

**Table 1**

Sample	d (mm)	Particle size (mm)	Density (kg/m <sup>3</sup> )
Sand	0.50-0.60	0.55	2523.98
	0.60-0.71	0.66	
	0.71-0.85	0.78	
	0.85-1.00	0.93	
	1.00-1.18	1.09	
Sisal residue	0.50-0.60	0.55	1700.04
	0.60-0.71	0.66	
	0.71-0.85	0.78	
	0.85-1.00	0.93	
	1.00-1.18	1.09	
Biochar	0.71-0.85	0.78	609.57

**Table 2**

	Tests	d <sub>sand</sub> (mm)	d <sub>bio</sub> (mm)	W <sub>bio</sub>	W <sub>bchar</sub>	U <sub>ff</sub> (m/s)	S (%)	d <sub>bio</sub> /d <sub>sand</sub>	W <sub>bio</sub> /W <sub>bchar</sub>
Simple factorial design	1	0.66 (-1)	0.66 (-1)	0.05 (-1)	0.05 (-1)	0.378	2.619	1.00	1
	2	0.95 (+1)	0.66 (-1)	0.05 (-1)	0.05 (-1)	0.655	13.643	0.71	1
	3	0.66 (-1)	0.95 (+1)	0.05 (-1)	0.05 (-1)	0.478	6.571	1.41	1
	4	0.95 (+1)	0.95 (+1)	0.05 (-1)	0.05 (-1)	0.680	4.640	1.00	1
	5	0.66 (-1)	0.66 (-1)	0.08(+1)	0.05 (-1)	0.504	3.429	1.00	1.6
	6	0.95 (+1)	0.66 (-1)	0.08(+1)	0.05 (-1)	0.629	56.665	0.71	1.6
	7	0.66 (-1)	0.95 (+1)	0.08(+1)	0.05 (-1)	0.604	7.476	1.41	1.6
	8	0.95 (+1)	0.95 (+1)	0.08(+1)	0.05 (-1)	0.730	15.108	1.00	1.6
	9	0.66 (-1)	0.66 (-1)	0.05 (-1)	0.08(+1)	0.453	2.614	1.00	0.63
	10	0.95 (+1)	0.66 (-1)	0.05 (-1)	0.08(+1)	0.629	7.403	0.71	0.63
	11	0.66 (-1)	0.95 (+1)	0.05 (-1)	0.08(+1)	0.529	5.668	1.41	0.63
	12	0.95 (+1)	0.95 (+1)	0.05 (-1)	0.08(+1)	0.579	17.440	1.00	0.63
	13	0.66 (-1)	0.66 (-1)	0.08(+1)	0.08(+1)	0.554	34.960	1.00	1
	14	0.95 (+1)	0.66 (-1)	0.08(+1)	0.08(+1)	0.553	13.968	0.71	1
	15	0.66 (-1)	0.95 (+1)	0.08(+1)	0.08(+1)	0.604	4.602	1.41	1
	16	0.95 (+1)	0.95 (+1)	0.08(+1)	0.08(+1)	0.705	15.737	1.00	1
Central points	17	0.80 (0)	0.80 (0)	0.065(0)	0.065(0)	0.453	8.285	1.00	1
	18	0.80 (0)	0.80 (0)	0.065(0)	0.065(0)	0.504	12.303	1.00	1
	19	0.80 (0)	0.80 (0)	0.065(0)	0.065(0)	0.453	7.087	1.00	1
Axial points	20	1.10 (+2)	0.80 (0)	0.065(0)	0.065(0)	0.654	7.945	0.75	1
	21	0.80 (0)	1.10 (+2)	0.065(0)	0.065(0)	0.629	8.649	1.34	1
	22	0.80 (0)	0.80 (0)	0.095(+2)	0.065(0)	0.604	6.625	1.00	1.46
	23	0.80 (0)	0.80 (0)	0.065(0)	0.095(+2)	0.579	9.895	1.00	0.68
	24	0.51 (-2)	0.80 (0)	0.065(0)	0.065(0)	0.453	2.025	1.52	1
	25	0.80 (0)	0.51 (-2)	0.065(0)	0.065(0)	0.579	6.052	0.66	1
	26	0.80 (0)	0.80 (0)	0.035(-2)	0.065(0)	0.453	3.324	1.00	0.54

**Table 3**

Eq.	Correlations	DCP (%)
(18)	$\pi_9 = \pi_1^{C1} \pi_2^{C2} \pi_3^{C3} \pi_4^{C4} \pi_5^{C5} \pi_6^{C6} \pi_7^{C7} \pi_8^{C8}$	9.1
(19)	$\pi_9 = C1(\pi_1 + \pi_2 + \pi_3) + C2(\pi_4 + \pi_5 + \pi_6) + \pi_7 + \pi_8 + C3$	11.2
(20)	$\pi_9 = C1\pi_1\pi_2 + C2\pi_3\pi_4 + C3\pi_5\pi_6 + C4\pi_7\pi_8$	8.9
(21)	$\pi_9 = C1(\pi_1 - \pi_2) + C2(\pi_3 - \pi_4) + C3(\pi_5 - \pi_6) + C4(\pi_7 - \pi_8)$	10.6
(22)	$\pi_9 = C1(\pi_1 + \pi_2) + C2(\pi_3 + \pi_4) + C3(\pi_5 + \pi_6) + C4(\pi_7 + \pi_8)$	9.2
(23)	$\pi_9 = C1 \pi_1 \pi_4 + C2(\pi_5/\pi_2) + C3 \pi_3 \pi_6^{C4} + C5 \pi_7 + C6 \pi_8 + C7$	6.7

**Table 4**

Grup	Subgrup	Tests
1 ( $d_{bio}/d_{sand} = 1$ )	1A ( $W_{bio}/W_{bchar} = 1$ )	1, 4, 13, 16, 17-19
	1B ( $W_{bio}/W_{bchar} < 1$ )	9, 12, 23, 26
	1C ( $W_{bio}/W_{bchar} > 1$ )	5, 8, 22, 27
2 ( $d_{bio}/d_{sand} < 1$ )	2A ( $W_{bio}/W_{bchar} = 1$ )	2, 14, 20, 25
	2B ( $W_{bio}/W_{bchar} < 1$ )	10
	2C ( $W_{bio}/W_{bchar} > 1$ )	6
3 ( $d_{bio}/d_{sand} > 1$ )	3A ( $W_{bio}/W_{bchar} = 1$ )	3, 15, 21, 24
	3B ( $W_{bio}/W_{bchar} < 1$ )	11
	3C ( $W_{bio}/W_{bchar} > 1$ )	7