

Appendix

Table A1. Averaged results of flotation tests of sandstone copper ore in Denver flotation machine (E – water solution of ethyl sodium xanthate; Z – water solution of isobutyl sodium xanthate)

No of test	Flotation machine	Copper ore type		Particle size fraction	Type of collector	Dose of collector
1	Denver	sandstone		0-20 μm	E	100 g/Mg
Product	γ	λ	β	ϑ	ε	η
			12,13%	1,55%	0,00%	100,00%
P1	11.41%	11.35%	11.35%	0.29%	83.44%	16.56%
P2	7.37%	1.31%	7.41%	0.20%	89.67%	10.33%
P3	8.68%	0.53%	5.24%	0.16%	92.63%	7.37%
P4	5.86%	0.36%	4.38%	0.14%	93.98%	6.02%
P5	5.15%	0.37%	3.84%	0.12%	95.19%	4.81%
P6	4.14%	0.30%	3.50%	0.11%	95.99%	4.01%
P7	12.12%	0.15%	2.76%	0.10%	97.14%	2.86%
P8	3.94%	0.13%	2.58%	0.09%	97.48%	2.52%
P9	3.08%	0.10%	2.46%	0.09%	97.68%	2.32%
T	38.26%	0.09%	1.55%	0.00%	100.00%	0.00%
No of test	Flotation machine	Copper ore type		Particle size fraction	Type of collector	Dose of collector
2	Denver	sandstone		0-20 μm	E	150 g/Mg
Product	γ	λ	β	ϑ	ε	η
			2.60%	0.51%	0.00%	100.00%
P1	14.87%	1.82%	1.82%	0.28%	53.14%	46.86%
P2	7.22%	1.29%	1.65%	0.19%	71.47%	28.53%
P3	9.63%	0.28%	1.23%	0.17%	76.71%	23.29%
P4	6.53%	0.38%	1.09%	0.15%	81.53%	18.47%
P5	7.31%	0.32%	0.96%	0.13%	86.05%	13.95%
P6	5.87%	0.29%	0.89%	0.11%	89.40%	10.60%
P7	5.37%	0.25%	0.83%	0.09%	92.08%	7.92%
P8	3.74%	0.20%	0.79%	0.08%	93.53%	6.47%
P9	6.47%	0.14%	0.72%	0.07%	95.34%	4.66%
T	32.98%	0.07%	0.51%	0.00%	100.00%	0.00%
No of test	Flotation machine	Copper ore type		Particle size fraction	Type of collector	Dose of collector
3	Denver	sandstone		0-20 μm	Z	100 g/Mg
Product	γ	λ	β	ϑ	ε	η
			9.22%	1.50%	0.00%	100.00%
P1	11.73%	8.44%	8.44%	0.58%	66.09%	33.91%
P2	4.75%	5.06%	7.47%	0.32%	82.15%	17.85%
P3	9.81%	0.98%	5.05%	0.23%	88.55%	11.45%
P4	5.46%	0.62%	4.29%	0.20%	90.82%	9.18%
P5	5.86%	0.49%	3.69%	0.17%	92.73%	7.27%
P6	3.84%	0.42%	3.39%	0.16%	93.80%	6.20%

P7	4.45%	0.39%	3.10%	0.14%	94.97%	5.03%
P8	2.93%	0.33%	2.93%	0.13%	95.61%	4.39%
P9	3.84%	0.25%	2.74%	0.12%	96.24%	3.76%
T	47.32%	0.12%	1.50%	0.00%	100.00%	0.00%
No of test	Flotation machine	Copper ore type		Particle size fraction	Type of collector	Dose of collector
4	Denver	sandstone		0-20 μm	Z	150 g/Mg
Product	γ	λ	β	ϑ	ε	η
			2.30%	0.54%	0.00%	100.00%
P1	14.35%	1.52%	1.52%	0.37%	40.63%	59.37%
P2	8.88%	1.27%	1.42%	0.27%	61.57%	38.43%
P3	14.88%	0.56%	1.09%	0.20%	77.21%	22.79%
P4	9.81%	0.33%	0.93%	0.17%	83.21%	16.79%
P5	8.74%	0.27%	0.83%	0.15%	87.55%	12.45%
P6	6.74%	0.29%	0.77%	0.13%	91.16%	8.84%
P7	8.48%	0.21%	0.71%	0.11%	94.45%	5.55%
P8	5.54%	0.21%	0.67%	0.08%	96.65%	3.35%
P9	4.30%	0.12%	0.64%	0.07%	97.62%	2.38%
T	18.28%	0.07%	0.54%	0.00%	100.00%	0.00%
No of test	Flotation machine	Copper ore type		Particle size fraction	Type of collector	Dose of collector
5	Denver	sandstone		20-40 μm	E	100 g/Mg
Product	γ	λ	β	ϑ	ε	η
			13.93%	0.63%	0.00%	100.00%
P1	4.33%	13.15%	13.15%	0.06%	90.18%	9.82%
P2	1.91%	0.66%	9.32%	0.05%	92.17%	7.83%
P3	3.22%	0.22%	6.22%	0.05%	93.28%	6.72%
P4	2.22%	0.13%	5.07%	0.04%	93.74%	6.26%
P5	2.52%	0.11%	4.19%	0.04%	94.16%	5.84%
P6	2.11%	0.08%	3.66%	0.04%	94.42%	5.58%
P7	2.42%	0.07%	3.19%	0.04%	94.67%	5.33%
P8	3.83%	0.03%	2.66%	0.04%	94.85%	5.15%
P9	6.24%	0.02%	2.08%	0.04%	95.04%	4.96%
T	71.20%	0.04%	0.63%	0.00%	100.00%	0.00%
No of test	Flotation machine	Copper ore type		Particle size fraction	Type of collector	Dose of collector
6	Denver	sandstone		20-40 μm	E	150 g/Mg
Product	γ	λ	β	ϑ	ε	η
			8.15%	0.61%	0.00%	100.00%
P1	7.52%	7.37%	7.37%	0.06%	91.04%	8.96%
P2	2.20%	0.65%	5.84%	0.04%	93.39%	6.61%
P3	2.91%	0.31%	4.57%	0.04%	94.85%	5.15%
P4	4.01%	0.13%	3.50%	0.03%	95.71%	4.29%
P5	4.81%	0.07%	2.73%	0.03%	96.26%	3.74%
P6	4.71%	0.05%	2.25%	0.03%	96.65%	3.35%
P7	4.41%	0.04%	1.93%	0.03%	96.94%	3.06%
P8	4.11%	0.04%	1.70%	0.03%	97.18%	2.82%

P9	4.81%	0.03%	1.50%	0.03%	97.41%	2.59%
T	60.52%	0.03%	0.61%	0.00%	100.00%	0.00%
No of test	Flotation machine	Copper ore type		Particle size fraction	Type of collector	Dose of collector
7	Denver	sandstone		20-40 μm	Z	100 g/Mg
Product	γ	λ	β	ϑ	ε	η
			18.32%	1.51%	0.00%	100.00%
P1	7.46%	17.54%	17.54%	0.22%	86.46%	13.54%
P2	3.86%	2.10%	12.28%	0.14%	91.82%	8.18%
P3	4.77%	0.88%	8.90%	0.10%	94.58%	5.42%
P4	3.45%	0.37%	7.39%	0.09%	95.43%	4.57%
P5	2.13%	0.33%	6.70%	0.08%	95.89%	4.11%
P6	2.23%	0.24%	6.09%	0.07%	96.24%	3.76%
P7	2.49%	0.22%	5.54%	0.07%	96.60%	3.40%
P8	1.83%	0.17%	5.19%	0.07%	96.80%	3.20%
P9	3.15%	0.13%	4.68%	0.06%	97.08%	2.92%
T	68.63%	0.06%	1.51%	0.00%	100.00%	0.00%
No of test	Flotation machine	Copper ore type		Particle size fraction	Type of collector	Dose of collector
8	Denver	sandstone		20-40 μm	Z	150 g/Mg
Product	γ	λ	β	ϑ	ε	η
			7.43%	0.26%	0.00%	100.00%
P1	2.76%	6.65%	6.65%	0.08%	69.37%	30.63%
P2	3.56%	0.63%	3.26%	0.06%	77.86%	22.14%
P3	2.61%	0.36%	2.41%	0.05%	81.43%	18.57%
P4	3.96%	0.24%	1.75%	0.05%	85.09%	14.91%
P5	3.06%	0.13%	1.44%	0.04%	86.60%	13.40%
P6	3.61%	0.11%	1.19%	0.04%	88.05%	11.95%
P7	2.51%	0.09%	1.07%	0.04%	88.86%	11.14%
P8	2.20%	0.07%	0.97%	0.04%	89.45%	10.55%
P9	3.11%	0.06%	0.87%	0.04%	90.11%	9.89%
T	72.65%	0.04%	0.26%	0.00%	100.00%	0.00%
No of test	Flotation machine	Copper ore type		Particle size fraction	Type of collector	Dose of collector
9	Denver	sandstone		40-71 μm	E	100 g/Mg
Product	γ	λ	β	ϑ	ε	η
			29.04%	1.21%	0.00%	100.00%
P1	3.87%	28.26%	28.26%	0.12%	90.55%	9.45%
P2	1.42%	1.56%	21.07%	0.10%	92.39%	7.61%
P3	2.75%	0.49%	14.04%	0.09%	93.51%	6.49%
P4	2.14%	0.44%	11.18%	0.08%	94.30%	5.70%
P5	1.83%	0.43%	9.54%	0.07%	94.95%	5.05%
P6	1.22%	0.43%	8.70%	0.06%	95.38%	4.62%
P7	2.24%	0.25%	7.48%	0.06%	95.85%	4.15%
P8	2.14%	0.21%	6.60%	0.06%	96.21%	3.79%
P9	2.34%	0.22%	5.85%	0.05%	96.65%	3.35%
T	80.06%	0.05%	1.21%	0.00%	100.00%	0.00%

