

INTEGRATED GEOMETALLURGICAL SIMULATOR

QUICK GUIDE

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Member of the SGS Group (SGS SA)

Comminution Quick Guide

1. START-UP

To create a new project, click on [File] on the menu bar and select [New]. Navigate to the folder location where the project file will be saved. Enter a filename and click [Save].

File	Edit View	Flowsheet	Data	Grinding	Flotation	Help	
D	New	Ctrl+N					
8	Open	Ctrl+O	geo	metall	urgical	approa	
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Videos		Example Project.igs	22/11/2010 12:59	IGS Project	18,772 KB	
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🜏 Homegroup		Test Project.igs	21/11/2010 5:01 PM	IGS Project	544 KB	
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File name:	lotatio	on Plant				
Save as type:	GS File	es (".jas)				

A premade project file is included in the manual. Open the "Demo Project.igs" file by following the instructions described in section 6.2 of the user manual.

2. CONFIGURE FLOWSHEET

1. To configure the comminution circuit, click on [Grinding] and select [Configure]. A graphical representation of a typical grinding circuit will appear.

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usher lindes	Pebble Crusher P	and the second se				
fault S.G. D	Enable Pebble Cr	10 IZ			Grind Target	
asher CSS (mm) 0	DOM PCAO	16	Ball Mill Paramet		Target P80 Min	0
4 Ci 10	PCCL Slope	1	Frable Bat Mit		Target #80 Max	0
nd Parameters	PCCL Intercept	0	Mil Power (kW)	0	Target TPH Max	0
5 Max 0.45			Bond Relationshi		-	
es Tuning 1	l i f		Bond Multiplier	0		
Slope 0.95		122	Bond Exponent	0	9-	
Intercept 0						
	- Stid Silling	Barrenti	Bond Constant	0.95	V I	
0 Stope 1 0 Intercept 0	2			095		
Steercept 0 Future 20 Steel Loos Vanable 7 Min S70 Min S70 M	SAG Mull SAG Mull biter 13 biter 0 power (WK) 0		Find Conter	019	-	

Note: Input boxes with red outline indicate an invalid input was entered. You cannot click [Ok] unless all inputs are valid.

2. Enter the values shown below and click [Ok].

Crusher Index		Pebble Crusher Param						
Vefault S.O.		inable Pebble Crushe IC50	10				Grind Target	
Crusher CSS (mm)		1080	16	271	Ball Mill Parameters		Target PS0 Min	150
Min G	10 0000	CCL Slope	1	3	Enable Ball Mill	2	Target P80 Max	250
Feed Parameters		CCL Intercept	0	- 1	Mill Power (kW)	23000	Target TPH Max	6000
PS0 Max	0.45				Bond Relationship	SPI Im		
Fines Tuning	1				Bond Multiplier	0		
F50 Slope	0.95				Bond Exponent	0	(† *)	
F50 Intercept	•		Barrow		Bond Constant	0.95	V	
180 Slope F80 Intercept					10 No.	-		
	Autogenous Mill Parameter					-		
	Enable AG/SAG Mill Type Steel Load [%] Variable Power Min/Triend Power [kW] Mills Power [kW] Mills Power [kW] Mills SPI Mills SPI Efficiency Factor	25 37000 0 0 0.93	Transfer Size Parameter Type Screen Size (mm) THO Sige TBD Intercept	1 9			L	
	Enable AG/SAG Mill Type Terel Lond [Ni] Variable Rower [kW] Mis Rower [kW] Mis SPI Mis SPI Efficiency Factor SAG/AG Factor Stope	25 37000 0 0 0.93 1.08	Transfer Size Paramete Type Screen Size (mm) Tillo Slope	Fixed *				
	Enable AG/SAG Mill Type Steel Load [%] Variable Power Min/Triend Power [kW] Mills Power [kW] Mills Power [kW] Mills SPI Mills SPI Efficiency Factor	25 37000 0 0 0.93	Transfer Size Paramete Type Screen Size (mm) Tillo Slope	Fixed *				

3. Save the flowsheet configuration by clicking [Flowsheet] and select [Save]. Enter a name and a description to identify the flowsheet.

