# CHAPTER 3. EXPERIMENTAL APPROACH

## Objective

Experiments were performed on a 165mm dense medium cyclone with the intention to, firstly, characterize the solids loading and overloading behaviour of the spigot, and, secondly, establish the variables that influence spigot capacity. Additional tests were performed with a larger 350mm dense medium cyclone to validate the results obtained with the smaller 165mm cyclone.

## 3.1. Experimental Set-up - 165mm Cyclone

A polyurethane cyclone with an internal body diameter of 165mm (Fig. 3.1(b)) was used to perform the test work. Fig. 3.1(a) shows a schematic diagram of the test rig used; in which the cyclone was installed at an inclination angle of 20$^{o}$ from the horizontal, and the sump below it had a capacity of about 180 litres. A picture of the cyclone rig with a centrifugal pump is shown in Fig. 3.2. The bypass valve was kept open for all the tests, and the cyclone valve was used to control the feed pressure.

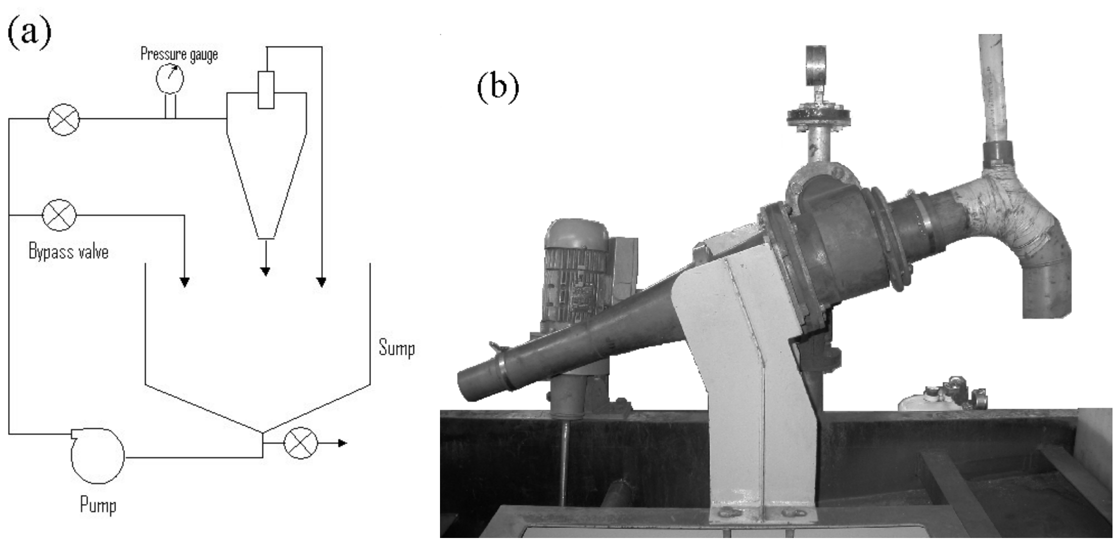



Figure 3.1. (a) A schematic of the test rig and (b) polyurethane cyclone employed to perform the experiments.

