New Reactive Extraction Based Reclaiming Technique for Amines Used in Carbon Dioxide Capture Process from Industrial Flue Gases

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Supporting Information

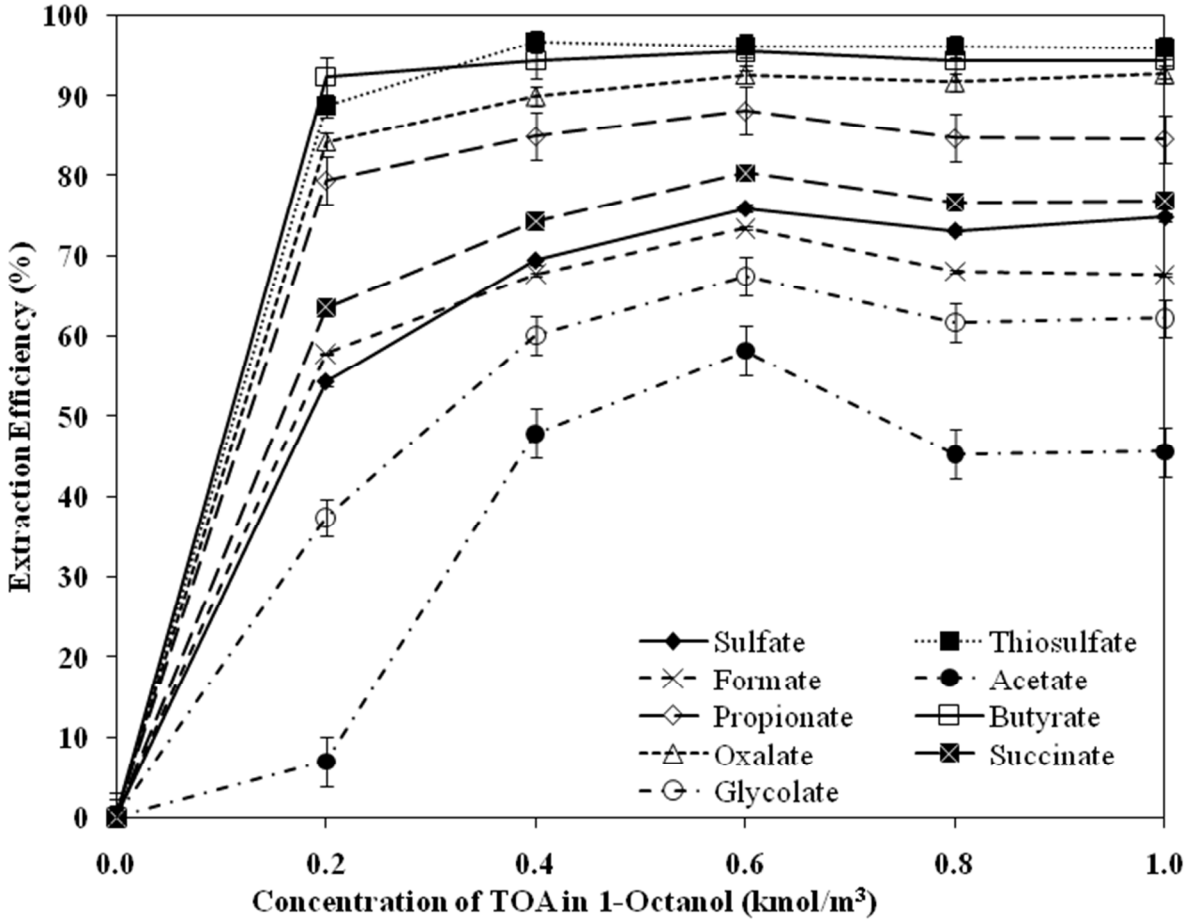

Figure S1. Effect of TOA concentration in 1-octanol on extraction of HSS in water (room temperature, 10 min mixing time, 1 to 1 phase ratio)

