CANTY
PROCESS TECHNOLOGY

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Lab Test Report
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Company:

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Sample Identity- The sample materials are Rougher Feed materials collected from the head courier flow-cell tube under three conditions: Normal, Course, fine.

Table 1, Sample identification

Canty Log Number	Sample Description
19322-285-58-1	Rougher feed bag A -copper ore - 6.195 pounds normal
19322-285-58-2	Rougher feed bag B -copper ore - 6.4 pounds coarse
19322-285-58-3	Rougher feed bag C -copper ore - 6.175 pounds fine

Purpose: This report details the Particle Size testing done in the Canty Lab for the above samples.
A dilute concentration slurry was prepared with approximately 100 grams of each dry powder added to 2 gallons of water. This same slurry was passed through the flow cell several times and data gathered for 20,000 to 30,000 particles indicating the size distribution for the sample. The degree of repeatability of the measurement process is indicated by comparison of data sets for the same sample, and the ability to distinguish between samples is indicated by comparison between samples.

Results: A typical process image and the CantyVision processing results are shown below to indicate the general measuring process. Following are plots of each of the data sets along with a summary comparison showing the D10, D50, D90 (10, 50, 90 percent passing size) statistics.

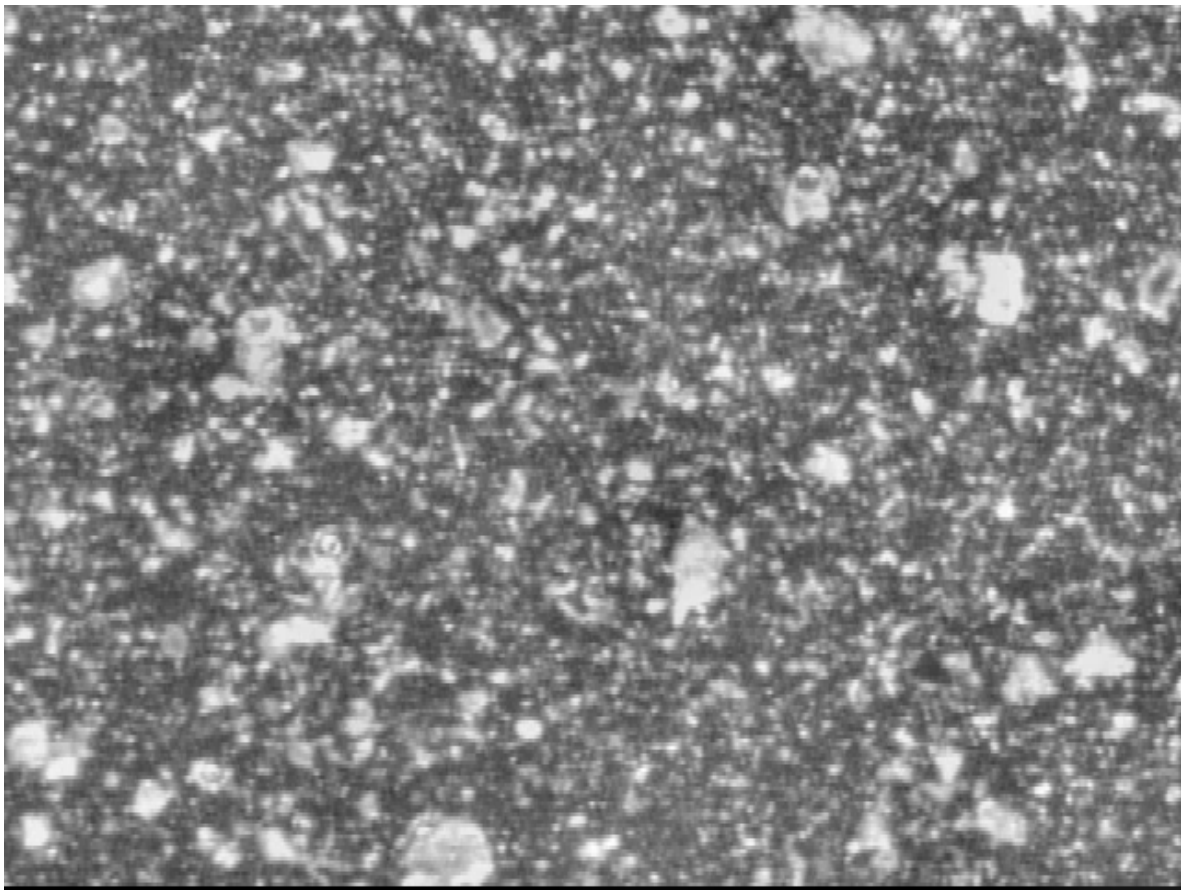


Figure 1, Typical product image from flow cell camera with 1.76 mm horizontal field of view