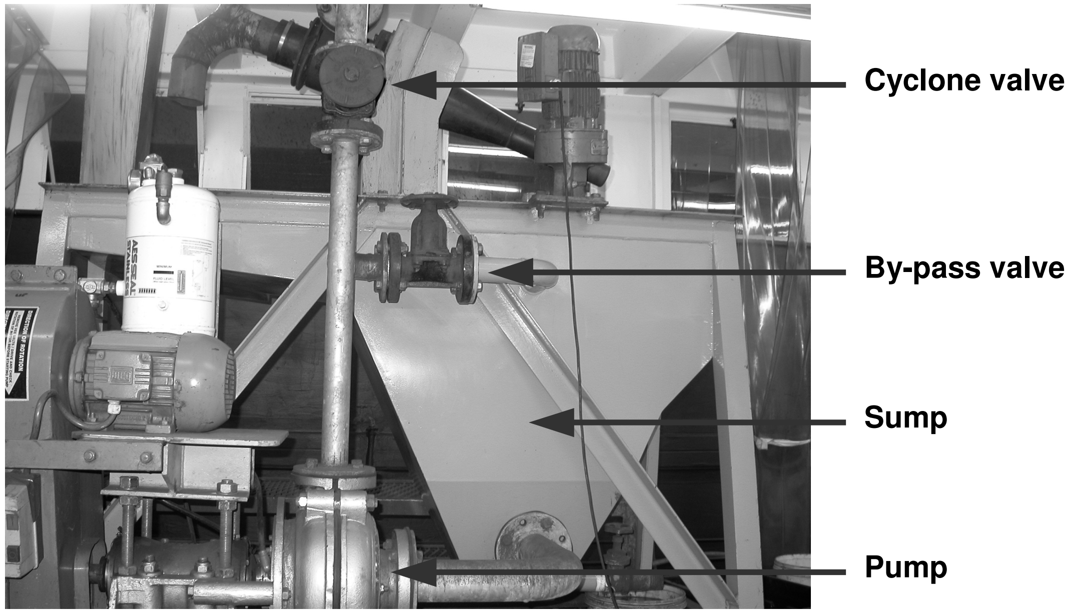



Figure 3.2. The test rig, with a 165mm cyclone, on which the experiments were performed.

### 3.1.1 Experimental Procedure: Characterisation of Overloading at Sinks

An aqueous suspension of magnetite particles was employed as medium, and the magnetite particles had a particle size distribution shown in Table 3.1. This particle size distribution was determined through wet screen analysis. For each new day of test-work a new batch of medium particles was used, this was done to ensure that medium contamination did not occur. Silica particles (-1.8+0.8mm and 2.65kg/l) were used as ore for all the tests, so that all of the ore was concentrated to the sinks stream and only medium exited at the floats stream when the spigot was not overloaded. A feed pressure of 20kPa, which is equivalent to about 9.5D, was maintained throughout the tests and the medium density was kept at around 1.3kg/l for all the tests. Table 3.2 shows the cyclone configuration adopted for this test-work.

Table 3.1. Screen analysis of the fine magnetite.

| **Size range (µm)** | **%Weight (wt%)** |
|---|---|
| -125+90 | 0.0 |
| -90+63 | 0.4 |
| -63+45 | 6.9 |
| -45+38 | 13.2 |
| -38 | 79.5 |

During this test-work silica particles were added into the cyclone in increments until the spigot was overloaded. Spigot overloading was easily recognizable by the change in the type of discharge at the spigot, and the presence of silica particles in the floats stream. Subsequent to every incremental addition of ore particles, flow-rate measurements were performed at both the floats and sinks streams. Flow-rate measurements were performed by taking timed samples with a 25-litre bucket; at least five flow-rates measurements were performed at each outlet per test (See Fig. A.9 in Appendix A). The slurry mass was measured in kg and time in seconds. Between each measurement the cyclone was allowed to stabilize and reach a steady state. This was followed by the taking of simultaneous samples (with 600ml sampling bottles) at both outlets to determine the volumetric percentage of ore and medium. Sampling had the effect of changing the 'equilibrium' state that the cyclone had reached; hence, the samples were taken simultaneously. The sampling bottles had to be large enough to take a representative sample, but small enough not to remove so much solids that the operation state of the cyclone changes from roping to semi-roping. The difference between semi-roping and roping was at times a few handfuls of silica particles added or removed from the sump. Due to the large differences in particle sizes between the magnetite and silica particles, the two could easily be separated out by wet screening to determine the volumetric compositions of the slurry at each outlet (See Fig. A.10 in Appendix A).

Table 3.2. The configuration of the cyclone used to perform test-work.

| | |
|---|---|
| **Cyclone diameter (mm)** | 165 |
| **Inlet area (mmxmm)** | 70x10 |
| **Vortex finder diameter (mm)** | 64 |
| **Spigot diameter (mm)** | 25,34,45 |
| **Cone angle ($^{o}$)** | 15 |
| **Barrel length (mm)** | None |

### 3.1.2. Experimental Procedure: Effect of Variables

The experimental procedure followed was similar to that in followed in characterising overloading at the sinks, except that the cyclone was operated with a rope discharge only for all the tests. Once the necessary variable change had been made and the cyclone had reached a 'steady state', flow-rates measurements were performed at both the floats and sinks streams. Flow-rate measurements were repeated five times at each outlet in order to ensure their accuracy. This was followed by taking simultaneous samples with 600ml bottles at both outlets, which were used to determine the solids composition at the floats and sinks streams. Just as in the test-work to characterise overloading at the sinks, a new batch of medium particles was used for each new day of test-work to ensure that there was no medium contamination.