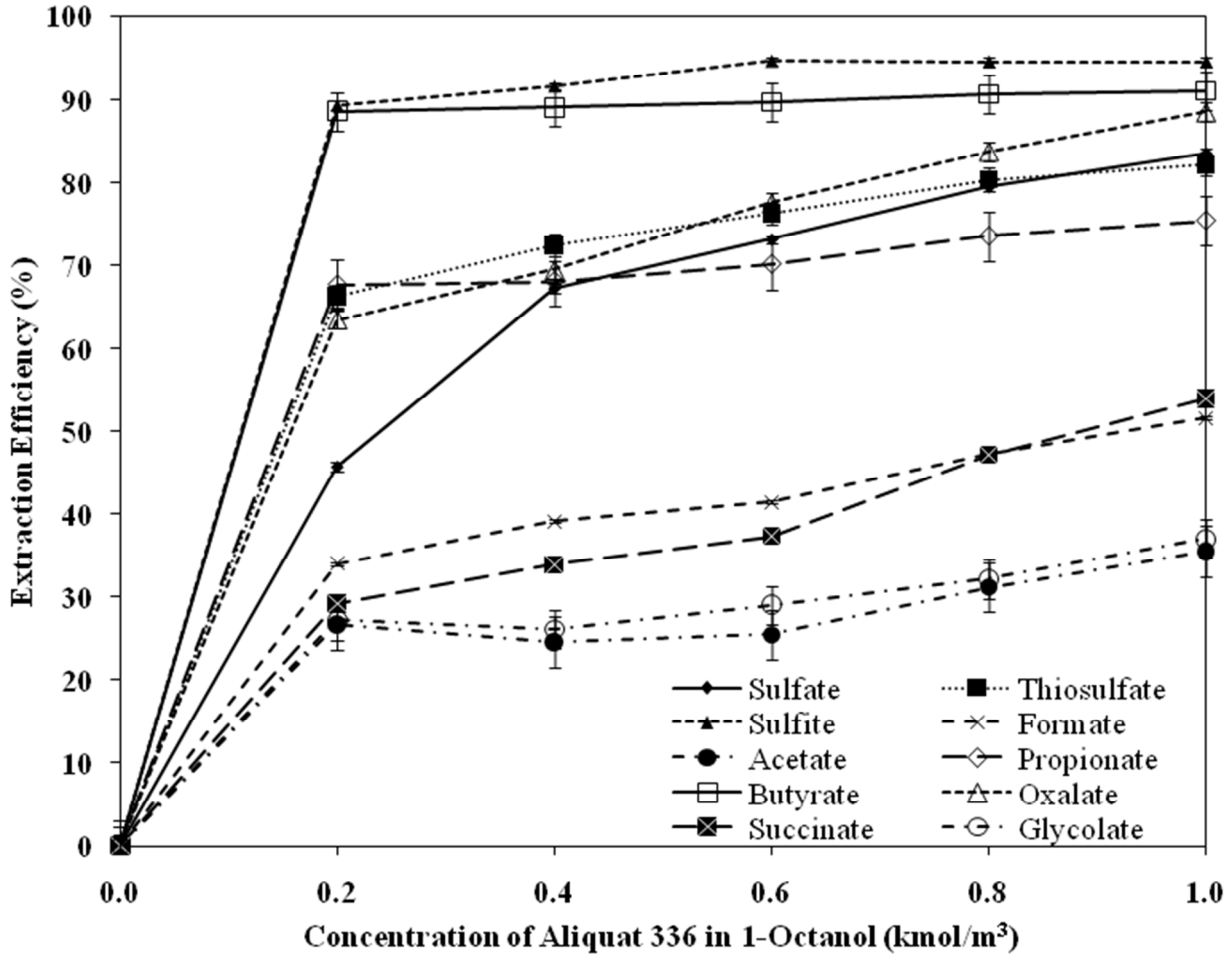

Figure S2. Effect of aliquat 336 concentration in 1-octanol on extraction of HSS in water (room temperature, 10 min mixing time, 1 to 1 phase ratio)

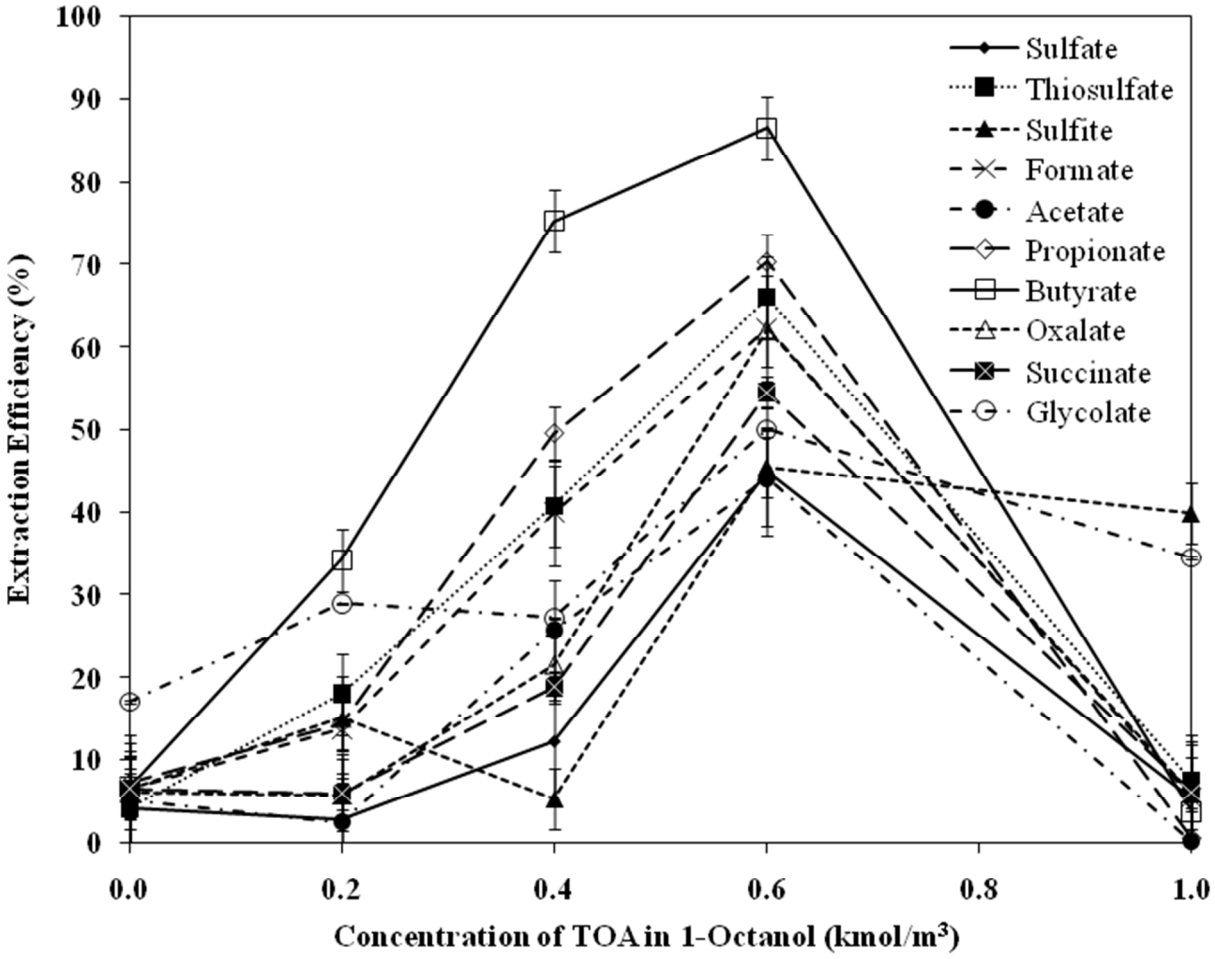

Figure S3. Effect of TOA concentration in 1-octanol on extraction of HSS in 5 kmol/m^3 MEA (room temperature, 10 min mixing time, and 1 to 1 phase ratio)