No of test	Flotation machine	Copper ore type		Particle size fraction	Type of collector	Dose of collector
10	Denver	sandstone		40-71 μm	E	150 g/Mg
Product	γ	λ	β	ϑ	ε	η
			6.13%	0.15%	0.00%	100.00%
P1	2.41%	5.35%	5.35%	0.02%	88.15%	11.85%
P2	1.31%	0.59%	3.68%	0.01%	93.39%	6.61%
P3	2.41%	0.18%	2.30%	0.01%	96.30%	3.70%
P4	1.51%	0.09%	1.87%	0.00%	97.24%	2.76%
P5	1.51%	0.10%	1.57%	0.00%	98.21%	1.79%
P6	1.61%	0.05%	1.35%	0.00%	98.81%	1.19%
P7	1.10%	0.06%	1.23%	0.00%	99.29%	0.71%
P8	1.10%	0.05%	1.13%	0.00%	99.64%	0.36%
P9	1.41%	0.04%	1.02%	0.00%	100.00%	0.00%
T	85.64%	0.00%	0.15%	0.00%	100.00%	0.00%
No of test	Flotation machine	Copper ore type		Particle size fraction	Type of collector	Dose of collector
11	Denver	sandstone		40-71 μm	Z	100 g/Mg
Product	γ	λ	β	ϑ	ε	η
			24.54%	1.10%	0.00%	100.00%
P1	4.05%	23.76%	23.76%	0.14%	87.92%	12.08%
P2	0.61%	5.35%	21.36%	0.10%	90.89%	9.11%
P3	1.32%	2.85%	17.28%	0.07%	94.32%	5.68%
P4	0.71%	2.02%	15.66%	0.05%	95.63%	4.37%
P5	0.71%	1.05%	14.26%	0.04%	96.31%	3.69%
P6	0.71%	0.77%	13.08%	0.04%	96.81%	3.19%
P7	0.61%	0.70%	12.22%	0.03%	97.19%	2.81%
P8	0.41%	0.68%	11.71%	0.03%	97.44%	2.56%
P9	0.30%	0.57%	11.35%	0.03%	97.60%	2.40%
T	90.58%	0.03%	1.10%	0.00%	100.00%	0.00%
No of test	Flotation machine	Copper ore type		Particle size fraction	Type of collector	Dose of collector
12	Denver	sandstone		40-71 μm	Z	150 g/Mg
Product	γ	λ	β	ϑ	ε	η
			5.30%	0.18%	0.00%	100.00%
P1	2.42%	4.52%	4.52%	0.08%	59.93%	40.07%
P2	2.42%	0.92%	2.72%	0.05%	72.08%	27.92%
P3	2.22%	0.60%	2.05%	0.04%	79.31%	20.69%
P4	1.01%	0.64%	1.87%	0.03%	82.82%	17.18%
P5	0.81%	0.54%	1.75%	0.03%	85.21%	14.79%
P6	1.51%	0.25%	1.53%	0.03%	87.31%	12.69%
P7	1.72%	0.19%	1.34%	0.02%	89.10%	10.90%
P8	1.51%	0.08%	1.20%	0.02%	89.79%	10.21%
P9	1.11%	0.07%	1.12%	0.02%	90.20%	9.80%
T	85.27%	0.02%	0.18%	0.00%	100.00%	0.00%
No of test	Flotation machine	Copper ore type		Particle size	Type of collector	Dose of collector

fraction						
13	Denver	sandstone		71-100 μm	E	100 g/Mg
Product	γ	λ	β	ϑ	ε	η
			11.49%	0.40%	0.00%	100.00%
P1	2.96%	10.71%	10.71%	0.09%	78.80%	21.20%
P2	1.95%	1.30%	6.97%	0.06%	85.10%	14.90%
P3	2.82%	0.62%	4.65%	0.05%	89.47%	10.53%
P4	1.61%	0.40%	3.92%	0.04%	91.06%	8.94%
P5	1.81%	0.29%	3.33%	0.03%	92.36%	7.64%
P6	1.68%	0.18%	2.92%	0.03%	93.09%	6.91%
P7	2.35%	0.14%	2.48%	0.03%	93.88%	6.12%
P8	1.34%	0.15%	2.29%	0.03%	94.37%	5.63%
P9	3.29%	0.07%	1.92%	0.03%	94.91%	5.09%
T	80.17%	0.03%	0.40%	0.00%	100.00%	0.00%
No of test	Flotation machine	Copper ore type		Particle size fraction	Type of collector	Dose of collector
14	Denver	sandstone		71-100 μm	E	150 g/Mg
Product	γ	λ	β	ϑ	ε	η
			9.78%	0.44%	0.00%	100.00%
P1	3.88%	9.00%	9.00%	0.09%	80.05%	19.95%
P2	2.46%	1.19%	5.97%	0.06%	86.76%	13.24%
P3	4.36%	0.43%	3.71%	0.04%	91.06%	8.94%
P4	2.21%	0.32%	3.13%	0.04%	92.68%	7.32%
P5	2.99%	0.18%	2.58%	0.03%	93.94%	6.06%
P6	2.57%	0.14%	2.24%	0.03%	94.78%	5.22%
P7	2.78%	0.12%	1.96%	0.02%	95.53%	4.47%
P8	1.77%	0.10%	1.82%	0.02%	95.95%	4.05%
P9	2.16%	0.06%	1.67%	0.02%	96.23%	3.77%
T	74.81%	0.02%	0.44%	0.00%	100.00%	0.00%
No of test	Flotation machine	Copper ore type		Particle size fraction	Type of collector	Dose of collector
15	Denver	sandstone		71-100 μm	Z	100 g/Mg
Product	γ	λ	β	ϑ	ε	η
			6.66%	0.42%	0.00%	100.00%
P1	3.09%	5.88%	5.88%	0.25%	43.20%	56.80%
P2	1.48%	1.81%	4.57%	0.22%	49.55%	50.45%
P3	2.31%	1.10%	3.40%	0.20%	55.63%	44.37%
P4	1.95%	0.71%	2.81%	0.19%	58.93%	41.07%
P5	2.55%	0.94%	2.39%	0.17%	64.60%	35.40%
P6	2.28%	0.31%	2.04%	0.16%	66.30%	33.70%
P7	2.48%	0.26%	1.77%	0.16%	67.85%	32.15%
P8	1.81%	0.22%	1.61%	0.16%	68.78%	31.22%
P9	2.62%	0.16%	1.43%	0.16%	69.76%	30.24%
T	79.44%	0.16%	0.42%	0.00%	100.00%	0.00%
No of test	Flotation machine	Copper ore type		Particle size fraction	Type of collector	Dose of collector
16	Denver	sandstone		71-100 μm	Z	150 g/Mg

Product	γ	λ	β	ϑ	ε	η
			8.10%	0.43%	0.00%	100.00%
P1	4.24%	7.32%	7.32%	0.12%	72.95%	27.05%
P2	2.84%	1.01%	4.79%	0.09%	79.69%	20.31%
P3	4.09%	0.54%	3.23%	0.07%	84.84%	15.16%
P4	2.91%	0.39%	2.65%	0.06%	87.51%	12.49%
P5	3.75%	0.30%	2.15%	0.05%	90.12%	9.88%
P6	2.42%	0.24%	1.92%	0.05%	91.50%	8.50%
P7	2.52%	0.21%	1.73%	0.04%	92.72%	7.28%
P8	1.90%	0.17%	1.61%	0.04%	93.49%	6.51%
P9	1.82%	0.11%	1.51%	0.04%	93.96%	6.04%
T	73.51%	0.04%	0.43%	0.00%	100.00%	0.00%

No of test	Flotation machine	Copper ore type	Particle size fraction	Type of collector	Dose of collector	
17	Denver	sandstone	100-125 μm	E	100 g/Mg	
Product	γ	λ	β	ϑ	ε	η
			10.77%	0.34%	0.00%	100.00%
P1	2.29%	9.99%	9.99%	0.11%	67.67%	32.33%
P2	0.94%	3.28%	8.04%	0.08%	76.83%	23.17%
P3	0.88%	1.61%	6.67%	0.07%	80.99%	19.01%
P4	1.01%	0.70%	5.49%	0.06%	83.08%	16.92%
P5	1.08%	0.44%	4.61%	0.06%	84.48%	15.52%
P6	0.81%	0.39%	4.12%	0.05%	85.41%	14.59%
P7	1.14%	0.24%	3.58%	0.05%	86.20%	13.80%
P8	0.74%	0.30%	3.30%	0.05%	86.86%	13.14%
P9	1.35%	0.17%	2.89%	0.05%	87.52%	12.48%
T	89.76%	0.05%	0.34%	0.00%	100.00%	0.00%

No of test	Flotation machine	Copper ore type	Particle size fraction	Type of collector	Dose of collector	
18	Denver	sandstone	100-125 μm	E	150 g/Mg	
Product	γ	λ	β	ϑ	ε	η
			18.46%	0.42%	0.00%	100.00%
P1	1.84%	17.68%	17.68%	0.09%	77.89%	22.11%
P2	1.41%	2.42%	11.05%	0.06%	86.07%	13.93%
P3	2.03%	0.77%	7.10%	0.04%	89.82%	10.18%
P4	1.34%	0.52%	5.77%	0.04%	91.50%	8.50%
P5	1.87%	0.29%	4.56%	0.03%	92.80%	7.20%
P6	1.07%	0.27%	4.08%	0.03%	93.50%	6.50%
P7	1.38%	0.21%	3.59%	0.03%	94.20%	5.80%
P8	1.37%	0.16%	3.21%	0.03%	94.73%	5.27%
P9	1.54%	0.08%	2.86%	0.02%	95.04%	4.96%
T	86.16%	0.02%	0.42%	0.00%	100.00%	0.00%

No of test	Flotation machine	Copper ore type	Particle size fraction	Type of collector	Dose of collector	
19	Denver	sandstone	100-125 μm	Z	100 g/Mg	
Product	γ	λ	β	ϑ	ε	η
			6.07%	0.30%	0.00%	100.00%

P1	1.85%	5.29%	5.29%	0.20%	32.97%	67.03%
P2	1.30%	1.65%	3.78%	0.18%	40.21%	59.79%
P3	1.92%	0.88%	2.69%	0.17%	45.89%	54.11%
P4	1.37%	0.76%	2.28%	0.16%	49.42%	50.58%
P5	2.87%	0.57%	1.75%	0.15%	54.92%	45.08%
P6	1.57%	0.35%	1.55%	0.14%	56.75%	43.25%
P7	1.57%	0.31%	1.39%	0.14%	58.39%	41.61%
P8	1.09%	0.25%	1.30%	0.14%	59.32%	40.68%
P9	1.09%	0.25%	1.22%	0.14%	60.23%	39.77%
T	85.36%	0.14%	0.30%	0.00%	100.00%	0.00%
No of test	Flotation machine	Copper ore type		Particle size fraction	Type of collector	Dose of collector
20	Denver	sandstone		100-125 μm	Z	150 g/Mg
Product	γ	λ	β	ϑ	ε	η
			9.95%	0.42%	0.00%	100.00%
P1	3.30%	9.17%	9.17%	0.12%	71.64%	28.36%
P2	1.54%	2.15%	6.94%	0.09%	79.49%	20.51%
P3	2.84%	0.78%	4.66%	0.07%	84.69%	15.31%
P4	2.39%	0.50%	3.67%	0.06%	87.50%	12.50%
P5	1.98%	0.43%	3.14%	0.05%	89.52%	10.48%
P6	1.39%	0.37%	2.85%	0.05%	90.75%	9.25%
P7	1.70%	0.33%	2.57%	0.04%	92.08%	7.92%
P8	1.32%	0.26%	2.38%	0.04%	92.90%	7.10%
P9	1.19%	0.20%	2.24%	0.03%	93.47%	6.53%
T	82.36%	0.03%	0.42%	0.00%	100.00%	0.00%
No of test	Flotation machine	Copper ore type		Particle size fraction	Type of collector	Dose of collector
21	Denver	sandstone		125-200 μm	E	100 g/Mg
Product	γ	λ	β	ϑ	ε	η
			12.02%	0.20%	0.00%	100.00%
P1	0.95%	11.24%	11.24%	0.09%	53.25%	46.75%
P2	0.34%	5.96%	9.85%	0.07%	63.33%	36.67%
P3	0.54%	2.79%	7.76%	0.06%	70.88%	29.12%
P4	0.34%	1.15%	6.72%	0.06%	72.83%	27.17%
P5	0.34%	0.94%	5.94%	0.05%	74.41%	25.59%
P6	0.47%	0.69%	5.11%	0.05%	76.04%	23.96%
P7	0.68%	0.52%	4.26%	0.05%	77.81%	22.19%
P8	0.47%	0.46%	3.82%	0.04%	78.91%	21.09%
P9	0.47%	0.46%	3.48%	0.04%	80.00%	20.00%
T	95.39%	0.04%	0.20%	0.00%	100.00%	0.00%
No of test	Flotation machine	Copper ore type		Particle size fraction	Type of collector	Dose of collector
22	Denver	sandstone		125-200 μm	E	150 g/Mg
Product	γ	λ	β	ϑ	ε	η
			12.22%	0.31%	0.00%	100.00%
P1	2.04%	11.44%	11.44%	0.07%	76.03%	23.97%
P2	0.60%	3.65%	9.67%	0.05%	83.18%	16.82%

