MIRLSim



User Manual

Mineral Industry Research Laboratory

University of Alaska Fairbanks

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mirl.uaf.edu

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1. Installation

MIRLSim is an application file which can be downloaded by following the link below

http://mirl.uaf.edu

1.1 System Requirements

Software

This version is compatible with Windows and has been tested on Windows 7. It will work well with any Windows 7 or newer versions (32-bit and 64-bit). It does not require any additional external program to run. The minimum system requirement is:

- Dual Core processor
- 2 GB RAM

Hardware:

The software will acquire a disk space of 98 MB

- 1. After downloading the package run the installation wizard by clicking on exicon.
- 2. Complete the installation as directed
- 3. After the software is installed it is ready for use.

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2. Different Unit Processes

Right clicking on the empty template will open a dialog box as shown below. The user can select any item on the list to start drawing the circuit.



There are six unit process that the user can add to their circuit. They are as follows:

- 1. Feed
- 2. Ball Mill
- 3. Semi-Autogenous Mill (SAG Mill)
- 4. Hydrocyclone
- 5. Sump Pump
- 6. Screen

Apart from these six unit processes, there are some added features that makes the simulator easy to use. They necessarily do not exist in plants, but help the user in simplifying/understanding the circuit easy. They are as follows:

- 1. Splitter 2
- 2. Splitter 4
- 3. Junction 2
- 4. Junction 4
- 5. Sub circuit
- 6. Circuit output

Details regarding each equipment will be stated in the following pages.

2.1 Feed





Right clicking on the feed icon will open menu named "Input Source Settings". By clicking, it will open a new tab in which the user can change the settings regarding the input to the circuit.



The maximum tonnage from a single feed is set at 2000 tph. If the user wants to have a feed greater than 2000 tph, they can add more feed to the circuit.

S Input Source Information		
Settings Output Graphs Script	Size Distribution	
Solids Density (g/cm³):	2.65 ≤20.00	*
Water Density (SG):	1.000 ▲ ≤5.000	
Label:	Input Source	
Propagation Delay (s):	0 ▲ ≤1800	
Use Random Weight Distribution:		
Water Flow (T/h):	35.0 ≤200.0	-
		Save

In this tab the user can change the ore characteristics like specific gravity, specific gravity of water, propagation delay, and tonnage of water. By default, the passing fraction of different size

ranges is set as shown in the image below, but the user can enter their own values as long as they are logical.

🛐 Input Source Information	
Settings Output Graphs Script Size Distribution	
[Pass Fraction, Size (mm)]	*
[0.85, 90.0] [0.65, 45.0] [0.4, 15.0] [0.2, 5.0] [0.1, 1.0]	

The "Output" tab will show the weight distribution of the input feed and also different calculations like Power (in kW), pulp TPH, etc.

😋 Input Source Information		
Settings Output Graphs Script Size Distribut	ion	
O: Size Range (mm) Flow (T/h)	Flow (%) Attributes	Value
137.0 - 123.0 5.235 123.0 - 111.0 9.703	5.235 Solids Density (SG) 9.703 Solids Flow (T/h)	2.65 100.00
111.0 - 100.0 8.561 100.0 - 90.00 7.796 90.00 - 81.00 5.999	8.561 Solids Flow (m³/h) 7.796 Solids Flow (gal/min) 5.999 Solids Proportion (%)	37.74 8.57 74.07
81.00 - 72.90 4.461 72.90 - 65.60 4.146	4.461 Water Density (SG) 4.146 Water Flow (T/h)	1.00
65.60 - 59.00 3.863 59.00 - 53.10 3.586 53.10 - 47.80 3.316	3.863 Water Flow (m³/h) 3.586 Water Flow (gal/min) 3.316 Pulp Density (SG)	35.00 7.95 1.86
47.80 - 43.00 3.086 43.00 - 38.70 2.618	3.086 Pulp Flow (T/h) 2.618 Pulp Flow (m ³ /h)	135.00 72.74
38.70 - 34.90 2.399 34.90 - 31.40 2.247 31.40 - 28.20 2.144	2.399 Puip Flow (gal/min) 2.247 D80 RR New (mm) 2.144 D80 RR Old (mm)	16.52 45.65 95.52
28.20 - 25.40 1.997 25.40 - 22.90 1.834 22.90 - 20.60 1.726	1.997 D80 GGS (mm) 1.834 D80 Linear (mm) 1.736 Bover (MM)	130.00 99.29
20.60 - 18.50 1.645	1.645	

The "Graph" tab will show the different graphs.

🛐 Input Source I	nformation			
Settings Output	Graphs Script S	Size Distribution		
Solids (T/h)	Water (T/h)	Pulp (T/h)]	
Solids (m³/h)	Water (m³/h)	Pulp (m³/h)]	
Solids (gal/min)	Water (gal/min)	Pulp (gal/min)]	
Solids (%)	Power (kW)	P80 (mm)		
Size Distribution				

The user can change the feed tonnage by dragging the slider on the feed icon left or right.

The "Script" allows the user to enter or save the current scenario to run the simulations. The files must be MS Excel (converted to .csv files). Here the user can also upload their own MS Excel file by clicking on the "Script" icon and then selecting "Load CSV" button.

S Input Source Information	
Settings Output Graphs Script Size Distribution	
Current Script:	
Enable Script	
Save CSV Load CSV Clear Script	

2.2 Ball Mill



Ball Mill Icon

To change settings of Ball Mill, the user has to right click on the ball mill icon. A menu will pop up with the title "Mill Settings".



On clicking the icon, a tab containing all the parameters will open.

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🛐 Ball Mill Information		
Settings Input Output Graph	s Script Selection Matri	ix
Ball Density (g/cm³):	7.86 🚖	≤20.00 ^
Ball Diameter (m):	0.025	≤1.000
Belly Length (m):	8.70 🚖	≤30.00
Critical Speed (r/min):	19.0 🔹	≤100.0
Label:	Ball Mill	
Ln(R/D*) (µm):	0.0 1.1 4.499 3.973 0.0 0.0	
Mill Diameter (m):	5.00 🚖	≤30.00
Fraction of Critical Speed (%):	64.3	≤100.0
Ball Volumetric Fill (%):	30.0 🗘	≤100.0
Propagation Delay (s):	60 🔹	≤1800
Size Knots (µm):	0.01 0.1 1.0 10.0 100.0 1000.0	
Use Appearance Function:		*
		Save

"Propagation delay" means the delay in output of ball mill. 1 step delay is equal to 1 second. So if a user opts for larger step delay, the output of ball mill will take longer to display.

"Appearance Function" relates to the retention of material in the ball mill. In the ideal situation, there will be no retention of material in the ball mill. If the user wants no retention of material in the ball mill, then they can check the "Use appearance function" box.

S Ball Mill Information			• X
Settings Input Output Graphs Script Selection Matrix			
Size Range (mm) Flow (T/h) Flow (%) Attributes	Т	Value	~
137.0 - 123.0 0.000 0.000 Solids Density (SG)	1	2.65	
123.0 - 111.0 0.000 0.000 Solids Flow (T/h)	1	0.00	
111.0 - 100.0 0.000 0.000 Solids Flow (m ³ /h)	1	0.00	
100.0 - 90.00 0.000 0.000 Solids Flow (gal/min)	1	0.00	
90.00 - 81.00 0.000 0.000 Solids Proportion (%)	1	100.00	
81.00 - 72.90 0.000 0.000 Water Density (SG)	1	1.00	
72.90 - 65.60 0.000 0.000 Water Flow (T/h)	1	0.00	
65.60 - 59.00 0.000 0.000 Water Flow (m ³ /h)	1	0.00	
59.00 - 53.10 0.000 0.000 Water Flow (gal/min)	1	0.00	
53.10 - 47.80 0.000 0.000 Pulp Density (SG)	1	2.65	
47.80 - 43.00 0.000 0.000 Pulp Flow (T/h)	1	0.00	
43.00 - 38.70 0.000 0.000 Pulp Flow (m ³ /h)	1	0.00	
38.70 - 34.90 0.000 0.000 Pulp Flow (gal/min)	1	0.00	
34.90 - 31.40 0.000 0.000 D80 RR New (mm)	1	0.01	
31.40 - 28.20 0.000 0.000 D80 RR Old (mm)	1	0.01	
28.20 - 25.40 0.000 0.000 D80 GGS (mm)	1	0.01	
25.40 - 22.90 0.000 0.000 D80 Linear (mm)	1	0.01	
22.90 - 20.60 0.000 0.000 Power (kW)	1	0.00	