The variables can be divided into two categories, namely: cyclone geometry and operational variables. Cyclone geometry includes: inlet size, vortex finder diameter, spigot diameter, cone angle, and barrel length. The changes in the cyclone dimensions executed during the test-work are shown in Table 3.3.

Table 3.3. Cyclone dimensions tested during the experimental work.

| **Variable** | **Value** |
|---|---|
| $D_i$ (mm x mm) | 70x10, 70x25 |
| $D_o$ (mm) | 40, 53, 64 |
| $D_u$ (mm) | 20,25,30,34,40,45 |
| $\alpha$ (deg) | 15, 20 |
| Barrel length (mm) | None, 200 |

Pictures of cone A ($20^o$) and the 200mm barrel employed are shown in Fig. 3.3 and 3.4, respectively.

Figure 3.3. The 20$^{o}$ cone with changeable spigots. (Cone A)

Figure 3.4. The 200mm long barrel used during the experiments.

The operational variables include: feed pressure, medium density, medium grade, and ore size. The changes in the operational variables carried out during the experimental work are shown in Table 3.4. The feed pressure is expressed in terms of head in cyclone diameters. The medium grade is expressed in terms of %passing 45µm, and three grades were tested as shown in Table 3.4. Ore density was also investigated, however, the heavier ore used during the test-work tended to block the spigot and the flow of the slurry was unstable. These results were not included in this report.

Table 3.4. Operating conditions tested during the experimental work.

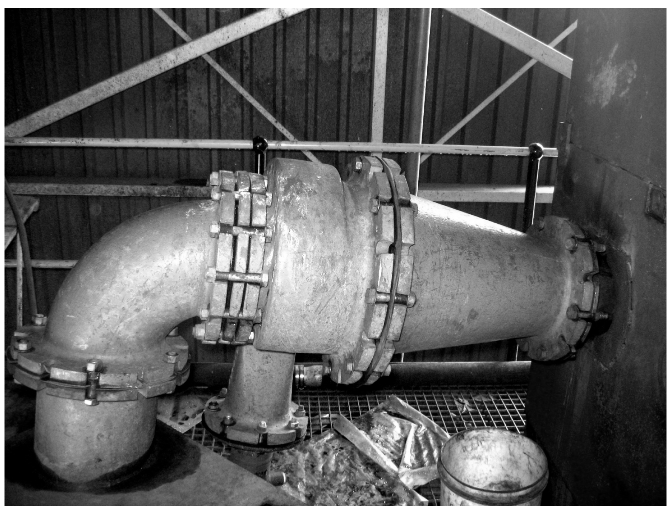
| **Variable** | **Value** |
|---|---|
| Feed head (D) | 9-17 |
| Medium Density (kg/l) | 1.3, 1.4, 1.5, 1.7 |
| Medium grade (%Passing 45µm) | 75, 85, 95 |
| Ore size (mm) | -1.8+0.8, -3+1, -5+3 |
| Medium Type | Magnetite |

