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Ain Shams Univeristy
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Improvement of the Physico-Chemical Characteristics of Low Porosity Cement Pastes Using Some Organic Admixtures

**A Thesis Submitted for
Degree of Ph.D. in Chemistry**

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Table (1): Adsorption–desorption isotherms of nitrogen gas at liquid nitrogen temperature (-195.8°C) on the neat hardened Portland cement paste (Blank) after 1, 3 and 7 days of hydration.

1 day		3 days		7 days	
P/p°	V (cc/g)	P/p°	V (cc/g)	P/p°	V (cc/g)
Adsorption		Adsorption		Adsorption	
0.070	1.88	0.070	1.80	0.060	1.40
0.200	4.50	0.150	3.40	0.120	2.49
0.300	6.16	0.240	5.10	0.210	3.80
0.350	6.88	0.300	6.20	0.310	5.28
0.430	8.00	0.350	7.00	0.400	6.65
0.490	8.78	0.450	8.50	0.500	8.08
0.551	9.55	0.550	10.00	0.570	9.05
0.630	10.54	0.610	11.00	0.650	10.21
0.700	11.40	0.683	12.60	0.710	11.30
0.790	13.00	0.807	16.20	0.780	13.00
0.858	15.00	0.884	19.60	0.855	15.80
0.930	18.48	0.924	21.80	0.913	18.80
0.960	20.95	0.970	25.40	0.965	23.20
1.000	27.59	1.000	27.70	1.000	26.60
Desorption		Desorption		Desorption	
0.912	20.70	0.920	23.90	0.924	22.00
0.855	17.60	0.850	20.10	0.850	17.90
0.760	14.00	0.760	16.20	0.760	14.00
0.665	11.60	0.650	12.00	0.668	10.65
0.600	10.27				

Table (2): Adsorption–desorption isotherms of nitrogen gas at liquid nitrogen temperature (-195.8°C) on the neat hardened Portland cement paste (Blank) after 28 and 90 days of hydration.

28 day		90 days	
P/p°	V (cc/g)	P/p°	V (cc/g)
Adsorption		Adsorption	
0.065	1.40	0.060	1.80
0.105	2.20	0.120	3.20
0.200	3.95	0.200	4.65
0.315	6.00	0.282	5.95
0.400	7.40	0.352	7.10
0.450	8.24	0.450	8.52
0.510	9.20	0.505	9.20
0.570	10.20	0.570	10.20
0.640	11.29	0.670	11.88
0.740	13.00	0.766	13.80
0.820	14.90	0.857	16.33
0.880	16.70	0.927	19.20
1.000	23.60	1.000	22.00
Desorption		Desorption	
0.942	20.50	0.938	21.52
0.895	18.49	0.850	17.53
0.780	14.90	0.790	15.71
0.670	12.28	0.670	12.28
0.620	10.94	0.650	11.47

Table (3): Adsorption–desorption isotherms of nitrogen gas at liquid nitrogen temperature (-195.8°C) on the hardened Portland cement paste admixed with 0.5% structuro 200 (IIIA) after 1, 3 and 7 days of hydration.

1 day		3 days		7 days	
P/p°	V (cc/g)	P/p°	V (cc/g)	P/p°	V (cc/g)
Adsorption		Adsorption		Adsorption	
0.075	2.00	0.070	1.40	0.075	1.60
0.110	2.80	0.110	2.24	0.150	3.08
0.200	4.60	0.195	3.82	0.200	3.85
0.310	6.60	0.310	5.90	0.300	5.40
0.410	8.20	0.400	7.48	0.400	6.86
0.530	10.30	0.510	9.40	0.510	8.45
0.630	12.00	0.585	10.72	0.640	10.40
0.700	13.40	0.655	11.80	0.735	12.00
0.884	18.80	0.760	13.80	0.820	13.91
0.911	20.00	0.830	15.20	0.891	15.75
0.950	22.40	0.894	16.95	0.968	18.60
0.980	24.60	0.960	19.80	1.000	21.23
1.000	26.60	1.000	23.00		
Desorption		Desorption		Desorption	
0.938	23.68	0.930	19.70	0.959	19.46
0.885	20.61	0.850	16.80	0.870	16.55
0.800	17.30	0.774	15.00	0.800	14.68
0.669	13.46	0.668	12.63	0.665	11.43

Table (4): Adsorption–desorption isotherms of nitrogen gas at liquid nitrogen temperature (-195.8°C) on the hardened Portland cement paste admixed with 0.5% structuro 200 (IIIA) after 28 and 90 days of hydration.