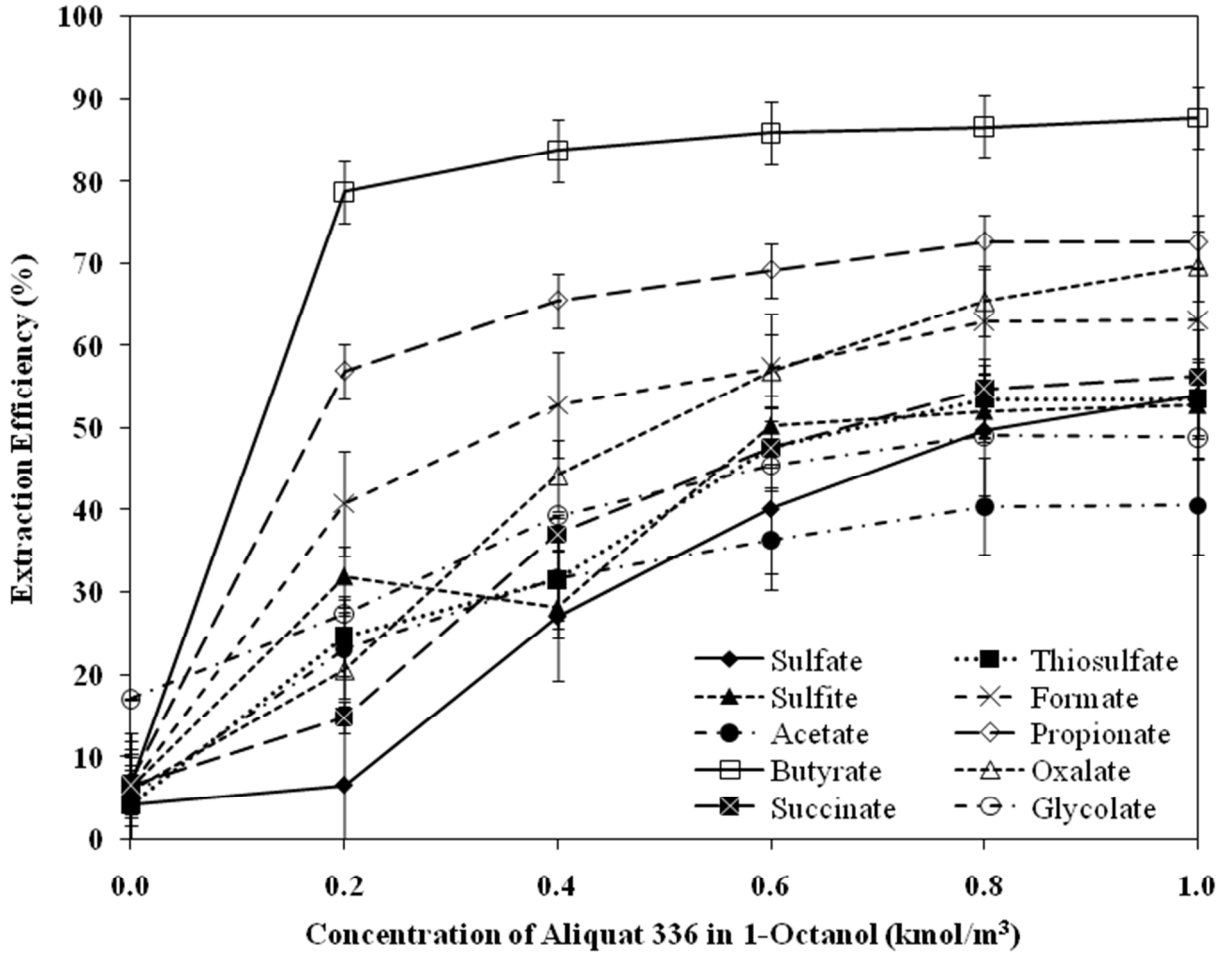

Figure S4. Effect of aliquat 336 concentration in 1-octanol on extraction efficiency of HSS in 5 kmol/m^3 MEA (room temperature, 10 min mixing time, 1 to 1 phase ratio)

