen feed were 30% and 70%. However the calculated concentrator feed samples had a solid density of approximately 11.50% while the SMP 70 has a calculated value of approximatly 18.50%. This difference occured because of the screen water. The results of the study show that both materials consist for more than 70% of particles smaller than 63 µm. By comparing these two there can be concluded that material X is coarser than material Y. From the results can be concluded that a higher density value results in a coarser concentrate and vice versa. The concentrate of material X were finer compared to the concentrate of material Y for both density values.

**KEYWORDS:** Mineral Processing, Gravity Concentration, Centrifugal Concentrator, Small scale operation, Gold mine, Concentration.

## 1. INTRODUCTION

Gravity concentration is one of the oldest and most used methods for separation of minerals. This is due to its relative simplicity of gravity process, a relative cheaper alternative to flotation and the fact they produce little environmental pollution (Holland-Batt, 1998). Over the years many machines have been designed and built in the past to achieve an effective separation. The Knelson concentrator, Falcon SB concentrator and the iCon Gold concentrator are good examples. These machines use centrifugal force to separate the high density minerals from the low density parts.

According to iCon Gold Recovery Corporation, the iCon variables for optimized concentration are speed, size distribution feed, feed rate, water pressure and density of slurry. (Wills & Napier-Munn, October 2006) have further identified these mechanisms and operational parameters which also play a significant role in the seperation inside the bowl. These include differential settling, density, water pressure, shape cycle time, particle size etc.

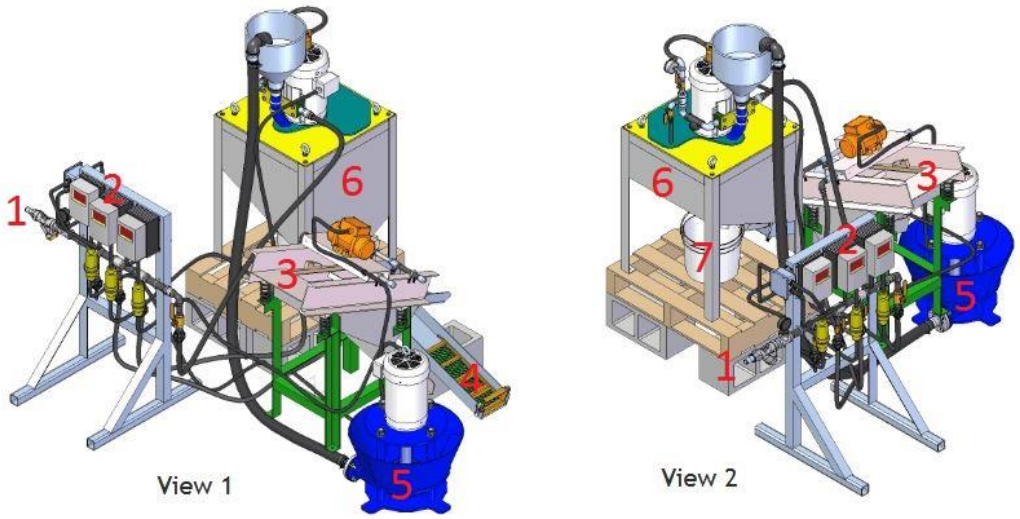
These variables need to be correct in order to get a good separation, high recovery and efficiency. This project studies the influence of material composition on the performance of the iCon concentrator when using different solid mass percentages.

The mass solid percentage recommended the iCon Gold Recovery Corporation lies between 5% and 65 %. The objective of this study is to get understand this equipment better and how the type of material (particle size distribution)SD) and solid mass percentage contributes to the operation of the concentrator, mainly the particle size distribution.

## 2. MATERIALS AND TECHNIQUES

Figure 1 gives an overview of the IGR 100 and how the material is processed. The IGR 100 gets process water pumped near 15 l/min at 1. This process water is divided among iScreen sprayer (3), the i150 (6) and a separate hose that is used while loading the feed onto the iScreen. The feed which is loaded onto the iScreen is sprayed with water to free lumps of materials leading to a classification of 2mm. Particles bigger than 2mm are then led to the mini sluice (4) where the heavier particles (e.g. gold nuggets) will be captured. Material at the iScreen smaller than 2mm falls through onto a gutter that leads to the iPump (5). The iPump will pump the material (feed) into the i150 (6) where it will concentrate and during rinsing all the concentrate will be collected at location 7.

