

Supplementary Information

Table S1. Minimum total amount of acid activated date stone carbon to remove IBU using the Langmuir-Freundlich model to achieve $C_2=5.0\% C_0$.

C_0 (mg/L)	C_2 (mg/L)	C_1 (mg/L)	S_{s1} (kg)	S_{s1} (kg)	$S_{s1}+S_{s2}$ (kg)
1	0.0500	0.2400	0.2739	0.4723	0.7462
2	0.1000	0.4810	0.2387	0.4016	0.6403
3	0.1500	0.7210	0.2236	0.3661	0.5897
4	0.2000	0.9610	0.2158	0.3435	0.5592
5	0.2500	1.2020	0.2116	0.3273	0.5390
6	0.3000	1.4420	0.2097	0.3151	0.5249
7	0.3500	1.6830	0.2093	0.3055	0.5148
8	0.4000	1.9230	0.2099	0.2977	0.5076
10	0.5000	2.4040	0.2132	0.2857	0.4990
12	0.6000	2.8850	0.2184	0.2771	0.4955
14	0.7000	3.3660	0.2249	0.2706	0.4955
15	0.7500	3.6060	0.2284	0.2680	0.4964
16	0.8000	3.8460	0.2322	0.2657	0.4979
18	0.9000	4.3270	0.2402	0.2619	0.5021
20	1.0000	4.8080	0.2486	0.2590	0.5076

Table S2. Minimum total amount of acid activated date stone carbon to remove IBU using the Langmuir-Freundlich model to achieve $C_2=2.0\% C_0$.

C_0 (mg/L)	C_2 (mg/L)	C_1 (mg/L)	S_{s1} (kg)	S_{s1} (kg)	$S_{s1}+S_{s2}$ (kg)
1	0.0200	0.1580	0.5064	1.0640	1.5704
2	0.0400	0.3160	0.4362	0.9025	1.3386
3	0.0600	0.4740	0.4035	0.8200	1.2230
4	0.0800	0.6320	0.3845	0.7665	1.1510
5	0.1000	0.7900	0.3723	0.7279	1.1002
6	0.1200	0.9480	0.3643	0.6980	1.0623
7	0.1400	1.1060	0.3591	0.6739	1.0330
8	0.1600	1.2640	0.3557	0.6540	1.0098
10	0.2000	1.5800	0.3530	0.6225	0.9755
12	0.2400	1.8960	0.3538	0.5985	0.9522
14	0.2800	2.2120	0.3569	0.5794	0.9362
15	0.3000	2.3700	0.3590	0.5711	0.9302
16	0.3200	2.5290	0.3616	0.5637	0.9253
18	0.3600	2.8450	0.3675	0.5506	0.9181
20	0.4000	3.1610	0.3743	0.5395	0.9138

Table S3. Minimum total amount of acid activated date stone carbon to remove IBU using the Langmuir-Freundlich model to achieve $C_2=1.0\% C_0$.

C_0 (mg/L)	C_2 (mg/L)	C_1 (mg/L)	S_{s1} (kg)	S_{s1} (kg)	$S_{s1}+S_{s2}$ (kg)
1	0.0100	0.1150	0.7832	1.9165	2.6996
2	0.0200	0.2310	0.6707	1.6245	2.2952
3	0.0300	0.3460	0.6167	1.4746	2.0913
4	0.0400	0.4610	0.5837	1.3774	1.9612
5	0.0500	0.5770	0.5617	1.3065	1.8681
6	0.0600	0.6920	0.5460	1.2514	1.7975
7	0.0700	0.8070	0.5345	1.2071	1.7416
8	0.0800	0.9230	0.5261	1.1700	1.6960
10	0.1000	1.1530	0.5152	1.1110	1.6262
12	0.1200	1.3840	0.5099	1.0654	1.5753
14	0.1400	1.6150	0.5081	1.0286	1.5367
15	0.1500	1.7300	0.5082	1.0128	1.5210
16	0.1600	1.8450	0.5089	0.9982	1.5071
18	0.1800	2.0760	0.5115	0.9723	1.4839
20	0.2000	2.3070	0.5156	0.9501	1.4657

Table S4. Minimum total amount of acid activated date stone carbon to remove IBU using the Langmuir-Freundlich model to achieve $C_2=0.5\% C_0$.

C_0 (mg/L)	C_2 (mg/L)	C_1 (mg/L)	S_{s1} (kg)	S_{s2} (kg)	$S_{s1}+S_{s2}$ (kg)
1	0.0050	0.0840	1.1918	3.4082	4.6000
2	0.0100	0.1690	1.0174	2.8866	3.9039
3	0.0150	0.2530	0.9315	2.6196	3.5511
4	0.0200	0.3370	0.8779	2.4456	3.3235
5	0.0250	0.4210	0.8407	2.3188	3.1595
6	0.0300	0.5060	0.8134	2.2203	3.0336
7	0.0350	0.5900	0.7925	2.1404	2.9329
8	0.0400	0.6740	0.7762	2.0736	2.8498
10	0.0500	0.8430	0.7529	1.9670	2.7199
12	0.0600	1.0120	0.7379	1.8843	2.6222
14	0.0700	1.1800	0.7285	1.8173	2.5458
15	0.0750	1.2640	0.7253	1.7883	2.5135
16	0.0800	1.3490	0.7229	1.7615	2.4844
18	0.0900	1.5170	0.7201	1.7139	2.4341
20	0.1000	1.6860	0.7196	1.6727	2.3922

Table S5. Minimum total amount of acid activated date stone carbon to remove IBU using the Langmuir-Freundlich model to achieve $C_2=0.20$ mg/L.

