

Concentration	Antoine Equation Constants			NRMSD
	A	B	C	(%)
Pure*	5.20409	1581.3410	-33.5	N/A
0.2M	7.2220	1575.0116	-36	0.577
0.5M	7.240744	1581.9301	-36	1.25
0.8M	7.2176	1575.0123	-36	0.879
1M	7.1841	1569.4013	-36	1.45

Table 1: Resulting polynomial fits of vapour pressure as a function of temperature for known solutions of paracetamol in methanol. \*Pure Antoine Equation Constants obtained from NIST

CONCENTRATION	FEED CONCENTRATION (G/G)	FEED FLOW RATE (G/S)	GAS FLOWRATE (L/MIN)	TEMPERATURE (°C)	EVAPORATION RATE (G/S)	PREDICTED RATE (G/S)	ERROR (%)	OUTLET CONCENTRATION (G/G)	% INCREASE
0.0741		0.07	1.4	50	0.0352	0.03385	3.9	0.122	64.6
		0.095	2.8	50	0.0635	0.0637	0.31	0.223	201
		0.12	3.4	46	0.0559	0.0561	0.356	0.123	65.9
		0.12	4.0	40	0.0407	0.04132	1.5	0.097	30.9

TEMP (°C)	Q (L/MIN)	DM/DT EXPERIMENTAL (G/MIN)	DM/DT PREDICTED (G/MIN)	ERROR (%)
50	0.5	-0.6802	-0.68289	0.39
	1	-1.3773	-1.36577	0.84
	1.5	-2.058	-2.04866	0.45
	2	-2.7754	-2.73155	1.6
	2.5	-3.4467	-3.41443	0.96
	3	-4.1102	-4.09732	0.31

Table 2: Results of evaporation rates and increase in solution concentration. Experiments were allowed to run for 20 minutes to ensure a steady state of operation before flow rate and concentration measurements were taken.

Table 3: Rate of evaporation associated with a concentration of 1M solution and a temperature of 50 °C with varying gas flow rate – as shown in figure 5.

Time (mins)	Tube Height (above frit) (cm)	$\dot{m}_{out}$ (g/min)	$\dot{m}_{evap}$ (g/min)	$\dot{m}_{evap}^{predicted}$ (g/min)	Error (%)
0	30	0.8962	1.2038	1.1952	0.719
10	30	0.8995	1.2005		0.443
20	30	0.9063	1.1937		0.125
30	25	0.9079	1.1921		0.259
40	20	0.9021	1.1979		0.226
50	15	0.9001	1.1999		0.393
60	10	0.9063	1.1947		0.042
70	7	0.9044	1.1956		0.033

Table 4: Rate of evaporation over time associated with position of dip tube. Mass flow rate measurements were taken as an average and the slope of the accumulation taken as the flow rate. Note the indistinguishable change in flow rate over the range of dip tube positions studied.

Time (mins)	$\dot{m}_{feed}$ (g/min)	$\dot{m}_{out}$ (g/min)	$c_{out}$ (wt%;M; g/g)	$\dot{m}_{evap}$ (g/min)	$\dot{m}_{evap-model}$ (g/min)	Error (%)	Concentration Increase (% (wt%))
0	5	-	-	-	2.747	-	-
20	5	2.371	12.8; 0.71; 0.147	2.629	2.747	4.29	124
25	5	2.323	12.5; 0.689; 0.143	2.677	2.747	2.55	119
30	5	2.253	12.6; 0.691; 0.144	2.702	2.747	1.64	121
40	5	2.291	12.58; 0.692; 0.1438	2.709	2.747	1.402	120
50	7.5	4.802	9.5; 0.513; 0.1044	2.698	2.785	3.12	67
60	7.5	4.789	9.14; 0.491; 0.0997	2.711	2.785	2.66	60
70	12.5	9.812	7.5; 0.398; 0.0801	2.688	2.785	3.483	31.5
80	12.5	9.756	7.32; 0.388; 0.0779	2.744	2.785	1.47	28.4
90	15	12.304	7.2; 0.382; 0.0766	2.696	2.785	3.19	26.3
100	15	12.262	7.0; 0.370; 0.0742	2.830	2.785	1.61	22.8

Table 5: Results of increasing feed flow rate on evaporation system. Rate of evaporation is consistent with that predicted by the model. ( $Q_{air} = 2\text{L/min}$ ,  $T = 50^\circ\text{C}$ ,  $c_{in} = 5.7\text{ wt\%}$ ;  $0.3\text{M}$ ;  $0.06\text{g/g}$ )

Time (mins)	$\dot{m}_{feed}$ (g/min)	$\dot{m}_{out}$ (g/min)	$c_{out}$ (wt %;M; g/g)	$\dot{m}_{evap}$ (g/min)	$\dot{m}_{evap-model}$ (g/min)	Error (%)	Concentration Increase (%)
30	15	8.098	10.8; 0.585; 0.120	6.902	6.868	0.49	89.5
40	15	8.109	10.5; 0.571; 0.117	6.891	6.868	0.33	84.2

Table 6: Results of increased feed flow rate on system. Gas flow rate increased to combat dilution effect caused by higher throughput. Results are consistent with model predictions as described by equation 2.0. ( $Q_{air} = 5\text{L/min}$ ,  $T = 50^\circ\text{C}$ )

Table 7: Results of concentration measurements for evaporation-MSMPR coupling

$C_{F\text{-Column}}$ (g/g)	Concentration Increase (%)	$c_{F\text{-Crystallizer}}$ (g/g)	$c_{\text{Mother-Liquor}}$ (g/g)	$c^*$ (g/g)	$Yield_{\text{Theoretical}}$	$Yield_{\text{Actual}}$
0.092	179	0.257	0.218	0.1745	32.1	15.2