Cape Peninsula
University of Technology

TEST DATASETS

THE EFFECT OF POLYCARBOXYLATE SUPERPLASTERCISER ON THE ADSORPTION AND RHEOLOGY OF SELF-COMPACTING CONCRETE PASTE

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Dataset A

This section presents the dataset created for the optimisation of the SP1 and SP2 for Cement 1, Cement 2 and Cement 3 with the addition of a Superplasticiser dosage ranging from 0.1% to 0.8% in order to identify the point at which no change can be observe as the SP dosage increases.

Table 1: Optimisation of Cement 1 with SP1 at a dosage of 0.1% to 0.8% by weight of the cement

	Dosage %							
	0.1	0.2	0.3	0.4	0.5	0.6	0.7	0.8
Yield stress (pa)	5.567	2.344	1.1	0.4	0.13	0.09	0.05	0.015
	6.523	2.733	0.8	0.32	0.11	0.07	0.066	0.008
	7.97	3.13	0.7	0.33	0.112	0.068	0.04	0.011
Plastic viscosity (Pa.s)	0.399	0.332	0.218	0.155	0.09	0.066	0.038	0.125
	0.392	0.297	0.221	0.143	0.082	0.052	0.078	0.201
	0.431	0.311	0.213	0.169	0.111	0.09	0.234	0.309
Average	6.687	2.736	0.867	0.35	0.117	0.076	0.052	0.011

Table 2: Optimisation of Cement 1 with SP2 at a dosage of 0.1% to 0.8% by weight of the cement

	Dosage							
	0.1	0.2	0.3	0.4	0.5	0.6	0.7	0.8
Yield stress	22.8	6.014	0.421	0.344	0.21	0.03	0.009	0.002
	12.748	4.547	0.777	0.3	0.15	0.02	0.005	0.002
	8.771	3.173	0.556	0.28	0.19	0.02	0.006	0.001
Plastic viscosity	0.397	0.414	0.295	0.231	0.197	0.151	0.154	0.112
	0.381	0.357	0.293	0.214	0.181	0.163	0.142	0.111
	0.412	0.307	0.247	0.198	0.17	0.162	0.159	0.146
Average	14.773	4.578	0.585	0.308	0.183	0.023	0.007	0.002

Table 3: Optimisation of Cement 2 with SP1 at a dosage of 0.1% to 0.8% by weight of the cement

	Dosage							
	0.1	0.2	0.3	0.4	0.5	0.6	0.7	0.8
Yield stress	2.469	1.239	0.149	0.235	0.31	0.231	0.156	0.04
	2.801	1.468	0.34	0.183	0.1	0.092	0.09	0.06
	2.663	1.74	0.587	0.123	0.045	0.09	0.087	0.03
Plastic viscosity	0.316	0.238	0.15	0.106	0.078	0.072	0.065	0.127
	0.306	0.217	0.141	0.091	0.07	0.072	0.075	0.166
	0.284	0.213	0.14	0.098	0.073	0.069	0.08	0.062
Average	2.644	1.482	0.359	0.180	0.152	0.138	0.111	0.043

Table 4: Optimisation of Cement 2 with SP2 at a dosage of 0.1% to 0.8% by weight of the cement

	Dosage							
	0.1	0.2	0.3	0.4	0.5	0.6	0.7	0.8
Yield stress	1.669	0.4	0.1	0.04	0.03	0.018	0.008	0.003
	0.909	0.5	0.09	0.045	0.028	0.015	0.009	0.002
	1.32	0.4	0.06	0.039	0.025	0.014	0.008	0.002
Plastic viscosity	0.3	0.226	0.172	0.14	0.12	0.112	0.073	0.055
	0.294	0.23	0.188	0.151	0.133	0.11	0.118	0.113
	0.285	0.222	0.17	0.146	0.123	0.126	0.1	0.051
Average	1.299	0.433	0.083	0.041	0.028	0.016	0.008	0.002