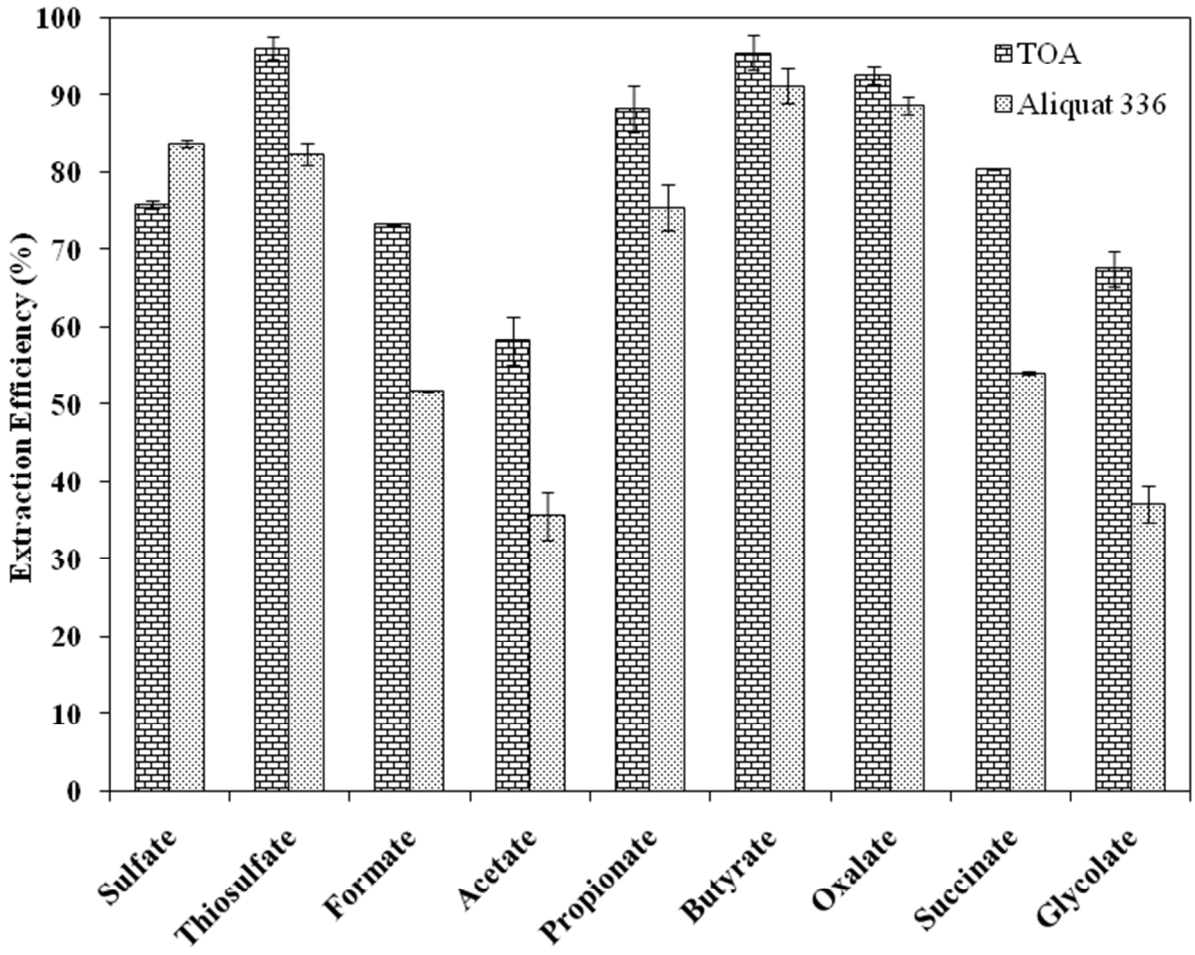

Figure S5. Comparison of 0.6 kmol/m^3 TOA and 1 kmol/m^3 aliquat 336 on extraction of HSS in water (room temperature, 10 min mixing time, and 1 to 1 phase ratio)

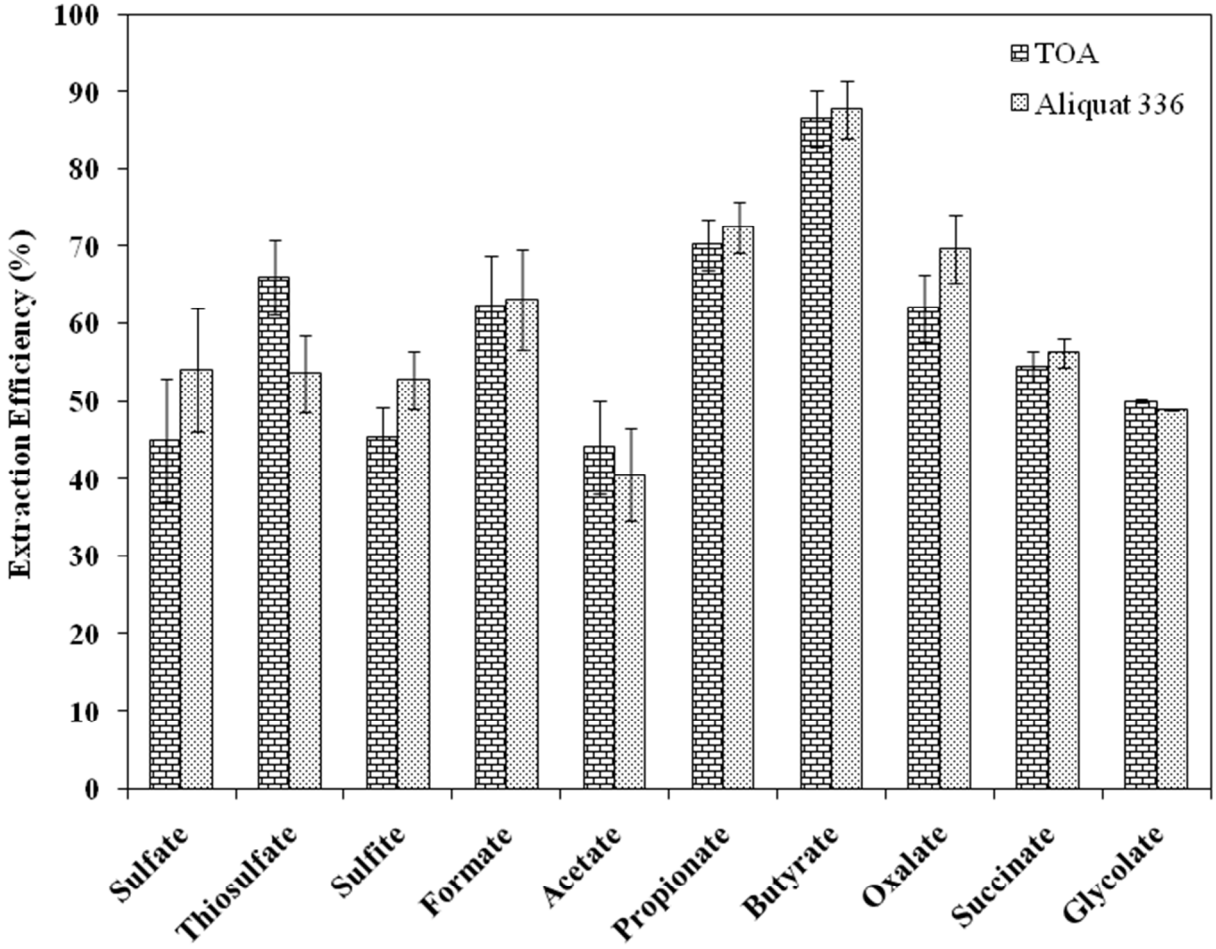

Figure S6. Comparison of 0.6 kmol/m^3 TOA and 1 kmol/m^3 aliquat 336 on extraction of HSS in 5 kmol/m^3 MEA (room temperature, 10 min mixing time, and 1 to 1 phase ratio)

