

G.1

PLOT THE DATA USING EXCEL

SMALL COLUMN

BREAKTHROUGH TIME = 9.0h = t_B (1 mg/L)

TWO WAYS TO ESTIMATE t_{SAT}

1) INTEGRATE $\int_0^{\infty} \left(1 - \frac{Y}{Y_F}\right) dt$

USING TRAPEZOID RULE $t_{SAT} = \underline{10.93h}$

2) ASSUME BREAKTHROUGH IS SYMMETRIC
THEN t_{SAT} OCCURS WHEN $\frac{Y}{Y_F} = 0.5$

OR $y = (0.5)(1440 \text{ mg/L}) = 720 \text{ mg/L}$

INTERPOLATE	<u>t</u>	<u>Y</u>
	10.80	650
	t_{SAT}	720
	11.00	800

$$\frac{0.20}{150} = \frac{t_{SAT} - 10.8}{70} \Rightarrow t_{SAT} = \underline{10.89h}$$

WE WILL USE $t_{SAT} = 10.93h$

$$L = 26.8 \text{ cm}$$

$$L_{UB} = 26.8 \text{ cm} \left(1 - \frac{9.0}{10.93}\right) = 4.73 \text{ cm}$$

$$\frac{t_{SAT}}{V_{qF}} = \frac{t_{SAT}}{L} = \frac{10.93}{26.8} = 0.408 \frac{h}{cm}$$

a) FOR LONGER COLUMN $L = 43.9 \text{ cm}$

$$t_{\text{SAT}} = L \frac{q_{\text{SAT}}}{v C_f} = 43.9 (0.408 \text{ h/cm})$$
$$= 17.9 \text{ h}$$