P3	1.14%	1.16%	7.10%	0.04%	87.48%	12.52%
P4	0.91%	0.59%	5.83%	0.03%	89.23%	10.77%
P5	0.91%	0.44%	4.95%	0.03%	90.55%	9.45%
P6	0.79%	0.34%	4.38%	0.03%	91.44%	8.56%
P7	0.83%	0.27%	3.91%	0.03%	92.16%	7.84%
P8	0.84%	0.11%	3.51%	0.03%	92.46%	7.54%
P9	0.89%	0.14%	3.18%	0.02%	92.87%	7.13%
T	91.04%	0.02%	0.31%	0.00%	100.00%	0.00%
No of test	Flotation machine	Copper ore type		Particle size fraction	Type of collector	Dose of collector
23	Denver	sandstone		125-200 μm	Z	100 g/Mg
Product	γ	λ	β	ϑ	ε	η
			9.28%	0.21%	0.00%	100.00%
P1	0.68%	8.50%	8.50%	0.16%	27.02%	72.98%
P2	0.34%	3.98%	6.99%	0.14%	33.35%	66.65%
P3	0.88%	1.65%	4.51%	0.13%	40.17%	59.83%
P4	0.68%	0.94%	3.57%	0.12%	43.15%	56.85%
P5	1.22%	0.64%	2.63%	0.12%	46.81%	53.19%
P6	1.22%	0.61%	2.14%	0.11%	50.29%	49.71%
P7	1.02%	0.60%	1.88%	0.11%	53.16%	46.84%
P8	0.88%	0.51%	1.70%	0.10%	55.26%	44.74%
P9	0.95%	0.44%	1.55%	0.10%	57.23%	42.77%
T	92.14%	0.10%	0.21%	0.00%	100.00%	0.00%
No of test	Flotation machine	Copper ore type		Particle size fraction	Type of collector	Dose of collector
24	Denver	sandstone		125-200 μm	Z	150 g/Mg
Product	γ	λ	β	ϑ	ε	η
			9.11%	0.27%	0.00%	100.00%
P1	2.22%	8.33%	8.33%	0.09%	67.78%	32.22%
P2	0.92%	1.76%	6.40%	0.07%	73.74%	26.26%
P3	1.27%	1.09%	4.87%	0.06%	78.82%	21.18%
P4	1.34%	0.63%	3.88%	0.05%	81.90%	18.10%
P5	1.08%	0.56%	3.35%	0.05%	84.14%	15.86%
P6	0.60%	0.64%	3.14%	0.04%	85.55%	14.45%
P7	0.91%	0.50%	2.85%	0.04%	87.22%	12.78%
P8	0.77%	0.44%	2.64%	0.03%	88.45%	11.55%
P9	0.67%	0.35%	2.49%	0.03%	89.33%	10.67%
T	90.21%	0.03%	0.27%	0.00%	100.00%	0.00%

Table A2. Averaged results of flotation test of dolomite copper ore in Denver flotation machine (E – water solution of ethyl sodium xanthate; Z – water solution of isobutyl sodium xanthate)

No of test	Flotation machine	Copper ore type		Particle size fraction	Type of collector	Dose of collector
25	Denver	dolomite		0-20 μm	E	100 g/Mg
Product	γ	λ	β	ϑ	ε	η
			5.42%	0.93%	0.00%	100.00%
P1	13.27%	4.64%	4.64%	0.36%	66.45%	33.55%
P2	5.41%	1.42%	3.71%	0.29%	74.75%	25.25%

P3	14.87%	0.71%	2.38%	0.19%	86.17%	13.83%
P4	7.72%	0.38%	2.00%	0.17%	89.33%	10.67%
P5	8.99%	0.28%	1.70%	0.15%	92.08%	7.92%
P6	5.91%	0.29%	1.55%	0.13%	93.91%	6.09%
P7	7.18%	0.22%	1.40%	0.11%	95.62%	4.38%
P8	6.42%	0.17%	1.28%	0.10%	96.77%	3.23%
P9	4.26%	0.14%	1.22%	0.09%	97.39%	2.61%
T	25.97%	0.09%	0.93%	0.00%	100.00%	0.00%
No of test	Flotation machine	Copper ore type		Particle size fraction	Type of collector	Dose of collector
26	Denver	dolomite		0-20 μm	E	150 g/Mg
Product	γ	λ	β	ϑ	ε	η
			4.75%	0.93%	0.00%	100.00%
P1	16.18%	3.97%	3.97%	0.34%	68.99%	31.01%
P2	8.27%	1.24%	3.05%	0.25%	79.96%	20.04%
P3	9.72%	0.60%	2.35%	0.19%	86.23%	13.77%
P4	6.16%	0.45%	2.06%	0.17%	89.19%	10.81%
P5	8.55%	0.31%	1.75%	0.15%	91.99%	8.01%
P6	6.42%	0.26%	1.58%	0.13%	93.81%	6.19%
P7	6.67%	0.21%	1.43%	0.11%	95.33%	4.67%
P8	3.56%	0.25%	1.37%	0.10%	96.27%	3.73%
P9	4.81%	0.17%	1.29%	0.09%	97.17%	2.83%
T	29.65%	0.09%	0.93%	0.00%	100.00%	0.00%
No of test	Flotation machine	Copper ore type		Particle size fraction	Type of collector	Dose of collector
27	Denver	dolomite		0-20 μm	Z	100 g/Mg
Product	γ	λ	β	ϑ	ε	η
			5.40%	0.22%	0.00%	100.00%
P1	4.62%	4.62%	4.62%	0.01%	6.62%	93.38%
P2	0.75%	0.75%	4.08%	0.00%	6.80%	93.20%
P3	0.33%	0.33%	3.86%	0.00%	6.83%	93.17%
P4	0.23%	0.23%	3.72%	0.00%	6.85%	93.15%
P5	0.20%	0.20%	3.60%	0.00%	6.86%	93.14%
P6	0.19%	0.19%	3.50%	0.00%	6.87%	93.13%
P7	0.21%	0.21%	3.40%	0.00%	6.89%	93.11%
P8	0.15%	0.15%	3.32%	0.00%	6.89%	93.11%
P9	0.11%	0.11%	3.27%	0.00%	6.90%	93.10%
T	0.10%	0.10%	3.22%	0.00%	6.90%	93.10%
No of test	Flotation machine	Copper ore type		Particle size fraction	Type of collector	Dose of collector
28	Denver	dolomite		0-20 μm	Z	150 g/Mg
Product	γ	λ	β	ϑ	ε	η
			5.56%	0.87%	0.00%	100.00%
P1	13.68%	4.78%	4.78%	0.26%	74.80%	25.20%
P2	12.68%	0.59%	2.76%	0.20%	83.33%	16.67%
P3	14.07%	0.33%	1.91%	0.17%	88.57%	11.43%
P4	11.35%	0.25%	1.55%	0.15%	91.80%	8.20%
P5	8.94%	0.22%	1.35%	0.13%	94.00%	6.00%
P6	7.34%	0.17%	1.22%	0.13%	95.43%	4.57%
P7	4.22%	0.17%	1.16%	0.12%	96.27%	3.73%
P8	2.77%	0.17%	1.13%	0.11%	96.81%	3.19%

P9	3.18%	0.16%	1.09%	0.11%	97.39%	2.61%
T	21.76%	0.11%	0.87%	0.00%	100.00%	0.00%
No of test	Flotation machine	Copper ore type		Particle size fraction	Type of collector	Dose of collector
29	Denver	dolomite		20-40 μm	E	100 g/Mg
Product	γ	λ	β	ϑ	ε	η
			14.58%	1.40%	0.00%	100.00%
P1	8.47%	13.80%	13.80%	0.25%	83.45%	16.55%
P2	5.34%	1.20%	8.93%	0.19%	88.03%	11.97%
P3	4.08%	1.01%	7.12%	0.15%	90.98%	9.02%
P4	2.92%	0.58%	6.20%	0.14%	92.19%	7.81%
P5	3.88%	0.53%	5.31%	0.12%	93.66%	6.34%
P6	2.67%	0.41%	4.83%	0.11%	94.44%	5.56%
P7	2.52%	0.38%	4.46%	0.10%	95.12%	4.88%
P8	3.07%	0.29%	4.07%	0.09%	95.76%	4.24%
P9	3.38%	0.25%	3.71%	0.08%	96.36%	3.64%
T	63.66%	0.08%	1.40%	0.00%	100.00%	0.00%
No of test	Flotation machine	Copper ore type		Particle size fraction	Type of collector	Dose of collector
30	Denver	dolomite		20-40 μm	E	150 g/Mg
Product	γ	λ	β	ϑ	ε	η
			13.23%	1.20%	0.00%	100.00%
P1	7.84%	12.45%	12.45%	0.24%	81.34%	18.66%
P2	6.92%	0.98%	7.07%	0.18%	86.99%	13.01%
P3	3.54%	0.93%	5.89%	0.15%	89.73%	10.27%
P4	3.23%	0.49%	5.07%	0.14%	91.04%	8.96%
P5	4.80%	0.43%	4.23%	0.12%	92.74%	7.26%
P6	2.29%	0.32%	3.91%	0.11%	93.34%	6.66%
P7	2.02%	0.35%	3.68%	0.11%	93.93%	6.07%
P8	2.23%	0.23%	3.45%	0.10%	94.36%	5.64%
P9	3.28%	0.22%	3.15%	0.10%	94.95%	5.05%
T	63.84%	0.10%	1.20%	0.00%	100.00%	0.00%
No of test	Flotation machine	Copper ore type		Particle size fraction	Type of collector	Dose of collector
31	Denver	dolomite		20-40 μm	Z	100 g/Mg
Product	γ	λ	β	ϑ	ε	η
			14.33%	1.07%	0.00%	100.00%
P1	6.25%	13.55%	13.55%	0.24%	79.00%	21.00%
P2	3.23%	1.58%	9.48%	0.19%	83.76%	16.24%
P3	3.46%	0.89%	7.18%	0.16%	86.63%	13.37%
P4	3.06%	0.62%	5.93%	0.15%	88.39%	11.61%
P5	2.98%	0.47%	5.07%	0.14%	89.71%	10.29%
P6	1.62%	0.38%	4.70%	0.13%	90.28%	9.72%
P7	2.16%	0.28%	4.28%	0.13%	90.85%	9.15%
P8	2.02%	0.24%	3.95%	0.12%	91.31%	8.69%
P9	2.55%	0.21%	3.60%	0.12%	91.81%	8.19%
T	72.65%	0.12%	1.07%	0.00%	100.00%	0.00%
No of test	Flotation machine	Copper ore type		Particle size fraction	Type of collector	Dose of collector
32	Denver	dolomite		20-40 μm	Z	150 g/Mg
Product	γ	λ	β	ϑ	ε	η