## 3.2. Experimental Set-Up and Procedure- 350mm Cyclone

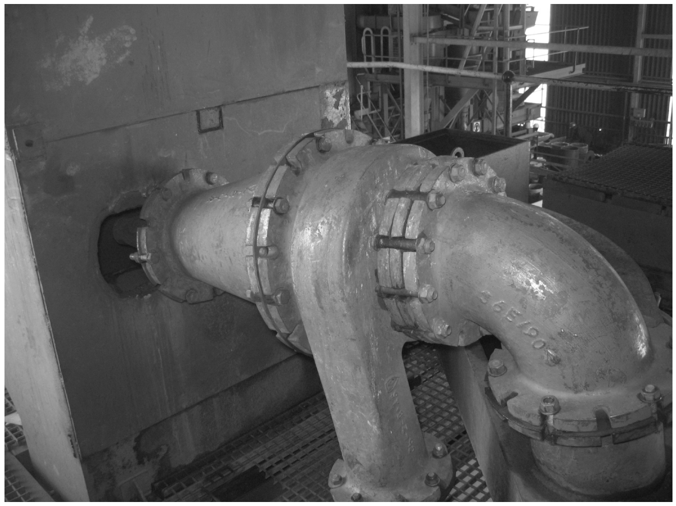
The 350mm dense medium cyclone employed during the test-work is shown in Fig. 3.5; the cyclone had a standard DSM configuration, and this is shown in Table 3.5. The dimension for the inlet size shown in Table 3.5 is the equivalent inlet diameter; the inlet was rectangular in shape. The spigot diameter is not shown in Table 3.5 because it was varied during the test-work.

Table 3.5. The dimensions of the 350mm industrial-scale cyclone.

| Cyclone Dimensions | Quantity |
|---|---|
| $D_i$ (mm) | 70 |
| $D_o$(mm) | 151 |
| $\alpha$ ($^o$) | 20 |
| Bl | None |



(a)



(b)

Figure 3.5 Pictures of the 350mm dense medium cyclone used to perform the validation work.

The flow-sheet of the DMS cyclone plant at Mintek is shown in Fig. 3.6; pictures of the plant and various equipment at the plant are shown as Figs. A.4 to A.8 in Appendix A. Medium particles were added directly into the sump and a Marcy scale was used to determine the medium density from the by-pass stream. The fine grade magnetite (95%-45μm) used during the test-work with the 165mm cyclone was employed in this test-work as well. Once the required medium density was achieved the ore particles were fed through a feed hopper into the sump, from where they were pumped together with medium into the cyclone. Silica particles with a size range of –5+3mm were employed as ore. A variable speed pump was used to control the feed pressure. The washed medium re-circulated from the vibrating screens was passed through a demagnetizing coil in order to minimize magnetization of the magnetite and thus viscosity effects.