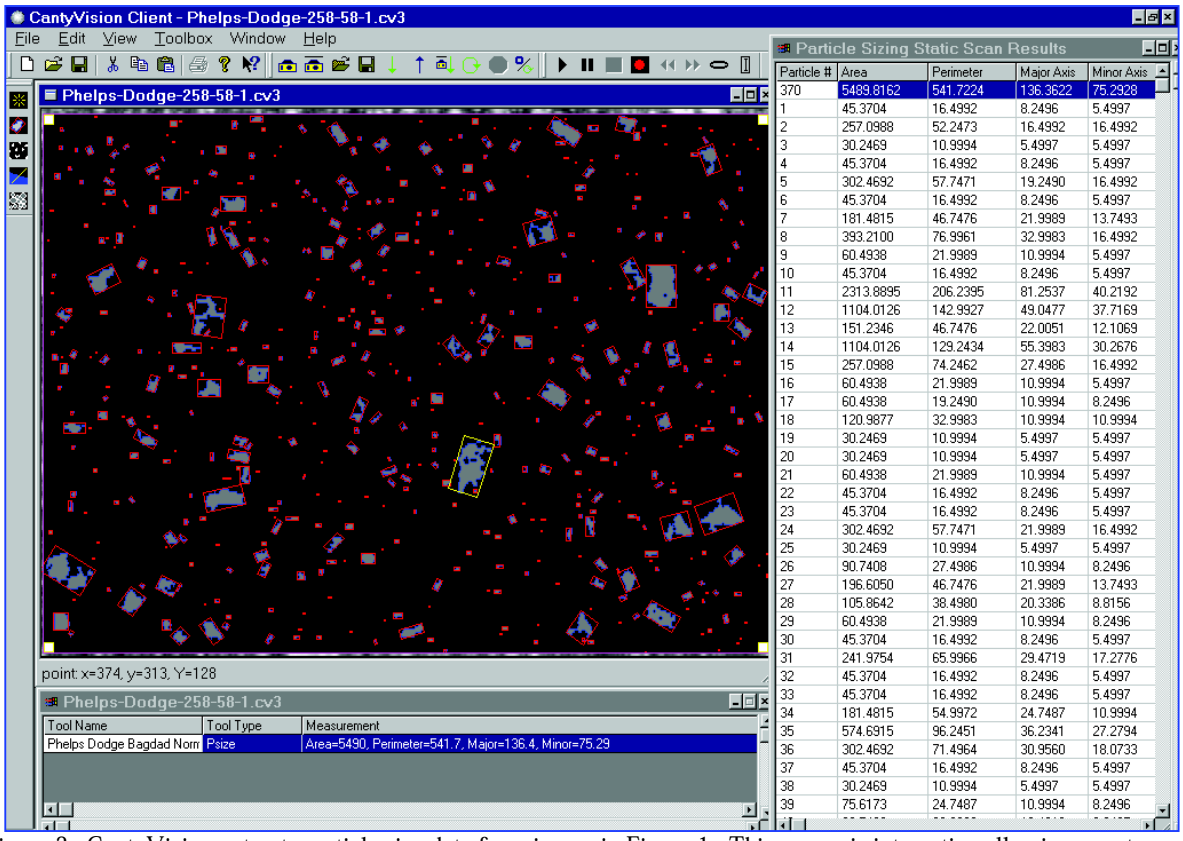


Figure 2 , CantyVision extracts particle size data from image in Figure 1. This screen is interactive allowing user to click on selected particle (yellow box in image) and the measured information is moved to the top of the table at the right.

Measurement data plots are presented below that indicate the percent passing by minor axis for several runs for each of the three sample materials. Table 2 (parts A, B, and C) show a summary for the several plots of each of the test materials.

Table 2A, 2B, and 2C show a summary comparing the three materials at the 10 percent, 50 percent and 90 percent passing minor axis size.

TABLE 2A
Minor axis Percent passing by volume

Normal run	10%	50%	90%
1	16.5	38.5	66
2	16.97	44	88.8
3	19.62	47.03	89.12
4	22	58.7	118.2
5			
6			
7			
mean	18.7725	47.0575	90.53
std dev	2.552664	8.52697	21.38793

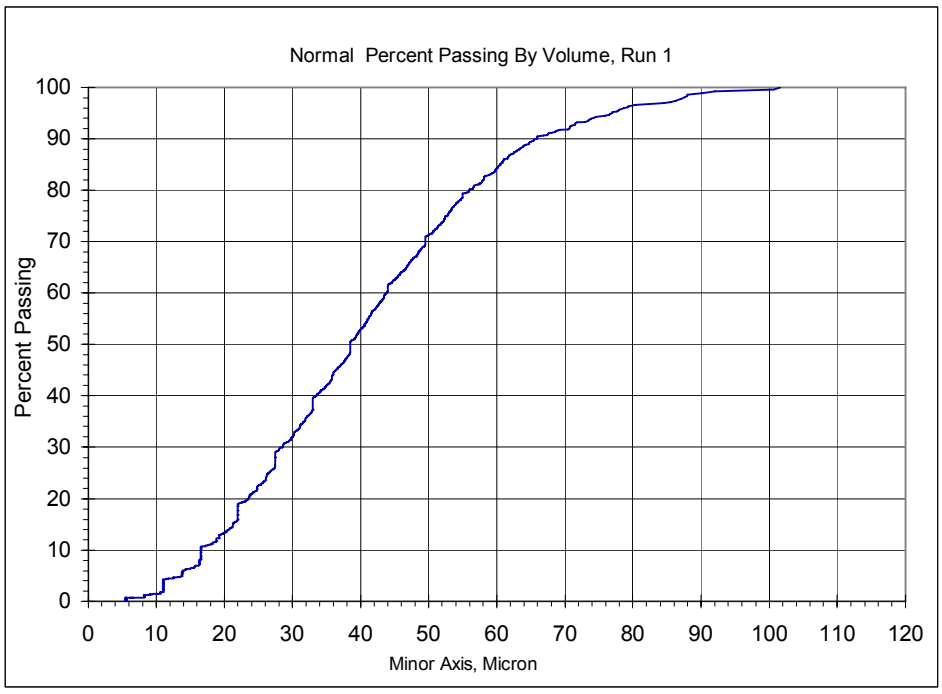
TABLE 2B
Minor axis Percent passing by volume

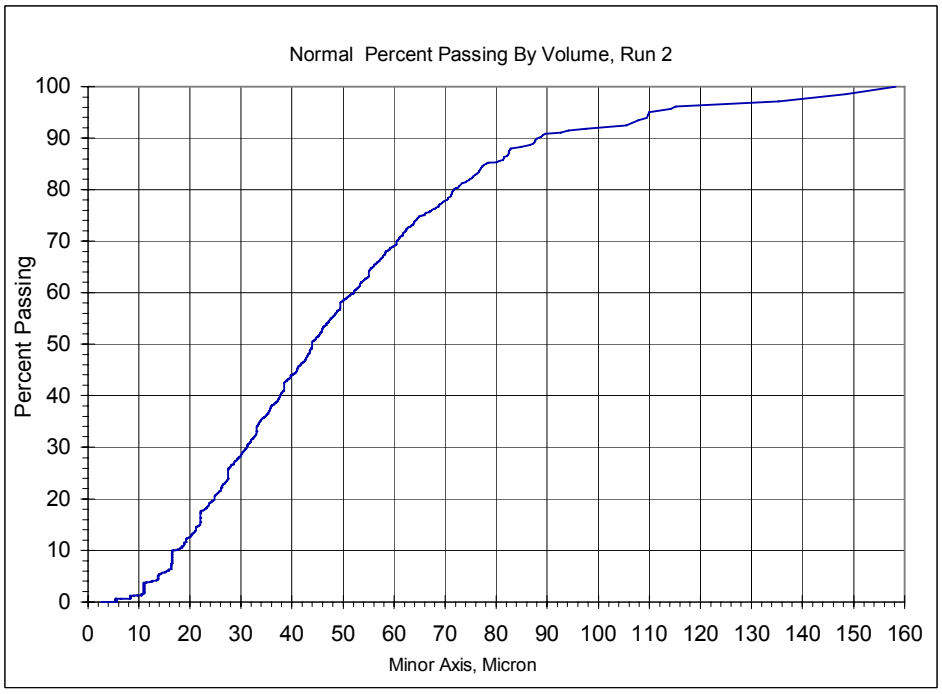
Coarse run	10%	50%	90%
1	15.55	34.14	74.3
2	19.25	76.68	482
3	16.5	41.14	99.93
4	16.3	37	101.7
5	16.5	43.62	100.2
6	16.5	46.62	122.5
7			
mean	16.76667	46.53333	163.4383
std dev	1.271089	15.43298	156.8102

