

APPENDIX A

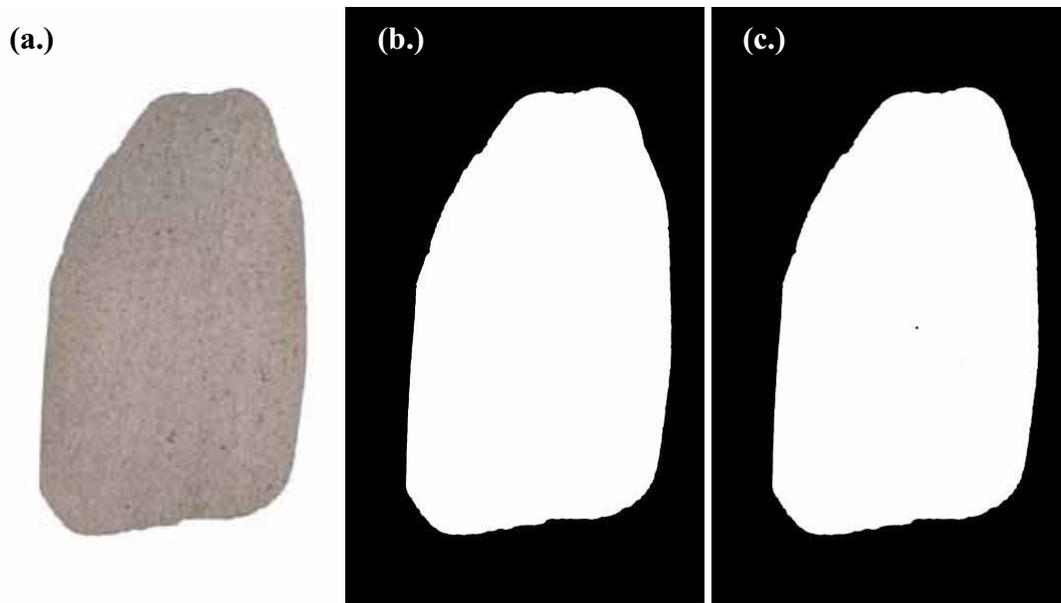


Figure A-1. Image Analysis for Crushed Gravel Sample #1 for (a.) Original Image, (b.) Image Processed for Blue Resin (Surface Porosity), and (c.) Image Processed for Yellow Resin (Internal Porosity).

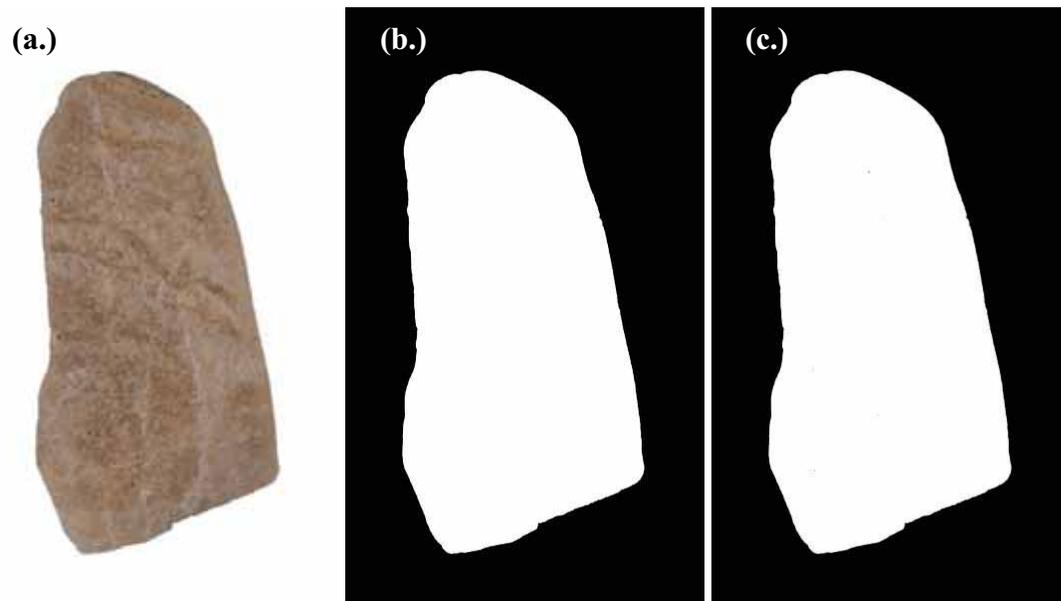


Figure A-2. Image Analysis for Crushed Gravel Sample #2 for (a.) Original Image, (b.) Image Processed for Blue Resin (Surface Porosity), and (c.) Image Processed for Yellow Resin (Internal Porosity).