Settings	Input	Output	Graph	ns Script S	elec	tion Ma	trix					
0:												
Size R	ange	(mm)	Flo	ow (T/h)	Т	Flow	(%)	I	Attributes	Т	Value	
137.	0 -	123.0	1	0.000)		0.000	1	Solids Density (SG)	1	2	. 65
123.	0 -	111.0	1	0.000			0.000	÷.	Solids Flow (T/h)	1	0	.00
111.	0 -	100.0	1	0.000			0.000	Т	Solids Flow (m³/h)	1	0	.00
100.	0 -	90.00	1	0.000			0.000	Т	Solids Flow (gal/min)	1	0	.00
90.0	0 -	81.00	1	0.000			0.000	Т	Solids Proportion (%)	1	100	.00
81.0	0 -	72.90	1	0.000			0.000	Т	Water Density (SG)	1	1	.00
72.9	0 -	65.60	1	0.000			0.000	Т	Water Flow (T/h)	1	0	.00
65.6	0 -	59.00	1	0.000			0.000	Т	Water Flow (m³/h)	1	0	.00
59.0	0 -	53.10	1	0.000			0.000	Т	Water Flow (gal/min)	1	0	.00
53.1	0 -	47.80	1	0.000			0.000	Т	Pulp Density (SG)	1	2	. 65
47.8	0 -	43.00	1	0.000			0.000	1	Pulp Flow (T/h)	1	0	.00
43.0	0 -	38.70	1	0.000			0.000	Т	Pulp Flow (m³/h)	1	0	.00
38.7	0 -	34.90	1	0.000			0.000	Т	Pulp Flow (gal/min)	1	0	.00
34.9	0 -	31.40	1	0.000	1 (0.000	1	D80 RR New (mm)	1	0	.01
31.4	0 -	28.20	1	0.000			0.000	1	D80 RR Old (mm)	1	0	.01
28.2	0 -	25.40	1	0.000			0.000	1	D80 GGS (mm)	1	0	.01
25.4	0 -	22.90	1	0.000			0.000	1	D80 Linear (mm)	1	0	.01
22.9	0 -	20.60	1	0.000			0.000	1	Power (kW)	1	0	.00

The above two tabs show the difference between the weight distribution in different size ranges for a particular input and output of a ball mill.

The variables for the ball mill include the ball density (in gm/cm³), ball diameter (in meter), belly length (in meter), mill diameter (in meter), volume of balls (in %), and rotation speed (in RPM).

After making all the changes, the user has to save them by clicking on the "Save" button.

Similar to the feed, the user can change the RPM of ball mill by dragging the slider on the ball mill icon left or right.

The "Graph" tab will show the different graphs.

🛐 Ball Mill Inforr	nation	
Settings Input (Dutput Graphs Script Selection Matrix	
Solids (T/h)	Water (T/h) Pulp (T/h)	
Solids (m³/h)	Water (m ³ /h) Pulp (m ³ /h)	
Solids (gal/min)	Water (gal/min) Pulp (gal/min)	
Solids (%)	Power (kW) P80 (mm)	
Size Distribution		

Similar to the feed, the user can change the RPM of ball mill by dragging the slider on the ball mill icon left or right.

"Selection Matrix" allows the user to choose which size range they want to break more or less.

🔄 BallMill Informa	tion		
Settings Input O	utput Graphs S	election Matrix	
Size Ranges (mm):	Breakage:		*
125 0-106 0	1.0		
106 0-100 0	1.0		
100.0-90.0	1.0		
90.0-75.0	1.0		
75.0-63.0	1.0		
63.0-53.0	1.0		
53.0-50.0	1.0		
50.0-45.0	1.0		
45.0-37.5	1.0		
37.5-31.5	1.0		
31.5-26.5	1.0		
26.5-25.0	1.0		
25.0-22.4	1.0		=
22.4-19.0	1.0		
19.0-16.0	1.0		
16.0-13.2	1.0		
13.2-12.5	1.0		
12.5-11.2	1.0		
11.2-9.5	1.0		
9.5-8.0	1.0		
8.0-6.7	1.0		
6.7-6.3	1.0		
6.3-5.6	1.0		
5.6-4.75	1.0		
4.75-4.0	1.0		
4.0-3.35	1.0		
3.35-2.8	1.0		
2.8-2.36	1.0		
2.36-2.0	1.0		
2.0-1.7	1.0		
1.7-1.4	1.0		
1.4-1.18	1.0		
1.18-1.0	1.0		
1.0-0.85	1.0		
0.85-0.71	1.0		
0.71-0.6	1.0		
0.6-0.5	1.0		
0.5-0.425	1.0		-
			Sma

2.3 Semi Autogenous Mill (SAG Mill)



SAG Mill Icon

To change the SAG Mill settings, the user can right click on the "SAG Mill" icon. A menu will pop up with the title "Mill Settings".



On clicking the icon, a tab containing all the parameters will open.

😋 Sag Mill Information		
Settings Input Output Graph	s Script Selection Matri	x
Ball Density (g/cm³):	7.86	≤20.00
Ball Diameter (m):	0.125 🛓	≤1.000
Belly Length (m):	2.51 ÷	≤20.00
Center Line Length (m):	3.47 🔹	≤20.00
Critical Speed (r/min):	16.5 🚖	≤100.0
Label:	Sag Mill	
Ln(R/D*) (µm):	0.0 1.1 4.499 3.973 0.0 0.0	E
Mill Diameter (m):	6.68 🛓	≤30.00
Fraction of Critical Speed (%):	73.8	≤100.0
Ball Volumetric Fill (%):	10.0 🚊	≤100.0
Propagation Delay (s):	60 🔹	≤1800
Size Knots (µm):	0.01 0.1 1.0 10.0 100.0 1000.0	
Use Appearance Function:		-
		Save

"Propagation delay" means the delay in output of SAG mill. 1 step delay is equal to 1 iteration. So if a user opts for larger step delay, the output of SAG mill will take longer to display.

"Appearance Function" relates to the retention of material in the SAG mill. In the ideal situation, there will be no retention of material in the ball mill. If the user wants no retention of material in

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the SAG mill, then they can check the "Use appearance Function" box.

The variables for the SAG mill include the ball density (in gm/cm³), ball diameter (in meter), belly length (in meter), center line length (in meter), mill diameter (in meter), volume of balls (in %), and rotation speed (in RPM).

After making all the changes, the user has to save them by clicking on the "Save" button.

Similar to the feed, the user can change the RPM of SAG mill by dragging the slider on the SAG mil icon left or right.

Sag Mill Information			• ×
Settings Input Output Graphs Script Selection Matrix			
Size Range (mm) Flow (T/h) Flow (%) Attributes	1	Value	*
137.0 - 123.0 0.000 0.000 Solids Density (SG)	I	2.65	
123.0 - 111.0 0.000 0.000 Solids Flow (T/h)	1	0.00	
111.0 - 100.0 0.000 0.000 Solids Flow (m ³ /h)	1	0.00	
100.0 - 90.00 0.000 0.000 Solids Flow (gal/min)	1	0.00	
90.00 - 81.00 0.000 0.000 Solids Proportion (%)	1	100.00	
81.00 - 72.90 0.000 0.000 Water Density (SG)	1	1.00	
72.90 - 65.60 0.000 0.000 Water Flow (T/h)	1	0.00	
65.60 - 59.00 0.000 0.000 Water Flow (m ³ /h)	1	0.00	
59.00 - 53.10 0.000 0.000 Water Flow (gal/min)	1	0.00	
53.10 - 47.80 0.000 0.000 Pulp Density (SG)	1	2.65	
47.80 - 43.00 0.000 0.000 Pulp Flow (T/h)	1	0.00	
43.00 - 38.70 0.000 0.000 Pulp Flow (m ³ /h)	1	0.00	
38.70 - 34.90 0.000 0.000 Pulp Flow (gal/min)	1	0.00	
34.90 - 31.40 0.000 0.000 D80 RR New (mm)	1	0.01	
31.40 - 28.20 0.000 0.000 D80 RR Old (mm)	1	0.01	
28.20 - 25.40 0.000 0.000 D80 GGS (mm)	1	0.01	
25.40 - 22.90 0.000 0.000 D80 Linear (mm)	1	0.01	
22.90 - 20.60 0.000 0.000 Power (kW)	1	0.00	

🛐 Sag Mill I	Informa	tion									
Settings In	put Ou	tput	Graphs	Script	Sele	ction Ma	trix				
D:											
Size Ran	ge (m	m)	Flow	/ (T/h) 1	Flow	(%)	I	Attributes	1.1	Value
137.0	- 123	.0	1	0.00	0 1		0.000	1	Solids Density (SG)	1	2.65
123.0	- 111	.0	i i	0.00	οi		0.000	i.	Solids Flow (T/h)	- i -	0.00
111.0	- 100	.0	i i	0.00	οi		0.000	i	Solids Flow (m3/h)	- i -	0.00
100.0	- 90.	00	1	0.00	0 1		0.000	i.	Solids Flow (gal/min)	1	0.00
90.00	- 81.	00	i i	0.00	οj		0.000	i	Solids Proportion (%)	1	100.00
81.00	- 72.	90	i i	0.00	οi		0.000	i	Water Density (SG)	- i -	1.00
72.90	- 65.	60	i i	0.00	0 1		0.000	Í.	Water Flow (T/h)	1	0.00
65.60	- 59.	00	i i	0.00	οi		0.000	i.	Water Flow (m ³ /h)	- i -	0.00
59.00	- 53.	10	i i	0.00	οi		0.000	i	Water Flow (gal/min)	- i -	0.00
53.10	- 47.	80	i i	0.00	οi		0.000	i.	Pulp Density (SG)	÷.	2.65
47.80	- 43.	00	i i	0.00	οi		0.000	i	Pulp Flow (T/h)	- i -	0.00
43.00	- 38.	70	i i	0.00	οi		0.000	i	Pulp Flow (m ³ /h)	- i -	0.00
38.70	- 34.	90	i i	0.00	οi		0.000	i.	Pulp Flow (gal/min)	- i -	0.00
34.90	- 31.	40	i i	0.00	οi		0.000	i.	D80 RR New (mm)	- i -	0.01
31.40	- 28.	20	i i	0.00	οi		0.000	÷	D80 RR Old (mm)	- i -	0.01
28.20	- 25.	40	i i	0.00	o i		0.000	i.	D80 GGS (mm)	- i -	0.01
25.40	- 22.	90	i i	0.00	οi		0.000	i	D80 Linear (mm)	- i -	0.01
22.90	- 20.	60	i i	0.00	οi		0.000	i.	Power (kW)	i.	0.00

The previous two tabs show the difference between the weight distribution in different size ranges for a particular input and output of a SAG mill.

