

# **Summary Report of Experiments Investigating the Sorption of Five Organic Acids on TC-75 16x40**

**Prepared By**

**Vinka Craver, Ph.D.**

**and**

**James Smith, Ph.D.**

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**For**

**George Alther**

**Biomin, Inc.**

**P. O. Box 20028**

**Ferndale, MI 48220**

This report presents data summarizing the results from five sets of column experiments studying the sorptive capacity of TC-75 (16x40 mesh) to aqueous solutions of five different organic acids. A 30-inch long (76.2 cm) by 3-inch diameter (7.62 cm) column was constructed from polyvinylchloride (PVC) and filled with the sorbent material to be studied. A peristaltic pump forced an aqueous solution containing between 700 and 1200 mg/L of organic acid up through the column to displace void-space air and ensure maximum contact with the sorbent material. Samples were collected periodically at the outflow of the column and analyzed using a spectrophotometric method.

The regeneration process used in some experiments consisted of filling the column with a solution of 3% sodium chloride and 1% sodium hydroxide overnight. After that, the column was rinsed with tap water for 5 min before feeding it again with the aqueous-organic-acid solution.

Results of these experiments are presented in Tables 1 to 10 and in Figures 1 to 5 as follows.

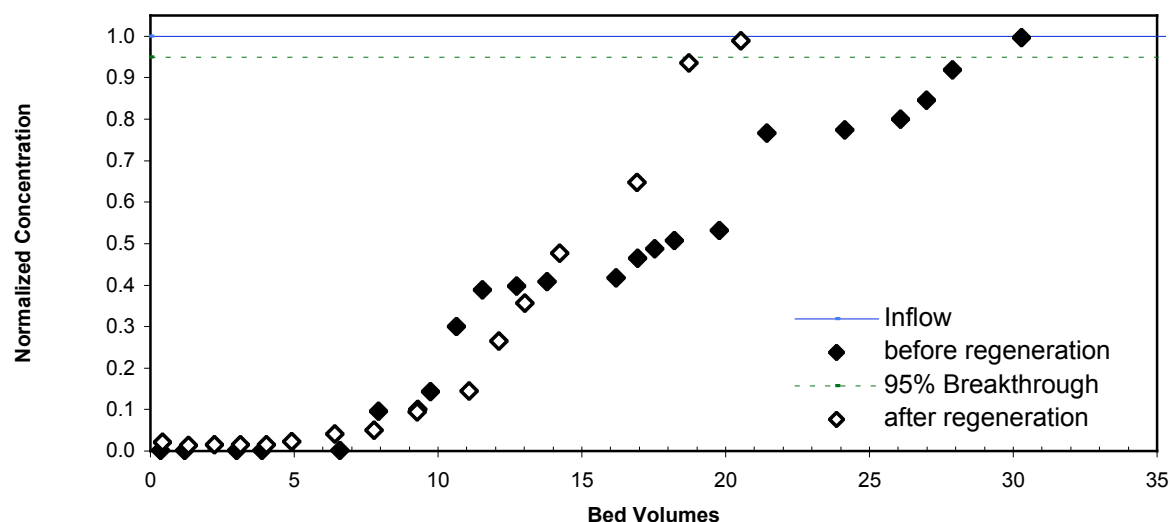
# Results of experiments investigating the sorption of tannic acid (Aldrich) on TC-75 16x40 with column regeneration

**Table 1.** Sorbent mass, porosity, flow rate, and residence time information for TC-75 16x40 sorbent column experiments.

Sorbent	Mass Sorbent		Porosity	Flow Rate		Residence (min)
	(kg)	(lb)		(mL/min)	(gal/hr)	
TC-75 16x40	2.1	4.6	0.3	48	0.76	21

**Table 2.** 95% breakthrough for TC-75 16x40 sorbent given in bed volumes and minutes along with estimated mass of tannic acid sorbed per mass of sorbent in mg/kg, lb/lb and percent basis.