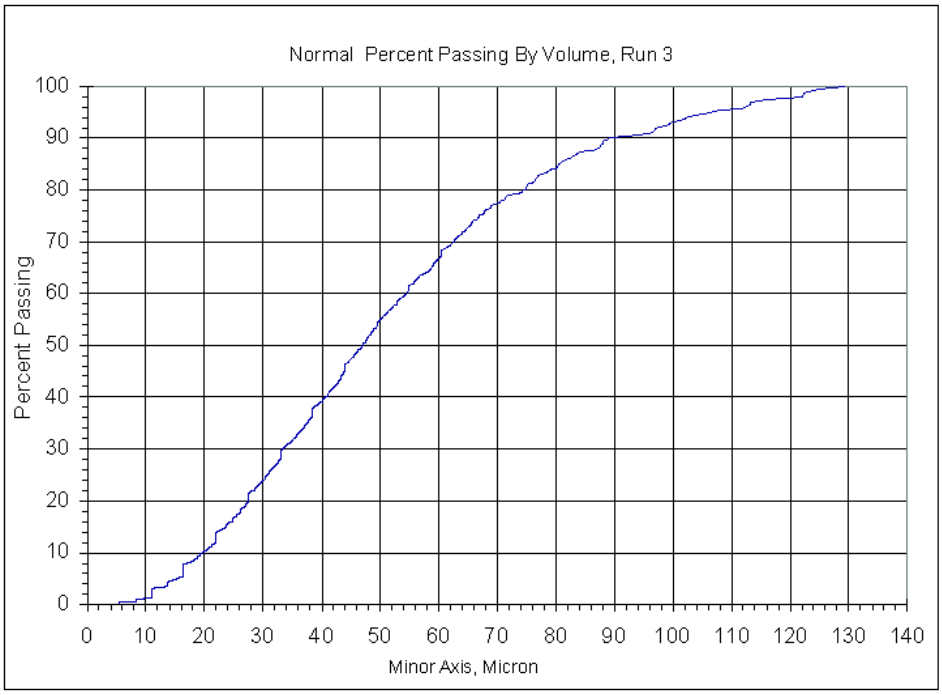
TABLE 2C
Minor axis Percent passing by volume

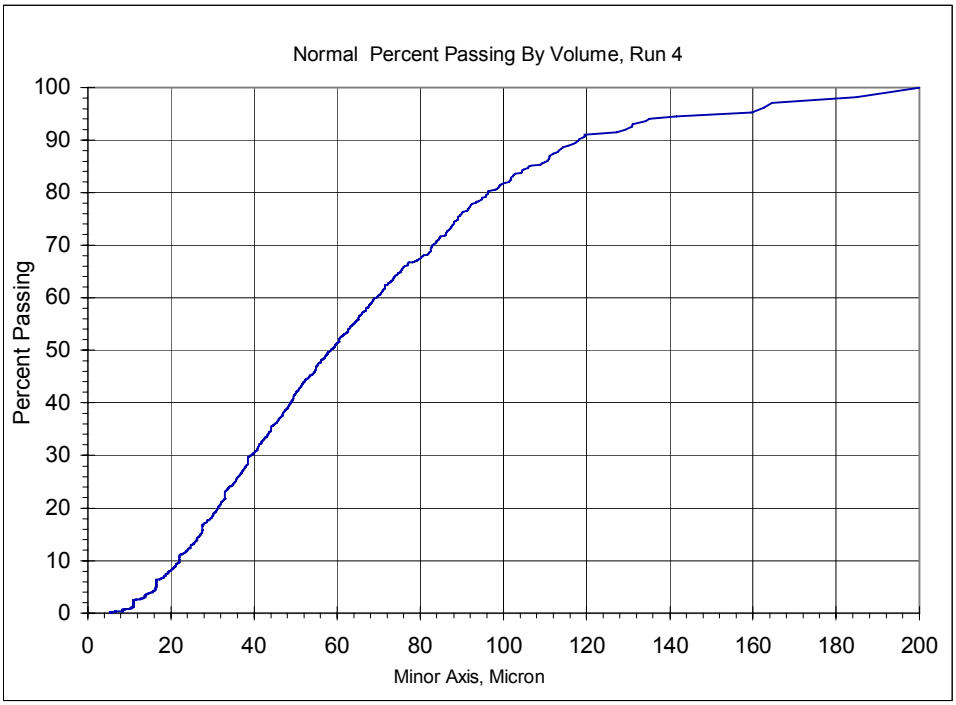
FINE run	10%	50%	90%
1	13.75	30.1	63.13
2	14.42	32.6	80.83
3	13.75	31.54	76.35
4	12.66	28.03	56.98
5	11	24.53	48.75
6	11	24.14	46.59
7	11	23.73	53.23
mean	12.51143	27.81	60.83714
std dev	1.504775	3.719839	13.33821