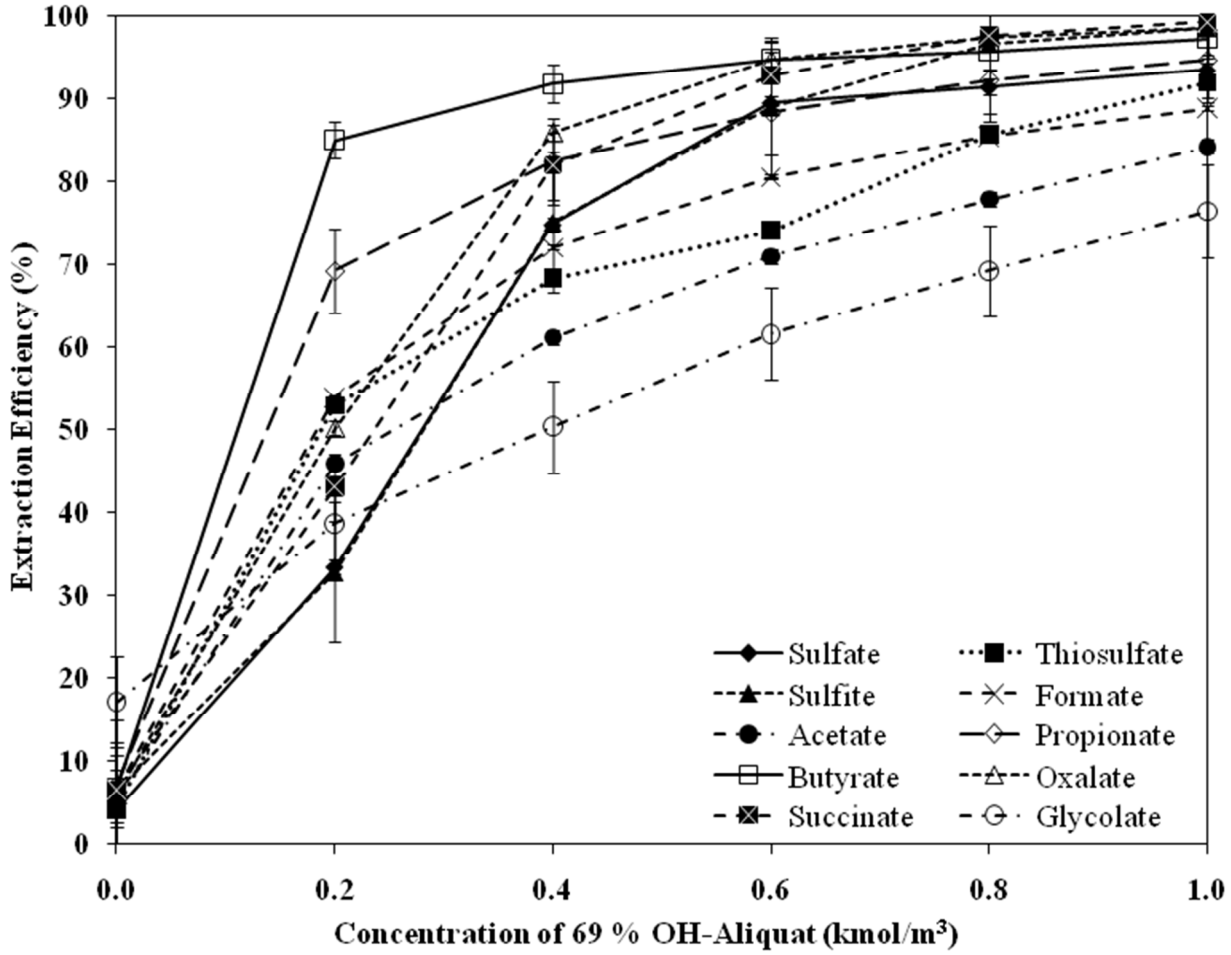

Figure S7. Effect of 69 % OH aliquat concentration on extraction of HSS in 5 kmol/m^3 MEA (room temperature, 10 min mixing ratio, and 1 to 1 phase ratio)