Sorbent	Breakthrough		Mass sorbed		Mass Sorbed/Mass Sorbent		
	BV	min	(mg)	(lb)	(mg/kg)	(lb/lb)	(% by sorbent)
Breakthrough before regeneration	32	2180	41300	0.091	19667	0.0197	1.97
Breakthrough after regeneration	20	1360	30499	0.067	14523	0.0145	1.45
Total	52	3540	71799	0.158	34190	0.0342	3.42



**Figure 1.** Breakthrough curve of tannic acid through a column of TC-75 16x40.

# Results of experiments investigating the sorption of fulvic acid (Horizon) to TC-75 16x40 with column regeneration

**Table 3.** Sorbent mass, porosity, flow rate and residence time information for TC-75 16x40 column experiments.

Sorbent	Mass Sorbent		Porosity	Flow Rate		Residence (min)
	(kg)	(lb)		(mL/min)	(gal/hr)	
TC-75 16x40	2.91	6.4	0.21	60	0.95	20

**Table 4.** 95% breakthrough for the TC-75 16x40 sorbent given in bed volumes and minutes along with estimated mass of fulvic acid sorbed per mass of sorbent in mg/kg, lb/lb and percent basis.

Sorbent	Breakthrough		Mass sorbed		Mass Sorbed/Mass Sorbent		
	BV	min	(mg)	(lb)	(mg/kg)	(lb/lb)	(% by sorbent)
Before regeneration	45	4440	42373	0.093	14561	0.0146	1.46
After first regeneration	27	2720	21410	0.047	7357	0.0074	0.74
After second regeneration	22	2000	16424	0.036	5644	0.0056	0.56
<b>Total</b>	94	9160	80207	0.176	27563	0.0276	2.76

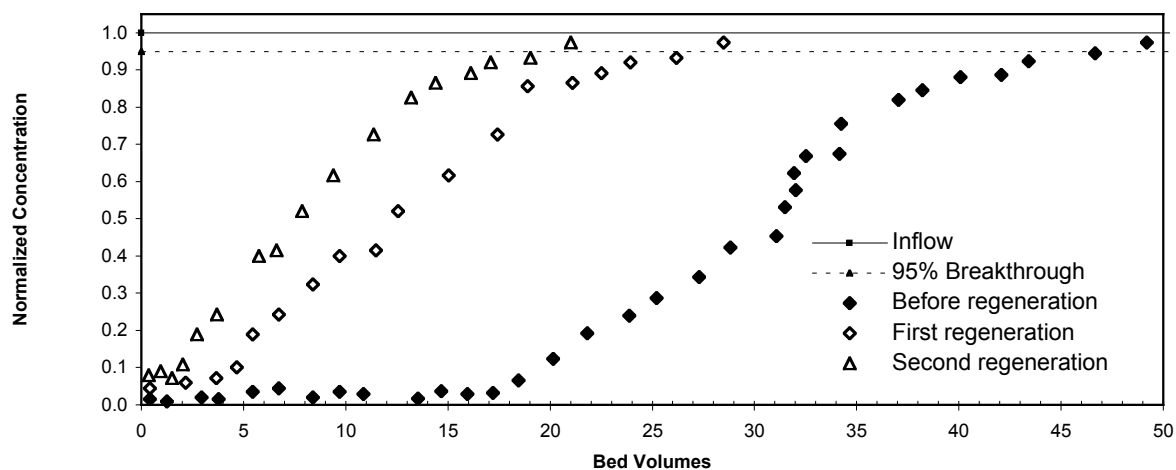


Figure 2. Breakthrough curve of fulvic acid through a column of TC-75 16x40.