The "Graph" tab will show the different graphs.

🔄 Sag Mill Inform	mation						×
Settings Input (Output Graphs S	cript Selection Mat	rix				
Solids (T/h)	Water (T/h)	Pulp (T/h)					
Solids (m³/h)	Water (m³/h)	Pulp (m³/h)					
Solids (gal/min)	Water (gal/min)	Pulp (gal/min)					
Solids (%)	Power (kW)	P80 (mm)					
Size Distribution							

Similar to the previous unit operations, the user can choose to upload their own script and selection matrix.

2.4 Hydrocyclone



Hydrocyclone Icon

The hydrocyclone will have two outlets and one inlet. The two outlets are overflow and underflow while one inlet is feed.



Hydrocyclone icon showing two outlets

To change the hydrocyclone settings, the user can right click on the "Hydrocyclone" icon. A menu will pop up with the title "Hydrocyclone Settings".



On clicking the icon, a tab containing all the parameters will open.

📉 Hydrocyclone Information			
Settings Input Output Grap	hs Script		
Apex Diameter (cm):	5.70	≤50.00	<u>^</u>
Apex to Vortex Distance (cm):	173 🔹	≤1000	
Cyclone Diameter (cm):	25.4 🔹	≤200.0	
F1:	1.00 ÷	≤10.00	
F2:	1.00 ÷	≤10.00	
F3:	1.00 ÷	≤10.00	
F4:	1.00 ÷	≤10.00	
Hydrodynamic Exponent:	0.500 🔹	≤1.000	Ξ
Inlet Diameter (cm):	10.0 🔹	≤100.0	
Label:	Hydrocyclone		
Number of Cyclones:	1 ÷	≤40	
Overflow Diameter (cm):	6.3 🔹	≤100.0	
d50c (µm):	0.0	≤100.0	
Pressure Drop (kPa):	0.0	≤500.0	
Propagation Delay (s):	10 🔹	≤1800	
Liquid Viscosity (cP):	1.00	≤10.00	-
			Save

The variables for the hydrocyclone include the apex diameter (in centimeter), distance between Apex and Vortex (in centimeter), cyclone diameter (in centimeter), hydrodynamic exponent, inlet diameter (in centimeter), number of hydrocyclone, overflow diameter (in in centimeter), propagation delay and liquid viscosity (in centipoise).

In a circuit, the hydrocyclone is always paired with the sump pump to provide water to it. Without the addition of sump pump, the hydrocyclone will give wrong output.

Hydrocyclone Information				
Settings Input Output Graphs	Script			
Size Range (mm) Flow	(T/h) Flow	7 (%) Attributes	Value	*
137.0 - 123.0	0.000	0.000 Solids Density (SG)	2.65	
123.0 - 111.0	0.000	0.000 Solids Flow (T/h)	0.00	
111.0 - 100.0	0.000	0.000 Solids Flow (m³/h)	0.00	
100.0 - 90.00	0.000	0.000 Solids Flow (gal/min)	0.00	
90.00 - 81.00	0.000	0.000 Solids Proportion (%)	100.00	
81.00 - 72.90	0.000	0.000 Water Density (SG)	1.00	
72.90 - 65.60	0.000	0.000 Water Flow (T/h)	0.00	
65.60 - 59.00	0.000	0.000 Water Flow (m³/h)	0.00	
59.00 - 53.10	0.000	0.000 Water Flow (gal/min)	0.00	
53.10 - 47.80	0.000	0.000 Pulp Density (SG)	2.65	
47.80 - 43.00	0.000	0.000 Pulp Flow (T/h)	0.00	
43.00 - 38.70	0.000	0.000 Pulp Flow (m³/h)	0.00	
38.70 - 34.90	0.000	0.000 Pulp Flow (gal/min)	0.00	
34.90 - 31.40	0.000	0.000 D80 RR New (mm)	0.01	
31.40 - 28.20	0.000	0.000 D80 RR Old (mm)	0.01	
28.20 - 25.40	0.000	0.000 D80 GGS (mm)	0.01	
25.40 - 22.90	0.000	0.000 D80 Linear (mm)	0.01	
22.90 - 20.60	0.000	0.000 Power (kW)	0.00	

🛐 Hydrocyclone Information			
Settings Input Output Graphs	Script		
Underflow:			*
Size Range (mm) Flow	(T/h) Flow	(%) Attributes	Value
137.0 - 123.0	0.000 (0.000 Solids Density (SG)	2.65
123.0 - 111.0	0.000 (0.000 Solids Flow (T/h)	0.00
111.0 - 100.0	0.000 (0.000 Solids Flow (m³/h)	0.00
100.0 - 90.00	0.000 (0.000 Solids Flow (gal/min)	0.00
90.00 - 81.00	0.000 0	0.000 Solids Proportion (%)	100.00
81.00 - 72.90	0.000 (0.000 Water Density (SG)	1.00
72.90 - 65.60	0.000 (0.000 Water Flow (T/h)	0.00
65.60 - 59.00	0.000 (0.000 Water Flow (m³/h)	0.00
59.00 - 53.10	0.000 (0.000 Water Flow (gal/min)	0.00
53.10 - 47.80	0.000 (0.000 Pulp Density (SG)	2.65
47.80 - 43.00	0.000 (0.000 Pulp Flow (T/h)	0.00
43.00 - 38.70	0.000 (0.000 Pulp Flow (m³/h)	0.00
38.70 - 34.90	0.000 (0.000 Pulp Flow (gal/min)	0.00
34.90 - 31.40	0.000 0	0.000 D80 RR New (mm)	0.01
31.40 - 28.20	0.000 (0.000 D80 RR Old (mm)	0.01
28.20 - 25.40	0.000 (0.000 D80 GGS (mm)	0.01
25.40 - 22.90	0.000 0	0.000 D80 Linear (mm)	0.01
22.90 - 20.60	0.000 (0.000 Power (kW)	0.00
Overflow:			
Size Range (mm) Flow	(T/h) Flow	(%) Attributes	Value
197 0 129 0 1	0 000 1 0	0.000 L Solida Dopaity (SC)	2.55

	1				
ettings Input Output Gra	phs Script				
31.40 - 28.20	0.000	0.000	D80 RR Old (mm)	0.01	[
28.20 - 25.40	0.000	0.000	D80 GGS (mm)	0.01	
25.40 - 22.90	0.000	0.000	D80 Linear (mm)	0.01	
22.90 - 20.60	0.000	0.000	Power (kW)	I 0.00	
verflow:					
ize Range (mm) F	low (T/h) Flo	ow (%) ∣	Attributes	Value	
137.0 - 123.0	0.000	0.000	Solids Density (SG)	2.65	
123.0 - 111.0	0.000	0.000	Solids Flow (T/h)	0.00	
111.0 - 100.0	0.000	0.000	Solids Flow (m3/h)	0.00	
100.0 - 90.00	0.000	0.000	Solids Flow (gal/min)	0.00	
90.00 - 81.00	0.000	0.000	Solids Proportion (%)	100.00	
81.00 - 72.90	0.000	0.000	Water Density (SG)	1.00	
72.90 - 65.60	0.000	0.000	Water Flow (T/h)	0.00	
65.60 - 59.00	0.000	0.000	Water Flow (m³/h)	0.00	
59.00 - 53.10	0.000	0.000	Water Flow (gal/min)	0.00	
53.10 - 47.80	0.000	0.000	Pulp Density (SG)	2.65	
47.80 - 43.00	0.000	0.000	Pulp Flow (T/h)	0.00	
43.00 - 38.70	0.000	0.000	Pulp Flow (m ³ /h)	0.00	
38.70 - 34.90	0.000	0.000	Pulp Flow (gal/min)	0.00	
34.90 - 31.40	0.000	0.000	D80 RR New (mm)	0.01	
31.40 - 28.20	0.000	0.000	D80 RR Old (mm)	0.01	
28.20 - 25.40	0.000	0.000	D80 GGS (mm)	0.01	
25.40 - 22.90	0.000	0.000	D80 Linear (mm)	0.01	
22.90 - 20.60	0.000	0.000	Power (kW)	0.00	

The previous three tabs show the input and output of a hydrocyclone. The user can see the output of both the overflow and underflow in the same table.