Four size distribution runs for the Normal Ro Feed sample

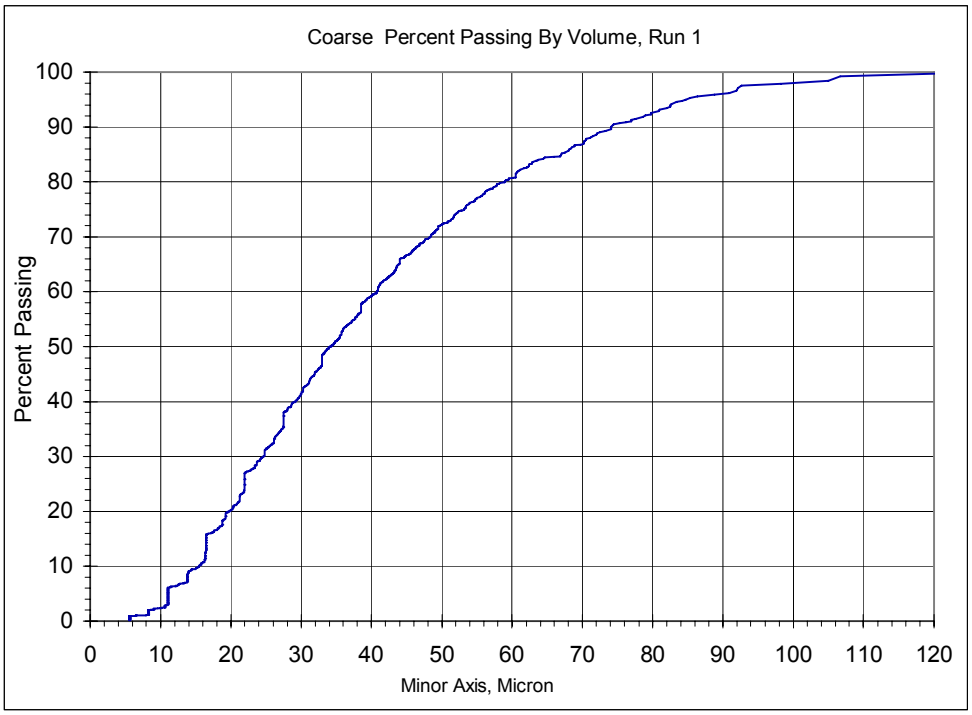


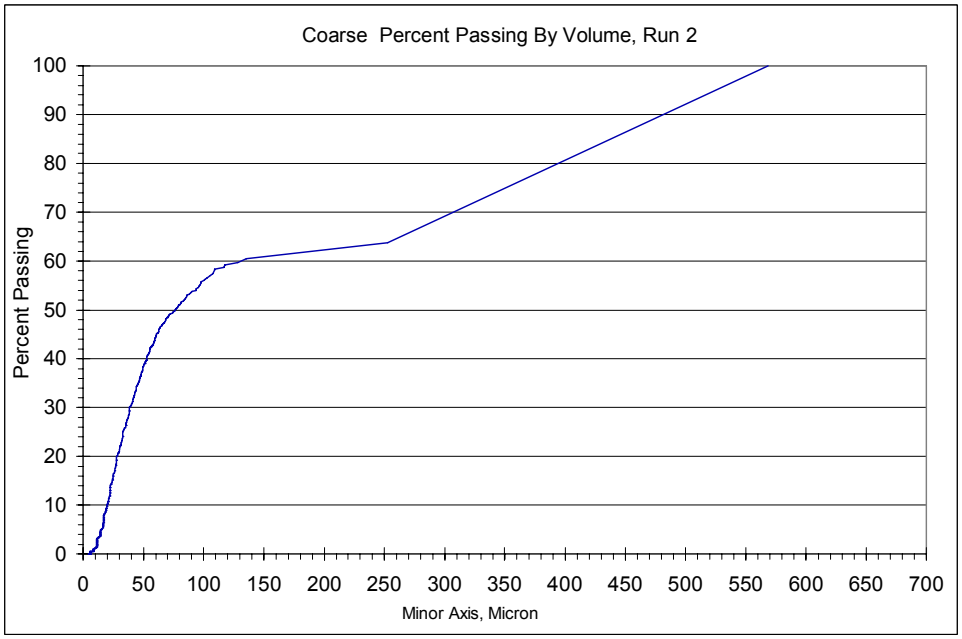


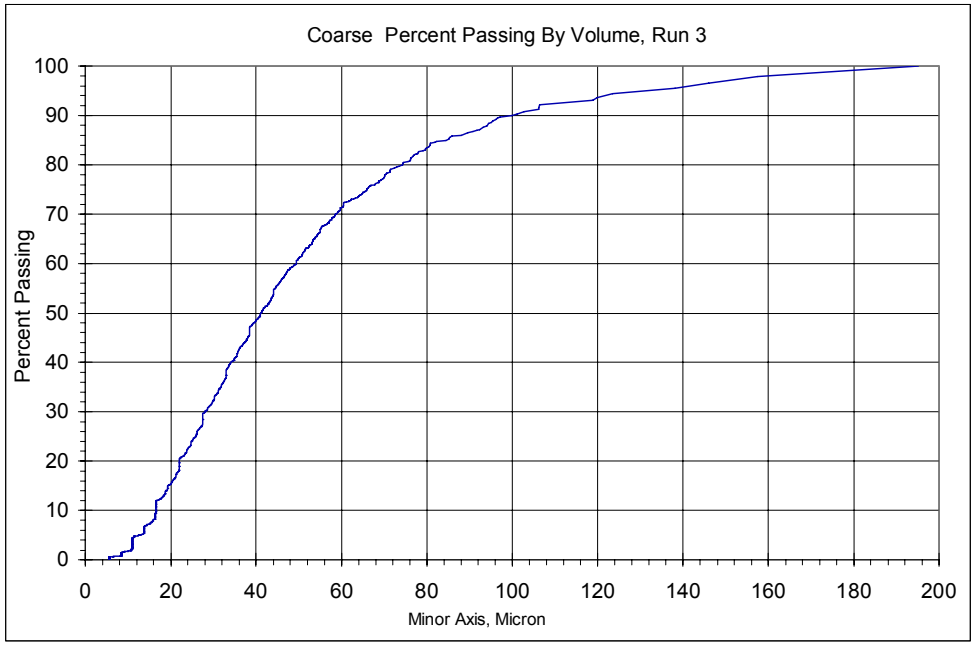

Normal Percent Passing By Volume, Run 3
Percent Passing
100
90
80
70
60
50
40
30
20
10
0
0 10 20 30 40 50 60 70 80 90 100 110 120 130 140
Minor Axis, Micron