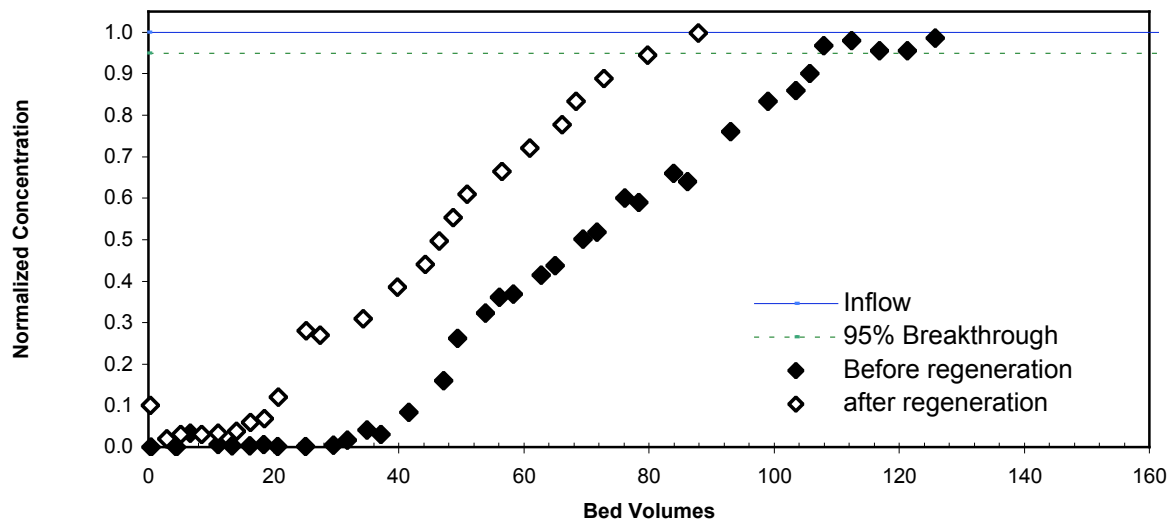
# Results of experiments investigating the sorption of humic acid (Aldrich) to TC-75 16x40 with column regeneration.

**Table 5.** Sorbent mass, porosity, flow rate and residence time information for TC-75 16x40 sorbent column experiments.

Sorbent	Mass Sorbent		Porosity	Flow Rate		Residence (min)
	(kg)	(lb)		(mL/min)	(gal/hr)	
<b>TC-75 16x40</b>	2.1	4.6	0.28	60.1	0.95	20

**Table 6.** 95% breakthrough for TC-75 16x40 sorbent given in bed volumes and minutes along with estimated mass of humic acid sorbed per mass of sorbent in mg/kg, lb/lb and percent basis.

Sorbent	Breakthrough		Mass sorbed		Mass Sorbed/Mass Sorbent		
	BV	min	(mg)	(lb)	(mg/kg)	(lb/lb)	(% by sorbent)
<b>Before regeneration</b>	107	7700	61475	0.135	29274	0.0293	2.93
<b>After regeneration</b>	79	5700	40573	0.089	19320	0.0193	1.93
<b>Total</b>	186	13400	102048	0.225	48594	0.0486	4.86



**Figure 3.** Breakthrough curve of humic acid through a column of TC-75 16x40.

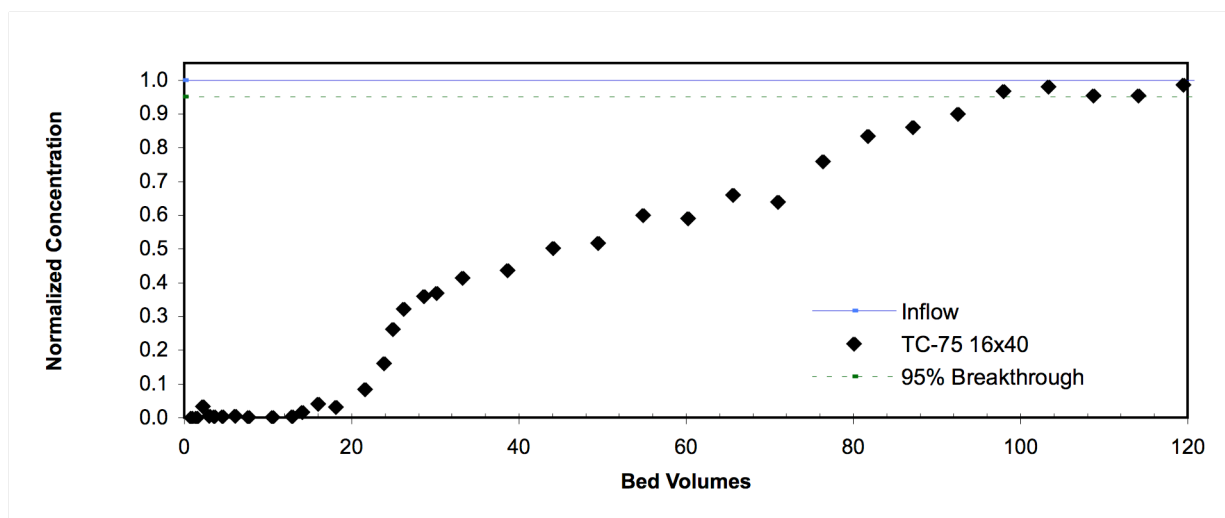
## Results of experiments investigating the sorption of Quantum H (humic acid, Horizon) to TC-75 16x40

**Table 7.** Sorbent mass, porosity, flow rate and residence time information for TC-75 16x40 sorbent column experiments.