The above three tabs show the difference between the weight distribution in different size ranges for a particular input and output of a hydrocyclone.

The "Graph" tab will show the different graphs for underflow and overflow.

Hydrocyclone Info	rr	mation
Settings Input Outp	ut	Graphs S
Inderflow		_
Solids (T/h) V	Vater (T/h)	
Solids (m³/h) W	/ater (m³/h)	
Solids (gal/min) Wa	ter (gal/min)	
Solids (%)	ower (kW)	j
Size Distribution		
Overflow		
Solids (T/h) V	Vater (T/h)	
Solids (m³/h) W	/ater (m³/h)	j
Solids (gal/min) Wa	ter (gal/min)	Ī
Solids (%)	ower (kW)	
Size Distribution		

The hydrocyclone is a very sensitive equipment and minor changes in the parameters can affect the performance. Below, the range of each parameter is mentioned where the hydrocyclone will work. Inlet area: 7% of cross section of cylindrical chamber Vortex finder area: 30% of cyclone diameter

Apex diameter: 10-35% of the cyclone diameter

Cone angle: 10°-20°

2.5 Sump Pump



Sump Pump Icon

To change the sump pump settings, the user can right click on the "SumpPump" icon. A menu will pop up with the title "SumpPump Settings".



Sump Pump Informa	ation	
Settings Input Output	t Graphs Script	
Label:	Sump Pump	^
Propagation Delay (s):	10 <u>▲</u> ≤1800	
Water Density (SG):	1.000 <u>▲</u> ≤5.000	
		Save

Here, the user has the option to change propagation delay, tonnage of water and the specific gravity of water. Changing specific gravity of water implies that the sump pump is now pumping a liquid that is not water.

Sump Pump Information				
Settings Input Output Graphs	Script			
Size Range (mm) Flow	(T/h) Flow	(%) Attributes	Value	*
137.0 - 123.0	0.000	0.000 Solids Density (SG)	2.65	
123.0 - 111.0	0.000	0.000 Solids Flow (T/h)	0.00	
111.0 - 100.0	0.000	0.000 Solids Flow (m³/h)	0.00	
100.0 - 90.00	0.000	0.000 Solids Flow (gal/min)	0.00	
90.00 - 81.00	0.000	0.000 Solids Proportion (%)	100.00	
81.00 - 72.90	0.000	0.000 Water Density (SG)	1.00	
72.90 - 65.60	0.000	0.000 Water Flow (T/h)	0.00	
65.60 - 59.00	0.000	0.000 Water Flow (m³/h)	0.00	
59.00 - 53.10	0.000	0.000 Water Flow (gal/min)	0.00	
53.10 - 47.80	0.000	0.000 Pulp Density (SG)	2.65	
47.80 - 43.00	0.000	0.000 Pulp Flow (T/h)	0.00	
43.00 - 38.70	0.000	0.000 Pulp Flow (m³/h)	0.00	
38.70 - 34.90	0.000	0.000 Pulp Flow (gal/min)	0.00	
34.90 - 31.40	0.000	0.000 D80 RR New (mm)	0.01	
31.40 - 28.20	0.000	0.000 D80 RR Old (mm)	0.01	
28.20 - 25.40	0.000	0.000 D80 GGS (mm)	0.01	
25.40 - 22.90	0.000	0.000 D80 Linear (mm)	0.01	
22.90 - 20.60	0.000	0.000 Power (kW)	0.00	

ettings Input Output	Graphs	Script						
:								
ize Range (mm)	Flow	(T/h)	Flow	(%)	I.	Attributes	1.	Value
137.0 - 123.0	1	0.000	1	0.000	T	Solids Density (SG)	1	2.65
123.0 - 111.0	1	0.000	1	0.000	Т	Solids Flow (T/h)	1	0.00
111.0 - 100.0	1	0.000	1	0.000	Т	Solids Flow (m³/h)	1	0.00
100.0 - 90.00	1	0.000	1	0.000	T	Solids Flow (gal/min)	1	0.00
90.00 - 81.00	1	0.000	1	0.000	T	Solids Proportion (%)	1	100.00
81.00 - 72.90	1	0.000	1	0.000	T	Water Density (SG)	1	1.00
72.90 - 65.60	1	0.000	1	0.000	Т	Water Flow (T/h)	1	0.00
65.60 - 59.00	1	0.000	1	0.000	Т	Water Flow (m³/h)	1	0.00
59.00 - 53.10	1	0.000	1	0.000	Т	Water Flow (gal/min)	1	0.00
53.10 - 47.80	1	0.000	1	0.000	Т	Pulp Density (SG)	1	2.65
47.80 - 43.00	1	0.000	1	0.000	Т	Pulp Flow (T/h)	1	0.00
43.00 - 38.70	1	0.000	1	0.000	Т	Pulp Flow (m³/h)	1	0.00
38.70 - 34.90	1	0.000	1	0.000	Т	Pulp Flow (gal/min)	1	0.00
34.90 - 31.40	1	0.000	1	0.000	T	D80 RR New (mm)	1	0.01
31.40 - 28.20	1	0.000	1	0.000	T	D80 RR Old (mm)	1	0.01
28.20 - 25.40	1	0.000	1	0.000	Ĩ.	D80 GGS (mm)	1	0.01
25.40 - 22.90	1	0.000	1	0.000	Í.	D80 Linear (mm)	1	0.01
22.90 - 20.60	1	0.000	1	0.000	i.	Power (kW)	1	0.00

As the sump pump is not a separate unit process, the output and input tabs will show the same data. The sump pump is there only to add water to the existing circuit parameters. It is used in conjunction with hydrocyclone.

2.6 Screens



Just like the hydrocyclone, the screen has two outputs, namely, overflow and underflow.

To change the screen settings, the user can right click on the screen icon and then click on the "Screen Settings" button.



The following window opens after clicking on the "Screen Settings".

Screen Information			- 0 X
Settings Input Output Grap	hs Script		
Coarse Bypass Fraction (R1):	0.000	≤1.000	*
Fine Bypass Fraction (R2):	0.200	≤1.000	
Label:	Screen		
Cut Size/d50c (mm):	12.0	≤400.0	
Propagation Delay (s):	10 🔹	≤1800	
Separation Efficiency (alpha):	3.00	≤10.00	

Here, the user has the option of setting their own coarse bypass fraction (R1), fine bypass fraction (R2), cut size (d50c in mm), propagation delay and separation efficiency (α).

Screen Information			- 0 X
Settings Input Output Graphs Script			
Size Range (mm) Flow (T/h)	Flow (%) Attributes	Value	*
137.0 - 123.0 0.000	0.000 Solids Density (SG)	2.0	 65
123.0 - 111.0 0.000	0.000 Solids Flow (T/h)	0.0	00
111.0 - 100.0 0.000	0.000 Solids Flow (m ³ /h)	0.0	00
100.0 - 90.00 0.000	0.000 Solids Flow (gal/min)	0.0	00
90.00 - 81.00 0.000	0.000 Solids Proportion (%)	100.0	00
81.00 - 72.90 0.000	0.000 Water Density (SG)	1.0	00
72.90 - 65.60 0.000	0.000 Water Flow (T/h)	0.0	00
65.60 - 59.00 0.000	0.000 Water Flow (m ³ /h)	0.0	00
59.00 - 53.10 0.000	0.000 Water Flow (gal/min)	0.0	00
53.10 - 47.80 0.000	0.000 Pulp Density (SG)	2.0	55
47.80 - 43.00 0.000	0.000 Pulp Flow (T/h)	0.0	00
43.00 - 38.70 0.000	0.000 Pulp Flow (m ³ /h)	0.0	00
38.70 - 34.90 0.000	0.000 Pulp Flow (gal/min)	0.0	00
34.90 - 31.40 0.000	0.000 D80 RR New (mm)	0.0	01
31.40 - 28.20 0.000	0.000 D80 RR Old (mm)	i 0.0	01
28.20 - 25.40 0.000	0.000 D80 GGS (mm)	0.0	01
25.40 - 22.90 0.000	0.000 D80 Linear (mm)	0.0	01
22.90 - 20.60 0.000	0.000 Power (kW)	0.0	00

The above table shows the feed size range and the corresponding tonnage.