28 days		90 days	
P/p°	V (cc/g)	P/p°	V (cc/g)
Adsorption		Adsorption	
0.070	1.20	0.065	1.20
0.115	2.00	0.100	1.80
0.190	3.12	0.200	3.39
0.250	3.95	0.280	4.64
0.340	5.12	0.340	5.47
0.420	6.09	0.420	6.59
0.510	7.20	0.520	8.00
0.570	7.89	0.590	8.90
0.650	8.86	0.650	9.85
0.760	10.60	0.747	11.56
0.830	12.00	0.865	14.21
0.896	13.80	0.944	16.80
0.960	16.40	0.970	18.00
1.000	19.53	1.000	19.80
Desorption		Desorption	
0.959	17.47	0.967	18.63
0.876	14.27	0.870	15.58
0.820	12.67	0.800	13.78
0.680	9.76	0.670	10.87
0.610	8.39	0.600	9.16

Table (5): Adsorption–desorption isotherms of nitrogen gas at liquid nitrogen temperature (-195.8°C) on the hardened Portland cement paste admixed with 0.5% structuro 132 (IIIB) after 1, 3 and 7 days of hydration.

1 day		3 days		7 days	
P/p°	V (cc/g)	P/p°	V (cc/g)	P/p°	V (cc/g)
Adsorption		Adsorption		Adsorption	
0.070	1.50	0.070	1.20	0.075	1.40
0.120	2.60	0.130	2.08	0.100	1.87
0.200	4.00	0.210	3.16	0.190	3.25
0.317	5.90	0.310	4.40	0.256	4.22
0.395	7.06	0.380	5.24	0.320	5.06
0.480	8.30	0.470	6.20	0.390	6.00
0.550	9.39	0.555	7.20	0.470	7.00
0.625	10.50	0.620	8.00	0.540	8.00
0.707	12.00	0.700	8.80	0.625	9.14
0.765	13.38	0.766	9.80	0.710	10.53
0.850	15.87	0.860	11.20	0.770	11.60
0.920	18.80	0.940	13.38	0.847	13.40
1.000	26.60	1.000	24.10	1.000	21.60
Desorption		Desorption		Desorption	
0.960	23.10	0.948	17.87	0.948	18.58
0.853	17.50	0.883	14.29	0.870	15.10
0.750	13.90	0.800	11.60	0.800	13.00
0.660	11.30	0.669	9.06	0.696	10.73
		0.632	8.30	0.603	8.86

Table (6): Adsorption–desorption isotherms of nitrogen gas at liquid nitrogen temperature (-195.8°C) on the hardened Portland cement paste admixed with 0.5% structuro 132 (IIIB) after 28 and 90 days of hydration.

28 days		90 days	
P/p°	V (cc/g)	P/p°	V (cc/g)
Adsorption		Adsorption	
0.060	1.09	0.080	1.20
0.100	1.67	0.110	1.60
0.180	2.84	0.210	2.80
0.300	4.57	0.300	3.84
0.380	5.69	0.380	4.80
0.480	7.00	0.500	6.20
0.560	8.00	0.650	7.95
0.615	8.73	0.730	9.00
0.700	10.04	0.810	10.29
0.780	11.43	0.858	11.17
0.842	12.88	0.940	13.40
0.900	14.80	1.000	15.60
0.980	19.00		
1.000	21.30		
Desorption		Desorption	
0.960	18.84	0.997	16.40
0.890	15.72	0.968	15.36
0.800	12.95	0.866	12.27
0.669	10.11	0.750	9.82
0.600	8.66	0.660	8.13

Table (7): Adsorption–desorption isotherms of nitrogen gas at liquid nitrogen temperature (-195.8°C) on the hardened Portland cement paste admixed with 0.5% structuro 333 (IIIC) after 1, 3 and 7 days of hydration.