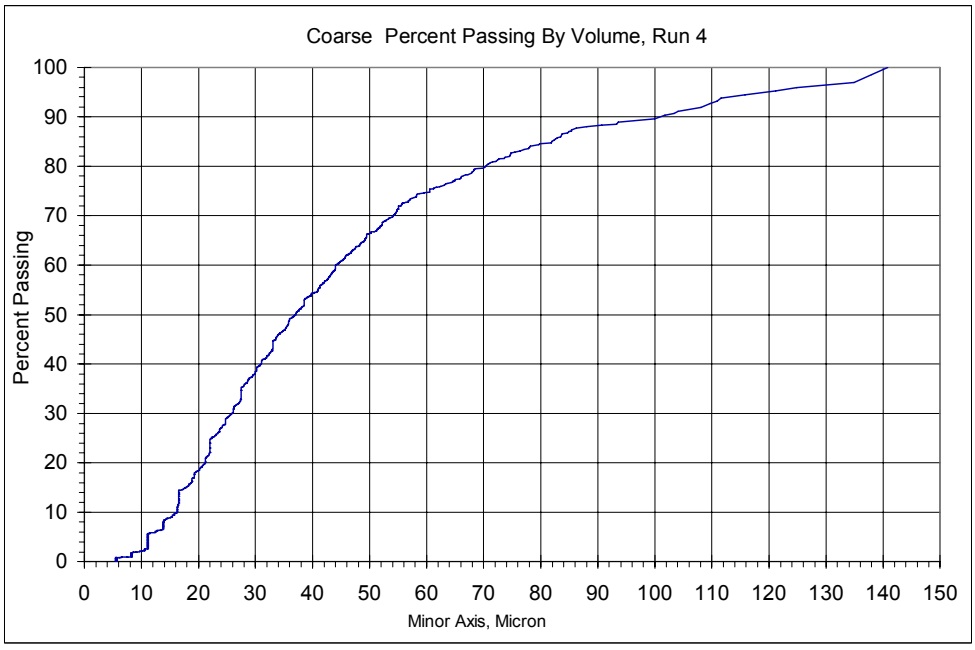

Normal Percent Passing By Volume, Run 4
Percent Passing
100
90
80
70
60
50
40
30
20
10
0
0 20 40 60 80 100 120 140 160 180 200
Minor Axis, Micron

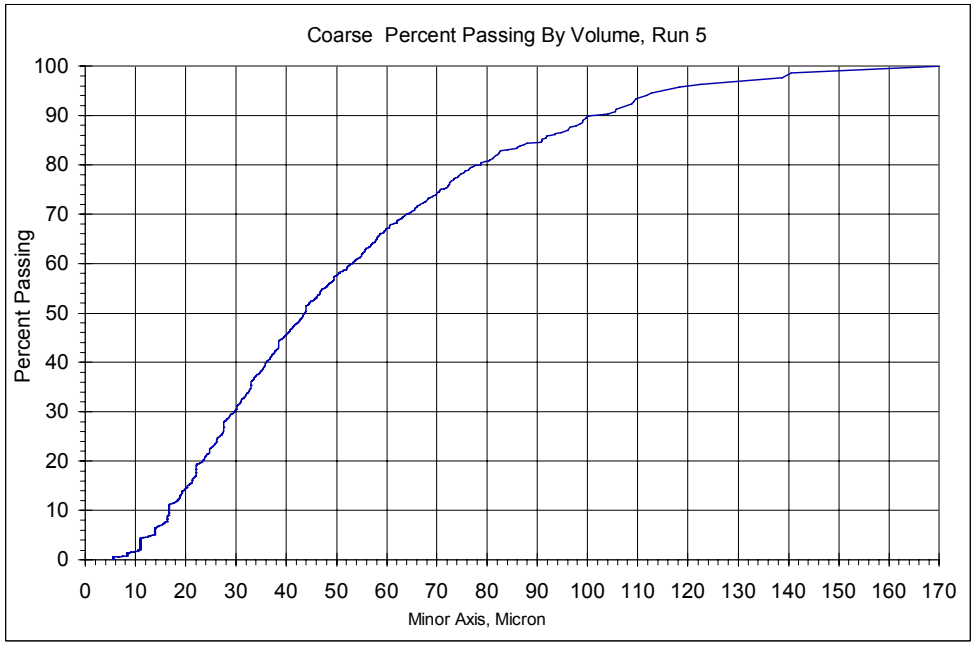
Six size distribution runs for the Coarse Ro Feed sample