There were 2 bulk materials (minimal 100 kg), named X and Y, sampled from the School of Geology and Mining Technology (SGMT) mine. These were picked at mine locations which were indicated resources for SGMT. These were transported to the capital at the work station, which is the UNASAT (University of Applied Science And Technology) complex. There the samples were dried and homogenized. A representative sample was taken and the rest and split in 2 parts for the processing with the IGR 100. The 2 parts will differ in SMP before processing. This includes mixing the slurry with a certain solid percentage (either 30% or 70%) in buckets. This makes it easier to feed the IGR 100.




Views 1 & 2 are engineering drawings showing the standard configuration of the IGR 100 iCon Gold Process Plant

**Figure 1. View of the IGR 100 plant.**

During the processing samples were taken with 12L buckets at the feed, just after the iPump , and at the tailing, right after the iCon concentrator. A total of 3 samples were taken at both the feed and the tailling. The average of these 3 will later be calculated. This means that one bulk material that was processed would consist of 7 samples but during the results phase these 7 samples will drop back to 3 due to the average calculations (feed, tailing and concentrate).

An overview of the samples is given in figure 2.

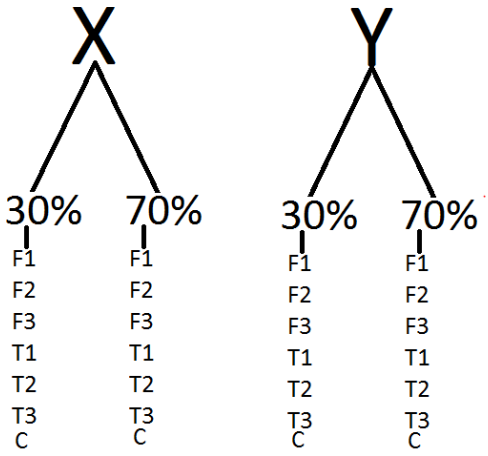



**Figure 2. Overview of the samples.**

The samples were given time to settle so that the material would sink to the ground and water would be on top to make it easier to get rid of the water. The material was then prepared to be dried with a oven. The samples were put in pre weighted plates where after they were put into the oven to dry for about a day which after they were weighted, the dry weight. From this the SMP of the sample was calculated.

After the sample has been dried and weighted the phase for sieve analysis would follow. To speed up the sieving process some samples were reduced to 1 kg or less. This process consists of the material being evenly split into 2 equal parts that consist of the same mineralogy and weight. This process of splitting the material (quartering method) is done until the desired weight has been reached. In this case the goal was to have a maximal weight of 1 kg. Afterwards the sample was sieved, dried and weighted. Using with this data the cumulative particle-size distribution curve was made.

## 3. RESULTS AND DISCUSSIONS

The results for the calculated SMP are given in table 1. For these results the water pressure was kept constant (10 PSI). The results show that the calculated SMP come nowhere near the desired SMP while processing with the IGR 100. There is water added at the iScreen and the hose. This addition should be constant for the bulk materials (30% and 70%). This is not the case looking at table 3. The samples with SMP 30% have a smaller difference. This is due to the water that is used from the hose which is added to the system. This water is used to spray the material loose from the bucket. The samples from SMP 70% have more material in their buckets which during the process settles onto the bottom. The buckets are poured one by one onto the sieve screen which means other materials in other buckets are settling onto the bottom.

**Table 1. Table overview with SMP values.**

| Desired SMP (%) | Calculated SMP (%) | | | |
|---|---|---|---|---|
| | Feed | | Tailing | |
| | X | Y | X | Y |
| 30 | 11.50 | 8.60 | 4.66 | 7.80 |
| 70 | 18.50 | 18.79 | 1.99 | 6.19 |

The latter buckets are using more water to loosen which means more water is added to the system in this phase. The tailing samples have a significant lower SMP than the feed samples which was to be expected. This is due to face that this is the part of the material that has material removed from it (the concentrate) and the added water from the spray nozzles in the iCon concentrator. The tailing is basically the feed with the concentrate derived from it and water added.

Figure 3 shows that both material X and Y consist largely of material smaller than 63µm. This is the case for all SMP variants, both 30% and 70%.

Figure 4 compares material X and Y. The feed with SMP 30 differs from the tailing with SMP 30. This is not the case with material with SMP 70. This can be an indication that SMP does have certain influence on the PSD of a material.