ettings Input Outpu	Graphs	Script							
versize: ize Range (mm)	Flow	(T/h)	Flow	(%)	ī	Attributes	ī	Value	
137.0 - 123.0	1	0.000	1	0.000		Solids Density (SG)		2.65	
123.0 - 111.0	1	0.000	i	0.000	i.	Solids Flow (T/h)	÷	0.00	
111.0 - 100.0	i	0.000	i i	0.000	i.	Solids Flow (m3/h)	÷	0.00	
100.0 - 90.00	i –	0.000	i -	0.000	i.	Solids Flow (gal/min)	÷	0.00	
90.00 - 81.00	i -	0.000	i -	0.000	i.	Solids Proportion (%)	- i	100.00	
81.00 - 72.90	i	0.000	i i	0.000	i.	Water Density (SG)	i	1.00	
72.90 - 65.60	i	0.000	i i	0.000	i.	Water Flow (T/h)	i	0.00	
65.60 - 59.00	1	0.000	i.	0.000	i.	Water Flow (m ³ /h)	1	0.00	
59.00 - 53.10	1	0.000	1	0.000	L.	Water Flow (gal/min)	1	0.00	
53.10 - 47.80	1	0.000	1	0.000	L.	Pulp Density (SG)	1	2.65	
47.80 - 43.00	1	0.000	1	0.000	I.	Pulp Flow (T/h)	1	0.00	
43.00 - 38.70	1	0.000	1	0.000	Ľ	Pulp Flow (m³/h)	1	0.00	
38.70 - 34.90	1	0.000	1	0.000	Ľ.	Pulp Flow (gal/min)	1	0.00	
34.90 - 31.40	1	0.000	1	0.000	Ľ.	D80 RR New (mm)	1	0.01	
31.40 - 28.20	1	0.000	1	0.000	Ľ.	D80 RR Old (mm)	1	0.01	
28.20 - 25.40	1	0.000	1	0.000	L.	D80 GGS (mm)	1	0.01	
25.40 - 22.90	1	0.000	1	0.000	L	D80 Linear (mm)	1	0.01	
22.90 - 20.60	1	0.000	1	0.000	L.	Power (kW)	1	0.00	
ndersize:									
ize Range (mm)	Flow	(T/n)	Flow	(*)	<u> </u>	Attributes		value	
137.0 - 123.0	1	0.000	1	0.000	Ē	Solids Density (SG)	1	2.65	
123.0 - 111.0	1	0.000	1	0.000	L.	Solids Flow (T/h)	1	0.00	
111.0 - 100.0	1	0.000	1	0.000	L.	Solids Flow (m³/h)	1	0.00	
100.0 - 90.00	1	0.000	1	0.000	I.	Solids Flow (gal/min)	1	0.00	
90.00 - 81.00	1	0.000	1	0.000	I.	Solids Proportion (%)	1	100.00	
50100 02100	1							1.00	
81.00 - 72.90		0.000	1	0.000	I.	Water Density (SG)	1		
81.00 - 72.90 72.90 - 65.60	i	0.000		0.000	I I	Water Density (SG) Water Flow (T/h)		0.00	
81.00 - 72.90 72.90 - 65.60 65.60 - 59.00	i	0.000 0.000 0.000		0.000 0.000 0.000	I I I	Water Density (SG) Water Flow (T/h) Water Flow (m³/h)	1	0.00	
81.00 - 72.90 72.90 - 65.60 65.60 - 59.00 59.00 - 53.10		0.000 0.000 0.000 0.000		0.000 0.000 0.000 0.000	I I I	Water Density (SG) Water Flow (T/h) Water Flow (m³/h) Water Flow (gal/min)		0.00 0.00 0.00	
81.00 - 72.90 72.90 - 65.60 65.60 - 59.00 59.00 - 53.10 53.10 - 47.80		0.000 0.000 0.000 0.000 0.000		0.000 0.000 0.000 0.000 0.000		Water Density (SG) Water Flow (T/h) Water Flow (m³/h) Water Flow (gal/min) Pulp Density (SG)		0.00 0.00 0.00 2.65	
$\begin{array}{rrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrr$		0.000 0.000 0.000 0.000 0.000 0.000		0.000 0.000 0.000 0.000 0.000 0.000		Water Density (SG) Water Flow (T/h) Water Flow (m²/h) Water Flow (gal/min) Pulp Density (SG) Pulp Flow (T/h)		0.00 0.00 2.65 0.00	
81.00 - 72.90 72.90 - 65.60 65.60 - 59.00 59.00 - 53.10 53.10 - 47.80 47.80 - 43.00 43.00 - 38.70		0.000 0.000 0.000 0.000 0.000 0.000		0.000 0.000 0.000 0.000 0.000 0.000 0.000		Water Density (SG) Water Flow (T/h) Water Flow (m²h) Water Flow (gal/min) Pulp Density (SG) Pulp Flow (T/h) Pulp Flow (m²h)		0.00 0.00 2.65 0.00 0.00	
$\begin{array}{rrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrr$		0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000		0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000		Water Density (SG) Water Flow (T/h) Water Flow (m ² /h) Water Flow (gal/min) Pulp Density (SG) Pulp Flow (T/h) Pulp Flow (m ² /h) Pulp Flow (gal/min)		0.00 0.00 2.65 0.00 0.00 0.00	
$\begin{array}{rrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrr$		0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000		0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000	+ $+$ $+$ $+$ $+$ $+$ $+$ $+$ $+$ $+$	Water Density (SG) Water Flow (T/h) Water Flow (m ² /h) Water Flow (gal/min) Pulp Flow (gal/min) Pulp Flow (m ⁷ /h) Pulp Flow (gal/min) D80 RR New (mm)		0.00 0.00 2.65 0.00 0.00 0.00 0.00	
$\begin{array}{rrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrr$		0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000		0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000		Water Density (SG) Water Flow (T/h) Water Flow (m ² /h) Pulp Density (SG) Pulp Flow (T/h) Pulp Flow (T/h) Pulp Flow (m ² /h) Pulp Flow (gal/min) D80 RR Old (mm)		0.00 0.00 2.65 0.00 0.00 0.00 0.01 0.01	
$\begin{array}{rrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrr$		0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000		0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000		Water Density (SG) Water Flow (T/h) Water Flow (m ² /h) Water Flow (m ² /h) Pulp Density (SG) Pulp Flow (T/h) Pulp Flow (m ² /h) Pulp Flow (gal/min) D80 RR New (mm) D80 GRS (mm)		0.00 0.00 2.65 0.00 0.00 0.00 0.01 0.01	

The table above shows the amount of particles in each size range for overflow and underflow of a screen. Oversize means particles that overflow while undersize means particles that pass through the screen and report to underflow.

Screen Information			
Settings Input	Output Graphs S	cript	
Oversize			
Solids (T/h)	Water (T/h)	Pulp (T/h)	
Solids (m³/h)	Water (m³/h)	Pulp (m³/h)	
Solids (gal/min)	Water (gal/min)	Pulp (gal/min)	
Solids (%)	Power (kW)	P80 (mm)	
Size Distribution			
Undersize			
Solids (T/h)	Water (T/h)	Pulp (T/h)	
Solids (m³/h)	Water (m³/h)	Pulp (m³/h)	
Solids (gal/min)	Water (gal/min)	Pulp (gal/min)	
Solids (%)	Power (kW)	P80 (mm)	
Size Distribution			

2.7 Splitter 2





Splitter 2 is used to split an input stream into two output streams.

To change the Splitter 2 settings, the user can right click on the splitter icon and then click on the "Splitter 2 Settings" button.



Splitter 2 Information			
Settings Input Output G	Graphs Script		
Label:	Splitter 2		~
Output Proportion 1 (%):	50.0 🛓	≤100.0	
Output Proportion 2 (%):	50.0 🚖	≤100.0	
Propagation Delay (s):	10 🔹	≤1800	

In the above tab, user can select the number of outputs from the splitter and set the respective percentage.

"Propagation delay" means the delay in output of splitter. 1 step delay is equal to 1 iteration. So if a user opts for larger step delay, the output of splitter will take longer to display.

Splitter 2 Information					Σ
ettings Input Output Grap	hs Script				
ize Range (mm) Fl	ow (T/h) Flo	w (%) Attrib	utes	Value	
137.0 - 123.0	0.000	0.000 Solids	Density (SG)	2.65	
123.0 - 111.0	0.000	0.000 Solids	Flow (T/h)	0.00	
111.0 - 100.0	0.000	0.000 Solids	Flow (m³/h)	0.00	
100.0 - 90.00	0.000	0.000 Solids	Flow (gal/min)	0.00	
90.00 - 81.00	0.000	0.000 Solids	Proportion (%)	100.00	
81.00 - 72.90	0.000	0.000 Water	Density (SG)	1.00	
72.90 - 65.60	0.000	0.000 Water	Flow (T/h)	0.00	
65.60 - 59.00	0.000	0.000 Water	Flow (m ³ /h)	0.00	
59.00 - 53.10	0.000	0.000 Water	Flow (gal/min)	0.00	
53.10 - 47.80	0.000	0.000 Pulp D	ensity (SG)	2.65	
47.80 - 43.00	0.000	0.000 Pulp F	low (T/h)	0.00	
43.00 - 38.70	0.000	0.000 Pulp F	'low (m³/h)	0.00	
38.70 - 34.90	0.000	0.000 Pulp F	'low (gal/min)	0.00	
34.90 - 31.40	0.000	0.000 D80 RR	New (mm)	0.01	
31.40 - 28.20	0.000	0.000 D80 RR	Old (mm)	0.01	
28.20 - 25.40	0.000	0.000 D80 GG	S (mm)	0.01	
25.40 - 22.90	0.000	0.000 D80 Li	near (mm)	0.01	
22.90 - 20.60	0.000 1	0.000 Power	(kW)	0.00	

In the "Input" and "Output" tab the user can see the input and output of the splitter.