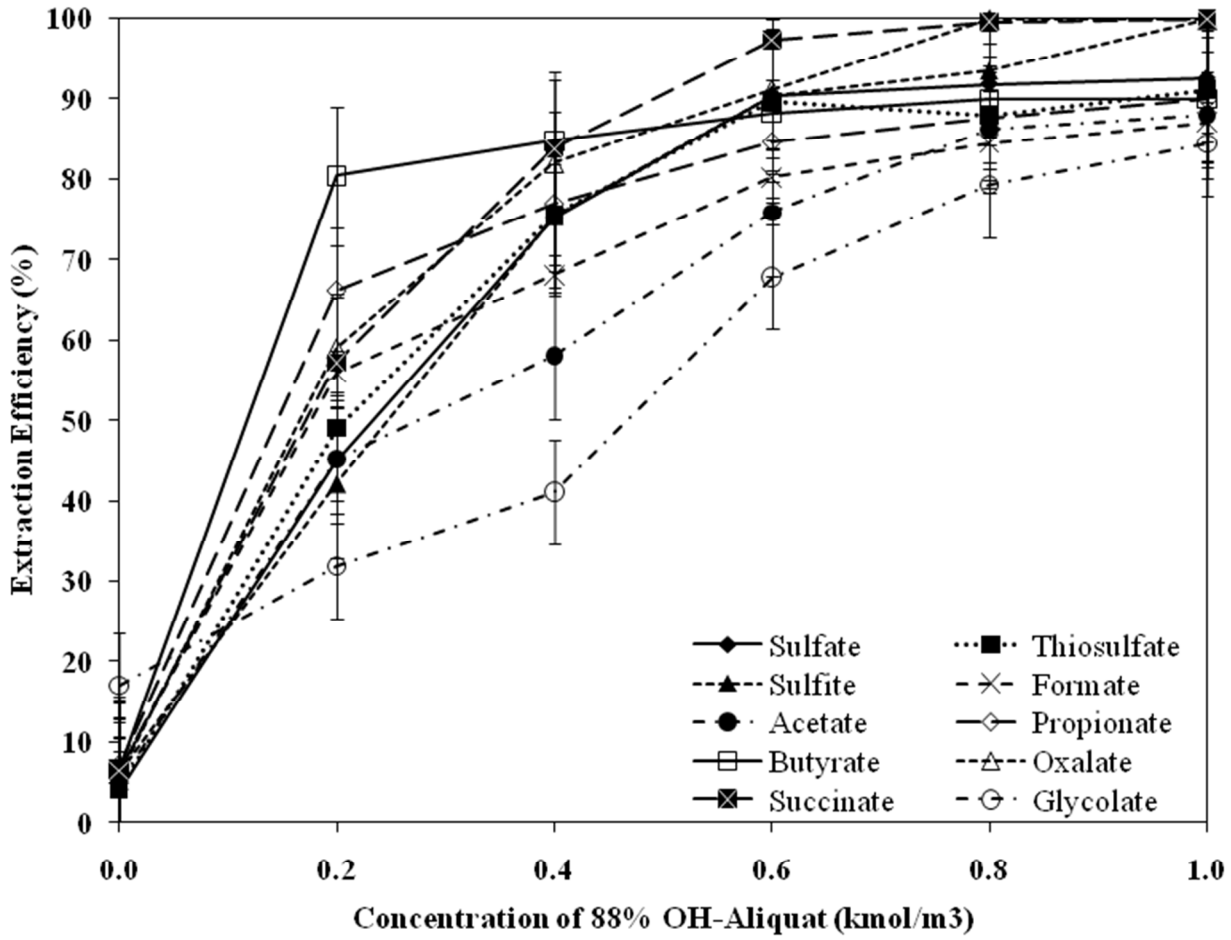

Figure S8. Effect of 88 % OH aliquat concentration on extraction of HSS in 5 kmol/m^3 MEA (room temperature, 10 min mixing time, and 1 to 1 phase ratio)

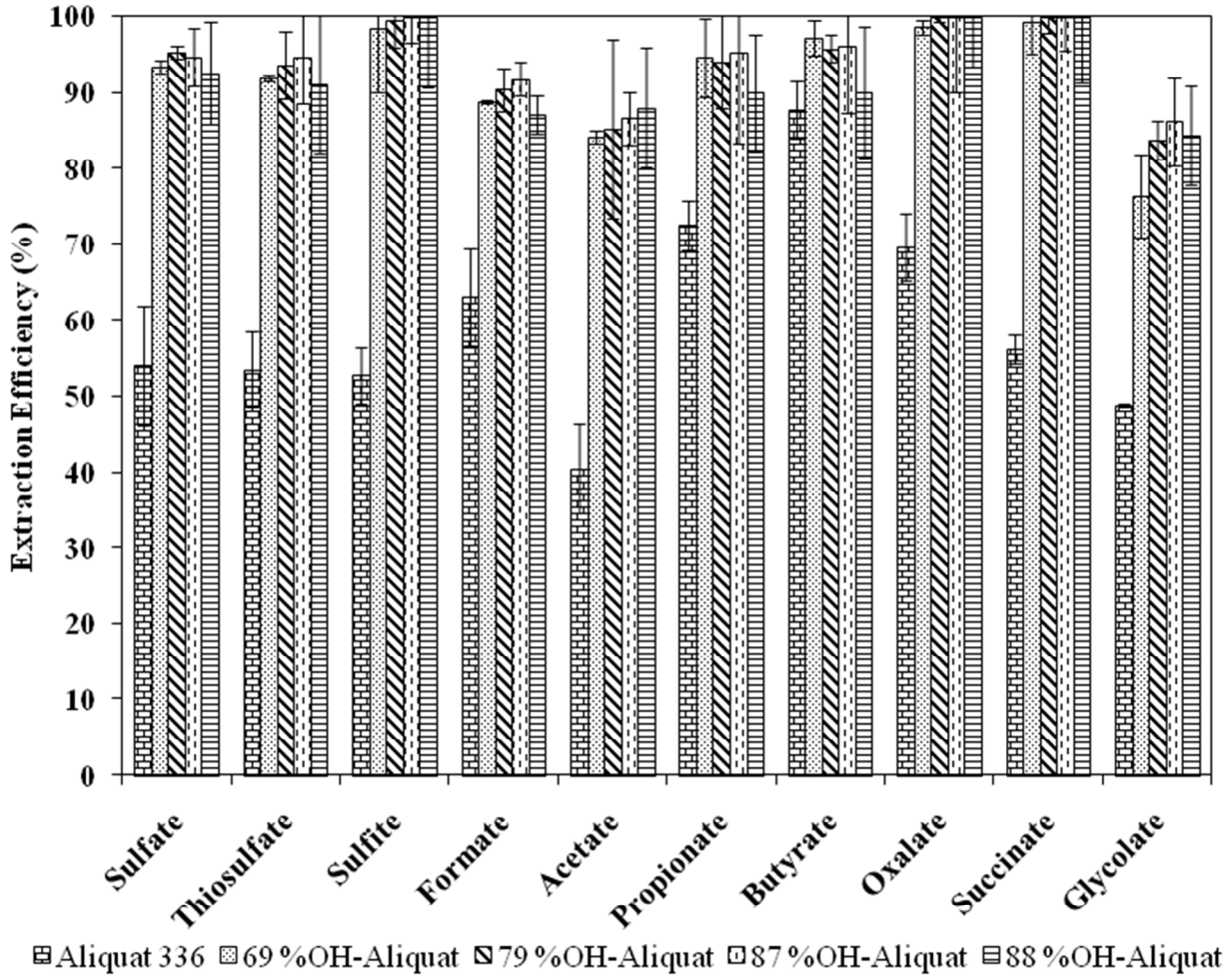

Figure S9. Effect of % OH in modified aliquat 336 on extraction of HSS in 5 kmol/m^3 MEA (1 kmol/m^3 modified aliquat, room temperature, 10 min mixing ratio, 1 to 1 phase ratio)

