Electronic Supplementary Information (ESI)

A Study of Cake Filtration Parameters Using Constant Rate Process

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Figure S1 shows the size distribution of both materials and indicate that both particle types have very similar size ranges, and we believe the distributions can be considered relatively narrow.

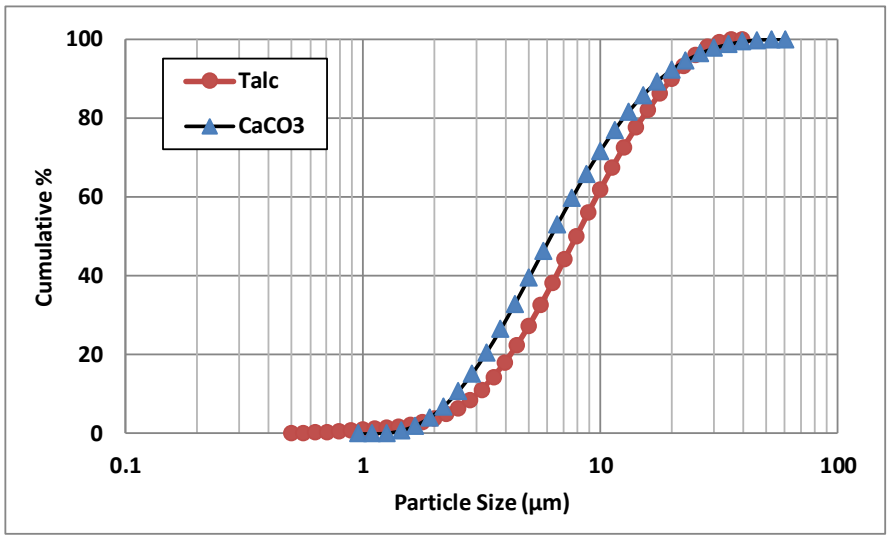

Figure S1: Malvern Mastersizer 2000 cumulative particle size distributions for tested calcium carbonate and talc particles.

Extended methodology description of the filtration rig and process

Figure S2 (across page) shows the constant rate filtration rig, which utilised a clear acrylic cell with an inner diameter of 60 mm and total volume of 424 mL. A peristaltic pump (Watson Marlow 401U/D1) was used to suck the filtrate through the depositing cake and a metal filter medium membrane, to ensure a clear filtrate in all tests and promote cake filtration. The membrane used incorporated 10 µm slots with a nominal thickness of 0.06 mm and a measured hydraulic permeability of 1.2E-13 m2, manufactured by Micropore Technologies Ltd. (Hatton, Derbyshire, UK). Also, a pressure transducer (HCX Series Honeywell S&C) and a vacuum gauge (WIKA Instruments Ltd.) were connected to monitor and check the pressure at the base of the cell, within the filtrate line. The filtrate was collected in a vessel placed on an electronic balance (OHAUS SPU601). The weight of the filtrate and pressure drop in the system, as a function of time, were recorded using a PC within LabVIEW software. For all tests, three different filtrate pump settings were used (10, 30 and 50% of full-scale) which gave rise to three different filtration rates and cake forming pressure profiles. To avoid any variability in the feed material, the same suspension was used many times. The loss in the reused suspension was monitored between filtrations and found to be very low (approx. 1% between runs). To validate the calculations

of the final cake concentrations a vernier-scale measuring calliper was used; measuring over five different positions of cake height per test (before and after filtration) and using the average cake height for a mass balance to give the cake concentration.