The splitter does not change the physical properties of the incoming feed. It only splits them into two or more parts.

The user can see the graphs for different outputs by clicking on the "Graph" tab.

2.8 Splitter 4



Splitter 4 Icon



To change the Splitter 4 settings, the user can right click on the splitter icon and then click on the "Splitter 4 Settings" button.

Splitter 4 Information			
Settings Input Output O	Graphs Script		
Label:	Splitter 4		*
Output Proportion 1 (%):	25.0 🗘	≤100.0	
Output Proportion 2 (%):	25.0 🗘	≤100.0	
Output Proportion 3 (%):	25.0 🚖	≤100.0	
Output Proportion 4 (%):	25.0 🚖	≤100.0	
Propagation Delay (s):	10 🚖	≤1800	

In the above tab, user can select the number of outputs from the splitter and set the respective percentage.

Settings Input Output Graphs Script Size Range (mm) Flow (T/h) Flow (%) Attributes Value 137.0 -123.0 0.000 Solids Density (SG) 2.65 123.0 -111.0 0.000 Solids Flow (T/h) 0.000 110.0 -100.0 0.000 Solids Flow (T/h) 0.00 110.0 -100.0 0.000 Solids Flow (m²/h) 0.00 100.0 -90.00 0.000 Solids Flow (m²/h) 0.00 90.00 81.00 0.000 0.000 Water Plensity (SG) 1.00 90.00 -85.60 0.000 0.000 Water Plensity (SG) 1.00 72.90 -65.60 0.000 0.000 Water Flow (m²/h) 0.00 59.00 -53.10 0.000 0.000 Water Flow (gal/min) 0.00 53.	Splitter 4 Information) 🗙
Size Range (mm) Flow (T/h) Flow (%) Attributes Value 137.0 - 123.0 0.000 0.000 Solids Density (SG) 2.65 123.0 - 111.0 0.000 0.000 Solids Flow (T/h) 0.00 111.0 - 100.0 0.000 0.000 Solids Flow (T/h) 0.00 100.0 - 90.00 0.000 0.000 Solids Flow (m²/h) 0.00 100.0 - 90.00 0.000 0.000 Solids Flow (gal/min) 0.00 90.00 - 81.00 0.000 0.000 Solids Flow (gal/min) 0.00 90.00 - 81.00 0.000 0.000 Solids Flow (gal/min) 0.00 81.00 - 72.90 0.000 0.000 Water Density (SG) 1.00 72.90 - 65.60 0.000 0.000 Water Flow (T/h) 0.00 65.60 - 59.00 0.000 0.000 Water Flow (m²/h) 0.00 53.10 - 47.80 0.000 0.000 Water Flow (gal/min) 0.00 53.10 - 47.80 0.000 0.000 Pulp Plow (T/h) 0.00 38.70 - 34.90 0.000 0.000 Pulp Flow (m²/h) 0.00 34.90 - 31.40 0.000 0.000 Pulp Flow (mm) 0.01 31.40 - 28.20 0.000 0.000 D80 RR New (mm) 0.01 31.40 - 28.20 0.000 0.000 D80 CGS (mm) 0.01 25.40 - 22.90 0.000 0.000 D80 BS Linear (mm) 0.01	Settings Input Output Graphs	Script			
137.0 123.0 0.000 0.000 Solids Density (SG) 2.65 123.0 111.0 0.000 0.000 Solids Flow (T/h) 0.00 111.0 100.0 0.000 Solids Flow (T/h) 0.00 111.0 100.0 0.000 Solids Flow (m²/h) 0.00 100.0 90.00 0.000 Solids Flow (gal/min) 0.00 90.00 81.00 0.000 Solids Froportion (%) 100.00 81.00 72.90 0.000 0.000 Water Density (SG) 1.00 72.90 65.60 0.000 0.000 Water Flow (m²/h) 0.00 65.60 0.000 0.000 Water Flow (m³/h) 0.00 0.00 59.00 53.10 0.000 0.000 Water Flow (m³/h) 0.00 53.10 0.000 0.000 Pulp Density (SG) 2.65 47.80 0.000 0.000 Pulp Flow (m³/h) 0.00 43.00 0.000 0.000 Pulp Flow (m³/h) 0.00	Size Range (mm) Flow	(T/h) Flow	(%) Attributes	Value	*
123.0 - 111.0 0.000 0.000 Solids Flow (T/h) 0.00 111.0 - 100.0 0.000 Solids Flow (m²/h) 0.00 100.0 - 90.00 0.000 Solids Flow (m²/h) 0.00 100.0 - 80.00 0.000 Solids Flow (m²/h) 0.00 90.00 - 81.00 0.000 Solids Froportion (%) 100.00 81.00 - 72.90 0.000 0.000 Water Density (SG) 1.00 72.90 - 65.60 0.000 0.000 Water Flow (T/h) 0.00 65.60 - 59.00 0.000 0.000 Water Flow (gal/min) 0.00 59.00 - 53.10 0.000 0.000 Water Flow (gal/min) 0.00 53.10 - 47.80 0.000 0.000 Pulp Density (SG) 2.65 47.80 - 43.00 0.000 0.000 Pulp Flow (T/h) 0.00 43.00 - 38.70 0.000 0.000 Pulp Flow (m²/h) 0.00 38.70 - 34.90 0.000 0.000 Pulp Flow (m²/h) 0.01 31.40 - 28.20 0.000 0.000 D80 RR New (mm) 0.01	137.0 - 123.0	0.000	0.000 Solids Density (SG)	2.65	
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90.00 - 81.00 0.000 0.000 Solids Proportion (%) 100.00 81.00 - 72.90 0.000 0.000 Water Density (SG) 1.00 72.90 - 65.60 0.000 0.000 Water Density (SG) 1.00 65.60 - 59.00 0.000 0.000 Water Flow (T/h) 0.00 59.00 - 53.10 0.000 0.000 Water Flow (gal/min) 0.00 53.10 - 47.80 0.000 0.000 Pulp Density (SG) 2.65 47.80 - 43.00 0.000 0.000 Pulp Flow (T/h) 0.00 43.00 - 38.70 0.000 0.000 Pulp Flow (m²/h) 0.00 36.70 - 34.90 0.000 0.000 Pulp Flow (m²/h) 0.00 34.90 - 31.40 0.000 0.000 D80 RR New (mm) 0.01 31.40 - 28.20 0.000 0.000 D80 GGS (mm) 0.01 25.40 - 22.90 0.000 0.000 D80 GGS (mm) 0.01	100.0 - 90.00	0.000	0.000 Solids Flow (gal/min)	0.00	
81.00 - 72.90 0.000 0.000 Water Density (SG) 1.00 72.90 - 65.60 0.000 0.000 Water Flow (T/h) 0.00 65.60 - 59.00 0.000 0.000 Water Flow (m ³ /h) 0.00 59.00 - 53.10 0.000 0.000 Water Flow (m ³ /h) 0.00 53.10 - 47.80 0.000 0.000 Pulp Density (SG) 2.65 47.80 - 43.00 0.000 0.000 Pulp Flow (T/h) 0.00 43.00 - 38.70 0.000 0.000 Pulp Flow (m ³ /h) 0.00 38.70 - 34.90 0.000 0.000 Pulp Flow (gal/min) 0.00 34.90 - 31.40 0.000 0.000 D80 RR New (mm) 0.01 31.40 - 28.20 0.000 0.000 D80 GGS (mm) 0.01 25.40 - 22.90 0.000 0.000 D80 GGS (mm) 0.01	90.00 - 81.00	0.000	0.000 Solids Proportion (%)	100.00	
72.90 - 65.60 0.000 0.000 Water Flow (T/h) 0.00 65.60 - 59.00 0.000 0.000 Water Flow (m³/h) 0.00 59.00 - 53.10 0.000 0.000 Water Flow (gal/min) 0.00 59.00 - 53.10 0.000 0.000 Water Flow (gal/min) 0.00 53.10 - 47.80 0.000 0.000 Pulp Density (SG) 2.65 47.80 - 43.00 0.000 0.000 Pulp Flow (T/h) 0.00 43.00 - 38.70 0.000 0.000 Pulp Flow (m²/h) 0.00 38.70 - 34.90 0.000 0.000 Pulp Flow (gal/min) 0.00 34.90 - 31.40 0.000 0.000 D80 R New (mm) 0.01 31.40 - 28.20 0.000 0.000 D80 GGS (mm) 0.01 28.20 - 25.40 0.000 0.000 D80 Linear (mm) 0.01	81.00 - 72.90	0.000	0.000 Water Density (SG)	1.00	
65.60 - 59.00 0.000 0.000 Water Flow (m³/h) 0.00 59.00 - 53.10 0.000 0.000 Water Flow (gal/min) 0.00 53.10 - 47.80 0.000 0.000 Pulp Density (SG) 2.65 47.80 - 43.00 0.000 0.000 Pulp Density (SG) 2.65 47.80 - 38.70 0.000 0.000 Pulp Flow (T/h) 0.00 38.70 - 34.90 0.000 0.000 Pulp Flow (m³/h) 0.00 34.90 - 31.40 0.000 0.000 D80 RR New (mm) 0.01 31.40 - 28.20 0.000 0.000 D80 GGS (mm) 0.01 25.40 - 22.90 0.000 0.000 D80 Linear (mm) 0.01	72.90 - 65.60	0.000	0.000 Water Flow (T/h)	0.00	
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47.80 - 43.00 0.000 0.000 Pulp Flow (T/h) 0.00 43.00 - 38.70 0.000 0.000 Pulp Flow (m³/h) 0.00 38.70 - 34.90 0.000 0.000 Pulp Flow (m³/h) 0.00 34.90 - 31.40 0.000 0.000 Pulp Flow (gal/min) 0.01 31.40 - 28.20 0.000 0.000 D80 RR New (mm) 0.01 28.20 - 25.40 0.000 0.000 D80 GGS (mm) 0.01 25.40 - 22.90 0.000 0.000 D80 Linear (mm) 0.01	53.10 - 47.80	0.000	0.000 Pulp Density (SG)	2.65	
43.00 - 38.70 0.000 0.000 Pulp Flow (m³/h) 0.000 38.70 - 34.90 0.000 0.000 Pulp Flow (gal/min) 0.000 34.90 - 31.40 0.000 0.000 Pulp Flow (gal/min) 0.001 34.90 - 31.40 0.000 0.000 D80 RR New (mm) 0.01 31.40 - 28.20 0.000 0.000 D80 RR Old (mm) 0.01 28.20 - 25.40 0.000 0.000 D80 GGS (mm) 0.01 25.40 - 22.90 0.000 0.000 D80 Linear (mm) 0.01	47.80 - 43.00	0.000	0.000 Pulp Flow (T/h)	0.00	
38.70 - 34.90 0.000 0.000 Pulp Flow (gal/min) 0.00 34.90 - 31.40 0.000 0.000 D80 RR New (mm) 0.01 31.40 - 28.20 0.000 0.000 D80 RR Old (mm) 0.01 28.20 - 25.40 0.000 0.000 D80 GGS (mm) 0.01 25.40 - 22.90 0.000 0.000 D80 Linear (mm) 0.01	43.00 - 38.70	0.000	0.000 Pulp Flow (m ³ /h)	0.00	
34.90 - 31.40 0.000 0.000 D80 RR New (mm) 0.01 31.40 - 28.20 0.000 0.000 D80 RR Old (mm) 0.01 28.20 - 25.40 0.000 0.000 D80 GGS (mm) 0.01 25.40 - 22.90 0.000 0.000 D80 GGS (mm) 0.01	38.70 - 34.90	0.000	0.000 Pulp Flow (gal/min)	0.00	
31.40 - 28.20 0.000 0.000 D80 RR Old (mm) 0.01 28.20 - 25.40 0.000 0.000 D80 GGS (mm) 0.01 25.40 - 22.90 0.000 0.000 D80 Linear (mm) 0.01	34.90 - 31.40	0.000	0.000 D80 RR New (mm)	0.01	
28.20 - 25.40 0.000 0.000 D80 GGS (mm) 0.01 25.40 - 22.90 0.000 0.000 D80 Linear (mm) 0.01	31.40 - 28.20	0.000	0.000 D80 RR Old (mm)	0.01	
25.40 - 22.90 0.000 0.000 D80 Linear (mm) 0.01	28.20 - 25.40	0.000	0.000 D80 GGS (mm)	0.01	
	25.40 - 22.90	0.000	0.000 D80 Linear (mm)	0.01	
22.90 - 20.60 0.000 0.000 Power (kW) 0.00	22.90 - 20.60	0.000 i	0.000 Power (kW)	0.00	