C_0 (mg/L)	C_2 (mg/L)	C_1 (mg/L)	S_{s1} (kg)	S_{s2} (kg)	$S_{s1}+S_{s2}$ (kg)
1	0.2000	0.4580	0.0900	0.1166	0.2066
2	0.2000	0.6630	0.1446	0.2086	0.3532
3	0.2000	0.8240	0.1837	0.2812	0.4649
4	0.2000	0.9620	0.2158	0.3435	0.5592
5	0.2000	1.0850	0.2436	0.3990	0.6427
6	0.2000	1.1970	0.2687	0.4498	0.7185
7	0.2000	1.3020	0.2918	0.4969	0.7887
8	0.2000	1.4000	0.3133	0.5410	0.8544
10	0.2000	1.5800	0.3530	0.6225	0.9755
12	0.2000	1.7450	0.3893	0.6970	1.0863
14	0.2000	1.8980	0.4233	0.7660	1.1893
15	0.2000	1.9710	0.4395	0.7988	1.2384
16	0.2000	2.0420	0.4554	0.8307	1.2861
18	0.2000	2.1780	0.4810	0.8919	1.3780
20	0.2000	2.3070	0.5156	0.9501	1.4657

Table S6. Minimum total amount of acid activated date stone carbon to remove IBU using the Langmuir-Freundlich model to achieve $C_2=0.10$ mg/L.

C_0 (mg/L)	C_2 (mg/L)	C_1 (mg/L)	S_{s1} (kg)	S_{s2} (kg)	$S_{s1}+S_{s2}$ (kg)
1	0.1000	0.3310	0.1637	0.2439	0.4076
2	0.1000	0.4810	0.2387	0.4016	0.6403
3	0.1000	0.5990	0.2919	0.5259	0.8179
4	0.1000	0.7000	0.3351	0.6327	0.9678
5	0.1000	0.7900	0.3723	0.7279	1.1002
6	0.1000	0.8730	0.4055	0.8149	1.2204
7	0.1000	0.9490	0.4359	0.8956	1.3315
8	0.1000	1.0210	0.4640	0.9713	1.4353
10	0.1000	1.1530	0.5152	1.1110	1.6262
12	0.1000	1.2740	0.5617	1.2386	1.8001
14	0.1000	1.3870	0.6047	1.3569	1.9616
15	0.1000	1.4400	0.6251	1.4132	2.0383
16	0.1000	1.4920	0.6450	1.4678	2.1128
18	0.1000	1.5910	0.6831	1.5729	2.2560
20	0.1000	1.6860	0.7196	1.6727	2.3922

Table S7. Minimum total amount of acid activated date stone carbon to remove IBU using the Langmuir-Freundlich model to achieve $C_2=0.05$ mg/L.

C_0 (mg/L)	C_2 (mg/L)	C_1 (mg/L)	S_{s1} (kg)	S_{s2} (kg)	$S_{s1}+S_{s2}$ (kg)
1	0.0500	0.2400	0.2739	0.4723	0.7462
2	0.0500	0.3500	0.3783	0.7439	1.1222
3	0.0500	0.4360	0.4519	0.9582	1.4101
4	0.0500	0.5100	0.5110	1.1422	1.6532
5	0.0500	0.5770	0.5617	1.3065	1.8681
6	0.0500	0.6370	0.6066	1.4565	2.0631
7	0.0500	0.6930	0.6474	1.5957	2.2430
8	0.0500	0.7460	0.6849	1.7261	2.4111
10	0.0500	0.8430	0.7529	1.9670	2.7200
12	0.0500	0.9320	0.8139	2.1870	3.0009
14	0.0500	1.0140	0.8698	2.3912	3.2610
15	0.0500	1.0530	0.8962	2.4884	3.3846
16	0.0500	1.0910	0.9219	2.5826	3.5045
18	0.0500	1.1640	0.9708	2.7637	3.7345
20	0.0500	1.2340	1.0172	2.9358	3.9531

Table S8. Minimum total amount of acid activated date stone carbon to remove IBU using the Langmuir-Freundlich model to achieve $C_2=0.01$ mg/L.

C_0 (mg/L)	C_2 (mg/L)	C_1 (mg/L)	S_{s1} (kg)	S_{s2} (kg)	$S_{s1}+S_{s2}$ (kg)
1	0.0100	0.1150	0.7832	1.9165	2.6996
2	0.0100	0.1690	1.0174	2.8866	3.9039
3	0.0100	0.2110	1.1813	3.6510	4.8323
4	0.0100	0.2470	1.3115	4.3080	5.6195
5	0.0100	0.2790	1.4215	4.8959	6.3173
6	0.0100	0.3080	1.5187	5.4309	6.9496
7	0.0100	0.3360	1.6058	5.9278	7.5337
8	0.0100	0.3610	1.6855	6.3937	8.0792
10	0.0100	0.4090	1.8275	7.2546	9.0821
12	0.0100	0.4520	1.9530	8.0409	9.9939
14	0.0100	0.4920	2.0663	8.7707	10.8370
15	0.0100	0.5110	2.1193	9.1183	11.2376
16	0.0100	0.5290	2.1705	9.4550	11.6255
18	0.0100	0.5650	2.2674	10.1011	12.3686
20	0.0100	0.5990	2.3578	10.7181	13.0759