3. IMPORTING AND SELECTING DATASETS

The dataset is vital for simulation. It contains all the mineral grindability information. A demonstration dataset (DataSet.igsdata) file is included in the manual.

- 1. Click on [Data] and select [Import Data]
- 2. Browse to the folder where the dataset file is located. Select the dataset file (DataSet.igsdata) to import and click [Open].
- 3. Click on [Data] and select [Select Data]. This will show all dataset available.
- 4. Select the "Grinding Plant Only" dataset and click [Select].

Select Block Set	Joint dataset	
Select dataset		
Flotation Plant Demo Flotation Feed Fake No. Items: 90 Minerals: CuSulf CuOx Moly Au Pyrite He User Name: ncylee Grinding Feed Fake No. Items: 90 User Name: ncylee	Flotation only dataset	Created: 12/5/2010 2:38:32 PM Modified: 12/5/2010 3:51:04 PM Created: 12/5/2010 4:09:52 PM Modified: 12/5/2010 9:23:59 PM
Flotation Plant Only Flotation Feed Float Feed No. Items: 90 Minerals: CuSulf CuOx Moly Au Pyrite He User Name: ncylee	ematite Silicates	Created: 12/5/2010 9:37:21 PM Modified: 12/5/2010 9:37:21 PM
Grinding Plant Only Grinding Feed Grind Feed No. Items: 90 User Name: ncylee	Grinding only dataset	Created: 12/5/2010 9:37:47 PM Modified: 12/5/2010 9:37:47 PM
		Select Cancel

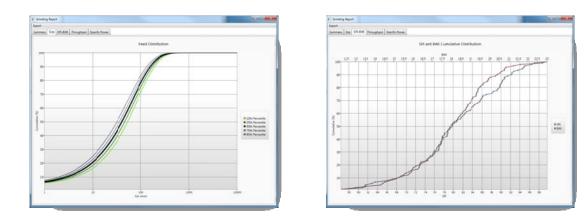
Note: Datasets containing both grinding and flotation feed can also be used for simulation. However, only the grinding feed will be used for the simulation.

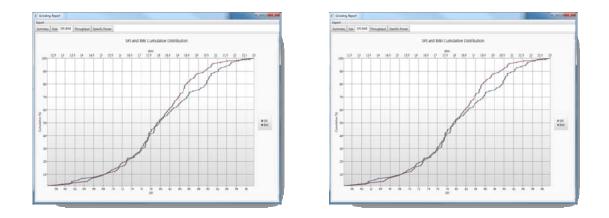
5. The selected dataset name will appear in the toolbar. Click on [Grinding] and select [Simulate] to start the simulation

4. **REPORTING**

Once the simulation is completed, a reporting window will appear. The report window will initially contain five tabs. The first tab reports the circuit's average performance while the other four reports the feed, SPI and BWi, throughput, and specific power distributions.

Grinding Report				
Export				
Summary Size SPI-BWI	Throughput 1	Specific Power		
Grind Size		Circulating Load		
F80 [mm]	110.38	PCCL [%]	35.79	
T80 [um]	963.23	PCCL [TPH]	137723.34	
P80 [um]	213.83	PCL Max [TPH]	158182.72	
Mill Power		Power Consumption		
SAG/AG [kW]	34410.00	SAG/AG [kWh]	297548178.29	
BM [kW]	23000.00	BM [kWh]	202678719.41	
Total [kW]	57410.00	Pebble Crusher [kWh]	8426826.23	
Throughput		Liner and Ball Wear		
SAG/AG [TPH]	3832.42	SAG/AG Ball [t]	21721.02	
BM [TPH]	4400.20	SAG/AG Liner [t]	1398.48	
Circuit [TPH]	3760.67	BM Ball [t]	14592.87	
		BM Liner [t]	628.30	
Specific Power		Mine Life		
SAG/AG [kWh/t]	8.98	Life [Weeks]	52.45	
Theoretical BM [kWh/t]	5.22			
Actual [BM kWh/t]	6.12			
Pebble Crusher [kWh/t]	0.25			





The simulation results can be export in excel (2003, 2007, 2010) or csv format. Click on [Export] and select [Results]. Browse to the folder where to save the file and enter a filename. Then click [Save].