"Propagation delay" means the delay in output of splitter. 1 step delay is equal to 1 iteration. So if a user opts for larger step delay, the output of splitter will take longer to display.

In the "Input" and "Output" tab the user can see the input and output of the splitter.

The splitter does not change the physical properties of the incoming feed. It only splits them into two or more parts.

The user can see the graphs for different outputs by clicking on the "Graph" tab.

The main use of splitter is to give freedom to the user so that they can split the feed. They can choose to divide the feed and send it to different unit operations and see the results.

2.9 Junction 2



Junction 2 Icon

The use of Junction 2 is to join two different streams.



To change the Junction 2 settings, the user can right click on the splitter icon and then click on the "Junction 2 Settings" button.

Junction 2 Informati	ion		×	
Settings Input Output	t Graphs			
Label:	Junction 2		*	
Propagation Delay (s):	10 🚖 ≤1800			

In the above tab, the user can only change "Propagation Delay".

2.10 Junction 4



Junction 4 Icon

The use of Junction 4 is to join four different streams.



To change the Junction 4 settings, the user can right click on the splitter icon and then click on the "Junction 4 Settings" button.

Junction 4 Informati	on	
Settings Input Output	: Graphs	
Label:	Junction 4	*
Propagation Delay (s):	10	

In the above tab, the user can only change "Propagation Delay".

2.11 Sub Circuit



Sub Circuit Icon

The sub circuit is just the extension of normal screen. It gives the user flexibility to expand the circuit or construct complicated circuits.

When the user click on "+", a new tab opens up as shown below:

File Edit H	Help		
Main Circuit	Sub Circu	uit	
Solids (T/h)	•	Pulp (T/h)	-
Water (T/h)	•	P80 (mm)	-

The screenshot below shows the "sub circuit" tab.





2.12 Circuit Output



Circuit Output Icon

The circuit output displays the output of the circuit. Similar to the splitter, it does not change any physical properties.

Right clicking on the circuit output icon opens a message box named "OutputSink Settings" from where the user can change the propagation delay.

C OutputSink Information	- 0 X
Settings Inputs	
Label: Circuit Output	*
Propagation Delay (s): 0.00 🚖	
	Ŧ
	Save

In every unit operation parameter, the maximum permissible values are mentioned. The user should keep the values within that limit.

3. Operation

3.1 Getting Started

1. On running the application the user will see white canvas which serves as a drawing board to draw any flow sheet.



Figure 1: Drawing Canvas

At the bottom right side of the canvas, the user can see two clocks labelled "Run Time" and "Simulation Time". Run time shows the time since the simulation was started while the simulation time shows the time for which the process runs in real time at a processing plant. The simulation time can be adjusted by dragging the simulation speed slider left or right.

At simulation speed of "1", 1 second of run time is equivalent to 30 seconds of simulation time while at a simulation speed of "600", 1 second of run time is equivalent to 30 minutes of simulation time.

The simulator creates "CSV" files which contains data from different unit process at different times. The software gives user the freedom to select a time period to do the sampling. This means if the user selects a sample period of 10 minutes, the simulator will record the data at every 10 minute interval and store it in a csv format.

If the user wishes not to store the data, then they can uncheck the "Enable Sampling" radio button at the bottom right corner of the simulator window.

2. Right click anywhere on the drawing board to access the equipments icon library, you can also access icon library by going to Menu Bar under **Edit > Add**.

MIRL Mining Simulator							
File Edit Halp Salids (T/h) ▼ Pul Water (T/h) ▼ P80	p (T/h) ▼) (mm) ▼	File solic pulp	Edit Help	Feed Circuit Output Ball Mill SAG Mill Sump Pump Hydrocyclone Screen Splitter			

Figure 2: Add Equipment

- 3. The library consists of equipments of the comminution and classification processes such as grinding, classification and handling units.
- 4. Select the equipments based on your choice or the flowsheet you are attempting to draw. The version is modular in nature and the order of equipment selection will not affect the simulation results.
- 5. The equipment icons can be placed anywhere on the drawing canvas by:
 - a. Selecting the icon by clicking on icon you want to move. Upon clicking, the icon gets highlighted and green "+" sign appears (*Figure 1*Figure 3).
 - b. You can also drag multiple icons by pressing **CTRL** and selecting multiple units by clicking on it.



Figure 3: Selection of Equipment Icon, Left: Single Unit, Right: Multiple Unit

- 6. Once the units are in place it should be interconnected by the stream lines which represents the flow of material (solid, water and slurry) from one equipment to another.
- 7. The stream line between two equipments can be drawn by selecting the equipment from which the stream line will be originating.
 - i) After selecting equipment icon will be highlighted and "+" sign will appear. Upon clicking the "+" sign, you can see the possibilities of joining the line other units.





Figure 4: Possibilities for joining stream lines

The dotted line turns green when the pointer reaches another "+" sign which means that the user can connect the stream as shown in the above screenshots.

ii) Click on the other "+" sign, the stream line will appear itself.



Figure 5: Create Stream Line

iii) Stream line can be deleted by reselecting them (which turns them into green) and pressing **Delete** button on keyboard.



Figure 6: Delete Stream Line

8. Ensure all the equipments are properly connected. The product stream should be connected to circuit output. In case of multiple product, multiple circuit output should be selected (Figure 7).