$$L_{\text{UB}} = L \left(1 - t_b / t_{\text{SAT}} \right)$$

$$4.73 = 43.9 \left(1 - t_b / 17.9 \right)$$

$$\underline{t_b = 16.0 \text{ h}}$$

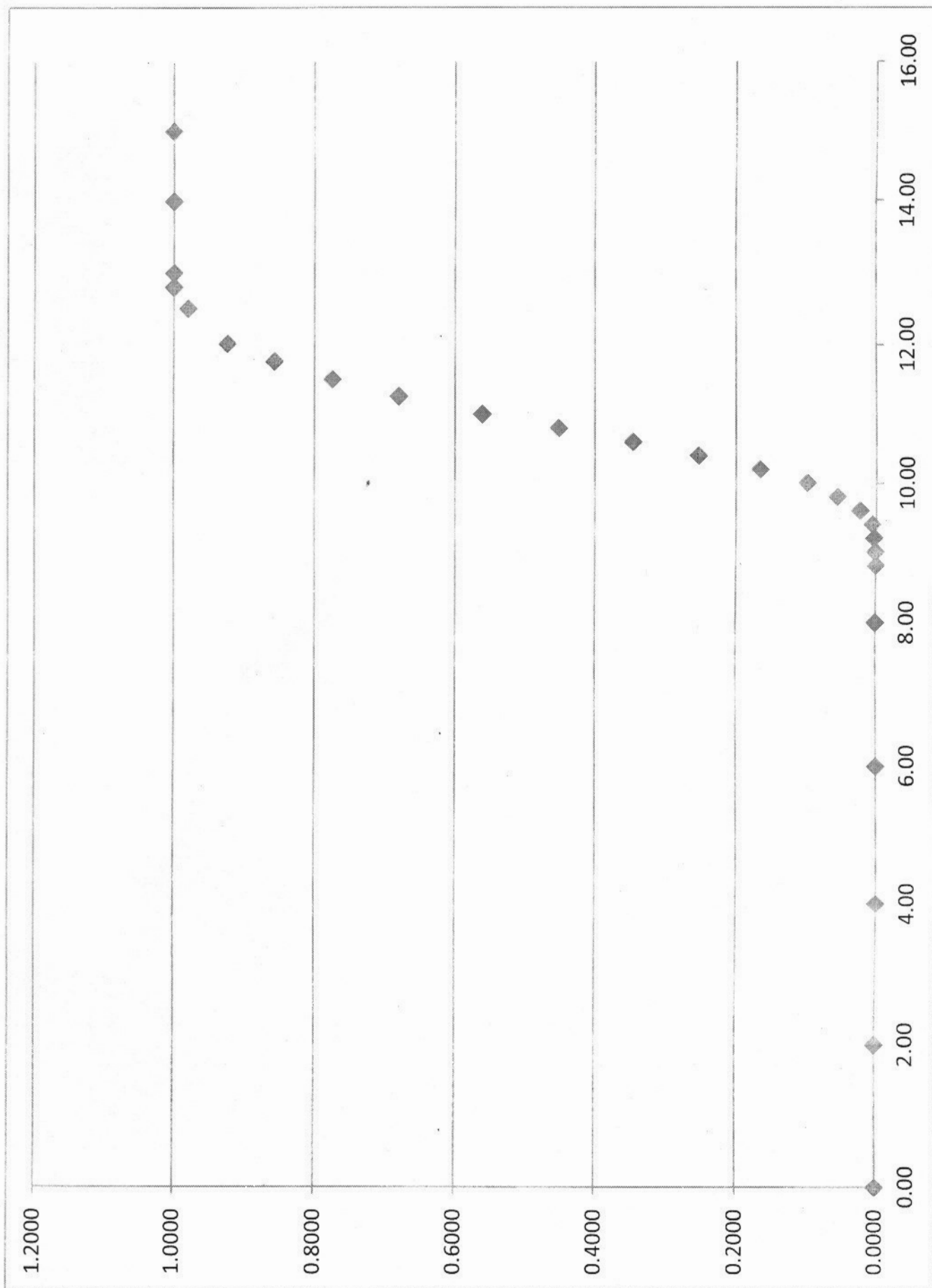
b) BECAUSE THE CONCENTRATION OF BREAKTHROUGH IS VERY LOW ($1 \text{ mg/L} \Rightarrow q = 0.0007$), ESSENTIALLY ALL OF THE MATERIAL FLOWING INTO BED HAS BEEN ADSORBED:

$$\text{SMALL COLUMN} \left(\frac{1440 \text{ mg}}{L} \right) \left(\frac{2.9 \text{ L}}{h} \right) (9.0 \text{ h}) \approx 37,600 \text{ mg}$$

$$\text{LONGER COLUMN} \left(\frac{1440 \text{ mg}}{L} \right) \left(\frac{2.9 \text{ L}}{h} \right) (16.0 \text{ h}) \approx 66,800 \text{ mg}$$

78% GREATER

c) A LARGER FRACTION OF THE COLUMN IS SATURATED FOR THE LONGER COLUMN BECAUSE L_{UB} IS SAME.



Time	Conc. in Effluent	y/yF	Area
0.00	0	0.0000	2.000
2.00	0	0.0000	2.000
4.00	0	0.0000	2.000
6.00	0	0.0000	2.000
8.00	0	0.0000	0.800
8.80	0	0.0000	0.200
9.00	1	0.0007	0.200
9.20	4	0.0028	0.199
9.40	9	0.0063	0.197
9.60	33	0.0229	0.192
9.80	80	0.0556	0.185
10.00	142	0.0986	0.174
10.20	238	0.1653	0.158
10.40	365	0.2535	0.140
10.60	498	0.3458	0.120
10.80	650	0.4514	0.099
11.00	808	0.5611	0.095
11.25	980	0.6806	0.068
11.50	1115	0.7743	0.046
11.75	1235	0.8576	0.027
12.00	1330	0.9236	0.024
12.50	1410	0.9792	0.003
12.80	1440	1.0000	0.000
13.00	1440	1.0000	0.000
14.00	1440	1.0000	0.000
15.00	1440	1.0000	

10.927 Area