Flotation Quick Guide

1. START-UP

To create a new project, click on [File] on the menu bar and select [New]. Navigate to the folder location where the project file will be saved. Enter a filename and click [Save].

File	Edit View	Flowsheet	Data Grinding	Flotation	Help		
D	New	Ctrl+N					
	Open	Ctrl+O	geometa	llurgical	approa		
-	Save	Ctrl+S	nderstanding	a of the or	o body ar		
Z	Save As		bility in the o		e body a		
	Close		services tal				
×	Exit	Alt+F4	ing the difficult production period				
RATOR	• 0	ptimizatio	to change th n of plant timescale				

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Videos		Example Project.igs	22/11/2010 12:59	IGS Project	18,772 KB	
		project.igs	22/11/2010 3:35 AM	IGS Project	1,408 KB	
🜏 Homegroup	1	1 Test Project.igs	21/11/2010 6:01 PM	IGS Project	544 KB	
Local Disk (D:) Backup I (E:) Backup II (F:) Backup II (G:) NEW VOLUME Local Disk (J:)	E					
File name:	Flotati	on Plant				
Save as type:	IGS File	es (*.ias)				

A premade project file is included in the manual. Open the "Demo Project.igs" file by following the instructions described in section 6.2 of the user manual.

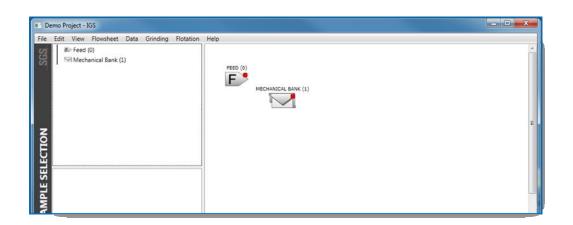
2. CREATING FLOWSHEET

- 4. Right click anywhere on the flowsheet construction frame to bring out a list of flotation unit icons.
- 5. Click on the desired unit will place the unit icon on the construction frame.

Note: All circuit must begin with a [Feed] unit and end with [Product] units.

 Placing a [Feed] and [Mechanical Bank] units on the construction frame looks like the following. The added units are also listed in the stage reporting frame.

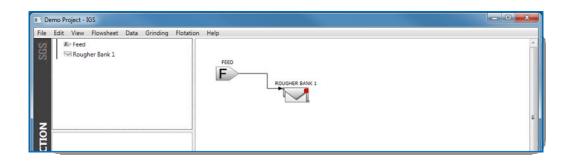
E	Feed
\square	Mechanical Bank
Ī	Column
	Regrind Modifier
M	Modifier
Ł	Water Adder
	Junction
	Mass Splitter
P	Product

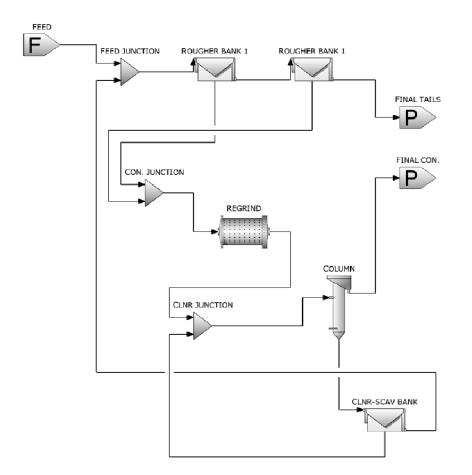


- Note: Notice the red dot on the top left corner of the unit. This indicates that the unit is not properly configured. Right click on the unit and select [Show Errors] to display the error list associated with the unit.
- Note: The yellow dots indicate the unit's input and output ports. Here, showing the mechanical bank's input and output ports. These ports are used to connect the units together.
- To move the units around the frame, place mouse over the center of the unit icon and the mouse cursor will become . Click and drag the unit to the desired location in the construction frame.
- 8. To name the units, click on the unit icon and enter a name in the unit's property frame.