Figure 4 compares material X and Y. The feed with SMP 30 differs from the tailing with SMP 30. This is not the case with material with SMP 70. This can be an indication that SMP does have certain influence on the PSD of a material.

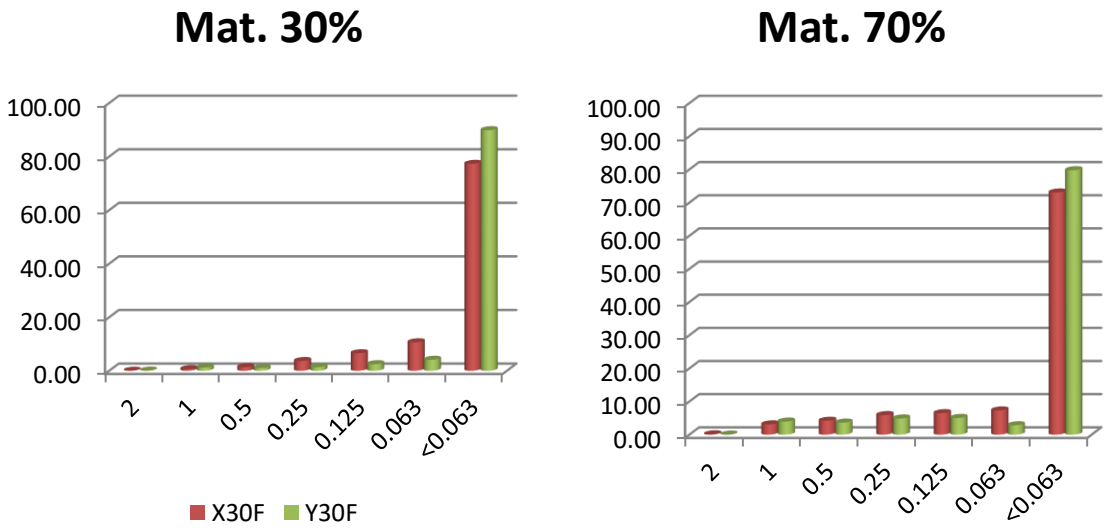



**Figure 3. Comparisons of the SMP values.**

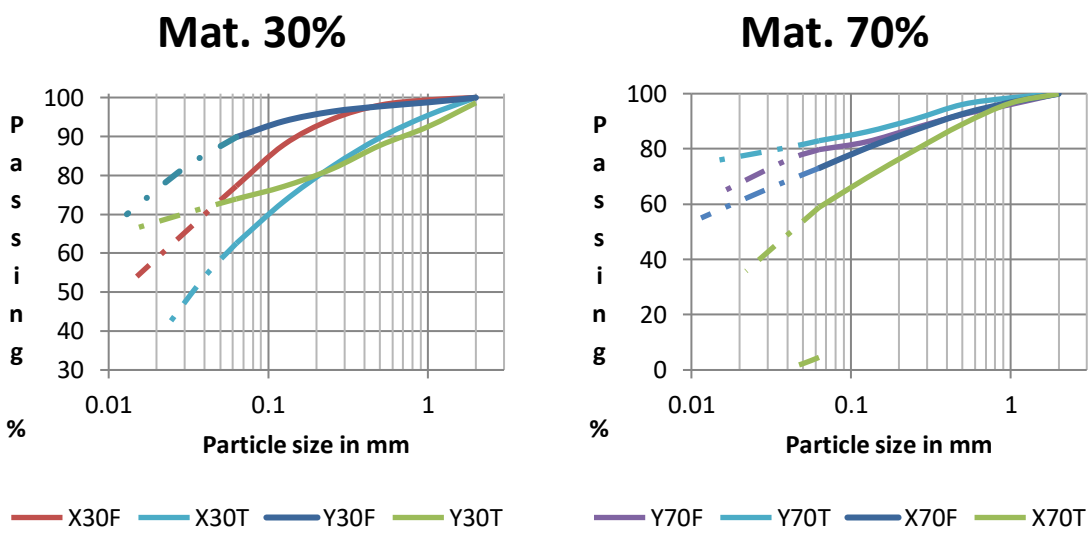



**Figure 4. Comparison of materials.**

Furthermore can be concluded from graph 1 that material Y is finer than material X in feed as in the tailing aspect. This can be seen after the comparing from figure 3; X30F-Y30F, X30T-Y30T and from figure 4; X70F-Y70F, X70T-Y70T. In the comparison of X30T-Y30T is seen that in the first trajectory of 2mm-0.2mm that Y30T is actually coarser than X30T. This is reversed in the seceond trajectory. In the commparison of X70F-Y70F is seen that these two have similarities between 2mm-0.125. After this phase is seen that Y70F is finer than X70F.