Table 5: Optimisation of Cement 3 with SP1 at a dosage of 0.1% to 0.8% by weight of the cement

	Dosage							
	0.1	0.2	0.3	0.4	0.5	0.6	0.7	0.8
Yield stress (pa)	5.833	3.957	3.219	0.782	0.2	0.09	0.009	0.002
	5.341	3.077	1.835	0.484	0.18	0.07	0.008	0.001
	4.878	4.36	2.917	0.4	0.17	0.05	0.005	0.001
Plastic viscosity (Pa.s)	0.39	0.319	0.209	0.127	0.06	0.172	0.336	0.278
	0.346	0.293	0.213	0.131	0.067	0.082	0.268	0.098
	0.382	0.318	0.227	0.108	0.055	0.042	0.121	0.076
Average	5.351	3.798	2.657	0.555	0.183	0.07	0.007	0.001

Table 6: Optimisation of Cement 3 with SP1 at a dosage of 0.1% to 0.8% by weight of the cement

	Dosage							
	0.1	0.2	0.3	0.4	0.5	0.6	0.7	0.8
Yield stress (Pa)	5.637	1.064	0.3	0.09	0.03	0.015	0.008	0.003
	4.219	1.282	0.2	0.069	0.03	0.01	0.007	0.002
	3.753	0.761	0.18	0.055	0.02	0.01	0.005	0.003
Plastic viscosity (Pa.s)	0.351	0.229	0.151	0.101	0.045	0.041	0.037	0.042
	0.331	0.221	0.142	0.098	0.05	0.046	0.049	0.044
	0.335	0.243	0.134	0.106	0.116	0.054	0.047	0.054
Average	4.536	1.036	0.227	0.071	0.027	0.012	0.007	0.003

Data set B

This section presents the effect of the SP on the rheology when the Cement paste is at rest.

The cement paste was left to rest and was then tested in 5 minute increments for 30mins

Table 7: Cement 1 at rest at 5 minutes intervals with the addition of 0.25% of SP-C 10/90

	Minutes						
	0	5	10	15	20	25	30
Yield stress (Pa)	0.3	0.743	0.809	1.132	1.038	1.669	2.693
	0.25	0.685	1.051	1.103	2.581	2.699	2.297
	0.28	0.336	0.595	0.598	1.045	1.389	1.276
Plastic viscosity (Pa.s)	0.307	0.311	0.314	0.327	0.32	0.315	0.317
	0.314	0.303	0.319	0.325	0.352	0.347	0.31
	0.296	0.298	0.309	0.291	0.312	0.318	0.325
Average	0.277	0.588	0.818	0.944	1.555	1.919	2.089

Table 8: Cement 1 at rest at 5 minutes intervals with the addition of 0.25% of SP-C 30/70

	Minutes						
	0	5	10	15	20	25	30
Yield stress (Pa)	0.2	1.188	1.548	1.804	1.936	2.087	2.299
	0.21	0.804	1.243	1.362	1.569	1.976	2.63
	0.215	0.614	0.911	1.28	1.25	1.883	1.645
Plastic viscosity (Pa.s)	0.316	0.316	0.317	0.339	0.343	0.323	0.335
	0.324	0.323	0.306	0.333	0.323	0.346	0.341
	0.309	0.319	0.319	0.331	0.334	0.345	0.338
Average	0.208	0.869	1.234	1.482	1.585	1.982	2.191

Table 9: Cement 1 at rest at 5 minutes intervals with the addition of 0.25% of SP-C 50/50

	Minutes						
	0	5	10	15	20	25	30
Yield stress (Pa)	0.18	0.973	1.051	1.135	2.12	1.877	1.797
	0.19	0.973	1.064	1.26	1.034	1.251	2.028
	0.101	0.253	0.371	0.906	0.738	1.237	1.394
Plastic viscosity (Pa.s)	0.288	0.322	0.316	0.336	0.317	0.34	0.352
	0.29	0.302	0.321	0.341	0.35	0.32	0.332
	0.306	0.307	0.323	0.314	0.335	0.31	0.33
Average	0.157	0.733	0.829	1.100	1.297	1.455	1.74