Demo Project - IGS					- • • ×
ile Edit View Flowsheet D	ata Grinding Fl	lotation Help			
IE Feed (0) ⊡ Rougher Bank 1		FEED (0)	ROUGHER BANK 1		
Mechanical Bank: Rougher B Name Rougher Bank 1 Dimensions	ank 1				
Name Rougher Bank 1					
Dimensions				1	
# Cells in row	20		Enter unit's		
		113 46666666666	name		

9. To connect the units, mouse over the output ports (indicated by yellow dots). The mouse cursor will turn into ^(h). Click and drag to another unit's input port (also indicated by yellow dots). If the unit cannot be connected at the cursor's location, the cursor shape will turn into ^(h). The mouse cursor ^(h) will indicate that the input port can be connected with.





10. Repeat steps 1 to 6 until the flowsheet is constructed.

11. Save the flowsheet by clicking on [Flowsheet] on the menu bar and select [Save Flowsheet]. Enter a name and a description and click [Ok].

3. UNITS CONFIGURATION

Each unit need to be manually configured. All newly created unit will have typical set values. Select a unit on the construction frame stage or the stage view frame and the unit's configuration inputs will appear in the unit property frame.

Mechanical Bank: Rougher Bank	1	Mechanical Bank: Rougher Bank	2	Mechanical Bank: Clnr-Scav Ban	k	
Name Rougher Bank 1		Name Rougher Bank 2		Name Clnr-Scav Bank		
Dimensions		Dimensions		Dimensions		
# Cells in row	8	# Cells in row	4	# Cells in row	4	
# Ideal cells	8	# Ideal cells	4	# Ideal cells	4	
# Parallel rows	8	# Parallel rows	5	# Parallel rows	2	
Volume [m3]	200.00	Volume [m3]	100.00	Volume [m3]	100.00	
Effective % volume	44.000	Effective % volume	51.268	Effective % volume	51.268	
Operating parameters		Operating parameters	Operating parameters		Operating parameters	
Froth recovery [%]	50.00	Froth recovery [%]	70.00	Froth recovery [%]	70.00	
Entrainment value	0.2000	Entrainment value	0.2000	Entrainment value	0.2000	
Water Recovery		Water Recovery	Water Recovery			
 Concentrate % solids 	30.00	Concentrate % solids	30.00	Concentrate % solids	30.00	
Fixed water recovery [%]	0.00	Fixed water recovery [%]	0.00	Fixed water recovery [%]	0.00	
Batch cell modelling		Batch cell modelling		Batch cell modelling		
Residence time is fixed		Residence time is fixed		Residence time is fixed		
Cell residence time [min]	0	Cell residence time [min]	0	Cell residence time [min]	0	

For the mechanical banks, use the values shown below.

For the flotation column:

Column: Column			
Name Column			
Dimensions			
# Columns in parallel	8		
Diameter [m]	4		
Height [m]	12		
Feed D50 [um]	75		
Operating parameters			
Froth recovery [%]	50.00		
Entrainment value	0.4000		
Efficiency factor	0.1		
Water Recovery			
Oncentrate % solids	40.00		
Fixed water recovery [%]	0.00		
Wash water per column			
Specify wash water?	E		
Wash water flow [m3/hr]	0.00		
Ratio of wash to froth water	1		
Wash efficiency [%]	95		
Advanced properties			
Height below spargers [m]	0.7		
Froth height [m]	0.5		
Gas velocity [cm/s]	1.5		

For the regrind modifier:

lame Regrind	
Modifier mode	
 Multiplier Constant 	
Maximum recovery [%]
CuSulf	0.95000
CuOx	0.50000
Moly	0.80000
Au	0.50000
Pyrite	0.80000
Hematite	0.10000
Silicates	0.20000
Average rate [1/min]	Ľ.
CuSulf	0.80000
CuOx	0.80000
Moly	0.80000
Au	0.80000
Pyrite	0.80000
Hematite	0.10000
Silicates	0,20000

4. STAGE SETUP

The flowsheet can be divided into three stages, overall, rougher, and cleaner stages.