Figure 7: Product Stream

9. The flowsheet drawn can be saved as well. The software has the feature to save the flowsheet anytime when the application is running. This can be done by going to Menu Bar and selecting File > Save or by using the "Save As" function also.

MIRL Mining	Simulator	MIRL Mining Simulator					
Solids (T/h) Water (T/h)	 ▼ Pulp (T/h) ▼ P80 (mm) 	•	New Open Save Save As Exit	water gpmsolids flow	*		

Enter the desired file name of the flowsheet and click save. The flowsheet will be saved with an extension **.sim.**

If the user changes the settings of individual unit processes and saves the flowsheet, it will be saved with an extension **.mirl_scenario**.

3.2 Data

Once the flowsheet is drawn, it requires design and operating data for simulation. This includes dimension of the equipments and operating feed, water and other model parameters.

- 1. The data can be entered by double clicking the equipment icon.
- 2. A dialog box of equipment settings appears, typical example of a ball mill is shown in Figure 8.
- 3. User can enter the design specification by typing in value for a particular process unit or by clicking arrows provided. Default value of parameters are already being provided.
- 4. The ore characteristics data such as particle size distribution and weight distribution can also be changed under circuit setting option.
 - a. This can be accessed by going to Menu Bar under Edit > Circuit Settings.



BallMill Information		8
Settings Inputs Output Grap	hs	
Ball Density (g/cm^3):	7.86	
Ball Diameter (m):	0.03	-
Belly Length (m):	8.70	-
Critical Speed:	18.96	- 1
Label	P-II-A	-
Ln(R/D")M):	0.0 1.1 4.499 3.973 0.0 0.0	=
Mill Diameter (m):	5.00	
% of Critical Speed:	10.02	
Volume % of Balls:	30.00	-
Propagation Delay (s):	5.00	-
Rotation Speed (RPM):	1.90	-
		_
Selection Matrix:	1.0 1.0 1.0 1.0 1.0 1.0 1.0 1.0	
Size Knots (mm): Use Appearance Function:	1.0 1.0 1.0 1.0 1.0 1.0 1.0 1.0	Ξ
Use size knots DE DE0 D00		
Use size knots as D5, D50, D80:	V Save	•

Figure 8: Equipment Setting Dialog for Ball Mill

b. Enter the size range which you intend to simulate and corresponding particle size distribution will change and then hit save. The size ranges should be in microns.



Figure 9: Circuit Settings

3.3 Simulating the flowsheet

After entering the data the simulator is ready to use. The simulation can be started by clicking the **Start** button at the bottom left corner of the interface. Similarly the simulation can be stopped by clicking **Stop** button next to start. On clicking the **Step** button, only one iteration is done. This is helpful in visualizing material flow step by step. **Reset** button resets the circuit to the original state.



The simulator is equipped with the feature to increase and decrease the simulation speed which is the number of iteration or calculation the simulator will be performing in a minute. This can be adjusted through a slider labelled "Simulation Speed" provided at the bottom center of the main drawing canvas.



3.4 Simulation Results

The simulation results and the response of the variables can be viewed in two ways. One is on the equipment basis i.e. the input and output response associated with each equipment while the other is few selected process variables which are/can be allowed displayed on the drawing canvas.

 Input and output response of the variables associated with every equipment can be accessed by double clicking the equipment icon of the equipment. For example in Figure 8 for a ball mill the dialog box contains input and output tabs next to settings tab (Figure 11).



Figure 11: Input-Output Tabs

Figure 12 shows the input data to sag mill at a particular instance of simulation.

Mill Informa	tion										x
Settings In	puts	Output	Graphs								
Size	Ran	ige mm	T	Tons	- I	Percent	I	Attributes	Т	Value	*
125.00	-	106.00	I	68.074	1	68.074%	I	Gravity of Solids (SG)	I	2.65	
106.00	-	100.00	- I.	25.986	- I.	25.986%	1	Solids TPH	1	100.00	
100.00	-	90.00	1.1	3.252	- I	3.252%	1	Solids Flow Rate (m³/hr)	1	37.74	
90.00	-	75.00	1	1.680	1	1.680%	1	Solids Flow Rate (gpm)	1	8.57	
75.00	-	63.00	1.1	0.293	1	0.293%	1	Percent Solid	1	74.1%	
63.00	-	53.00	1.1	0.510	1	0.510%	1	Gravity of Water (SG)	1	1.00	
53.00	-	50.00	1.1	0.169	1	0.169%	1	Water TPH	1	35.00	
50.00	-	45.00	1.1	0.026	1	0.026%	1	Water Flow Rate (m³/hr)	1	35.00	
45.00	-	37.50	1.1	0.003	1	0.003%	1	Water Flow Rate (gpm)	1	7.95	
37.50	-	31.50	1.1	0.008	1	0.008%	1	Gravity of Pulp (SG)	1	1.86	
31.50	-	26.50	1.1	0.000	1	0.000%	1	Pulp TPH	1	135.00	
26.50	-	25.00	1.1	0.000	1	0.000%	1	Pulp Flow Rate (m³/hr)	1	72.74	
25.00	-	22.40	1.1	0.000	1	0.000%	1	Pulp Flow Rate (gpm)	1	16.52	
22.40	-	19.00	1.1	0.000	1	0.000%	1	D80 RR (mm)	1	115.85	
19.00	-	16.00	1.1	0.000	1	0.000%	1	RR Old	1	30.39	
16.00	-	13.20	1	0.000	1	0.000%	1	D80 GGS (mm)	1	962.54	
13.20	-	12.50	1	0.000	1	0.000%	1	Power (kW)	1	0.00	

Figure 12: Input Data to Ball Mill

2) From an operator or an engineer's prospective process variables such as mass flow rate of solids/water or percent solids, mill power, product particle size etc. are monitored at regular interval and are crucial. Hence, the simulator allows these variable to be displayed on main drawing canvas simulator allow to view these variables from the dashboard. These variables are displayed with the stream originating from the equipment (Figure 133).



Figure 13: Display of process variables on drawing canvas

Onscreen displays four variables and the choice of the variable can be made by clicking drop down arrows under menu bar (top – left corner below **File** option, **Error! Reference source not found.**).

MIRL Mining Simulator	MIRL Mining Simulator
Ella Esta Usia	File Edit Help
File Edit Help	solids tph 💌 water gpm 💌
Solids (T/h)	solids tph water tph
Water (T/h) v P80 (mm) v	pulp tph
	solids flow
	water flow
	pulp flow
	solids gpm
	water gpm
	pulp gpm
	p80
	percent solids
	power

Figure 14: Choosing variables to be displayed

User can also see the trends of the selected variable and how they change with time during the simulation. For example in Figure 13 the user can see how mill response (power) has changed by clicking on the values displayed.



Figure 15: Data Trends

4. Example

People not directly related to Mining/Mineral industry or having less technical knowledge in the field can start with the example flowsheet of a typical grinding circuit of a gold mine operating in Alaska.

4.1 Circuit Description

This flowsheet consists of a feeder, sag mill, ball mill, hydrocyclone and sump-pumps. The sag mill is used for primary grinding, (i.e. it will reduce the size of incoming feed to a certain limit) which is fed by the means of a feeder. The material after being reduced in size in sag mill is discharged into a sump pump. This material is then transferred to ball mill for further size reduction operating in close circuit with a cyclone (Figure).

The ground material is then subjected to classification based on size using cyclone of a particular cut size. The underflow which is the coarse material is sent to ball mill for further size reduction while the overflow is reported to circuit output for subsequent operation.

So our circuit has:

- Solid tonnage, water to sag mill, sag mill discharge sump and cyclone sump as inputs to the circuit which are manipulated variables and can be changed during the simulation.
- The main product of the circuit is cyclone overflow whose size is supposed to be in the range of 60 ± 10 microns.
- Along with that the response of the circuit includes solid mass flow rate, water volumetric flow rate, particle size of the respective streams and cyclone overflow and mill power.



Figure 16: Example Flowsheet

The design and other model parameters are pre-defined.

4.2 Objective

As an operator your objective is to ensure all the response variables which are critical from operational point of view are within acceptable limit ensuring maximum production.

Task:

- Maintain circuit output particle size and maximize solid tph.
- Maintain sag mill power in the range of 500 kW to 550 kW by varying the operating speed (but the maximum permissible limit of the speed is 14.6 rpm which is 80 percent of critical speed).
- Maintain ball power in the range of 570 kW to 630 kW by varying the rpm from 14.3 to a maximum value of 16.8.
- Mill power is also affected by feed tonnage and water addition to the mill. Indicate how the response is affected by changing both.
- Ensure cyclone overflow is in range of 50 to 70 micron. Overgrinding also leads to reduced recovery for downstream processes.
- Less fluctuation is response and input resembles smooth operation.
- Operate sag in a percent solid range of 65-75.

• Ball mill percent solid in the range of 45-55.

Explain the following

- Effect of cyclone feed specific gravity on overflow size.
- Effect of percent solids on hydrocyclone outputs.

5. Reference

AMIT 135 & AMIT 145 Course Content

http://mirl.uaf.edu/research/preparing-the-unemployed-for-the-mining-sector-a-taaccct-funded-project/