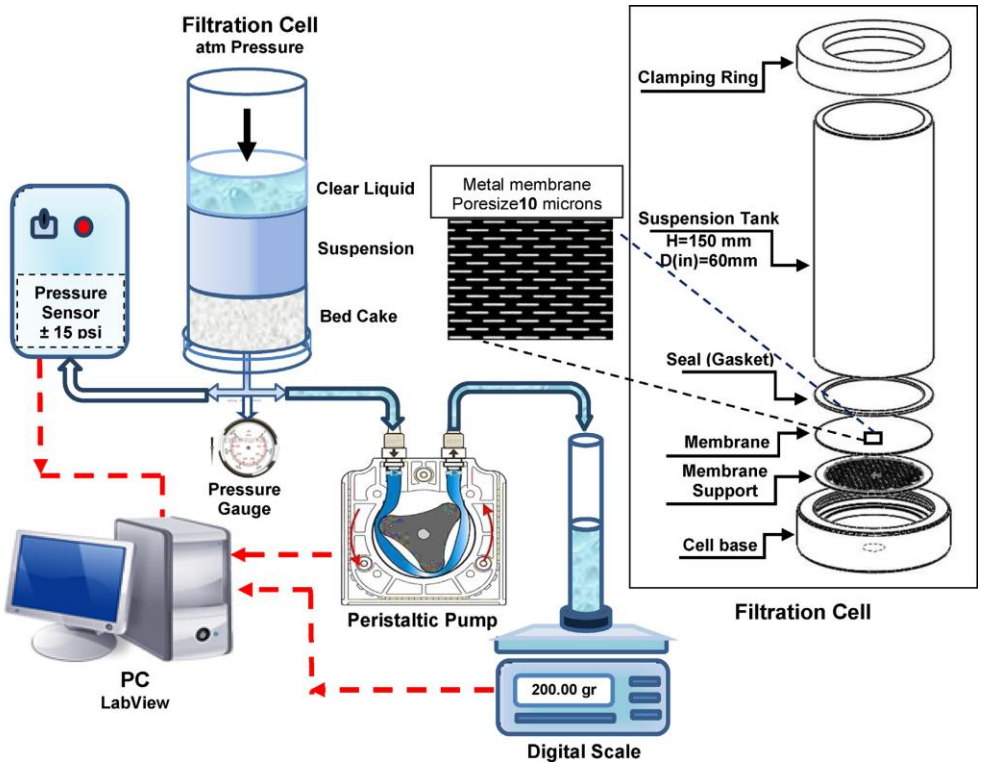

Figure S2: Schematic diagram of constant rate vacuum filtration equipment.

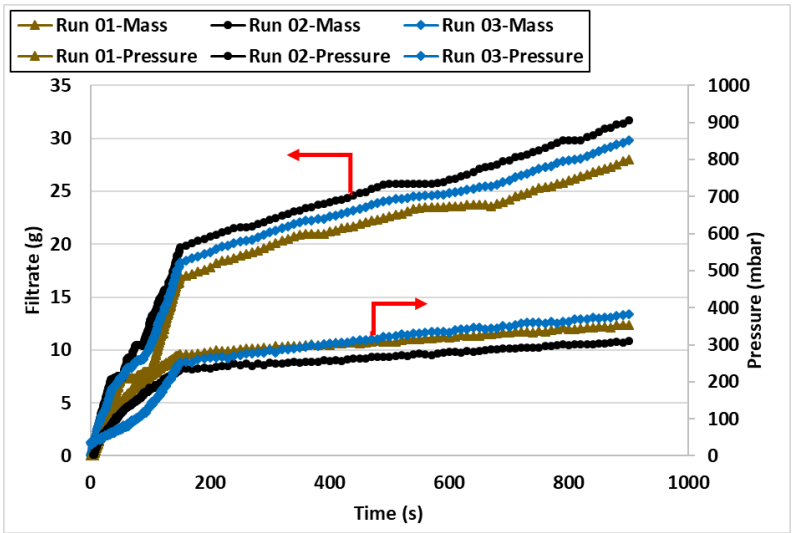

Figure S3: Experimental data of filtrate and pressure for three runs of calcium carbonate at 30 rpm pump speed and 0.19 v/v initial concentration, to demonstrate the general reproducibility of results.

Table S1: A comparison between experimental permeability data derived from Darcy law calculations and predicted permeability using Kozeny-Carman theory. Results are based on Table 3 information.

	a) Talc Permeability k (m^2)								
P.Sp.	***5 rpm***			***10 rpm***			***30 rpm***		
Ci (v/v)	***C.C (v/v)***	**Experiment**	**K.C**	***C.C (v/v)***	**Experiment**	**K.C**	***C.C (v/v)***	**Experiment**	**K.C**
0.01	0.19	1.68E-14	1.04E-10	0.19	1.41E-14	1.00E-10	0.22	8.83E-15	6.71E-11
0.02	0.18	2.14E-14	1.21E-10	0.20	1.87E-14	9.34E-11	0.25	1.14E-14	4.92E-11
0.03	0.18	2.52E-14	1.17E-10	0.22	2.47E-14	7.34E-11	0.26	1.43E-14	4.17E-11
0.04	0.21	2.87E-14	8.16E-11	0.22	2.81E-14	7.15E-11	0.26	1.73E-14	4.17E-11
0.05	0.20	3.62E-14	9.34E-11	0.22	3.47E-14	7.53E-11	0.26	1.99E-14	4.12E-11

	b) Calcium Carbonate Permeability k (m^2)								
P.Sp	***5 rpm***			***10 rpm***			***30 rpm***		
Ci (v/v)	***C.C (v/v)***	**Experiment**	**K.C**	***C.C (v/v)***	**Experiment**	**K.C**	***C.C (v/v)***	**Experiment**	**K.C**
0.09	0.48	1.64E-14	3.21E-12	0.49	1.39E-14	2.65E-12	0.52	1.60E-14	2.00E-12
0.11	0.48	5.19E-14	3.08E-12	0.55	7.38E-15	1.51E-12	0.59	1.94E-14	1.01E-12
0.13	0.44	3.56E-14	4.54E-12	0.50	4.91E-14	2.58E-12	0.52	1.30E-14	2.09E-12
0.15	0.44	3.80E-14	4.63E-12	0.49	1.88E-14	2.71E-12	0.53	1.50E-14	1.94E-12
0.17	0.41	1.41E-14	6.23E-12	0.51	1.75E-14	2.31E-12	0.52	1.33E-14	2.04E-12
0.19	0.45	4.98E-14	4.19E-12	0.51	2.1E-14	2.19E-12	0.53	1.17E-14	1.79E-12
0.21	0.43	5.42E-14	5.01E-12	0.50	1.93E-14	2.53E-12	0.53	1.44E-14	1.89E-12

(Ci) Initial concentration, (P.Sp.) Pump speed and (C.C) Final cake concentration; Kozeny-Carman (K-C)