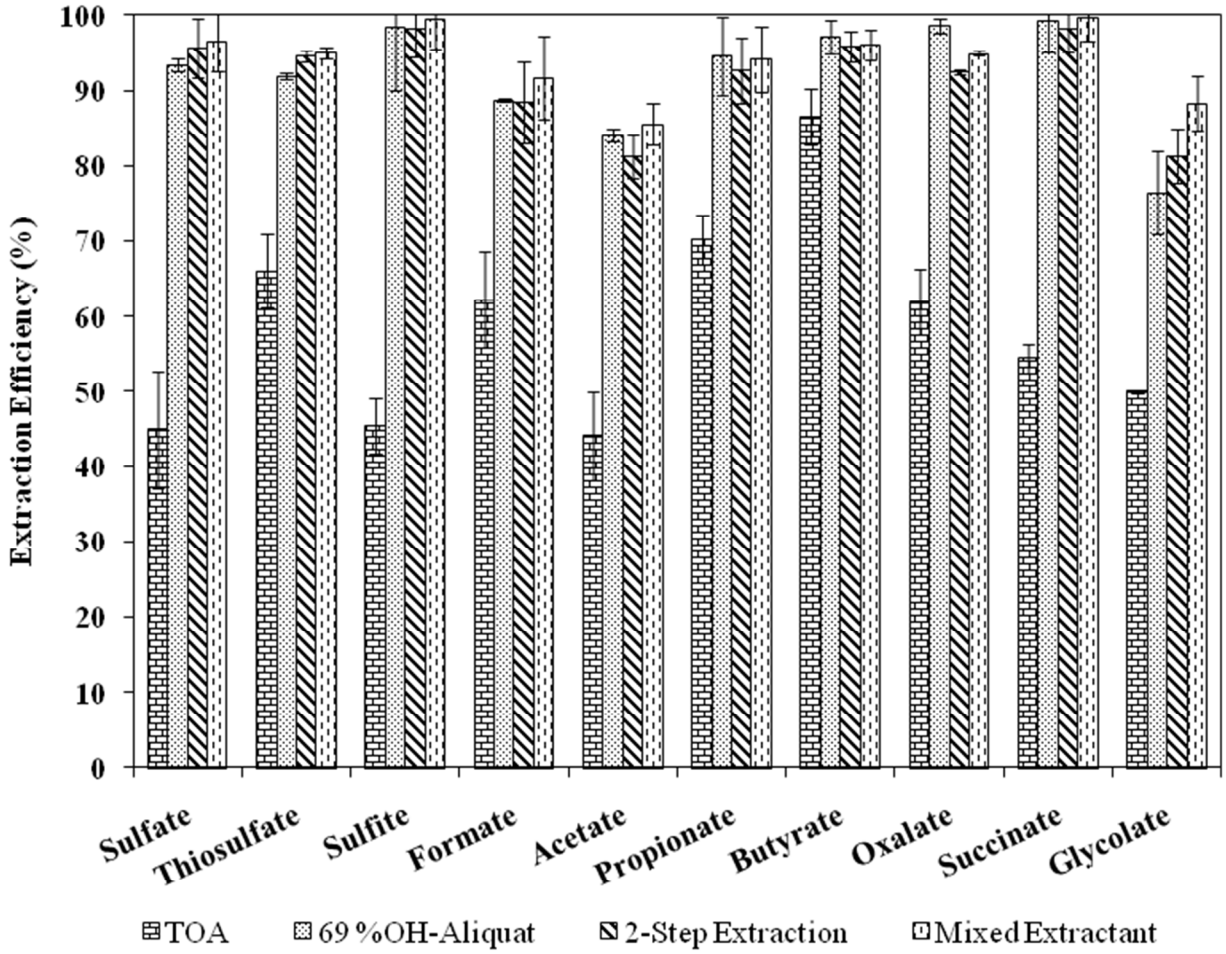

Figure S10. Comparison of HSS extraction in 5 kmol/m^3 MEA using 1 kmol/m^3 TOA, 0.6 kmol/m^3 69 % OH aliquat, and their 2-step extraction and mixture (room temperature, 10 min mixing time, and 1 to 1 phase ratio)

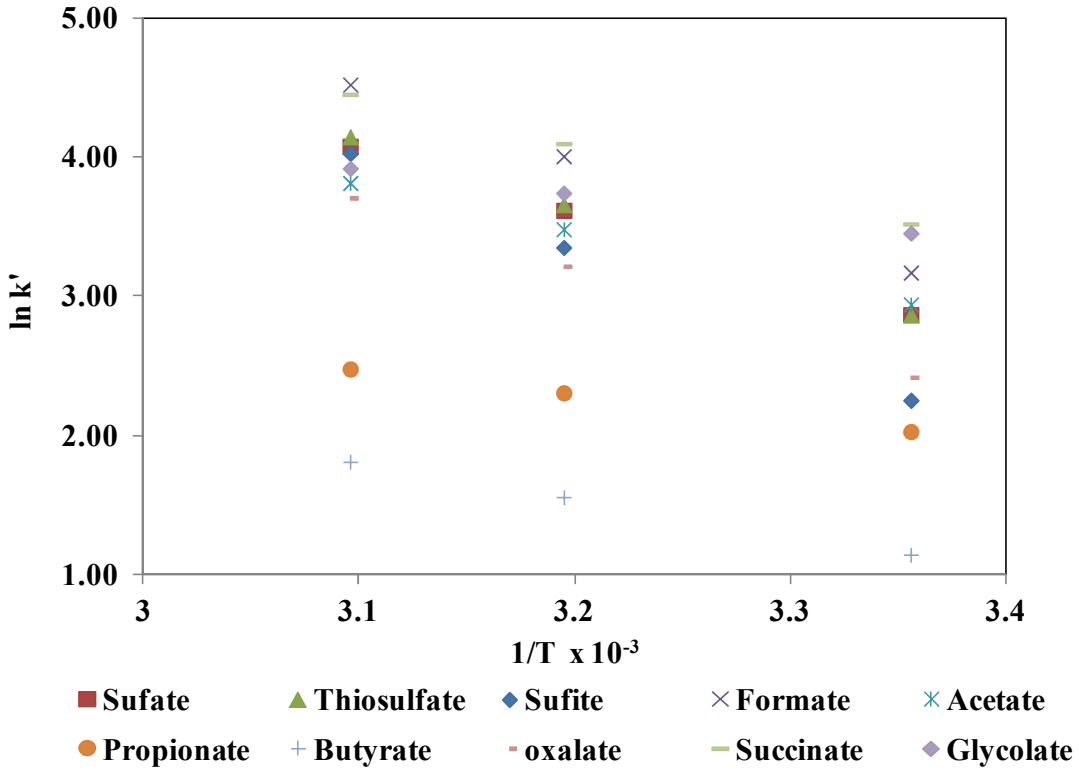

Figure S11. Arrhenius plot of HSS regeneration process

(10 min mixing time, 1 to 2 phase ratio, and 4 kmol/m^3 NaOH)