1 day		3 days		7 days	
P/p°	V (cc/g)	P/p°	V (cc/g)	P/p°	V (cc/g)
Adsorption		Adsorption		Adsorption	
0.065	1.80	0.060	1.40	0.060	1.40
0.170	3.80	0.120	2.60	0.130	2.60
0.215	4.70	0.210	4.30	0.220	4.00
0.270	5.60	0.280	5.50	0.299	5.30
0.360	7.00	0.380	7.10	0.400	6.80
0.430	8.20	0.440	8.01	0.520	8.60
0.490	9.20	0.500	9.00	0.610	10.00
0.600	11.10	0.580	10.40	0.700	11.60
0.665	12.30	0.680	12.00	0.790	13.50
0.730	13.60	0.735	13.00	0.850	15.00
0.800	15.30	0.800	14.40	0.900	16.60
0.860	17.40	0.850	15.60	0.960	19.90
1.000	28.50	1.000	26.10	1.000	27.50
Desorption		Desorption		Desorption	
0.940	23.80	0.950	21.80	0.941	21.30
0.865	19.30	0.873	17.90	0.850	17.00
0.750	15.10	0.750	14.10	0.760	14.10
0.621	11.50	0.713	13.10	0.651	10.80
		0.650	11.50	0.941	21.30

Table (8): Adsorption–desorption isotherms of nitrogen gas at liquid nitrogen temperature (-195.8°C) on the hardened Portland cement paste admixed with 0.5% structuro 333 (IIIC) after 28 and 90 days of hydration.

28 days		90 days	
P/p°	V (cc/g)	P/p°	V (cc/g)
Adsorption		Adsorption	
0.070	1.40	0.060	1.28
0.140	2.60	0.130	2.40
0.240	4.10	0.230	3.68
0.290	4.80	0.330	4.88
0.390	6.30	0.410	5.80
0.500	7.70	0.510	7.00
0.580	8.80	0.590	8.05
0.680	10.40	0.700	9.67
0.790	12.40	0.790	11.47
0.860	14.30	0.853	13.00
0.930	17.00	0.930	15.60
0.980	20.20	0.980	18.40
1.000	24.00	1.000	22.40
Desorption		Desorption	
0.942	19.70	0.957	18.58
0.895	17.30	0.857	14.47
0.801	13.90	0.790	12.59
0.705	11.50	0.680	9.93
0.620	9.50	0.627	8.65

Table (9): V_1 – t data of nitrogen gas adsorption at -195.8°C on the hardened neat Portland cement paste (Blank) after 1,3 and 7 days of hydration.

P/p°	t (Å)	V_1 (ml/g) 1 day	t (Å)	V_1 (ml/g) 3 days	t (Å)	V_1 (ml/g) 7 days
0.05	0.71	0.00249	0.71	0.0022	0.71	0.0018
0.10	1.33	0.00405	1.33	0.0037	1.33	0.0032
0.15	1.95	0.00530	1.95	0.0053	1.95	0.0046
0.20	2.55	0.00650	2.55	0.0067	2.55	0.0057
0.25	3.04	0.00780	3.04	0.0078	3.04	0.0068
0.30	3.45	0.00900	3.45	0.0092	3.45	0.0079
0.35	3.98	0.01000	3.98	0.0100	3.98	0.0092
0.40	4.60	0.01100	4.60	0.0120	4.60	0.0103
0.45	5.22	0.01290	5.22	0.0135	5.22	0.0115
0.50	5.66	0.01400	5.66	0.0146	5.66	0.0127
0.55	6.02	0.01590	6.02	0.0160	6.02	0.0140
0.60	6.37	0.01730	6.37	0.0180	6.37	0.0146
0.65	6.90	0.01880	6.90	0.0196	6.90	0.0164
0.70	7.43	0.02040	7.43	0.0215	7.43	0.0174
0.75	7.97	0.02200	7.97	0.0237	7.97	0.0190
0.80	8.67	0.02300	8.67	0.0265	8.67	0.0215
0.85	9.84	0.02500	9.84	0.0296	9.84	0.0240
0.90	12.74	0.02800	12.74	0.0340	12.74	0.0290
0.95	21.59	0.03000	21.59	0.0390	21.59	0.0346
1.00	28.00	0.03700	28.00	0.0440	28.00	0.0410

Table (10): V_1 – t data of nitrogen gas adsorption at -195.8°C on the hardened neat Portland cement paste (Blank) after 28 and 90 days of hydration.

