Supplementary Information

Utilizing solid polyamine in a rotary bed to capture CO_2 in an energy and cost-efficient manner

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Table S1 Constants for gas properties.

Gas components	Constants	Equation $C_{P,i}$	Equation K_i	Equation μ_i
CO_2	C_1	1194.11	0	0
	C_2	1.8865	7.5×10^{-5}	0.0624×10^{-6}
	C_3	-0.636×10^{-3}	0	5.0×10^{-11}
	C_4	0	0	4.0×10^{-14}
N_2	C_1	1206.07	1.6452×10^{-3}	2.306×10^{-6}
	C_2	0.2595	0.8726×10^{-4}	0.0603×10^{-6}
	C_3	-0.0129×10^{-3}	-0.3×10^{-7}	3.0×10^{-11}
	C_4	0	0	8.0×10^{-14}

Table S2 Constants for equation 9.

Constants	C_1	C_2	C_3	C_4	C_5	C_6
H_2O	68.5549	-7004.80	0.0035888	-6.6689	-8.505e-7	2

Table S3 Boundary and initial conditions.

Section	Bottom		Top	
Adsorption	$T = 303K$	$C_i = C_{feed,i}$	$\partial T / \partial z = 0$	$\partial C_i / \partial z = 0$
Vacuum	$\partial T / \partial z = 0$	$\partial C_i / \partial z = 0$	$T = 348K$	$C_i = C_{vout,i}$
Purge	$T = T_{aout}$	$C_i = C_{aout,i}$	$\partial T / \partial z = 0$	$\partial C_i / \partial z = 0$

Where T_{aout} denotes the average temperature at outlet of adsorption section or column. $C_{feed,i}$ is the concentration of gas component i at inlet of adsorption section or column. $C_{vout,i}$ and $C_{aout,i}$ refer to the average concentration of gas component i at outlet of vacuum and

adsorption section or column, respectively.

Table S4 Calculation of Total CO_2 Capture Cost (TCC)

Item	Measures
TCC	Annual capital cost (ACC) + Annual operating cost (AOC)
ACC	Total capital investment (TCI) with a coefficient
TCI	Fixed capital investment (FCI) + working capital + startup cost + initial solvent cost
FCI	Direct cost (DC) + Indirect cost (IC)
AOC	Variable operating cost (VOC) + Fixed operating cost (FOC)

Table S5 Total Capital Investment (TCI).

Item	Values
Direct Cost (DC)	
Equipments installation	5% of EC
Instrumentation and Control	10% of EC
Piping	10% of EC
Building and building services	5% of EC
Yard improvements	5% of EC
Land and Miscellaneous	5% of EC
Indirect Cost (IC)	
Procurement cost	2% of DC
Contingency	10% of DC
Engineering and Supervision	15% of DC
Startup cost	1% of FCI
Working capital	15% of FCI
Initial solvent cost	Original materials cost with a coefficient

Table S6 Annual Operating Cost (AOC).

Item	Values
Variable Operating Costs (VOC)	
Electrical cost of blower and pump	0.07 US$/kWh
Adsorbents make-up	10% of total adsorbent costs
Fixed Operating Costs (FOC)	
Maintenance (M)	3% of FCI
Insurance	1% of FCI
Local tax	1% of FCI
Operating supplies	15% of M
Operating labor (OL)	34.5 US$/h
Operating hours	7000 h/a

Table S7 Comparison of energy and cost of different processes

Materials	TCC ($/t)	TCI ($/t)	FOC ($/t)	VOC ($/t)	Energy Consumption (GJ/t)	Reference
MEA	70	14	13	43	3.72	[32]
[Bpy]BF_4—MEA	60	14	12	34	2.51	[32]
Polyamine-fixed bed	41.64	17.03	12.45	12.17	1.28	This work
Polyamine-rotating column	32.6	13.3	11.49	7.77	1.11	This work