			17.59%	1.05%	0.00%	100.00%
P1	4.73%	16.81%	16.81%	0.27%	75.81%	24.19%
P2	2.91%	2.20%	11.25%	0.21%	81.90%	18.10%
P3	3.03%	0.98%	8.33%	0.18%	84.74%	15.26%
P4	3.43%	0.65%	6.46%	0.16%	86.87%	13.13%
P5	3.35%	0.50%	5.32%	0.15%	88.47%	11.53%
P6	2.78%	0.39%	4.64%	0.14%	89.50%	10.50%
P7	3.06%	0.31%	4.07%	0.13%	90.41%	9.59%
P8	2.90%	0.27%	3.65%	0.13%	91.15%	8.85%
P9	4.20%	0.22%	3.18%	0.12%	92.03%	7.97%
T	69.62%	0.12%	1.05%	0.00%	100.00%	0.00%
No of test	Flotation machine	Copper ore type		Particle size fraction	Type of collector	Dose of collector
33	Denver	dolomite		40-71 μm	E	100 g/Mg
Product	γ	λ	β	ϑ	ε	η
			14.32%	1.23%	0.00%	100.00%
P1	6.41%	13.54%	13.54%	0.39%	70.67%	29.33%
P2	5.81%	2.30%	8.20%	0.26%	81.54%	18.46%
P3	4.21%	1.36%	6.44%	0.20%	86.21%	13.79%
P4	4.16%	0.98%	5.34%	0.16%	89.52%	10.48%
P5	2.61%	0.96%	4.85%	0.14%	91.56%	8.44%
P6	1.65%	0.71%	4.57%	0.12%	92.51%	7.49%
P7	2.20%	0.54%	4.25%	0.11%	93.48%	6.52%
P8	2.55%	0.41%	3.91%	0.10%	94.34%	5.66%
P9	2.61%	0.33%	3.62%	0.09%	95.04%	4.96%
T	67.78%	0.09%	1.23%	0.00%	100.00%	0.00%
No of test	Flotation machine	Copper ore type		Particle size fraction	Type of collector	Dose of collector
34	Denver	dolomite		40-71 μm	E	150 g/Mg
Product	γ	λ	β	ϑ	ε	η
			12.92%	1.21%	0.00%	100.00%
P1	6.93%	12.14%	12.14%	0.39%	69.70%	30.30%
P2	5.55%	1.77%	7.52%	0.31%	77.83%	22.17%
P3	4.44%	1.20%	5.86%	0.26%	82.25%	17.75%
P4	3.33%	0.88%	5.04%	0.23%	84.67%	15.33%
P5	1.89%	0.87%	4.68%	0.22%	86.03%	13.97%
P6	1.91%	0.63%	4.36%	0.21%	87.03%	12.97%
P7	2.51%	0.50%	4.00%	0.20%	88.06%	11.94%
P8	2.25%	0.35%	3.71%	0.19%	88.72%	11.28%
P9	2.98%	0.24%	3.39%	0.19%	89.31%	10.69%
T	68.20%	0.19%	1.21%	0.00%	100.00%	0.00%
No of test	Flotation machine	Copper ore type		Particle size fraction	Type of collector	Dose of collector
35	Denver	dolomite		40-71 μm	Z	100 g/Mg
Product	γ	λ	β	ϑ	ε	η
			14.93%	1.27%	0.00%	100.00%
P1	6.09%	14.15%	14.15%	0.43%	67.93%	32.07%
P2	2.04%	3.56%	11.50%	0.36%	73.65%	26.35%
P3	2.33%	1.94%	9.37%	0.32%	77.22%	22.78%
P4	2.31%	1.35%	7.92%	0.30%	79.68%	20.32%
P5	2.37%	1.12%	6.85%	0.27%	81.77%	18.23%

P6	1.10%	1.16%	6.47%	0.26%	82.77%	17.23%
P7	2.38%	0.78%	5.74%	0.25%	84.25%	15.75%
P8	1.96%	0.69%	5.26%	0.23%	85.31%	14.69%
P9	2.10%	0.52%	4.82%	0.23%	86.17%	13.83%
T	77.33%	0.23%	1.27%	0.00%	100.00%	0.00%
No of test	Flotation machine	Copper ore type		Particle size fraction	Type of collector	Dose of collector
36	Denver	dolomite		40-71 μm	Z	150 g/Mg
Product	γ	λ	β	ϑ	ε	η
			13.99%	1.22%	0.00%	100.00%
P1	6.14%	13.21%	13.21%	0.44%	66.25%	33.75%
P2	2.96%	2.92%	9.86%	0.36%	73.30%	26.70%
P3	3.30%	1.78%	7.71%	0.31%	78.08%	21.92%
P4	2.10%	1.33%	6.79%	0.28%	80.36%	19.64%
P5	1.96%	0.93%	6.09%	0.27%	81.84%	18.16%
P6	1.48%	0.77%	5.65%	0.26%	82.77%	17.23%
P7	1.34%	0.74%	5.31%	0.25%	83.58%	16.42%
P8	1.20%	0.65%	5.04%	0.24%	84.22%	15.78%
P9	1.10%	0.68%	4.82%	0.24%	84.83%	15.17%
T	78.42%	0.24%	1.22%	0.00%	100.00%	0.00%
No of test	Flotation machine	Copper ore type		Particle size fraction	Type of collector	Dose of collector
37	Denver	dolomite		71-100 μm	E	100 g/Mg
Product	γ	λ	β	ϑ	ε	η
			10.88%	1.26%	0.00%	100.00%
P1	7.11%	10.10%	10.10%	0.58%	57.08%	42.92%
P2	3.04%	3.20%	8.03%	0.49%	64.81%	35.19%
P3	7.64%	1.50%	5.23%	0.40%	73.93%	26.07%
P4	5.23%	1.00%	4.27%	0.36%	78.09%	21.91%
P5	5.36%	0.79%	3.61%	0.33%	81.46%	18.54%
P6	3.55%	0.68%	3.28%	0.31%	83.38%	16.62%
P7	4.59%	0.55%	2.94%	0.29%	85.39%	14.61%
P8	1.74%	0.57%	2.83%	0.28%	86.18%	13.82%
P9	4.79%	0.42%	2.56%	0.27%	87.78%	12.22%
T	56.93%	0.27%	1.26%	0.00%	100.00%	0.00%
No of test	Flotation machine	Copper ore type		Particle size fraction	Type of collector	Dose of collector
38	Denver	dolomite		71-100 μm	E	150 g/Mg
Product	γ	λ	β	ϑ	ε	η
			9.58%	1.25%	0.00%	100.00%
P1	8.23%	8.80%	8.80%	0.57%	57.94%	42.06%
P2	5.76%	2.06%	6.03%	0.47%	67.42%	32.58%
P3	7.87%	1.31%	4.33%	0.39%	75.66%	24.34%
P4	5.19%	0.87%	3.67%	0.36%	79.27%	20.73%
P5	4.25%	0.75%	3.27%	0.33%	81.82%	18.18%
P6	4.35%	0.62%	2.95%	0.31%	83.97%	16.03%
P7	3.83%	0.58%	2.72%	0.29%	85.75%	14.25%
P8	3.41%	0.48%	2.54%	0.28%	87.06%	12.94%
P9	5.29%	0.42%	2.31%	0.27%	88.81%	11.19%
T	51.82%	0.27%	1.25%	0.00%	100.00%	0.00%
No of test	Flotation	Copper ore		Particle size	Type of	Dose of

	machine	type		fraction	collector	collector
39	Denver	dolomite		71-100 μm	Z	100 g/Mg
Product	γ	λ	β	ϑ	ε	η
			0.10477	0.012155	0	1
P1	0.079786	0.09697	0.09697	0.004801	0.636508	0.363492
P2	0.04008	0.01913	0.070942	0.004149	0.699587	0.300413
P3	0.051429	0.01261	0.053429	0.003624	0.75294	0.24706
P4	0.051787	0.00806	0.042897	0.003328	0.787279	0.212721
P5	0.041905	0.00545	0.036975	0.003207	0.806068	0.193932
P6	0.029495	0.0054	0.033812	0.003115	0.819172	0.180828
P7	0.040601	0.00417	0.030221	0.003051	0.8331	0.1669
P8	0.025477	0.00431	0.02839	0.003001	0.842134	0.157866
P9	0.031002	0.004	0.026459	0.00295	0.852336	0.147664
T	0.608438	0.00295	0.012155	0	1	0
No of test	Flotation machine	Copper ore type		Particle size fraction	Type of collector	Dose of collector
40	Denver	dolomite		71-100 μm	Z	150 g/Mg
Product	γ	λ	β	ϑ	ε	η
			0.10091	0.012088	0	1
P1	0.083293	0.09311	0.09311	0.004727	0.641561	0.358439
P2	0.05516	0.01759	0.063023	0.003903	0.721826	0.278174
P3	0.061546	0.00988	0.046669	0.003443	0.772128	0.227872
P4	0.047246	0.00683	0.039056	0.003231	0.798822	0.201178
P5	0.038151	0.00545	0.034564	0.003112	0.816022	0.183978
P6	0.026395	0.00524	0.032081	0.003031	0.827464	0.172536
P7	0.036363	0.00418	0.029167	0.002966	0.840038	0.159962
P8	0.022363	0.004	0.027648	0.00293	0.847438	0.152562
P9	0.020726	0.00351	0.02637	0.00291	0.853456	0.146544
T	0.608757	0.00291	0.012088	0	1	0
No of test	Flotation machine	Copper ore type		Particle size fraction	Type of collector	Dose of collector
41	Denver	dolomite		100-125 μm	E	100 g/Mg
Product	γ	λ	β	ϑ	ε	η
			8.83%	1.25%	0.00%	100.00%
P1	8.75%	8.05%	8.05%	0.60%	56.26%	43.74%
P2	6.13%	2.16%	5.62%	0.49%	66.83%	33.17%
P3	2.45%	1.44%	5.03%	0.46%	69.65%	30.35%
P4	3.89%	1.04%	4.30%	0.43%	72.88%	27.12%
P5	4.97%	0.88%	3.65%	0.40%	76.37%	23.63%
P6	1.89%	0.75%	3.46%	0.39%	77.50%	22.50%
P7	3.99%	0.69%	3.11%	0.37%	79.70%	20.30%
P8	2.80%	0.68%	2.92%	0.36%	81.22%	18.78%
P9	3.29%	0.57%	2.71%	0.35%	82.72%	17.28%
T	61.83%	0.35%	1.25%	0.00%	100.00%	0.00%
No of test	Flotation machine	Copper ore type		Particle size fraction	Type of collector	Dose of collector
42	Denver	dolomite		100-125 μm	E	150 g/Mg
Product	γ	λ	β	ϑ	ε	η
			8.48%	1.21%	0.00%	100.00%
P1	9.30%	7.70%	7.70%	0.54%	59.28%	40.72%
P2	0.60%	1.80%	7.35%	0.53%	60.16%	39.84%