Table 10: Cement 1 at rest at 5 minutes intervals with the addition of 0.25% of SP-C 60/40

	Minutes						
	0	5	10	15	20	25	30
Yield stress (Pa)	0.17	1.04	1.177	1.509	1.694	1.984	2.643
	0.14	0.748	1.017	0.991	1.407	1.742	1.633
	0.18	0.89	1.191	1.306	1.55	1.559	2.089
Plastic viscosity (Pa.s)	0.288	0.317	0.33	0.343	0.313	0.332	0.319
	0.3	0.3	0.305	0.304	0.324	0.317	0.332
	0.305	0.316	0.321	0.335	0.316	0.33	0.338
Average	0.163	0.893	1.128	1.269	1.550	1.762	2.122

Table 11: Cement 1 at rest at 5 minutes intervals with the addition of 0.25% of SP-C 80/20

	Minutes						
	0	5	10	15	20	25	30
Yield stress (Pa)	0.13	0.2	0.379	0.422	0.951	1.051	1.247
	0.15	0.391	0.41	0.905	0.955	1.265	1.296
	0.16	0.321	0.427	0.718	0.788	1.703	1.797
Plastic viscosity (Pa.s)	0.289	0.296	0.322	0.322	0.317	0.329	0.322
	0.298	0.322	0.334	0.324	0.329	0.339	0.331
	0.305	0.311	0.32	0.33	0.331	0.317	0.324
Average	0.147	0.304	0.405	0.682	0.898	1.34	1.447

Table 12: Cement 2 at rest at 5 minutes intervals with the addition of 0.25% of SP-C 10/90

	Minutes						
	0	5	10	15	20	25	30
Yield stress (Pa)	0.1	0.1	0.2	0.18	0.078	0.336	0.885
	0.11	0.14	0.2	0.25	0.598	0.942	1.258
	0.1	0.13	0.15	0.234	0.429	0.946	1.488
Plastic viscosity (Pa.s)	0.188	0.182	0.225	0.288	0.335	0.32	0.36
	0.187	0.192	0.22	0.282	0.336	0.34	0.351
	0.183	0.192	0.237	0.32	0.319	0.374	0.423
Average	0.103	0.123	0.183	0.221	0.368	0.741	1.210

Table 13: Cement 2 at rest at 5 minutes intervals with the addition of 0.25% of SP-C 30/70

	Minutes						
	0	5	10	15	20	25	30
Yield stress (Pa)	0.09	0.09	0.15	0.08	0.255	0.409	1.742
	0.1	0.12	0.18	0.452	0.2	0.06	0.159
	0.075	0.06	0.1	0.008	0.441	1.394	1.433
Plastic viscosity (Pa.s)	0.18	0.165	0.224	0.294	0.305	0.34	0.424
	0.174	0.168	0.261	0.274	0.334	0.368	0.377
	0.195	0.197	0.229	0.321	0.354	0.386	0.446
Average	0.088	0.09	0.143	0.18	0.299	0.621	1.111

Table 14: Cement 2 at rest at 5 minutes intervals with the addition of 0.25% of SP-C 40/60

	Minutes						
	0	5	10	15	20	25	30
Yield stress (Pa)	0.07	0.11	0.14	0.15	0.15	0.45	0.447
	0.09	0.13	0.14	0.16	0.455	0.519	1.087
	0.08	0.09	0.1	0.17	0.19	0.33	1.1
Plastic viscosity (Pa.s)	0.175	0.154	0.218	0.271	0.315	0.358	0.338
	0.176	0.181	0.237	0.29	0.326	0.382	0.384
	0.163	0.185	0.237	0.313	0.31	0.368	0.431
Average	0.08	0.11	0.127	0.16	0.265	0.433	0.878

Table 15: Cement 2 at rest at 5 minutes intervals with the addition of 0.25% of SP-C 50/50