Figure 5 show that material X has more finer particles than material Y which can be seen at <0.063. Both materials have more 1mm particles at SMP 70 concentrate although material Y has a slighty higher value.

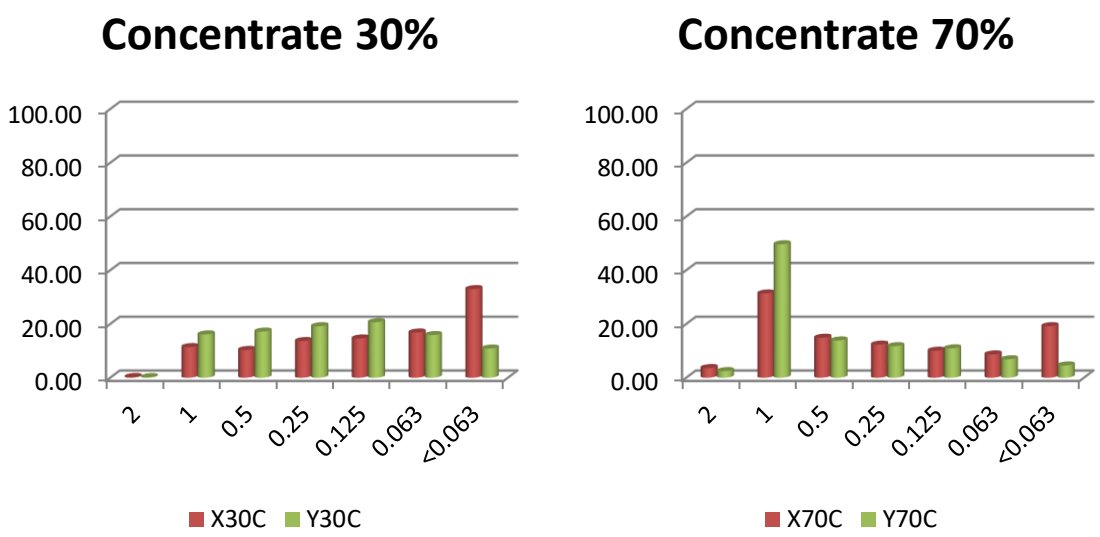



**Figure 5. Comparison of concentrate at different SMP.**

Figure 5 shows that SMP 30 (X30F,Y30F) has finer materials than SMP 70 (X70F, Y70F). This is done by comparing X30F-X70F and Y30F-Y70F. X70F is almost similar to RepX meaning they have almost identical PSD. It can be argued that Y70F would have the same PSD as RepY if the 2mm did not play such a big role by having such a big portion of 2mm. If this is the case it may be that SMP 70 has the same PSD as a sample which has not even been processed(Representative samples). This should be the case since the feed is the sample which has not been processed fully. It has only undergone the 2mm iScreen which makes the PSD of SMP 30 interesting.

It may be that with the sample of SMP 30 has a finer PSD due to the added water. The addition of extra water in comparison to the SMP 70 samples results in a finer slurry which is seen above. The SMP 70 samples however contains a slurry which material is almost similar to the repressentative samples.