P3	8.18%	1.39%	4.65%	0.45%	69.58%	30.42%
P4	4.65%	1.06%	3.92%	0.41%	73.66%	26.34%
P5	3.61%	0.83%	3.49%	0.39%	76.14%	23.86%
P6	3.61%	0.79%	3.17%	0.37%	78.50%	21.50%
P7	0.11%	0.75%	3.16%	0.37%	78.57%	21.43%
P8	2.68%	0.64%	2.95%	0.36%	79.99%	20.01%
P9	3.46%	0.53%	2.72%	0.35%	81.51%	18.49%
T	63.82%	0.35%	1.21%	0.00%	100.00%	0.00%
No of test	Flotation machine	Copper ore type		Particle size fraction	Type of collector	Dose of collector
43	Denver	dolomite		100-125 μm	Z	100 g/Mg
Product	γ	λ	β	ϑ	ε	η
			10.02%	1.20%	0.00%	100.00%
P1	8.09%	9.24%	9.24%	0.50%	62.06%	37.94%
P2	3.82%	1.97%	6.91%	0.43%	68.30%	31.70%
P3	3.52%	1.02%	5.56%	0.41%	71.29%	28.71%
P4	3.46%	0.79%	4.69%	0.39%	73.56%	26.44%
P5	2.75%	0.64%	4.18%	0.38%	75.02%	24.98%
P6	1.82%	0.52%	3.89%	0.38%	75.81%	24.19%
P7	1.73%	0.47%	3.66%	0.38%	76.48%	23.52%
P8	1.30%	0.41%	3.50%	0.38%	76.92%	23.08%
P9	1.73%	0.30%	3.30%	0.38%	77.35%	22.65%
T	71.79%	0.38%	1.20%	0.00%	100.00%	0.00%
No of test	Flotation machine	Copper ore type		Particle size fraction	Type of collector	Dose of collector
44	Denver	dolomite		100-125 μm	Z	150 g/Mg
Product	γ	λ	β	ϑ	ε	η
			9.29%	1.16%	0.00%	100.00%
P1	8.34%	8.51%	8.51%	0.50%	60.99%	39.01%
P2	3.73%	2.23%	6.57%	0.42%	68.12%	31.88%
P3	4.36%	1.13%	5.13%	0.39%	72.33%	27.67%
P4	3.82%	0.81%	4.31%	0.37%	74.99%	25.01%
P5	3.12%	0.60%	3.82%	0.36%	76.60%	23.40%
P6	2.11%	0.55%	3.55%	0.35%	77.60%	22.40%
P7	2.14%	0.50%	3.31%	0.35%	78.52%	21.48%
P8	1.51%	0.49%	3.16%	0.34%	79.15%	20.85%
P9	1.22%	0.48%	3.06%	0.34%	79.66%	20.34%
T	69.66%	0.34%	1.16%	0.00%	100.00%	0.00%
No of test	Flotation machine	Copper ore type		Particle size fraction	Type of collector	Dose of collector
45	Denver	dolomite		125-200 μm	E	100 g/Mg
Product	γ	λ	β	ϑ	ε	η
			6.38%	1.14%	0.00%	100.00%
P1	11.47%	5.60%	5.60%	0.56%	56.26%	43.74%
P2	5.65%	1.90%	4.38%	0.47%	65.66%	34.34%
P3	4.58%	1.36%	3.74%	0.42%	71.12%	28.88%
P4	4.35%	1.00%	3.28%	0.39%	74.93%	25.07%
P5	3.48%	0.90%	3.00%	0.36%	77.67%	22.33%
P6	2.24%	0.85%	2.85%	0.35%	79.34%	20.66%
P7	2.84%	0.72%	2.68%	0.33%	81.13%	18.87%
P8	1.67%	0.55%	2.58%	0.32%	81.93%	18.07%

P9	1.00%	0.55%	2.52%	0.32%	82.42%	17.58%
T	62.72%	0.32%	1.14%	0.00%	100.00%	0.00%
No of test	Flotation machine	Copper ore type		Particle size fraction	Type of collector	Dose of collector
46	Denver	dolomite		125-200 μm	E	150 g/Mg
Product	γ	λ	β	ϑ	ε	η
			6.28%	1.13%	0.00%	100.00%
P1	11.16%	5.50%	5.50%	0.58%	54.28%	45.72%
P2	4.82%	1.70%	4.35%	0.52%	61.54%	38.46%
P3	5.19%	1.35%	3.62%	0.46%	67.74%	32.26%
P4	3.08%	1.10%	3.30%	0.44%	70.74%	29.26%
P5	2.81%	1.08%	3.07%	0.41%	73.43%	26.57%
P6	2.04%	0.55%	2.89%	0.41%	74.42%	25.58%
P7	2.14%	0.98%	2.76%	0.39%	76.28%	23.72%
P8	2.04%	0.88%	2.64%	0.37%	77.87%	22.13%
P9	1.61%	0.58%	2.55%	0.37%	78.69%	21.31%
T	65.09%	0.37%	1.13%	0.00%	100.00%	0.00%
No of test	Flotation machine	Copper ore type		Particle size fraction	Type of collector	Dose of collector
47	Denver	dolomite		125-200 μm	Z	100 g/Mg
Product	γ	λ	β	ϑ	ε	η
			9.13%	1.18%	0.00%	100.00%
P1	7.63%	8.35%	8.35%	0.58%	54.14%	45.86%
P2	3.68%	2.00%	6.28%	0.53%	60.40%	39.60%
P3	3.92%	1.17%	4.97%	0.50%	64.29%	35.71%
P4	2.71%	0.85%	4.34%	0.48%	66.24%	33.76%
P5	1.74%	0.67%	4.02%	0.48%	67.23%	32.77%
P6	0.83%	0.53%	3.88%	0.48%	67.60%	32.40%
P7	1.83%	0.55%	3.60%	0.48%	68.46%	31.54%
P8	0.84%	0.48%	3.49%	0.48%	68.80%	31.20%
P9	0.99%	0.61%	3.37%	0.48%	69.32%	30.68%
T	75.83%	0.48%	1.18%	0.00%	100.00%	0.00%
No of test	Flotation machine	Copper ore type		Particle size fraction	Type of collector	Dose of collector
48	Denver	dolomite		125-200 μm	Z	150 g/Mg
Product	γ	λ	β	ϑ	ε	η
			8.27%	1.16%	0.00%	100.00%
P1	7.93%	7.49%	7.49%	0.61%	51.33%	48.67%
P2	4.52%	2.26%	5.59%	0.53%	60.17%	39.83%
P3	4.65%	1.26%	4.41%	0.49%	65.21%	34.79%
P4	2.86%	1.00%	3.92%	0.47%	67.68%	32.32%
P5	2.53%	0.89%	3.58%	0.45%	69.62%	30.38%
P6	1.78%	0.67%	3.37%	0.45%	70.65%	29.35%
P7	1.22%	0.72%	3.24%	0.44%	71.42%	28.58%
P8	0.98%	0.78%	3.15%	0.44%	72.07%	27.93%
P9	2.21%	0.64%	2.96%	0.43%	73.30%	26.70%
T	71.32%	0.43%	1.16%	0.00%	100.00%	0.00%

Table A3. Averaged results of flotation test of shale copper ore in Denver flotation machine (E – water solution of ethyl sodium xanthate; Z – water solution of isobutyl sodium xanthate)

No of test	Flotation	Copper ore	Particle	Type of	Dose of
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	machine	type		size fraction	collector	collector
49	Denver	shale		0-20 μm	E	100 g/Mg
Product	γ	λ	β	ϑ	ε	η
			7.53%	1.76%	0.00%	100.00%
P1	17.56%	6.75%	6.75%	0.70%	67.38%	32.62%
P2	10.37%	2.18%	5.05%	0.48%	80.19%	19.81%
P3	16.19%	1.10%	3.60%	0.30%	90.28%	9.72%
P4	11.53%	0.52%	2.96%	0.25%	93.69%	6.31%
P5	11.14%	0.38%	2.53%	0.20%	96.09%	3.91%
P6	8.10%	0.26%	2.29%	0.19%	97.29%	2.71%
P7	5.31%	0.25%	2.15%	0.17%	98.03%	1.97%
P8	4.91%	0.17%	2.04%	0.17%	98.51%	1.49%
P9	2.70%	0.18%	1.98%	0.17%	98.78%	1.22%
T	12.15%	0.17%	1.76%	0.00%	99.96%	0.04%
No of test	Flotation machine	Copper ore type		Particle size fraction	Type of collector	Dose of collector
50	Denver	shale		0-20 μm	E	150 g/Mg
Product	γ	λ	β	ϑ	ε	η
			6.23%	1.75%	0.00%	100.00%
P1	21.03%	5.45%	5.45%	0.76%	65.52%	34.48%
P2	7.57%	3.38%	4.90%	0.49%	80.15%	19.85%
P3	17.17%	1.08%	3.47%	0.30%	90.70%	9.30%
P4	13.82%	0.50%	2.78%	0.23%	94.65%	5.35%
P5	9.28%	0.37%	2.45%	0.19%	96.59%	3.41%
P6	6.73%	0.29%	2.26%	0.16%	97.70%	2.30%
P7	4.83%	0.27%	2.14%	0.14%	98.45%	1.55%
P8	4.93%	0.21%	2.03%	0.11%	99.04%	0.96%
P9	1.20%	0.17%	2.00%	0.11%	99.16%	0.84%
T	13.42%	0.11%	1.75%	0.00%	100.00%	0.00%
No of test	Flotation machine	Copper ore type		Particle size fraction	Type of collector	Dose of collector
51	Denver	shale		0-20 μm	Z	100 g/Mg
Product	γ	λ	β	ϑ	ε	η
			6.56%	1.83%	0.00%	100.00%
P1	22.62%	5.78%	5.78%	0.67%	71.47%	28.53%
P2	14.43%	1.41%	4.08%	0.51%	82.57%	17.43%
P3	13.99%	0.69%	3.15%	0.45%	87.81%	12.19%
P4	9.45%	0.40%	2.72%	0.47%	89.85%	10.15%
P5	5.65%	0.33%	2.51%	0.49%	90.87%	9.13%
P6	6.07%	0.25%	2.32%	0.54%	91.71%	8.29%
P7	5.89%	0.20%	2.16%	0.64%	92.34%	7.66%
P8	4.54%	0.17%	2.05%	0.76%	92.77%	7.23%
P9	3.45%	0.16%	1.98%	0.91%	93.07%	6.93%
T	13.88%	0.91%	1.83%	0.00%	99.97%	0.03%
No of test	Flotation machine	Copper ore type		Particle size fraction	Type of collector	Dose of collector