	Minutes						
	0	5	10	15	20	25	30
Yield stress (Pa)	0.08	0.1	0.13	0.155	0.673	0.972	0.349
	0.06	0.12	0.15	0.183	0.513	0.788	0.572
	0.07	0.08	0.12	0.5	0.683	0.788	1.627
Plastic viscosity (Pa.s)	0.129	0.167	0.226	0.287	0.331	0.332	0.318
	0.178	0.188	0.248	0.328	0.366	0.358	0.392
	0.186	0.216	0.275	0.336	0.423	0.393	0.423
Average	0.07	0.1	0.133	0.279	0.623	0.849	0.849

Table 16: Cement 2 at rest at 5 minutes intervals with the addition of 0.25% of SP-C 60/40

	Minutes						
	0	5	10	15	20	25	30
Yield stress (Pa)	0.08	0.09	0.1	0.18	0.638	0.565	1.144
	0.04	0.07	0.14	0.315	0.704	0.532	1.481
	0.06	0.09	0.13	0.209	0.421	0.868	2.504
Plastic viscosity (Pa.s)	0.15	0.149	0.217	0.233	0.357	0.366	0.339
	0.151	0.183	0.259	0.31	0.352	0.363	0.396
	0.166	0.194	0.256	0.318	0.356	0.352	0.452
Average	0.06	0.083	0.123	0.235	0.588	0.655	1.71

Table 17: Cement 2 at rest at 5 minutes intervals with the addition of 0.25% of SP-C 80/20

	Minutes						
	0	5	10	15	20	25	30
Yield stress (Pa)	0.06	0.07	0.1	0.152	1.022	1.063	1.294
	0.07	0.08	0.09	0.655	1.159	2.573	2.469
	0.04	0.05	0.07	0.351	1.02	1.332	1.861
Plastic viscosity (Pa.s)	0.141	0.145	0.221	0.291	0.32	0.353	0.377
	0.166	0.19	0.26	0.315	0.325	0.412	0.403
	0.159	0.195	0.256	0.307	0.333	0.359	0.38
Average	0.0567	0.067	0.087	0.386	1.067	1.656	1.875

Table 18: Cement 3 at rest at 5 minutes intervals with the addition of 0.25% of SP-C 10/90

	Minutes						
	0	5	10	15	20	25	30
Yield stress (Pa)	0.28	0.694	1.529	3.835	3.583	3.517	3.658
	0.29	0.385	1.091	1.345	1.948	2.014	3.77
	0.3	1.546	2.315	2.258	2.521	2.78	2.991
Plastic viscosity (Pa.s)	0.216	0.279	0.333	0.406	0.416	0.386	0.425
	0.202	0.282	0.351	0.32	0.35	0.369	0.408
	0.234	0.301	0.325	0.339	0.359	0.366	0.371
Average	0.29	0.875	1.645	2.479	2.684	2.770	3.473

Table 19: Cement 3 at rest at 5 minutes intervals with the addition of 0.25% of SP-C 30/70

	Minutes						
	0	5	10	15	20	25	30
Yield stress (Pa)	0.3	1.147	2.232	2.866	3.35	5.013	6.679
	0.27	1.152	2.558	2.751	2.916	3.622	4.688
	0.26	2.009	2.539	3.343	4.34	7.203	7.076
Plastic viscosity (Pa.s)	0.231	0.287	0.333	0.344	0.373	0.467	0.441
	0.238	0.31	0.352	0.351	0.363	0.38	0.396
	0.249	0.317	0.375	0.383	0.402	0.459	0.465
Average	0.277	1.436	2.443	2.987	3.535	5.279	6.148

Table 20: Cement 3 at rest at 5 minutes intervals with the addition of 0.25% of SP-C 40/60