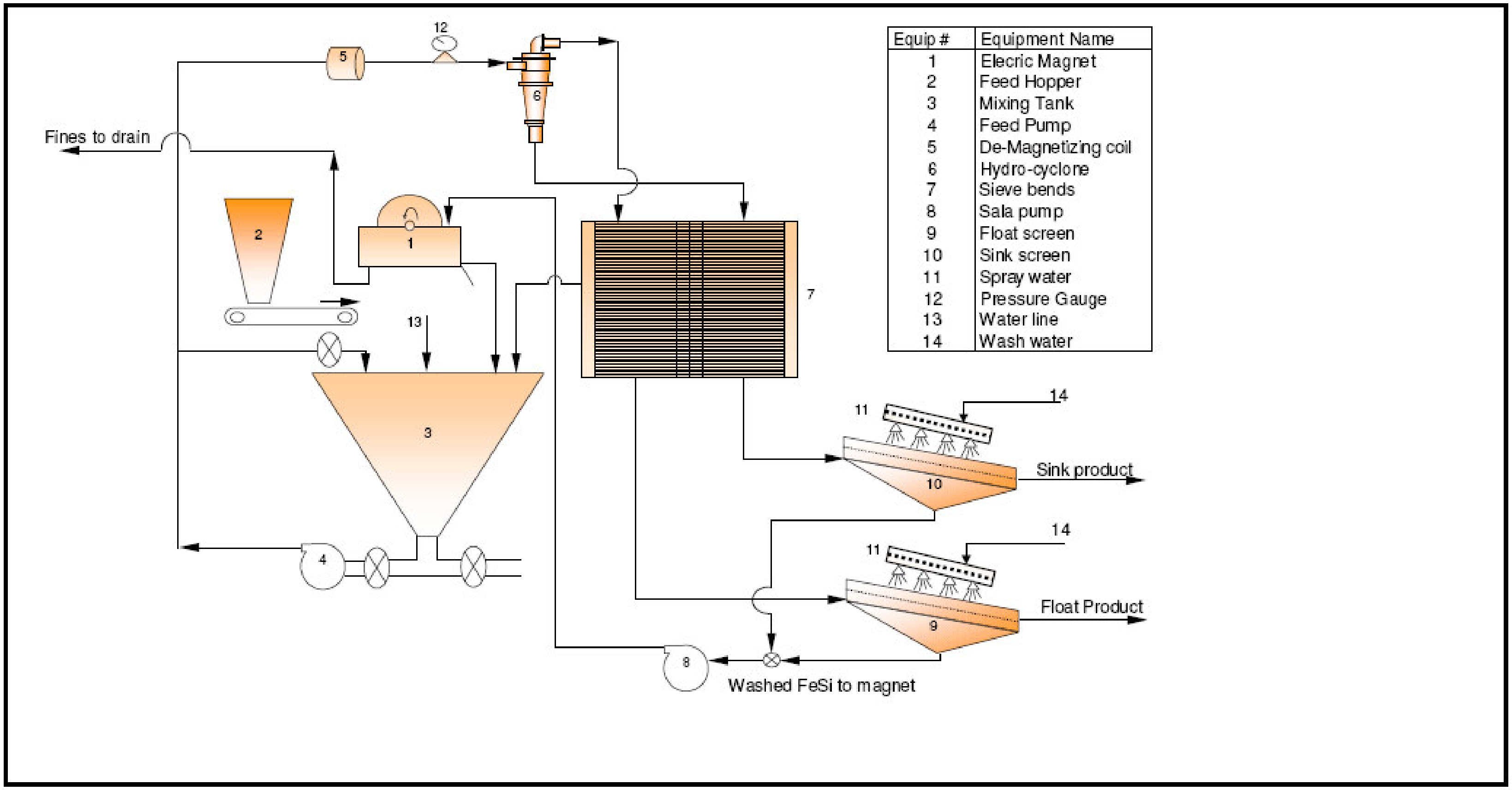



Figure 3.6. The flow-sheet of the DMS plant at *Mintek*.

Normally the slurry from the floats and the sinks streams discharge onto separate sievebends from where the medium particles are washed off on vibrating screens, from which the wet sink and float products can be captured. In this case, just as with the 165mm laboratory cyclone, all of the silica particles were recovered at the sinks (during spray and semi-rope discharges). Spigot overloading could not be achieved with the plant operating in this condition because the ore particles were exiting much quicker than the rate at which they were introduced through the feed hopper. As a result the sievebends were removed so that the slurry from the floats and sinks stream was re-circulated back into the sump; this way sufficient ore particles could accumulate within the system, and overloading of the spigot was achieved.

Spigot overloading could be detected by, firstly, observing the discharge type at the sinks and, secondly, monitoring misplacement of silica particles to the floats stream. Once roping had been achieved and the necessary operating conditions had been set, a timed sample of slurry from the sinks stream was diverted onto the vibrating screen. The washed silica particles were then collected at the end of the screen and the medium particles re-circulated back into the sump. The ore particles were then bagged and kept for drying and weighing at a later stage. Caution was taken not to divert the sinks slurry for too long, otherwise, just as with the smaller 165mm cyclone, the flow at the sinks would revert back to a semi-rope discharge during the flow measurements. This procedure was repeated for each change in the operating conditions and cyclone geometry that was made. Two flow-rate measurements were performed at each test.

### 3.2.1. Variables Investigated

Only three variables were varied on the 350mm cyclone, namely: spigot diameter; feed pressure and medium density. These parameters were varied as shown in Table 3.6. Initially the plan was to change the feed head (pressure) from 9D up to 18D, however, due to the limitations imposed by the excessive solids concentrations and the pump, the feed head was varied from about 10D and 17D. Below about 10D some of the pipes were blocked due to the relatively high settling rate of the silica particles, especially at the lower medium densities. Above about 17D there was the risk of overloading the pump. The measuring point of the pressure gauge was located 0.915m below the centre line of the cyclone inlet; the pressure read off the gauge had to be corrected by taking this into account.