- 1. Right click on the stage reporting frame and add a new stage.
- 2. Name the stage "Overall". Click and drag the Feed, Final Tails, and Final Con. Units into the "Overall" stage.
- 3. Create a "Rougher" stage with the following units:
 - Con. Junction
 - Feed Junction
 - Rougher Bank 1
 - Rougher Bank 2
- 4. Lastly, create a "Cleaner" stage with the following units:
 - CInr. Junction
 - Regrind
 - Column
 - CInr-Scav Bank
- 5. Configure each stage's feed, concentrate, and tails streams.
 - Overall stage: Set "Feed" as the stage's feed, "Clnr-Scav Bank tails" as the stage's tails and the "Column conc" as the stage's concentrate.
 - Rougher stage: Set "Clnr-Scav Bank tails" and "Feed" as the feed of the stage, "Con. Junction" as the stage's concentrate, and "Rougher Bank 1 tail" as the stage's tails.
 - Cleaner stage: Set "Con. Junction" as the stage's feed, "Clnr-Scav Bank tail" as the stage's tail, and "Column Conc" as the stage's concentrate.

Note: The project file contains the flowsheet with the units configured. Click on [Flowsheet] and select [Open]. Select the "Example Flowsheet" and click [Open].

5. IMPORTING, SELECTING DATASETS, AND SIMULATION

The dataset is vital for simulation. It contains all the mineral flotability information. A demonstration dataset (DataSet.igsdata) file is included in the manual.

- 6. Click on [Data] and select [Import Data]
- 7. Browse to the folder where the dataset file is located. Select the dataset file (DataSet.igsdata) to import and click [Open].

- 8. Click on [Data] and select [Select Data]. This will show all dataset available.
- To do a standalone flotation simulation, select the "Flotation Plant Only" dataset and click [Select].
 To do a joint comminution and flotation simulation, select the "Flotation Plant Demo" dataset and click [Select].

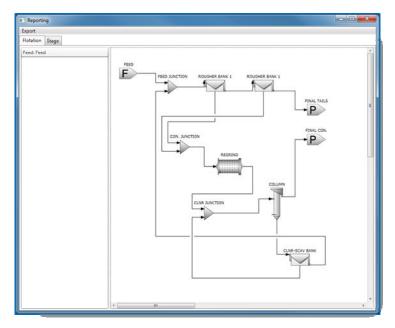
Select Block Set	Joint dataset	
Select dataset		
Flotation Plant Demo Flotation Feed Fake No. Items: 90 Minerals: CuSulf CuOx Moly Au Pyrit User Name: ncylee	te Hematite Silicates	Created: 12/5/2010 2:38:32 PM Modified: 12/5/2010 3:51:04 PM
Grinding Feed Fake No. Items: 90 User Name: ncylee	Flotation only dataset	Created: 12/5/2010 4:09:52 PM Modified: 12/5/2010 9:23:59 PM
Flotation Plant Only Flotation Feed Float Feed No. Items: 90 Minerals: CuSulf CuOx Moly Au Pyrit User Name: ncylee	te Hematite Silicates	Created: 12/5/2010 9:37:21 PM Modified: 12/5/2010 9:37:21 PM
Grinding Plant Only Grinding Feed Grind Feed No. Items: 90 User Name: ncylee	Grinding only dataset	Created: 12/5/2010 9:37:47 PM Modified: 12/5/2010 9:37:47 PM
		Select Cancel

Note: To perform a joint simulation, the comminution circuit needs to be configured.