52	Denver	shale		0-20 μm	Z	150 g/Mg
Product	γ	λ	β	ϑ	ε	η
			6.75%	1.71%	0.00%	100.00%
P1	20.76%	5.97%	5.97%	0.59%	72.63%	27.37%
P2	8.23%	2.20%	4.90%	0.40%	83.25%	16.75%
P3	11.30%	0.89%	3.77%	0.31%	89.14%	10.86%
P4	10.64%	0.48%	3.08%	0.27%	92.10%	7.90%
P5	10.30%	0.31%	2.62%	0.27%	93.98%	6.02%
P6	8.05%	0.28%	2.35%	0.26%	95.30%	4.70%
P7	7.46%	0.20%	2.14%	0.28%	96.17%	3.83%
P8	3.77%	1.18%	2.09%	0.11%	98.77%	1.23%
P9	2.92%	0.13%	2.02%	0.10%	98.98%	1.02%
T	16.57%	0.11%	1.71%	0.00%	100.00%	0.00%
No of test	Flotation machine	Copper ore type		Particle size fraction	Type of collector	Dose of collector
53	Denver	shale		20-40 μm	E	100 g/Mg
Product	γ	λ	β	ϑ	ε	η
			8.40%	2.70%	0.00%	100.00%
P1	29.67%	7.62%	7.62%	0.63%	83.70%	16.30%
P2	10.56%	1.91%	6.12%	0.40%	91.17%	8.83%
P3	9.49%	0.96%	5.14%	0.29%	94.55%	5.45%
P4	5.97%	0.77%	4.67%	0.23%	96.25%	3.75%
P5	5.88%	0.48%	4.27%	0.19%	97.29%	2.71%
P6	4.73%	0.37%	3.99%	0.16%	97.94%	2.06%
P7	3.88%	0.31%	3.79%	0.15%	98.39%	1.61%
P8	3.79%	0.26%	3.61%	0.13%	98.75%	1.25%
P9	3.51%	0.19%	3.45%	0.12%	99.00%	1.00%
T	22.53%	0.12%	2.70%	0.00%	100.00%	0.00%
No of test	Flotation machine	Copper ore type		Particle size fraction	Type of collector	Dose of collector
54	Denver	shale		20-40 μm	E	150 g/Mg
Product	γ	λ	β	ϑ	ε	η
			8.25%	2.86%	0.00%	100.00%
P1	32.23%	7.47%	7.47%	0.67%	84.19%	15.81%
P2	9.92%	1.99%	6.18%	0.44%	91.09%	8.91%
P3	9.01%	0.99%	5.27%	0.34%	94.21%	5.79%
P4	7.07%	0.79%	4.72%	0.26%	96.16%	3.84%
P5	4.84%	0.51%	4.40%	0.23%	97.02%	2.98%
P6	3.87%	0.44%	4.17%	0.21%	97.62%	2.38%
P7	4.05%	0.39%	3.96%	0.18%	98.17%	1.83%
P8	3.73%	0.33%	3.77%	0.16%	98.60%	1.40%
P9	3.43%	0.21%	3.62%	0.15%	98.85%	1.15%
T	21.85%	0.15%	2.86%	0.00%	100.00%	0.00%
No of test	Flotation machine	Copper ore type		Particle size fraction	Type of collector	Dose of collector
55	Denver	shale		20-40 μm	Z	100 g/Mg
Product	γ	λ	β	ϑ	ε	η

			9.08%	2.70%	0.00%	100.00%
P1	28.04%	8.30%	8.30%	0.51%	86.35%	13.65%
P2	10.96%	1.55%	6.40%	0.32%	92.65%	7.35%
P3	8.38%	0.83%	5.42%	0.24%	95.23%	4.77%
P4	2.98%	0.76%	5.14%	0.21%	96.07%	3.93%
P5	1.55%	0.71%	5.01%	0.20%	96.48%	3.52%
P6	2.40%	0.56%	4.81%	0.18%	96.98%	3.02%
P7	1.15%	0.54%	4.72%	0.17%	97.21%	2.79%
P8	1.69%	0.41%	4.60%	0.16%	97.46%	2.54%
P9	2.48%	0.32%	4.42%	0.15%	97.75%	2.25%
T	40.38%	0.15%	2.70%	0.00%	100.00%	0.00%
No of test	Flotation machine	Copper ore type		Particle size fraction	Type of collector	Dose of collector
56	Denver	shale		20-40 μm	Z	150 g/Mg
Product	γ	λ	β	ϑ	ε	η
			9.01%	2.76%	0.00%	100.00%
P1	29.01%	8.23%	8.23%	0.53%	86.40%	13.60%
P2	8.91%	1.81%	6.72%	0.35%	92.25%	7.75%
P3	10.53%	0.81%	5.44%	0.25%	95.34%	4.66%
P4	5.24%	0.56%	4.96%	0.21%	96.40%	3.60%
P5	4.60%	0.44%	4.60%	0.19%	97.14%	2.86%
P6	2.75%	0.37%	4.41%	0.18%	97.50%	2.50%
P7	2.65%	0.27%	4.24%	0.17%	97.76%	2.24%
P8	0.83%	0.39%	4.19%	0.17%	97.88%	2.12%
P9	2.71%	0.23%	4.03%	0.16%	98.10%	1.90%
T	32.76%	0.16%	2.76%	0.00%	100.00%	0.00%
No of test	Flotation machine	Copper ore type		Particle size fraction	Type of collector	Dose of collector
57	Denver	shale		40-71 μm	E	100 g/Mg
Product	γ	λ	β	ϑ	ε	η
			7.49%	2.73%	0.00%	100.00%
P1	35.03%	6.71%	6.71%	0.59%	86.08%	13.92%
P2	9.01%	1.58%	5.66%	0.42%	91.29%	8.71%
P3	9.17%	0.87%	4.83%	0.34%	94.22%	5.78%
P4	4.97%	0.62%	4.47%	0.30%	95.35%	4.65%
P5	4.31%	0.53%	4.20%	0.28%	96.19%	3.81%
P6	3.51%	0.50%	4.01%	0.25%	96.83%	3.17%
P7	3.68%	0.46%	3.82%	0.23%	97.45%	2.55%
P8	3.32%	0.37%	3.66%	0.21%	97.90%	2.10%
P9	2.24%	0.35%	3.56%	0.20%	98.19%	1.81%
T	24.75%	0.20%	2.73%	0.00%	100.00%	0.00%
No of test	Flotation machine	Copper ore type		Particle size fraction	Type of collector	Dose of collector
58	Denver	shale		40-71 μm	E	150 g/Mg
Product	γ	λ	β	ϑ	ε	η
			7.59%	2.92%	0.00%	100.00%
P1	36.64%	6.81%	6.81%	0.68%	85.32%	14.68%

P2	9.79%	1.72%	5.74%	0.49%	91.08%	8.92%
P3	10.10%	0.99%	4.89%	0.37%	94.49%	5.51%
P4	5.53%	0.68%	4.51%	0.33%	95.77%	4.23%
P5	4.89%	0.64%	4.23%	0.28%	96.84%	3.16%
P6	3.85%	0.48%	4.03%	0.25%	97.47%	2.53%
P7	4.54%	0.36%	3.81%	0.23%	98.04%	1.96%
P8	3.81%	0.32%	3.64%	0.22%	98.45%	1.55%
P9	2.59%	0.23%	3.53%	0.22%	98.66%	1.34%
T	18.27%	0.22%	2.92%	0.00%	100.00%	0.00%

No of test	Flotation machine	Copper ore type		Particle size fraction	Type of collector	Dose of collector
59	Denver	shale		40-71 μm	Z	100 g/Mg
Product	γ	λ	β	ϑ	ε	η
			7.07%	2.60%	0.00%	100.00%
P1	34.88%	6.29%	6.29%	0.62%	84.47%	15.53%
P2	9.49%	1.66%	5.30%	0.44%	90.54%	9.46%
P3	5.49%	1.18%	4.85%	0.36%	93.02%	6.98%
P4	2.89%	0.90%	4.63%	0.33%	94.02%	5.98%
P5	2.66%	0.75%	4.45%	0.30%	94.78%	5.22%
P6	1.30%	0.67%	4.36%	0.29%	95.12%	4.88%
P7	1.17%	0.55%	4.28%	0.29%	95.37%	4.63%
P8	1.23%	0.50%	4.20%	0.28%	95.61%	4.39%
P9	1.02%	0.49%	4.14%	0.27%	95.80%	4.20%
T	39.86%	0.27%	2.60%	0.00%	100.00%	0.00%

No of test	Flotation machine	Copper ore type		Particle size fraction	Type of collector	Dose of collector
60	Denver	shale		40-71 μm	Z	150 g/Mg
Product	γ	λ	β	ϑ	ε	η
			7.36%	2.80%	0.00%	100.00%
P1	37.00%	6.58%	6.58%	0.58%	87.01%	12.99%
P2	8.67%	1.57%	5.63%	0.42%	91.87%	8.13%
P3	6.37%	0.99%	5.06%	0.34%	94.12%	5.88%
P4	3.08%	0.76%	4.82%	0.31%	94.96%	5.04%
P5	3.02%	0.53%	4.60%	0.30%	95.53%	4.47%
P6	1.46%	0.56%	4.50%	0.29%	95.82%	4.18%
P7	1.34%	0.54%	4.41%	0.28%	96.07%	3.93%
P8	1.10%	0.48%	4.34%	0.28%	96.26%	3.74%
P9	1.48%	0.41%	4.25%	0.27%	96.48%	3.52%
T	36.48%	0.27%	2.80%	0.00%	100.00%	0.00%

No of test	Flotation machine	Copper ore type		Particle size fraction	Type of collector	Dose of collector
61	Denver	shale		71-100 μm	E	100 g/Mg
Product	γ	λ	β	ϑ	ε	η
			6.73%	2.50%	0.00%	100.00%
P1	33.94%	5.95%	5.95%	0.72%	80.90%	19.10%
P2	9.43%	1.68%	5.02%	0.56%	87.25%	12.75%
P3	11.28%	1.01%	4.19%	0.45%	91.81%	8.19%