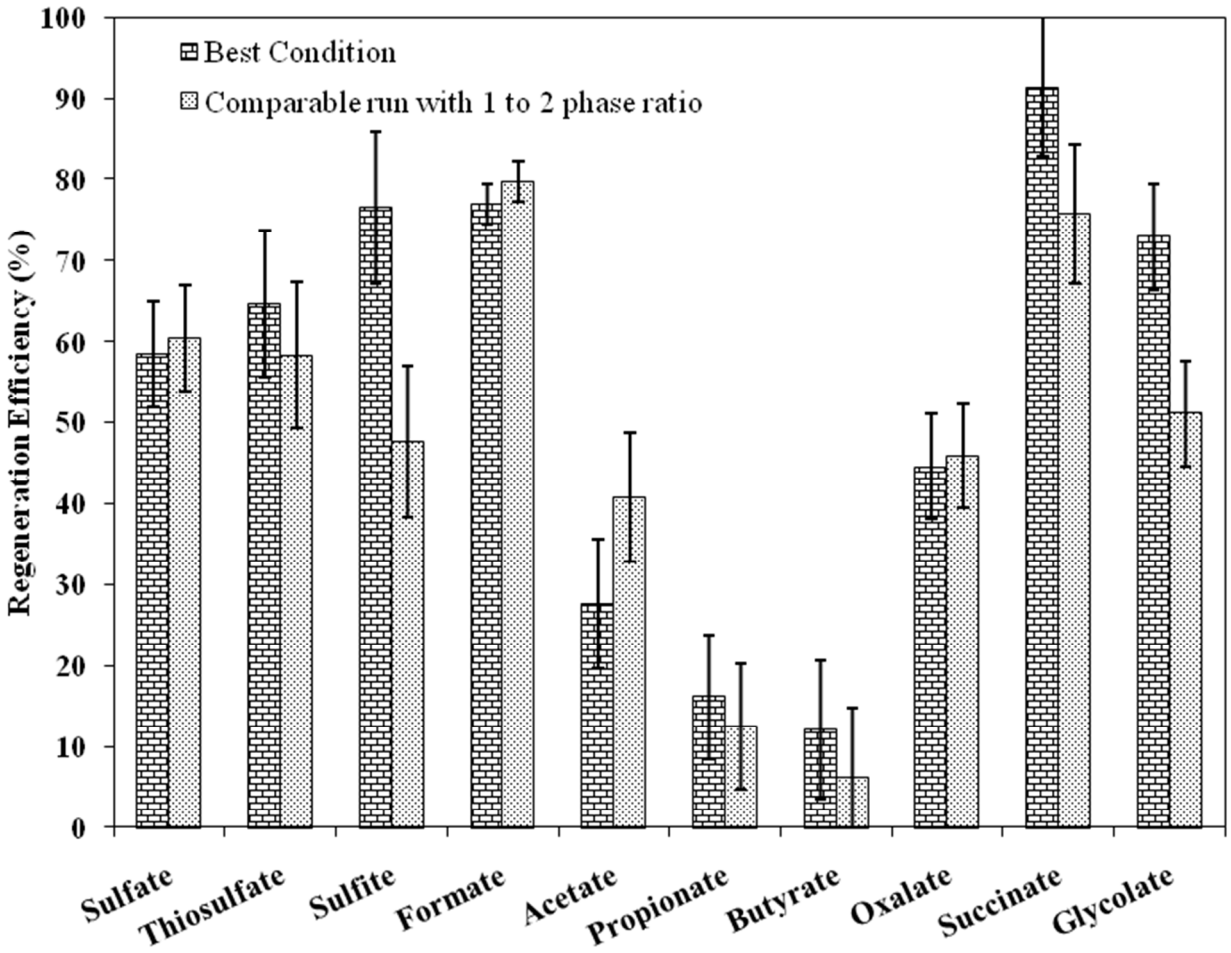

Figure S12. Comparison of regeneration efficiency using 1 to 1 and 1 to 2 phase ratio with respective 88 % and 69 % aliquat preloaded with HSS

(323 K, 10 min mixing time, and 4 kmol/m^3 NaOH)

Table S1. Summary of extraction conditions

Extraction Parameter	Range
TOA concentration	0 – 1 kmol/m^3
Aliquat 336 concentration	0 – 1 kmol/m^3
OH Aliquat concentration	1 kmol/m^3
Volume Phase Ratio	1 to 1, 1 to 2, and 2 to 1
Temperature	298 – 338 K
Mixing time	10 min

Table S2. Summary of chemical modification condition of aliquat 336

Chemical	Contact time	Volume Phase ratio	Temperature (K)	Mixing time (min)	Degree of OHConversion (%, ±2)
2 kmol/m^3 KOH	10	1 to 1	298	5	69
4 kmol/m^3 NaOH	15	1 to 1	313	10	79
5 kmol/m^3 NaOH	15	1 to 2	333	10	87
5 kmol/m^3 NaOH	21	1 to 1	333	10	88

Table S3. Langmuir correlation data of TOA and Aliquat extraction systems

HSS	TOA			Aliquat 336		
	a	b	R^2	a	b	R^2
Thiosulafte	0.00062	-0.00947	0.62	0.00110	-0.01106	0.98
Sulfate	0.00227	-0.00970	0.99	0.00176	-0.01106	0.79
Oxalate	0.00034	-0.01039	0.85	0.00205	-0.00091	0.96
Formate	0.00353	-0.00899	0.56	0.00470	-0.01482	0.94
Succinate	0.00207	-0.00987	0.66	0.00780	-0.01093	0.94
Acetate	0.03948	0.03475	0.71	0.00817	-0.02014	0.79
Glycolate	0.01161	0.00222	0.54	0.00728	-0.01998	0.87
Propionate	0.00183	-0.00874	0.51	0.00090	-0.01239	0.91
Butyrate	0.00038	-0.00997	0.54	0.00015	-0.01082	0.93
Average R^2	0.67			0.91		

Table S4. Summary of HSS preloaded 1 kmol/m^3 OH aliquat

HSS	Concentration (ppm)			
	69% OH Aliquat	79% Aliquat	87% Aliquat	88% Aliquat
Formate	877	910	930	852
Acetate	845	771	920	825
Propionate	880	921	874	846
Butyrate	938	960	893	818
Glycolate	808	859	813	789
Oxalate	995	990	999	999
Succinate	1032	1019	955	999
Sulfate	924	961	911	864
Thiosulfate	915	895	889	830