Sorbent	Mass Sorbent		Porosity	Flow Rate		Residence (min)
	(kg)	(lb)		(mL/min)	(gal/hr)	
<b>TC-75 16x40</b>	2.81	6.2	0.28	155	2.46	5.8

**Table 8.** 95% breakthrough for TC-75 16x40 sorbent material given in bed volumes and minutes along with estimated mass of Quantum H sorbed per mass of sorbent in mg/kg, lb/lb and percent basis.

Sorbent	Breakthrough		Mass sorbed		Mass Sorbed/Mass Sorbent		
	BV	min	(mg)	(lb)	(mg/kg)	(lb/lb)	(% by sorbent)
<b>TC-75 16x40</b>	364	2111	106201	0.234	37794	0.0378	3.78



**Figure 4.** Breakthrough curve of Quantum H through a column of TC-75 16x40.

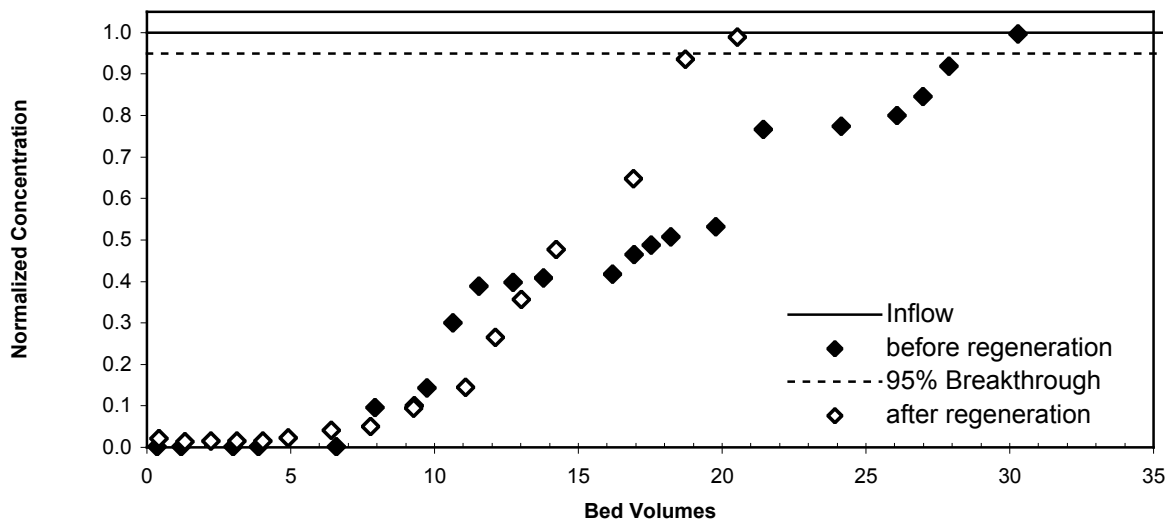
# Results of experiments investigating the sorption of tannic acid (Aldrich) on TC-75 with column regeneration

**Table 9.** Sorbent mass, porosity, flow rate, and residence time information for TC-75 sorbent column experiments.

Sorbent	Mass Sorbent		Porosity	Flow Rate		Residence (min)
	(kg)	(lb)		(mL/min)	(gal/hr)	
TC-75	2.1	4.6	0.30	50	0.81	21

**Table 10.** 95% breakthrough for TC-75 sorbent materials given in pore volumes and minutes along with estimated mass of tannic acid sorbed per mass of sorbent in mg/kg, lb/lb and percent basis.

Sorbent	Breakthrough		Mass sorbed		Mass Sorbed/Mass Sorbent		
	BV	min	(mg)	(lb)	(mg/kg)	(lb/lb)	(% by sorbent)
Breakthrough before regeneration	32.7	2180	41300	0.091	19667	0.0197	1.97
Breakthrough after regeneration	20.4	1360	30499	0.067	14523	0.0145	1.45
Total	53.1	3540	71799	0.178	34189	0.0342	3.42



**Figure 5.** Breakthrough curve of tannic acid through a column of TC-75 16x40