10. The selected dataset name will appear in the toolbar. Click on [Flotation] and select [Simulate] to start the simulation

6. REPORTING

Once the simulation is completed, a reporting window will appear. The report window will initially contain two tabs, a "Flotation" and "Stage" tab. The "Flotation" tab displays the flowsheet and the "Stage" tab reports the grade and recovery of the stages.



▼ Overall ▼ Rougher ▼ Cleaner					Ove	srall				
		1	Metals				Minerals			
	Name	Con Gra	de (%)	Recover	y (%)	Name	Con Grade (%)		Recover	ry (%)
	Name	Mean	σ	Mean	σ		Mean	σ	Mean	σ
	Cu	13.05	7.83	74.34	6.79	CuSulf	33.25	20.45	80.65	5.2
	s	45.49	4.58	64.84	12.48	CuOx	0.52	0.00	27.45	7.9
	Fe	39.25	4.41	6.01	3.31	Moly	0.32	0.00	57.17	8.3
	Mo	0.19	0.00	57.17	8.38	Au	28.56	25.32	28.46	10.4
	Au	28.56	25.32	28.45	10.49	Pyrite	63.88	21.60	60.62	13.47
	Si	0.69	0.00	0.09	0.00	Hematite	0.33	0.00	0.02	0.00
	100 50- 0, 200 50-	, s	I Recov	Mo '	Si	100 50- 01 CuSu 100- 50-	f cuOx	And Grain And Gr	Hematike	; Silicates

To view the grade and recovery of a mechanical bank or flotation column, double click on the unit icon on the flowsheet in the "Flotation" tab. Double click on "Rougher Bank 1" will display the follow report in a new tab.

					Roug	her Bank 1						
Genera	l parameters				Metals				N	linerals		
			Con Grade (%)		Recover	Recovery (%)		Con Grad	le (%)	Recovery (%)		
	Mean	ean σ	Name	Mean	σ	Mean	σ	Name	Mean	σ	Mean	σ
Residence time	49.15	0.00	Cu	4.94	2.04	77.18	5.06	CuSulf	12.27	6.00	82.18	4.0
Mass recovery	9.75	3.38	s	22.19	7.26	70.70	8.10	CuOx	0.32	0.00	45.49	8.38
Water recovery	8.60	2.85	Fe	29.36	6.10	11.54	5.41	Moly	0.14	0.00	64.97	5.05
			Mo	0.08	0.00	64.97	5.05	Au	20.90	14.47	46.84	11.50
			Au	20.90	14.47	46.84	11.56	Pyrite	33.67	15.27	67.80	8.7
			Si	13.63	4.91	6.37	1.88	Hematite	20.45	9.03	4.19	1.2
								Silicates	33.15	12.38	6.42	1.93
100-		Metal (I	Mo	I SI		100- 50- 0-1 Cut	Sulf CuOx	Mineral G		Hematite S	licates
0+ Cu	's	Aetal Re	covery				100-		Mineral Re	covery		incares

Double clicking on a stream (line connecting the units) will display the stream's flowrate, percent solids, the metals and minerals grade, and the minerals' flotation kinetics in a new report tab. For the junction, regrind, or feed unit, the output stream is reported in the same fashion.

Double clicking on the "Con. Junction" will display the junction's product stream report shown below.