	Minutes						
	0	5	10	15	20	25	30
Yield stress (Pa)	0.304	2.067	2.877	2.951	3.72	4.734	6.105
	0.28	2.014	2.556	3.205	3.311	3.585	5.269
	0.27	0.992	2.774	2.574	3.386	3.603	3.763
Plastic viscosity (Pa.s)	0.241	0.306	0.367	0.378	0.397	0.396	0.418
	0.231	0.306	0.333	0.351	0.364	0.368	0.398
	0.237	0.283	0.348	0.353	0.365	0.375	0.375
Average	0.285	1.691	2.736	2.91	3.472	3.974	5.046

Table 21: Cement 3 at rest at 5 minutes intervals with the addition of 0.25% of SP-C 50/50

	Minutes						
	0	5	10	15	20	25	30
Yield stress (Pa)	0.26	1.531	2.705	3.961	4.443	5.594	7.568
	0.3	2.235	3.154	3.12	2.753	3.798	4.193
	0.29	1.874	2.834	3.358	4.117	4.226	4.369
Plastic viscosity (Pa.s)	0.223	0.29	0.364	0.403	0.387	0.421	0.483
	0.267	0.319	0.345	0.358	0.372	0.387	0.378
	0.265	0.312	0.344	0.358	0.362	0.37	0.39
Average	0.283	1.88	2.898	3.48	3.771	4.539	5.377

Table 22: Cement 3 at rest at 5 minutes intervals with the addition of 0.25% of SP-C 60/40

	Minutes						
	0	5	10	15	20	25	30
Yield stress (Pa)	0.25	2.11	3.202	4.019	3.294	4.551	5.181
	0.28	2.858	2.72	3.608	4.1	3.983	4.233
	0.24	2.692	3.056	4.409	5.044	4.243	4.595
Plastic viscosity (Pa.s)	0.239	0.301	0.352	0.374	0.397	0.378	0.412
	0.272	0.307	0.356	0.365	0.376	0.398	0.396
	0.276	0.319	0.343	0.326	0.358	0.376	0.388
Average	0.257	2.553	2.993	4.012	4.146	4.259	4.67

Table 23: Cement 3 at rest at 5 minutes intervals with the addition of 0.25% of SP-C 80/20

	Minutes						
	0	5	10	15	20	25	30
Yield stress (Pa)	0.26	3.794	3.93	4.055	4.565	5.414	7.819
	0.27	3.151	3.839	4.597	4.753	5.052	5.967
	0.23	4.098	4.676	4.703	4.067	5.152	5.148
Plastic viscosity (Pa.s)	0.287	0.35	0.372	0.401	0.413	0.413	0.454
	0.307	0.336	0.358	0.369	0.38	0.404	0.384
	0.312	0.338	0.352	0.396	0.425	0.419	0.457
Average	0.253	3.681	4.148	4.452	4.462	5.206	6.311

Dataset C

The section presents a summary of the datasets with regards to yield stress, viscosity and adsorption with the addition of SP-C to Cement 1, Cement 2 and Cement 3

Table 24: Dataset C represents the summary of the results with the addition of SP-C

	Yield stress (P.a) (Rheometer)			Yield stress (P.a) (Mini-slump)			Viscosity (Pa.s) (rheometer)			Adsorption (mg/g cement)		
SP-C	**C1**	**C2**	**C3**	**C1**	**C2**	**C3**	**C1**	**C2**	**C3**	**C1**	**C2**	**C3**
10/90	0.28	0.10	0.29	0.25	0.12	0.29	0.31	0.19	0.22	154	99	174
30/70	0.21	0.09	0.28	0.20	0.10	0.27	0.32	0.18	0.24	181	105	203
40/60	0.20	0.08	0.28	0.20	0.09	0.27	0.30	0.17	0.24	202	134	179
50/50	0.16	0.07	0.28	0.16	0.07	0.27	0.29	0.16	0.25	192	171	198
60/40	0.16	0.06	0.26	0.15	0.07	0.25	0.30	0.16	0.26	209	183	218
80/20	0.15	0.06	0.25	0.14	0.06	0.24	0.30	0.16	0.30	204	193	239