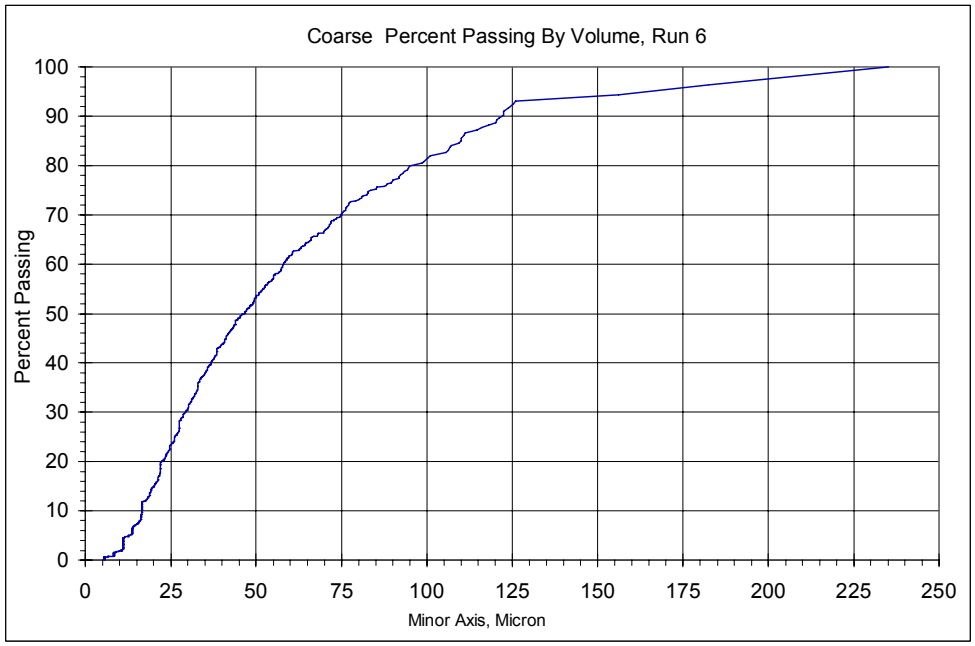




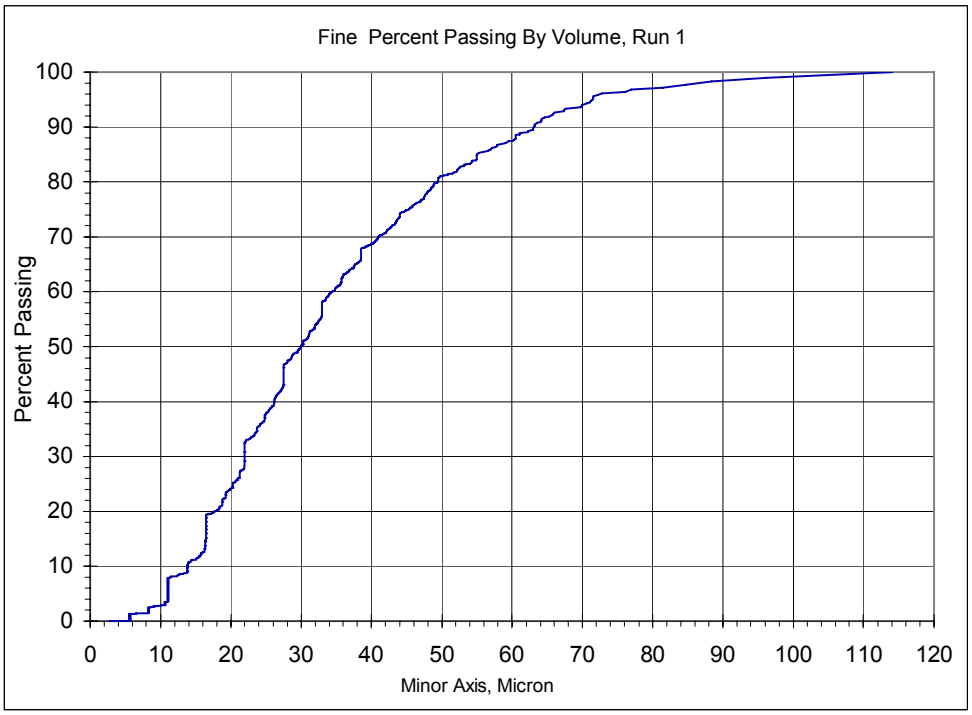

Coarse Percent Passing By Volume, Run 3
Percent Passing
0
10
20
30
40
50
60
70
80
90
100
0
20
40
60
80
100
120
140
160
180
200
Minor Axis, Micron

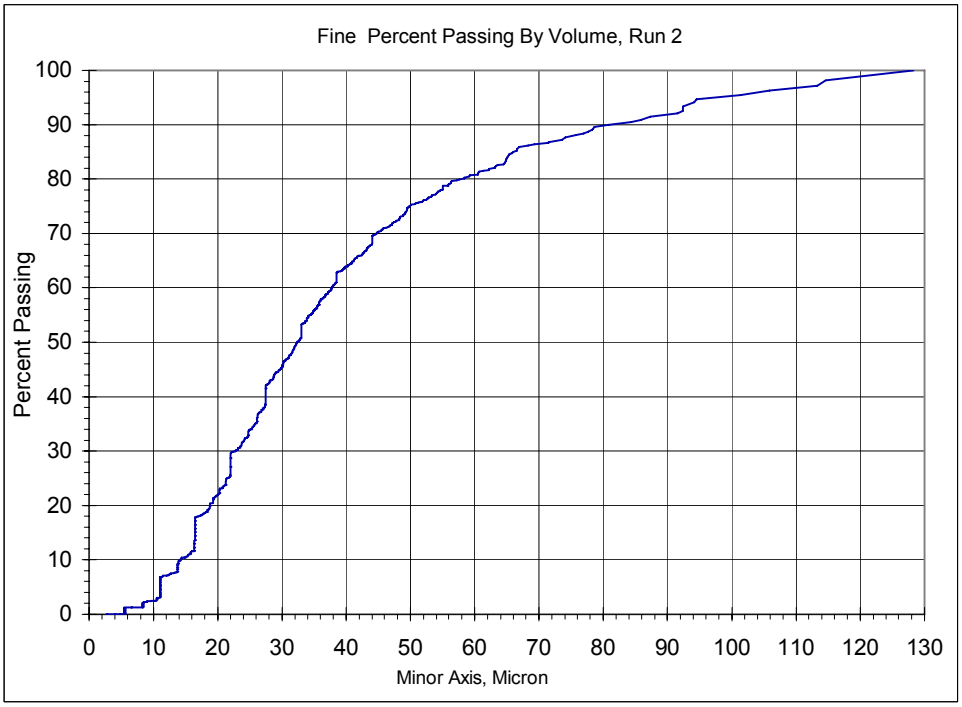

Coarse Percent Passing By Volume, Run 4
Percent Passing
0
10
20
30
40
50
60
70
80
90
100
0
10
20
30
40
50
60
70
80
90
100
110
120
130
140
150
Minor Axis, Micron