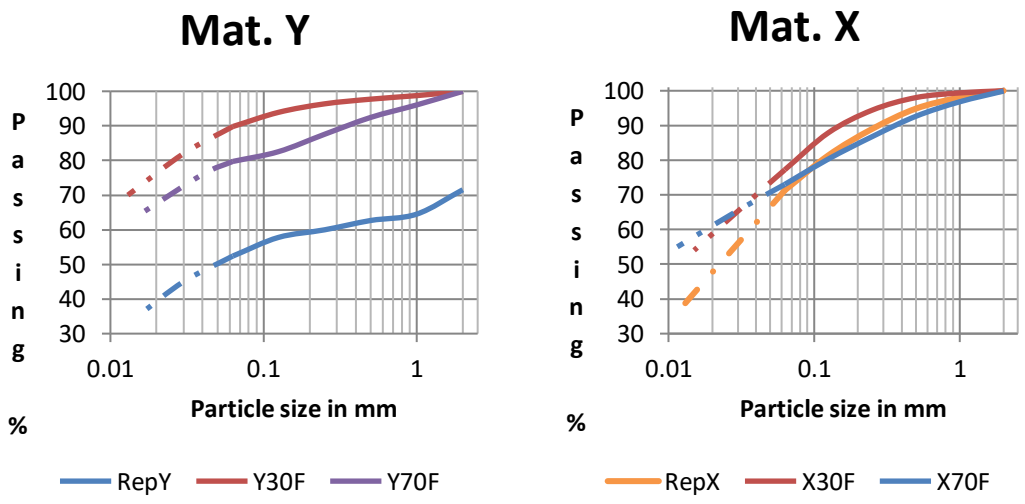



**Figure 6. Comparison of material.**

Comparing the SMP values of both materials in Figure 7 it can be concluded that SMP 30% results in a finer concentrate compared to the samples with SMP 70%. It can also be seen here that concentrate Y is coarser than concentrate X. This is the opposite looking at earlier comparisons made of the feed and representative samples which show that material Y is finer than material X.

This may be due to the possibility that a finer feed results in a coarser concentration and vice versa.

Another possibility may be that material X has clay particles which were lumped together and when processed with the iCon 150, the spray nozzles broke these lumps down into finer particles.

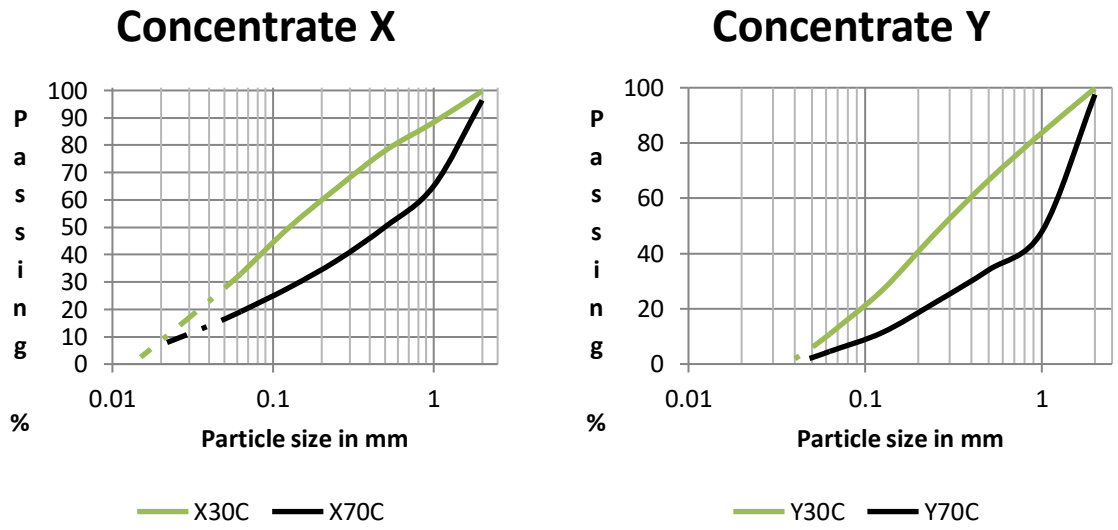



**Figure 7. Comparison of concentrates with differing SMP.**

## 4. CONCLUSION

The SMP that was set out was not achieved. This is due to the excess of water that was used to spray the material loose from the buckets while feeding which influences the SMP. Therefore manually feeding the IGR 100 is not recommended if the goal is to process the material with a certain percentage of solid in the slurry.

Looking at material X and Y it can be concluded that both consist of particles smaller than 63µm for at least 70%. This means that it is a very fine material which may contain silt and clay (<0.05mm and <0.02mm respectively). The presence of clay in the process feed of mines not an ideal situation and it is usually removed during processing to prevent difficulties as early as possible.

From both feeds can be seen that a higher SMP value results in a coarser concentrate while a feed with a lower SMP value results in a finer concentrate. This leads to the conclusion that SMP does have an influence on the iCON concentration, in particular the PSD of the concentrate.

From the concentrate can be seen that concentrate Y is coarser than concentrate X in both SMP's (30 and 70). Thus material X resulted in a finer concentrate than Y eventhough the feed was coarser than Y. This leads to the conclusion that material type does have influence on the iCON concentrator, in particular the PSD of the concentrate.

## 5. ACKNOWLEGMENTS

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