xport	_			-C									
Flotation	Stage	Rougher 8	Bank 1	Con. Junct	on-Product >	·							
						Con. Ju	nction-Produ	ct					
(Seneral	parameter	s		Metals					Minerals			
			Grade		Rmax	ix kavg			Grad	e			
		Mean	σ	Name	Mean	σ	Name	Mean	σ	Mean	σ	Mean	σ
% Solids		30.00	0.00	Cu	4.74	1.91	CuSulf	99.65	0.00	2.13	0.00	11.77	5.6
Solids ma	ss flo	577.29	238.70	s	21.46	7.26	CuOx	97.63	1.63	1.49	0.00	0.31	0.0
Volume fi	ow	1500.54	612.78	Fe	29.10	6.12	Moly	99.06	0.00	2.00	0.00	0.14	0.0
Water flow	N	1347.01	556.97	Mo	0.08	0.00	Au	97.55	2.19	1.58	0.00	20.23	14.0
				Au	20.23	14.05	Pyrite	99.20	0.00	2.22	0.00	32.62	15.1
				Si	13.97	4.94	Hematite	56.24	16.25	0.13	0.00	21.19	9.3
							Silicates	73.05	8.89	0.20	0.00	33.97	12.4
100 							ity Distribu					CuSulf CuOx Moly Au Pyrite Hemat	lite
20-	5	10 15	20 2	25 30 3	5 40 45	50 Rate [1/m	55 60 6	5 70 75	80 8	5 90 9	5 100	= Sdicate	в

The simulation results can be export in excel (2003, 2007, 2010) or csv format. Click on [Export] and select [Results]. Browse to the folder where to save the file and enter a filename. Then click [Save].

Flotation Benchmark Quick Guide

1. START-UP

Create a new IGS project and construct a flowsheet (refer to *Flotation Quick Guide* step 1 through 4) or open the pre-constructed flowsheet found in the Demo Project zip file.

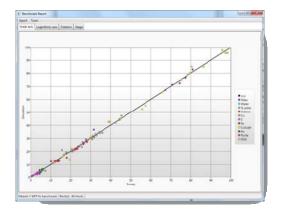
2. IMPORTING, SELECTING DATASETS, AND BENCHMARK

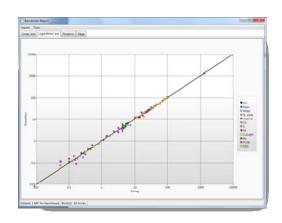
The dataset is vital for simulation. It contains the mineral flotability information and plant survey data. A demonstration dataset (BenchmarkDataSet.igsdata) file is included in the Demo Project zip file.

- 1. Click on [Data] and select [Import Data]
- 2. Browse to the folder where the dataset file is located. Select the dataset file (BenchmarkDataSet.igsdata) to import and click [Open].
- 3. Click on [Data] and select [Select]. This will display all dataset available.
- 4. Click on the dataset containing both a flotation feed and survey data. Click [Select] will make it the active dataset for simulation.
- The selected dataset name will appear in the toolbar. Click on [Flotation] and select [Benchmark] to start the benchmarking. In the event where [Benchmark] option is not available, please contact SGS at <u>IGS@SGS.com</u> for more information and assistance.

3. REPORTING

Once the objective function is solved, a report window with four tabs will appear. The first two tabs show the accuracy of the benchmark on a linear and logarithmic axis respectively. The remaining two are standard flotation simulation report window with the same functionality.





Flotation Optimization Quick Guide

4. START-UP

Create a new IGS project and construct a flowsheet (refer to *Flotation Quick Guide* step 1 through 4) or open the pre-constructed flowsheet found in the Demo Project zip file.

5. IMPORTING, SELECTING DATASETS, AND BENCHMARK

The dataset is vital for simulation. It contains the mineral flotability information and the optimization target. A demonstration dataset (OptimizationDataSet.igsdata) file is included in the Demo Project zip file.

- 1. Click on [Data] and select [Import Data]
- 2. Browse to the folder where the dataset file is located. Select the dataset file (OptimizationDataSet.igsdata) to import and click [Open].
- 3. Click on [Data] and select [Select]. This will display all dataset available.
- 4. Click on the newly added dataset containing the flotation feed. Click [Select] will make it the active dataset for simulation.
- The selected dataset name will appear in the toolbar. Click on [Flotation] and select [Optimize] to start the optimization process. In the event where [Optimize] option is not available, please contact SGS at <u>IGS@SGS.com</u> for more information and assistance.

6. **REPORTING**

Once the objective function is solved, a standard flotation simulation report window with the same functionality will appear.