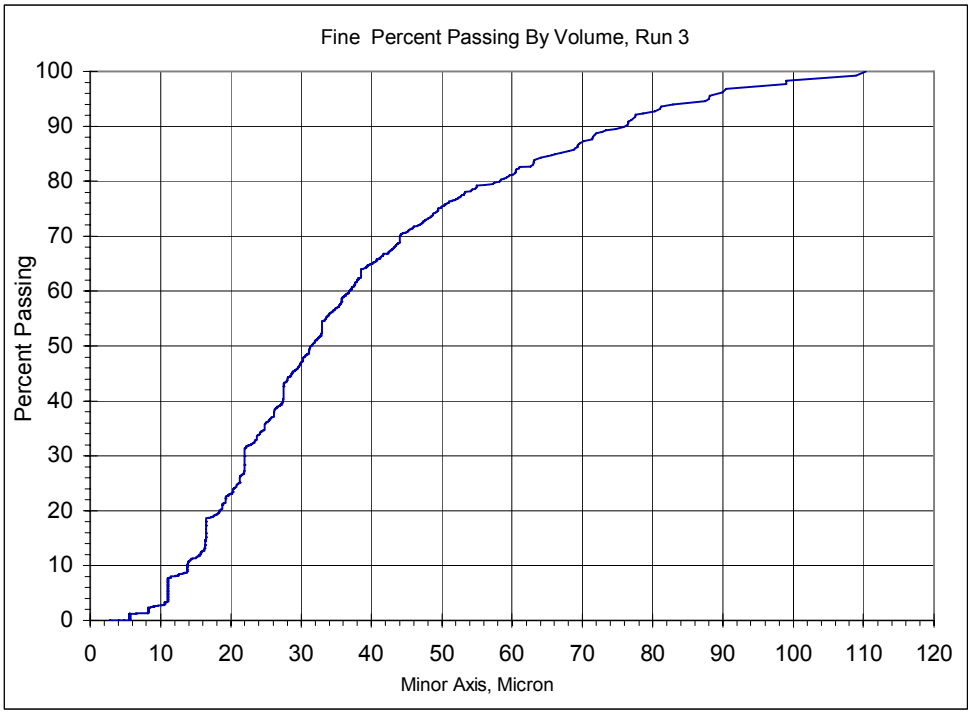

Coarse Percent Passing By Volume, Run 5
Percent Passing
100
90
80
70
60
50
40
30
20
10
0
0 10 20 30 40 50 60 70 80 90 100 110 120 130 140 150 160 170
Minor Axis, Micron

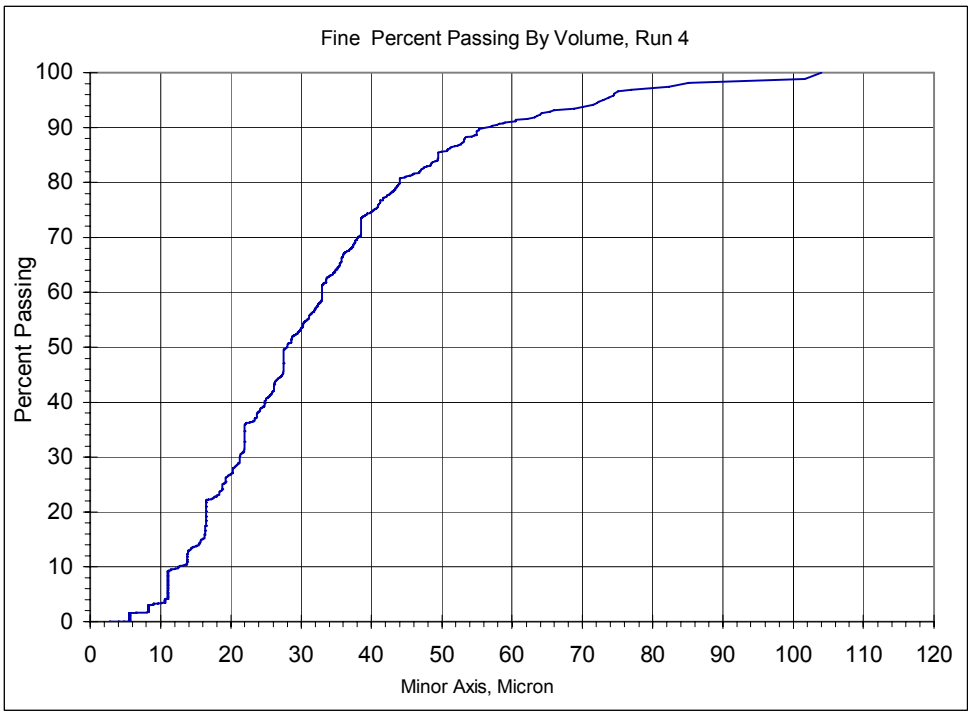

Coarse Percent Passing By Volume, Run 6
Percent Passing
100
90
80
70
60
50
40
30
20
10
0
0 25 50 75 100 125 150 175 200 225 250
Minor Axis, Micron

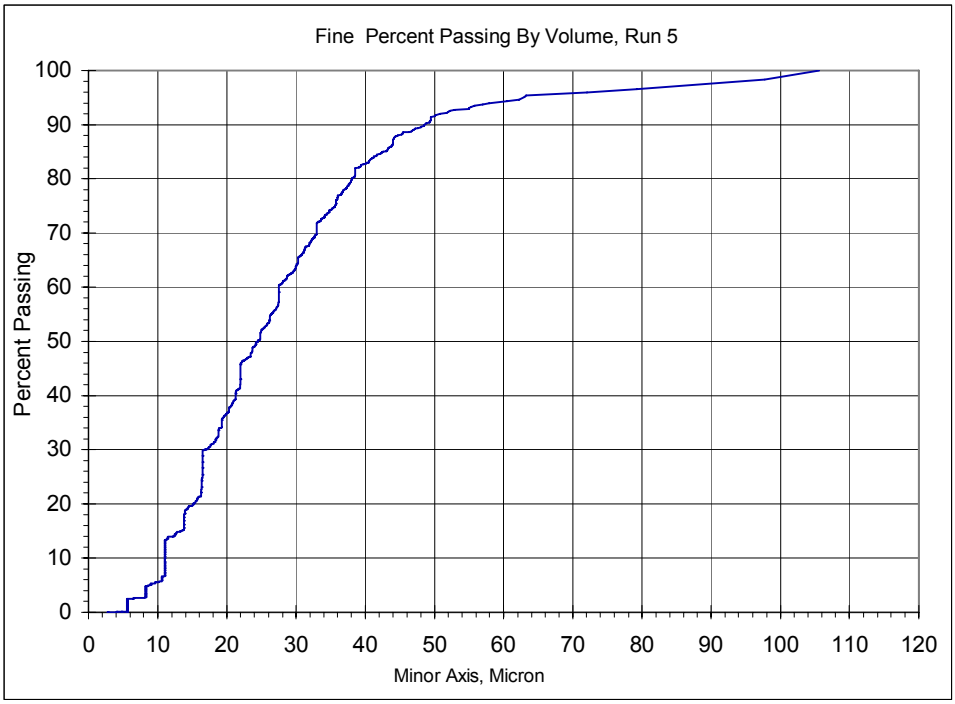
Seven size distribution runs for the Fine Ro Feed sample