Table 3.6. Conditions tested on the 350mm dense medium cyclone.

| **Variable** | **Quantity** |
|---|---|
| $D_u$ (mm) | 60, 75, 90, 100 |
| Feed head (D) | 13-17 |
| Medium Density (kg/l) | 1.3, 1.5, 1.7 |

## 3.3. Experimental Matrix

The experimental matrix for all the tests performed under roping conditions are illustrated in Tables 3.7-3.13. The numbers in these tables represent the number of tests performed under those particular conditions.

Table 3.7. Conditions tested when operating with the 15° cone angle and $D_i$ =0.2D, with silica that had a size range of –1.8+0.8mm. (Roping only)

| | | $D_i$ = 30mm, 15° Cone Angle, $d_{ore}$ =-1.8+0.8mm | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Fine Magnetite Grade | | | | | | | | | | | | | | | | | | Medium Magnetite Grade | | | | | | | | | | | | Coarse Magnetite Grade | | | | | | | | | | | |
| | | $D_o$ = 64mm | | | | | | $D_o$ = 53mm | | | | | | $D_o$ = 40mm | | | | | | $D_o$ = 64mm | | | | | | $D_o$ = 40mm | | | | | | $D_o$ = 64mm | | | | | | $D_o$ = 40mm | | | | | |
| | $D_u$ (mm) = | 20 | 25 | 30 | 34 | 40 | 45 | 20 | 25 | 30 | 34 | 40 | 45 | 20 | 25 | 30 | 34 | 40 | 45 | 20 | 25 | 30 | 34 | 40 | 45 | 20 | 25 | 30 | 34 | 40 | 45 | 20 | 25 | 30 | 34 | 40 | 45 | 20 | 25 | 30 | 34 | 40 | 45 |
| H (D) | $\rho_{med}$ (kg/l) | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 9D | 1.3 | 1 | 9 | 5 | 11 | 1 | 12 | 1 | 4 | | 7 | | 6 | 1 | 2 | 2 | 7 | | 2 | | 1 | | 1 | | 1 | | 1 | | 1 | | 1 | | 1 | | 1 | | 1 | | 1 | | 1 | | 1 |
| | 1.4 | | 1 | | 1 | | 1 | | | | | | | | | | | | | | 3 | | 4 | | 1 | | | | | | | | 1 | | 1 | | 1 | | | | | | |
| | 1.5 | | 1 | | 1 | | 1 | | | | | | | | | | | | | | | | 2 | | | | | | | | | | | | | | | | | | | | |
| | 1.6 | | | | | | | | | | | | | | | | | | | | 1 | | | | 1 | | | | | | | | 1 | | 1 | | | | | | | | |
| | 1.7 | | 1 | | 1 | | 1 | | | | | | | | | | | | | | | | | | | | | | | | | | 1 | | 1 | | 1 | | | | | | |
| 12D | 1.3 | | 1 | | 1 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| | 1.4 | | 1 | | 1 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| | 1.5 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| | 1.6 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | 1 | | | | | | | | |
| | 1.7 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 15D | 1.3 | | 1 | | 1 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| | 1.4 | | 1 | | 1 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| | 1.5 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| | 1.6 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | 1 | | | | | | | | |
| | 1.7 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |

Table 3.8. Conditions tested when operating with the 15° cone angle and $D_i$ =0.2D, with silica that had a size range of –3+1mm. (Roping only)

| | | $D_i$ = 30mm, $D_o$ = 64mm, 15° Cone Angle, $d_{ore}$ = -3+1mm | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Fine Grade | | | | | | Medium Grade | | | | | | Coarse Grade | | | | | |
| | $D_u$ (mm) = | 20 | 25 | 30 | 34 | 40 | 45 | 20 | 25 | 30 | 34 | 40 | 45 | 20 | 25 | 30 | 34 | 40 | 45 |
| H (D) | $\rho_{med}$ (kg/l) | | | | | | | | | | | | | | | | | | |
| 9D | 1.3 | | 2 | | 2 | | 2 | | 1 | | 1 | | 1 | | | | | | |
| | 1.4 | | | | 1 | | 1 | | 1 | | 2 | | 1 | | | | | | |
| | 1.5 | 1 | 1 | 1 | 1 | 1 | 1 | | 1 | | | | | | | | | | |
| | 1.6 | | | | | | | | | | | | 1 | | 1 | | 1 | | 1 |
| | 1.7 | | | | | | | | | | | | | | | | | | |
| 12D | 1.3 | | | | | | | | | | | | | | | | | | |
| | 1.4 | | | | 1 | | | | | | | | | | | | | | |
| | 1.5 | | | | 1 | | | | | | | | | | | | | | |
| | 1.6 | | | | | | | | | | | | | | | | 1 | | |
| | 1.7 | | | | | | | | | | | | | | | | | | |
| 15D | 1.3 | | | | | | | | | | | | | | | | | | |
| | 1.4 | | | | 1 | | | | | | | | | | | | | | |
| | 1.5 | | | | 1 | | | | | | | | | | | | | | |
| | 1.6 | | | | | | | | | | | | | | | | 1 | | |
| | 1.7 | | | | | | | | | | | | | | | | | | |