P4	7.74%	0.73%	3.76%	0.39%	94.08%	5.92%
P5	4.34%	0.68%	3.56%	0.36%	95.26%	4.74%
P6	3.41%	0.53%	3.42%	0.34%	95.98%	4.02%
P7	4.34%	0.43%	3.24%	0.32%	96.73%	3.27%
P8	2.37%	0.37%	3.15%	0.31%	97.08%	2.92%
P9	0.94%	0.42%	3.12%	0.31%	97.24%	2.76%
T	22.22%	0.31%	2.50%	0.00%	100.00%	0.00%
No of test	Flotation machine	Copper ore type		Particle size fraction	Type of collector	Dose of collector
62	Denver	shale		71-100 μm	E	150 g/Mg
Product	γ	λ	β	ϑ	ε	η
			6.63%	2.60%	0.00%	100.00%
P1	36.88%	5.85%	5.85%	0.70%	82.99%	17.01%
P2	13.10%	1.36%	4.67%	0.53%	89.84%	10.16%
P3	11.38%	0.93%	3.98%	0.41%	93.92%	6.08%
P4	3.39%	0.81%	3.81%	0.37%	94.97%	5.03%
P5	3.95%	0.56%	3.63%	0.35%	95.82%	4.18%
P6	3.17%	0.47%	3.49%	0.33%	96.40%	3.60%
P7	2.88%	0.36%	3.37%	0.33%	96.79%	3.21%
P8	0.67%	0.65%	3.34%	0.32%	96.96%	3.04%
P9	0.33%	0.41%	3.33%	0.32%	97.01%	2.99%
T	24.26%	0.32%	2.60%	0.00%	100.00%	0.00%
No of test	Flotation machine	Copper ore type		Particle size fraction	Type of collector	Dose of collector
63	Denver	shale		71-100 μm	Z	100 g/Mg
Product	γ	λ	β	ϑ	ε	η
			7.76%	2.61%	0.00%	100.00%
P1	29.10%	6.98%	6.98%	0.82%	77.78%	22.22%
P2	10.40%	1.78%	5.61%	0.65%	84.87%	15.13%
P3	7.39%	1.66%	4.99%	0.51%	89.56%	10.44%
P4	3.97%	0.96%	4.67%	0.48%	91.02%	8.98%
P5	2.30%	0.75%	4.50%	0.46%	91.68%	8.32%
P6	1.52%	0.67%	4.40%	0.46%	92.07%	7.93%
P7	1.51%	0.59%	4.29%	0.45%	92.41%	7.59%
P8	1.00%	0.55%	4.23%	0.45%	92.62%	7.38%
P9	0.32%	0.49%	4.21%	0.45%	92.68%	7.32%
T	42.48%	0.45%	2.61%	0.00%	100.00%	0.00%
No of test	Flotation machine	Copper ore type		Particle size fraction	Type of collector	Dose of collector
64	Denver	shale		71-100 μm	Z	150 g/Mg
Product	γ	λ	β	ϑ	ε	η
			7.78%	2.65%	0.00%	100.00%
P1	29.63%	7.00%	7.00%	0.82%	78.22%	21.78%
P2	10.76%	1.80%	5.61%	0.64%	85.52%	14.48%
P3	7.76%	1.74%	4.99%	0.48%	90.61%	9.39%
P4	4.16%	0.91%	4.67%	0.44%	92.03%	7.97%
P5	3.05%	0.80%	4.45%	0.42%	92.95%	7.05%

P6	1.49%	0.67%	4.35%	0.41%	93.33%	6.67%
P7	1.78%	0.65%	4.24%	0.40%	93.77%	6.23%
P8	1.08%	0.65%	4.18%	0.39%	94.03%	5.97%
P9	0.16%	0.61%	4.17%	0.39%	94.07%	5.93%
T	40.13%	0.39%	2.65%	0.00%	100.00%	0.00%
No of test	Flotation machine	Copper ore type		Particle size fraction	Type of collector	Dose of collector
65	Denver	shale		100-125 μm	E	100 g/Mg
Product	γ	λ	β	ϑ	ε	η
			6.88%	2.53%	0.00%	100.00%
P1	32.41%	6.10%	6.10%	0.82%	78.16%	21.84%
P2	11.92%	1.90%	4.97%	0.59%	87.11%	12.89%
P3	9.92%	1.08%	4.26%	0.48%	91.35%	8.65%
P4	4.22%	0.92%	4.02%	0.43%	92.88%	7.12%
P5	2.66%	0.64%	3.87%	0.42%	93.55%	6.45%
P6	2.06%	0.61%	3.76%	0.41%	94.05%	5.95%
P7	2.23%	0.49%	3.65%	0.40%	94.48%	5.52%
P8	0.83%	0.50%	3.61%	0.40%	94.65%	5.35%
P9	0.42%	0.51%	3.59%	0.40%	94.73%	5.27%
T	33.32%	0.40%	2.53%	0.00%	100.00%	0.00%
No of test	Flotation machine	Copper ore type		Particle size fraction	Type of collector	Dose of collector
66	Denver	shale		100-125 μm	E	150 g/Mg
Product	γ	λ	β	ϑ	ε	η
			6.98%	2.55%	0.00%	100.00%
P1	32.47%	6.20%	6.20%	0.79%	79.07%	20.93%
P2	9.91%	1.79%	5.17%	0.62%	86.04%	13.96%
P3	10.17%	1.15%	4.39%	0.50%	90.63%	9.37%
P4	5.37%	0.87%	4.06%	0.46%	92.47%	7.53%
P5	4.83%	0.77%	3.81%	0.41%	93.93%	6.07%
P6	1.83%	0.79%	3.73%	0.40%	94.50%	5.50%
P7	2.41%	0.60%	3.61%	0.38%	95.06%	4.94%
P8	1.14%	0.47%	3.56%	0.38%	95.28%	4.72%
P9	1.37%	0.32%	3.50%	0.38%	95.45%	4.55%
T	30.50%	0.38%	2.55%	0.00%	100.00%	0.00%
No of test	Flotation machine	Copper ore type		Particle size fraction	Type of collector	Dose of collector
67	Denver	shale		100-125 μm	Z	100 g/Mg
Product	γ	λ	β	ϑ	ε	η
			7.73%	2.58%	0.00%	100.00%
P1	28.71%	6.95%	6.95%	0.82%	77.26%	22.74%
P2	9.42%	1.87%	5.70%	0.66%	84.08%	15.92%
P3	6.57%	1.49%	5.08%	0.57%	87.87%	12.13%
P4	2.30%	1.23%	4.89%	0.54%	88.96%	11.04%
P5	2.19%	0.94%	4.71%	0.52%	89.76%	10.24%
P6	2.41%	0.72%	4.53%	0.51%	90.43%	9.57%
P7	2.03%	0.70%	4.38%	0.50%	90.98%	9.02%

P8	0.75%	0.61%	4.33%	0.50%	91.16%	8.84%
P9	0.70%	0.54%	4.28%	0.50%	91.31%	8.69%
T	44.91%	0.50%	2.58%	0.00%	100.00%	0.00%
No of test	Flotation machine	Copper ore type		Particle size fraction	Type of collector	Dose of collector
68	Denver	shale		100-125 μm	Z	150 g/Mg
Product	γ	λ	β	ϑ	ε	η
			7.47%	2.49%	0.00%	100.00%
P1	29.16%	6.69%	6.69%	0.76%	78.35%	21.65%
P2	9.68%	1.70%	5.45%	0.61%	84.96%	15.04%
P3	6.88%	1.14%	4.80%	0.55%	88.11%	11.89%
P4	2.93%	0.91%	4.57%	0.52%	89.18%	10.82%
P5	2.93%	0.85%	4.35%	0.51%	90.18%	9.82%
P6	3.01%	0.75%	4.16%	0.49%	91.09%	8.91%
P7	2.59%	0.74%	4.00%	0.47%	91.86%	8.14%
P8	1.36%	0.72%	3.92%	0.47%	92.25%	7.75%
P9	1.17%	0.63%	3.86%	0.46%	92.55%	7.45%
T	40.28%	0.46%	2.49%	0.00%	100.00%	0.00%
No of test	Flotation machine	Copper ore type		Particle size fraction	Type of collector	Dose of collector
69	Denver	shale		125-200 μm	E	100 g/Mg
Product	γ	λ	β	ϑ	ε	η
			7.38%	2.43%	0.00%	100.00%
P1	27.36%	6.60%	6.60%	0.86%	74.25%	25.75%
P2	12.35%	2.00%	5.17%	0.63%	84.41%	15.59%
P3	8.34%	1.20%	4.48%	0.54%	88.52%	11.48%
P4	3.86%	1.05%	4.22%	0.50%	90.19%	9.81%
P5	1.93%	0.95%	4.11%	0.48%	90.94%	9.06%
P6	1.11%	0.88%	4.04%	0.47%	91.34%	8.66%
P7	0.91%	0.75%	3.99%	0.46%	91.62%	8.38%
P8	0.33%	0.58%	3.97%	0.46%	91.70%	8.30%
P9	0.75%	0.49%	3.92%	0.46%	91.85%	8.15%
T	43.07%	0.46%	2.43%	0.00%	100.00%	0.00%
No of test	Flotation machine	Copper ore type		Particle size fraction	Type of collector	Dose of collector
70	Denver	shale		125-200 μm	E	150 g/Mg
Product	γ	λ	β	ϑ	ε	η
			6.44%	2.50%	0.00%	100.00%
P1	35.70%	5.66%	5.66%	0.74%	80.93%	19.07%
P2	3.98%	1.98%	5.29%	0.66%	84.09%	15.91%
P3	5.39%	1.37%	4.82%	0.59%	87.04%	12.96%
P4	5.38%	1.10%	4.43%	0.53%	89.42%	10.58%
P5	5.45%	0.94%	4.09%	0.48%	91.47%	8.53%
P6	1.96%	0.86%	3.98%	0.47%	92.14%	7.86%
P7	1.62%	0.75%	3.89%	0.45%	92.63%	7.37%
P8	0.85%	0.61%	3.84%	0.45%	92.84%	7.16%
P9	0.41%	0.53%	3.82%	0.45%	92.93%	7.07%

T	39.25%	0.45%	2.50%	0.00%	100.00%	0.00%
No of test	Flotation machine	Copper ore type		Particle size fraction	Type of collector	Dose of collector
71	Denver	shale		125-200 μm	Z	100 g/Mg
Product	γ	λ	β	ϑ	ε	η
			8.30%	2.40%	0.00%	100.00%
P1	22.94%	7.52%	7.52%	0.88%	71.85%	28.15%
P2	6.37%	2.58%	6.45%	0.72%	78.70%	21.30%
P3	5.03%	1.65%	5.74%	0.65%	82.15%	17.85%
P4	3.12%	1.41%	5.38%	0.62%	83.98%	16.02%
P5	3.31%	1.01%	5.03%	0.59%	85.37%	14.63%
P6	0.56%	0.83%	4.97%	0.59%	85.56%	14.44%
P7	0.67%	1.10%	4.91%	0.59%	85.87%	14.13%
P8	0.68%	0.90%	4.85%	0.58%	86.12%	13.88%
P9	0.94%	0.67%	4.76%	0.58%	86.38%	13.62%
T	56.38%	0.58%	2.40%	0.00%	100.00%	0.00%
No of test	Flotation machine	Copper ore type		Particle size fraction	Type of collector	Dose of collector
72	Denver	shale		125-200 μm	Z	150 g/Mg
Product	γ	λ	β	ϑ	ε	η
			8.28%	2.43%	0.00%	100.00%
P1	24.50%	7.50%	7.50%	0.78%	75.65%	24.35%
P2	6.98%	2.13%	6.31%	0.65%	81.77%	18.23%
P3	5.99%	1.36%	5.52%	0.58%	85.12%	14.88%
P4	3.97%	1.07%	5.09%	0.54%	86.87%	13.13%
P5	2.69%	0.84%	4.83%	0.53%	87.80%	12.20%
P6	1.63%	0.84%	4.69%	0.52%	88.36%	11.64%
P7	0.84%	0.92%	4.62%	0.51%	88.68%	11.32%
P8	0.49%	0.95%	4.58%	0.51%	88.87%	11.13%
P9	0.62%	1.17%	4.54%	0.50%	89.17%	10.83%
T	52.27%	0.50%	2.43%	0.00%	100.00%	0.00%

Table A4. Averaged results of flotation test of dolomite copper ore in Jameson cell (E – water solution of ethyl sodium xanthate; Z – water solution of isobutyl sodium xanthate)