P/p°	t (Å)	V_1 (ml/g) 28 days	t (Å)	V_1 (ml/g) 90 days
0.05	0.71	0.001560	1.24	0.0023
0.10	1.33	0.003120	1.95	0.0043
0.15	1.95	0.004680	2.42	0.0059
0.20	2.55	0.006240	3.01	0.0071
0.25	3.04	0.007488	3.45	0.0082
0.30	3.45	0.009048	3.98	0.0093
0.35	3.98	0.010296	4.34	0.0106
0.40	4.60	0.011544	4.78	0.0118
0.45	5.22	0.012792	5.31	0.0131
0.50	5.66	0.014040	5.77	0.0143
0.55	6.02	0.015600	6.12	0.0154
0.60	6.37	0.016848	6.37	0.0166
0.65	6.90	0.018096	6.97	0.0180
0.70	7.43	0.019344	7.47	0.0198
0.75	7.97	0.020904	7.97	0.0209
0.80	8.67	0.022464	8.78	0.0230
0.85	9.84	0.024336	9.77	0.0250
0.90	12.74	0.026208	12.96	0.0280
0.95	21.59	0.028704	20.06	0.0320
1.00	28.00	0.031824	27.00	0.0400

Table (11): V_1-t data of nitrogen gas adsorption at -195.8°C on the hardened Portland cement paste admixed with 0.5% structuro 200 (IIIA) after 1, 3 and 7 days of hydration.

P/p°	t (Å)	V_1 (ml/g) 1 day	t (Å)	V_1 (ml/g) 3 days	t (Å)	V_1 (ml/g) 7 days
0.05	0.71	0.00218	0.71	0.001716	0.71	0.001716
0.10	1.33	0.00405	1.33	0.003276	1.33	0.003276
0.15	1.95	0.00560	1.95	0.004680	1.95	0.004680
0.20	2.55	0.00700	2.55	0.006160	2.55	0.00590
0.25	3.04	0.00870	3.04	0.007410	3.04	0.00717
0.30	3.45	0.00990	3.45	0.008700	3.45	0.00840
0.35	3.98	0.01120	3.98	0.010100	3.98	0.00936
0.40	4.60	0.01260	4.60	0.011500	4.60	0.01060
0.45	5.22	0.01380	5.22	0.013000	5.22	0.01170
0.50	5.66	0.01520	5.66	0.014300	5.66	0.01279
0.55	6.02	0.01650	6.02	0.015700	6.02	0.01400
0.60	6.37	0.01790	6.37	0.017000	6.37	0.01520
0.65	6.90	0.01950	6.90	0.018700	6.90	0.01638
0.70	7.43	0.02150	7.43	0.019900	7.43	0.01778
0.75	7.97	0.02300	7.97	0.021000	7.97	0.01934
0.80	8.67	0.02550	8.67	0.023000	8.67	0.02060
0.85	9.84	0.02800	9.84	0.025000	9.84	0.02300
0.90	12.74	0.03000	12.74	0.026800	12.74	0.02530
0.95	21.59	0.03500	21.59	0.029900	21.59	0.02820
1.00	28.00	0.04200	28.00	0.035800	28.00	0.03240

Table (12): V_1 - t data of nitrogen gas adsorption at -195.8°C on the hardened Portland cement paste admixed with 0.5% structuro 200 (IIIA) after 28 and 90 days of hydration.

P/p°	t (Å)	V_1 (ml/g) 28 days	t (Å)	V_1 (ml/g) 90 days
0.05	0.71	0.001404	0.71	0.001560
0.10	1.33	0.002808	1.33	0.002808
0.15	1.95	0.003822	1.95	0.004056
0.20	2.55	0.004992	2.55	0.005304
0.25	3.04	0.005928	3.04	0.006552
0.30	3.45	0.006864	3.45	0.007488
0.35	3.98	0.007956	3.98	0.008736
0.40	4.60	0.009048	4.60	0.009672
0.45	5.22	0.009984	5.22	0.010920
0.50	5.66	0.011076	5.66	0.012168
0.55	6.02	0.012168	6.02	0.013104
0.60	6.37	0.013104	6.37	0.014352
0.65	6.90	0.014040	6.90	0.015600
0.70	7.43	0.015210	7.43	0.016848
0.75	7.97	0.016224	7.97	0.018408
0.80	8.67	0.017784	8.67	0.019968
0.85	9.84	0.019422	9.84	0.021840
0.90	12.74	0.021840	12.74	0.024024
0.95	21.59	0.024960	21.59	0.026832
1.00	28.00	0.029952	28.00	0.034320