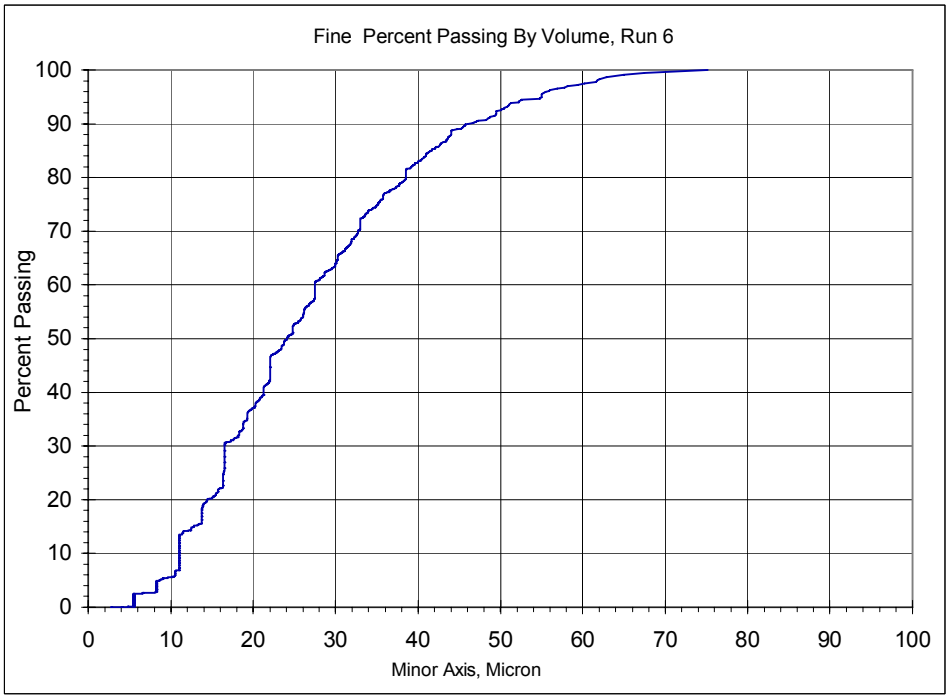


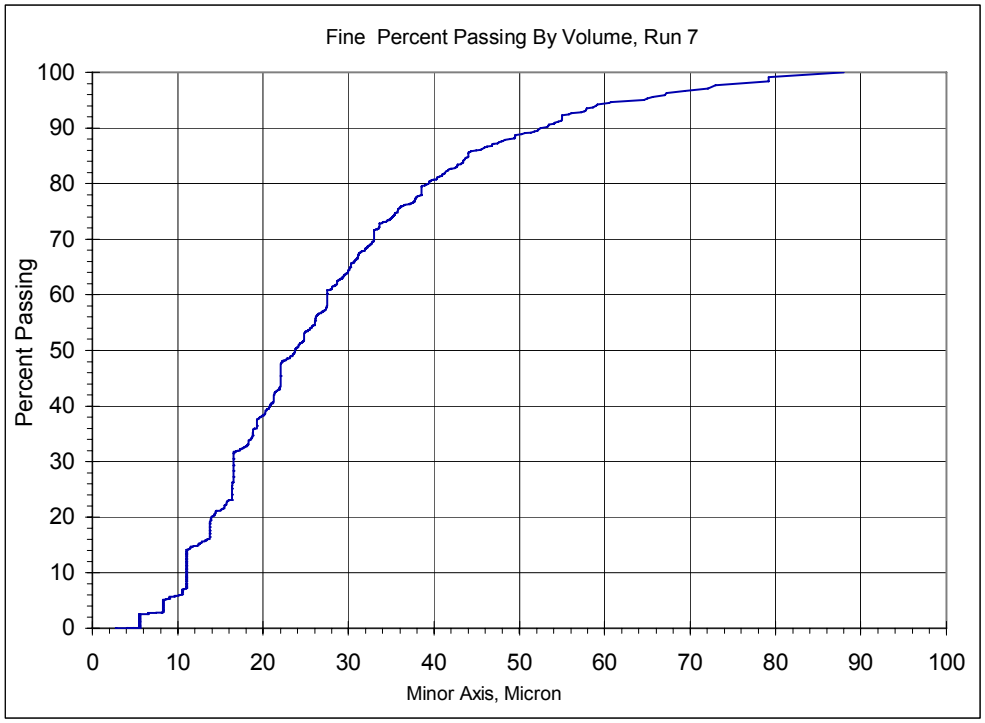



Fine Percent Passing By Volume, Run 3
Percent Passing
100
90
80
70
60
50
40
30
20
10
0
0
10
20
30
40
50
60
70
80
90
100
110
120
Minor Axis, Micron


Fine Percent Passing By Volume, Run 4
Percent Passing
100
90
80
70
60
50
40
30
20
10
0
0
10
20
30
40
50
60
70
80
90
100
110
120
Minor Axis, Micron


Fine Percent Passing By Volume, Run 5
Percent Passing
Minor Axis, Micron
0
10
20
30
40
50
60
70
80
90
100
110
120


Fine Percent Passing By Volume, Run 6
Percent Passing
Minor Axis, Micron
0
10
20
30
40
50
60
70
80
90
100



Discussion: Table 2 shows the Canty vision based measurements of the minor axis size at 10, 50, and 90 percent passing. The three materials have the most distinguishing difference at the 90 percent passing point. The individual runs are reporting the size characteristic for approximately 30,000 particles and when the same material is run again the measured value for a given percent passing is somewhat different. The mean of the several runs can be compared for the three materials. For the coarse material, the mean minor axis is 163 micron at 90 percent passing compared to 90 micron for the normal material and 60 micron for the fine material. It should be noted that the coarse material has more variation from run to run as indicated by the ratio of std dev (standard deviation) to the mean. The camera video was observed during each run providing visual verification of the general results. During the coarse material run several 'large particles' were seen passing the camera. The log normal size distribution expected for many grinding processes has a wide size range that extends with a low count far into the large size range. The data obtained for the coarse material is more representative of the log normal distribution than the others. The low count of these large particles causes a relative wide range in the measured data.

Conclusion: The Canty vision based measurement does make repeatable measurements of the range of Ro Feed materials provided in the three samples. The Canty measured D90 minor axis size is an effective indicator to use for grinding process control. A working control system for size control will require an effective sampling system to extract representative materials from the process and a dilution system to reduce the particle concentration to a useable level.