No of test	Flotation machine	Copper ore type	Particle size fraction	Type of collector	Dose of collector
73	Jameson	dolomite	0-25 μm	E	100 g/Mg
Product	γ	β	ϑ	ε	η
	0,00%	17,50%	1,64%	0,00%	100,00%
P1	0,44%	16,93%	1,58%	3,95%	96,05%
P2	1,87%	15,42%	1,35%	19,30%	80,70%
P3	4,61%	14,60%	0,97%	43,44%	56,56%
P4	6,75%	13,52%	0,78%	55,69%	44,31%
P5	8,58%	11,94%	0,67%	62,53%	37,47%
P6	9,80%	10,76%	0,65%	64,40%	35,60%
P7	12,04%	9,62%	0,55%	70,70%	29,30%
P8	14,18%	8,86%	0,45%	76,65%	23,35%

P9	16,52%	7,94%	0,39%	80,02%	19,98%
T	100,00%	1,64%	0,00%	100,00%	0,00%
No of test	Flotation machine	Copper ore type	Particle size fraction	Type of collector	Dose of collector
74	Jameson	dolomite	0-25 μm	E	150 g/Mg
Product	γ	β	ϑ	ε	H
	0,00%	12,00%	1,22%	0,00%	100,00%
P1	1,04%	11,68%	1,12%	9,43%	90,57%
P2	2,38%	11,02%	0,96%	22,81%	77,19%
P3	4,02%	10,97%	0,81%	36,09%	63,91%
P4	5,33%	9,95%	0,73%	43,50%	56,51%
P5	7,36%	8,50%	0,64%	51,25%	48,75%
P6	10,46%	7,35%	0,62%	54,42%	45,58%
P7	13,71%	5,71%	0,51%	64,12%	35,88%
P8	16,99%	5,10%	0,43%	71,06%	28,94%
P9	20,45%	4,53%	0,37%	75,94%	24,06%
T	100,00%	1,22%	0,00%	100,00%	0,00%
No of test	Flotation machine	Copper ore type	Particle size fraction	Type of collector	Dose of collector
75	Jameson	dolomite	0-25 μm	Z	100 g/Mg
Product	γ	β	ϑ	ε	H
	0,00%	19,00%	1,77%	0,00%	100,00%
P1	1,05%	18,15%	1,61%	9,86%	90,14%
P2	2,39%	17,27%	1,37%	24,52%	75,48%
P3	3,82%	16,65%	1,15%	37,32%	62,68%
P4	5,76%	14,89%	0,97%	48,45%	51,55%
P5	8,20%	12,70%	0,79%	58,80%	41,20%
P6	11,10%	10,87%	0,63%	68,16%	31,84%
P7	14,10%	9,36%	0,52%	74,61%	25,39%
P8	16,65%	8,33%	0,46%	78,34%	21,66%
P9	18,98%	7,55%	0,42%	81,00%	19,00%
T	100,00%	1,77%	0,00%	100,00%	0,00%
No of test	Flotation machine	Copper ore type	Particle size fraction	Type of collector	Dose of collector
76	Jameson	dolomite	0-25 μm	Z	150 g/Mg
	γ	β	ϑ	ε	H
	0,00%	17,50%	0,99%	0,00%	100,00%
P1	0,70%	16,88%	0,88%	11,87%	88,13%
P2	1,32%	15,90%	0,79%	21,26%	78,74%
P3	2,09%	15,10%	0,69%	31,88%	68,12%
P4	2,73%	13,90%	0,63%	38,30%	61,70%
P5	3,46%	12,44%	0,58%	43,47%	56,53%
P6	4,12%	11,08%	0,56%	46,15%	53,85%
P7	5,42%	9,26%	0,52%	50,68%	49,32%
P8	6,72%	8,09%	0,48%	54,95%	45,05%
P9	8,91%	6,59%	0,44%	59,33%	40,68%
T	100,00%	0,99%	0,00%	100,00%	0,00%

No of test	Flotation machine	Copper ore type	Particle size fraction	Type of collector	Dose of collector
77	Jameson	dolomite	25-45 μm	E	100 g/Mg
Product	γ	β	ϑ	ε	H
	0,00%	8,00%	1,55%	0,00%	100,00%
P1	0,79%	7,59%	1,50%	3,85%	96,15%
P2	1,52%	7,37%	1,46%	7,22%	92,78%
P3	2,39%	7,57%	1,40%	11,67%	88,33%
P4	3,36%	7,40%	1,35%	16,03%	83,97%
P5	4,06%	7,51%	1,30%	19,67%	80,33%
P6	4,54%	7,53%	1,27%	22,04%	77,96%
P7	5,30%	7,57%	1,21%	25,84%	74,16%
P8	5,84%	7,33%	1,19%	27,61%	72,39%
P9	8,84%	6,21%	1,10%	35,44%	64,56%
T	100,00%	1,55%	0,00%	100,00%	0,00%
No of test	Flotation machine	Copper ore type	Particle size fraction	Type of collector	Dose of collector
78	Jameson	dolomite	25-45 μm	E	150 g/Mg
Product	γ	β	ϑ	ε	H
	0,00%	7,00%	1,54%	0,00%	100,00%
P1	0,25%	6,73%	1,52%	1,09%	98,91%
P2	0,51%	7,45%	1,51%	2,46%	97,54%
P3	0,89%	7,50%	1,48%	4,32%	95,68%
P4	1,16%	7,65%	1,47%	5,80%	94,20%
P5	1,72%	7,42%	1,43%	8,29%	91,71%
P6	2,17%	7,35%	1,41%	10,36%	89,64%
P7	2,81%	6,84%	1,38%	12,48%	87,52%
P8	3,51%	6,75%	1,35%	15,42%	84,58%
P9	4,55%	6,24%	1,31%	18,47%	81,53%
T	100,00%	1,54%	0,00%	100,00%	0,00%
No of test	Flotation machine	Copper ore type	Particle size fraction	Type of collector	Dose of collector
79	Jameson	dolomite	25-45 μm	Z	100 g/Mg
Product	γ	β	ϑ	ε	H
	0,00%	7,00%	1,13%	0,00%	100,00%
P1	0,57%	6,43%	1,10%	3,23%	96,77%
P2	1,10%	7,11%	1,06%	6,94%	93,06%
P3	1,72%	7,72%	1,01%	11,74%	88,26%
P4	2,50%	6,94%	0,98%	15,36%	84,64%
P5	3,68%	5,91%	0,95%	19,25%	80,75%
P6	4,72%	5,32%	0,92%	22,22%	77,78%
P7	6,54%	4,63%	0,88%	26,80%	73,20%
P8	8,31%	4,06%	0,86%	29,88%	70,12%
P9	11,28%	3,53%	0,82%	35,28%	64,72%
T	100,00%	1,13%	0,00%	100,00%	0,00%
No of test	Flotation machine	Copper ore type	Particle size	Type of collector	Dose of collector

fraction					
80	Jameson	dolomite	25-45 μm	Z	150 g/Mg
Products	γ	β	ϑ	ε	H
	0,00%	17,00%	1,30%	0,00%	100,00%
P1	0,74%	16,33%	1,18%	9,38%	90,62%
P2	1,55%	14,27%	1,09%	17,03%	82,97%
P3	2,87%	12,78%	0,96%	28,28%	71,72%
P4	4,21%	11,51%	0,85%	37,41%	62,59%
P5	5,44%	10,29%	0,78%	43,25%	56,75%
P6	6,84%	9,01%	0,73%	47,60%	52,40%
P7	8,31%	7,94%	0,69%	50,91%	49,09%
P8	9,71%	7,28%	0,65%	54,60%	45,40%
P9	11,14%	6,65%	0,62%	57,25%	42,75%
T	100,00%	1,30%	0,00%	100,00%	0,00%

No of test	Flotation machine	Copper ore type	Particle size fraction	Type of collector	Dose of collector
81	Jameson	dolomite	45-75 μm	E	100 g/Mg
Product	γ	β	ϑ	ε	H
	0,00%	8,00%	1,19%	0,00%	100,00%
P1	0,31%	7,25%	1,17%	1,89%	98,11%
P2	0,68%	6,34%	1,16%	3,61%	96,39%
P3	1,29%	6,03%	1,13%	6,51%	93,49%
P4	1,70%	6,07%	1,11%	8,69%	91,32%
P5	2,24%	6,04%	1,08%	11,34%	88,66%
P6	3,01%	5,77%	1,05%	14,59%	85,41%
P7	3,77%	5,23%	1,03%	16,59%	83,41%
P8	4,57%	5,27%	0,99%	20,23%	79,77%
P9	6,16%	4,92%	0,95%	25,49%	74,51%
T	100,00%	1,19%	0,00%	100,00%	0,00%

No of test	Flotation machine	Copper ore type	Particle size fraction	Type of collector	Dose of collector
82	Jameson	dolomite	45-75 μm	E	150 g/Mg
Product	γ	β	ϑ	ε	H
	0,00%	7,00%	1,10%	0,00%	100,00%
P1	0,80%	6,22%	1,06%	4,50%	95,50%
P2	1,19%	6,32%	1,04%	6,81%	93,19%
P3	1,72%	6,65%	1,00%	10,36%	89,64%
P4	2,01%	6,78%	0,98%	12,40%	87,60%
P5	2,62%	6,57%	0,95%	15,62%	84,38%
P6	3,11%	6,40%	0,93%	18,11%	81,89%
P7	4,17%	5,90%	0,89%	22,35%	77,65%
P8	5,23%	5,73%	0,85%	27,18%	72,82%
P9	6,69%	5,30%	0,80%	32,17%	67,83%
T	100,00%	1,10%	0,00%	100,00%	0,00%

No of test	Flotation machine	Copper ore type	Particle size fraction	Type of collector	Dose of collector
83	Jameson	dolomite	45-75 μm	Z	100 g/Mg

Product	γ	β	ϑ	ε	H
	0,00%	10,00%	1,82%	0,00%	100,00%
P1	0,23%	9,57%	1,80%	1,23%	98,77%
P2	0,64%	7,38%	1,78%	2,59%	97,41%
P3	1,26%	7,17%	1,75%	4,96%	95,04%
P4	2,07%	6,74%	1,71%	7,67%	92,33%
P5	2,77%	6,19%	1,69%	9,44%	90,56%
P6	3,49%	5,71%	1,68%	10,96%	89,04%
P7	4,43%	5,44%	1,65%	13,23%	86,77%
P8	5,37%	5,11%	1,63%	15,08%	84,92%
P9	6,48%	4,69%	1,62%	16,71%	83,29%
T	100,00%	1,82%	0,00%	100,00%	0,00%
No of test	Flotation machine	Copper ore type	Particle size fraction	Type of collector	Dose of collector
84	Jameson	dolomite	45-75 μm	Z	150 g/Mg
Product	γ	β	ϑ	ε	H
	0,00%	8,00%	2,17%	0,00%	100,00%
P1	0,54%	7,05%	1,79%	1,73%	98,27%
P2	1,24%	7,06%	1,75%	4,04%	95,96%
P3	2,45%	6,19%	1,71%	6,97%	93,03%
P4	3,35%	5,96%	1,68%	9,18%	90,82%
P5	4,50%	5,58%	1,64%	11,56%	88,44%
P6	5,89%	5,36%	1,60%	14,53%	85,48%
P7	7,80%	5,29%	1,53%	18,96%	81,04%
P8	9,52%	5,17%	1,47%	22,64%	77,36%
P9	11,58%	4,75%	1,44%	25,30%	74,70%
T	100,00%	2,17%	0,00%	100,00%	0,00%