Table 3.9. Conditions tested when operating with the 15$^o$ cone angle and $D_i$ =0.3D. (Roping only)

| | | $D_i$ = 47mm, 15$^o$ Cone Angle, $d_{ore}$ = -1.8+0.8mm, Fine Grade | | | | | | | | | | | | | | | | | | $D_i$ = 47mm, 15$^o$ Cone Angle, $d_{ore}$ = -5+3mm, Fine Grade | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | $D_o$ = 64mm | | | | | | $D_o$ = 53mm | | | | | | $D_o$ = 40mm | | | | | | $D_o$ = 64mm | | | | | | $D_o$ = 53mm | | | | | | $D_o$ = 40mm | | | | | |
| | $D_u$ (mm) = | 20 | 25 | 30 | 34 | 40 | 45 | 20 | 25 | 30 | 34 | 40 | 45 | 20 | 25 | 30 | 34 | 40 | 45 | 20 | 25 | 30 | 34 | 40 | 45 | 20 | 25 | 30 | 34 | 40 | 45 | 20 | 25 | 30 | 34 | 40 | 45 |
| H (D) | $\rho_{med}$ (kg/l) | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 9D | 1.3 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| | 1.4 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| | 1.5 | | 1 | | 1 | | 1 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| | 1.6 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| | 1.7 | | 1 | | 1 | | 1 | | 1 | | 1 | | 1 | | 1 | | 1 | | 1 | | 1 | | 1 | | | | | | | | | | 1 | | 1 | | |
| 12D | 1.3 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| | 1.4 | | 1 | | 1 | | 1 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| | 1.5 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| | 1.6 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| | 1.7 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |

Table 3.10. Conditions tested when operating with cone A and $D_i$ =0.2D. (Roping only)

| | | $D_i$ = 30mm, Cone A (20°), $d_{ore}$ =-1.8+0.8mm | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Fine Magnetite Grade | | | | | | | | | | | | | | | | | | Medium Magnetite Grade | | | | | | | | | | | | | | | | | | | | | | | |
| | | No Barrel | | | | | | | | | | | | | | | | | | No Barrel | | | | | | With Barrel | | | | | | | | | | | | | | | | | |
| | | $D_o$ = 64mm | | | | | | $D_o$ = 53mm | | | | | | $D_o$ = 40mm | | | | | | $D_o$ = 64mm | | | | | | $D_o$ = 64mm | | | | | | $D_o$ = 53mm | | | | | | $D_o$ = 40mm | | | | | |
| | $D_u$ (mm) = | 20 | 25 | 30 | 34 | 40 | 45 | 20 | 25 | 30 | 34 | 40 | 45 | 20 | 25 | 30 | 34 | 40 | 45 | 20 | 25 | 30 | 34 | 40 | 45 | 20 | 25 | 30 | 34 | 40 | 45 | 20 | 25 | 30 | 34 | 40 | 45 | 20 | 25 | 30 | 34 | 40 | 45 |
| H (D) | $\rho_{med}$ (kg/l) | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 9D | 1.3 | | | | | | | | | | | | | | | | | | | | 1 | | 1 | | 1 | | 2 | | 2 | | 2 | | | | | | 1 | | | | | | 1 |
| | 1.4 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | 1 | | | | | | | | | | | | |
| | 1.5 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| | 1.6 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| | 1.7 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 12D | 1.3 | | 1 | | 2 | | | | 1 | | 1 | | | | 1 | | 1 | 1 | | | 1 | | 1 | | 1 | | | | | | | | | | | | | | | | | | |
| | 1.4 | | | | | | | | | | | | | | | | | | | | 1 | | 1 | | 1 | | 1 | | 1 | | | | | | | | | | | | | | |
| | 1.5 | | 1 | | 1 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| | 1.6 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| | 1.7 | | 1 | | 1 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 15D | 1.3 | | 1 | | 1 | | 1 | | 1 | | 1 | | 1 | | 1 | | 1 | 1 | | | | | | | | | | | | | | | | | | | | | | | | | |
| | 1.4 | | | | | | | | | | | | | | | | | | | | | | | | | | 1 | | 1 | | | | | | | | | | | | | | |
| | 1.5 | | 1 | | 1 | | 1 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| | 1.6 | | | | | | 1 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| | 1.7 | | 1 | | 1 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 17D | 1.3 | | 1 | | 1 | | | | 1 | | 1 | | | | 1 | | 1 | 1 | | | | | | | | | | | | | | | | | | | | | | | | | |
| | 1.4 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| | 1.5 | | 1 | | 1 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| | 1.6 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| | 1.7 | | 1 | | 1 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |

Table 3.11. Conditions tested when operating with cone A and $D_i$ =0.3D. (Roping only)

| | | $D_i$ = 47mm, Cone A (20°), $d_{ore}$ =-1.8+0.8mm, Fine Magnetite Grade | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | $D_o$ = 64mm | | | | | | $D_o$ = 53mm | | | | | | $D_o$ = 40mm | | | | | |
| | $D_u$ (mm) = | 20 | 25 | 30 | 34 | 40 | 45 | 20 | 25 | 30 | 34 | 40 | 45 | 20 | 25 | 30 | 34 | 40 | 45 |
| H (D) | $\rho_{med}$ (kg/l) | | | | | | | | | | | | | | | | | | |
| 12D | 1.3 | | 1 | | 1 | | | | | | | | | | 1 | | 1 | | |
| | 1.4 | | | | | | | | | | | | | | | | | | |
| | 1.5 | | | | | | | | | | | | | | | | | | |
| | 1.6 | | | | | | | | | | | | | | | | | | |
| | 1.7 | | | | | | | | | | | | | | | | | | |
| 15D | 1.3 | | 1 | | 1 | | | | | | | | | | 1 | | | | |
| | 1.4 | | | | | | | | | | | | | | | | | | |
| | 1.5 | | | | | | | | | | | | | | | | | | |
| | 1.6 | | | | | | | | | | | | | | | | | | |
| | 1.7 | | | | | | | | | | | | | | | | | | |

Table 3.12. Conditions tested when operating with cone B. (Roping only)

$D_i$ = 30mm; $D_u$ = 45mm, $\alpha = 20^o$, Bl = 0mm,
dore =-1.8+0.8mm, Fine Magnetite

| | **$D_o$ (mm) =** | **40** | **53** | **64** |
|---|---|---|---|---|
| **H (D)** | **$\rho_{med}$ (kg/l) =** | | | |
| **9D** | **1.3** | 1 | | 1 |
| | **1.4** | 1 | 1 | 1 |
| | **1.5** | | | 1 |
| | **1.7** | | | 1 |

Table 3.13. Conditions tested when operating the 350mm dense medium cyclone. (Roping only)

| | **H =13D** | | | | **H =14D** | | | | **H =15D** | | | | **H =17D** | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **$D_u$ (mm) =** | 60 | 75 | 90 | 100 | 60 | 75 | 90 | 100 | 60 | 75 | 90 | 100 | 60 | 75 | 90 | 100 |
| **$\rho_{med}$ (kg/l)** | | | | | | | | | | | | | | | | |
| 1.3 | 1 | | | | | 1 | 1 | 1 | 1 | 1 | | | 1 | | | |
| 1.5 | 1 | 1 | 1 | 1 | | | | | | | | | 1 | | 1 | 1 |
| 1.7 | 1 | 1 | 1 | | | | | | | | | | | | 1 | |