

Table S1. Comparison of the reflux ratio and CO₂ capture.

Reflux ratio	CO ₂ capture (kg/s)	CO ₂ capture (%)
1.00	100.85	90.02
2.00	99.81	89.09
3.00	98.78	88.17
3.95	97.80	87.3
5.00	96.72	86.34
6.00	95.70	85.43

Table S2. Comparison of the reboiler duty and CO₂ capture.

Reboiler duty (MW)	CO ₂ capture (kg/s)	CO ₂ capture (%)
110.0	98.57	87.99
120.5	99.71	89.00
131.0	100.85	90.02
141.0	101.94	90.99
151.0	103.04	91.97
161.5	104.2	93.01
171.5	105.32	94.01
181.5	106.43	95.00

Table S3. Comparison of Semi-lean feed stage.

Semi-lean feed stage	CO ₂ removal rate (%)
1	90.009
2	90.021
3	90.023
4	90.021
5	90.012
6	89.933

Table S4. Operating condition for 90% removal rate.

Ammonia solution (kg/sec)	Reflux ratio	Reboiler duty (MW)	NH₃ mass fraction (%)	NH₃ solution temperature (°C)
375	1.0	131	7	25

Table S5. Material balance table

Stream Name	Units	CO2	FEED	LEANIN	LEANOUT	NH3	PURECO2	RECYCLE	RICHIN	RICHOUT	LEANIN2	SPLIT	VENT
Temperature	C	85.6613	50	25	87.4927	25	30	30	80	45.3489	25	85.6874	26.1994
Pressure	bar	1.0133	1.0133	1.0133	1.0133	1.0133	1.0133	1.0133	1.0133	1.0133	1.0133	1.0133	1.0133
Mole Flows	kmol/s	167.82	20.48	160.99	161	20.9	2.38	130.94	167.2	166.09	5	5	16.52
Mole Fractions													
H2O		0.5611	0.1184	0.9575	0.9548	0.9262	0.0365	0.4648	0.9424	0.9437	0.9534	0.95	0.0325
CO2		0.2193	0.1243	3.46E-07	3.68E-05	0	0.9613	9.51E-05	0.0067	4.29E-05	6.52E-07	5.48E-05	0.0004
N2		6.34E-06	0.7573	0	2.39E-26	0	0.0004	2.64E-09	6.36E-06	6.40E-06	0	1E-30	0.939
NH3		0.2196	0	0.0212	0.025	0.0737	0.0018	0.0005	0.0164	0.0069	0.019	0.0237	0.0281
H3O+		0	0	4.04E-12	1.13E-10	8.52E-15	0	5.76E-10	2.69E-10	1.38E-10	5.99E-12	1.47E-10	0
NH4+		0	0	0.0114	0.0102	8.82E-05	0	0.2712	0.0175	0.0255	1.47E-02	0.0133	0
NH2COO-		0	0	0.0064	0.0038	0	0	0.0098	0.0049	0.0066	0.0081	0.0048	0
HCO3-		0	0	0.0021	0.0059	0	0	0.246	0.0116	0.0155	0.0031	0.0078	0
OH-		0	0	1.36E-06	1.83E-06	8.82E-05	0	6.40E-08	8.91E-07	3.73E-07	1.03E-06	1.50E-06	0
CO3--		0	0	0.0014	0.0003	0	0	0.0076	0.0005	0.0017	0.0017	0.0004	0