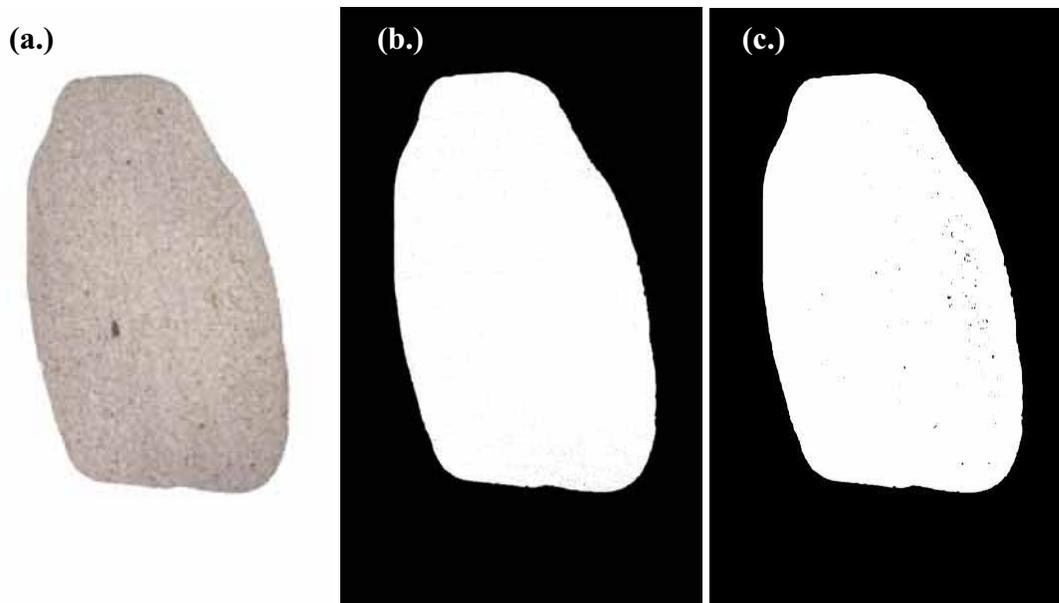


Figure A-3. Image Analysis for Crushed Gravel Sample #3 for (a.) Original Image, (b.) Image Processed for Blue Resin (Surface Porosity), and (c.) Image Processed for Yellow Resin (Internal Porosity).

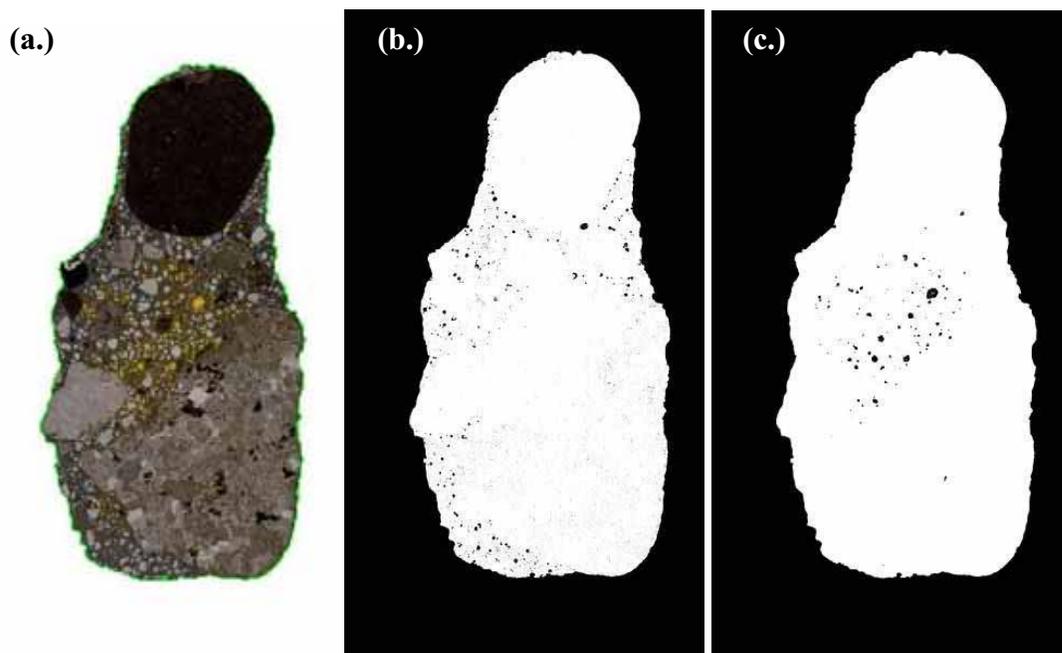


Figure A-4. Image Analysis for Crushed Gravel RCA Sample #1 for (a.) Original Image, (b.) Image Processed for Blue Resin (Surface Porosity), and (c.) Image Processed for Yellow Resin (Internal Porosity).

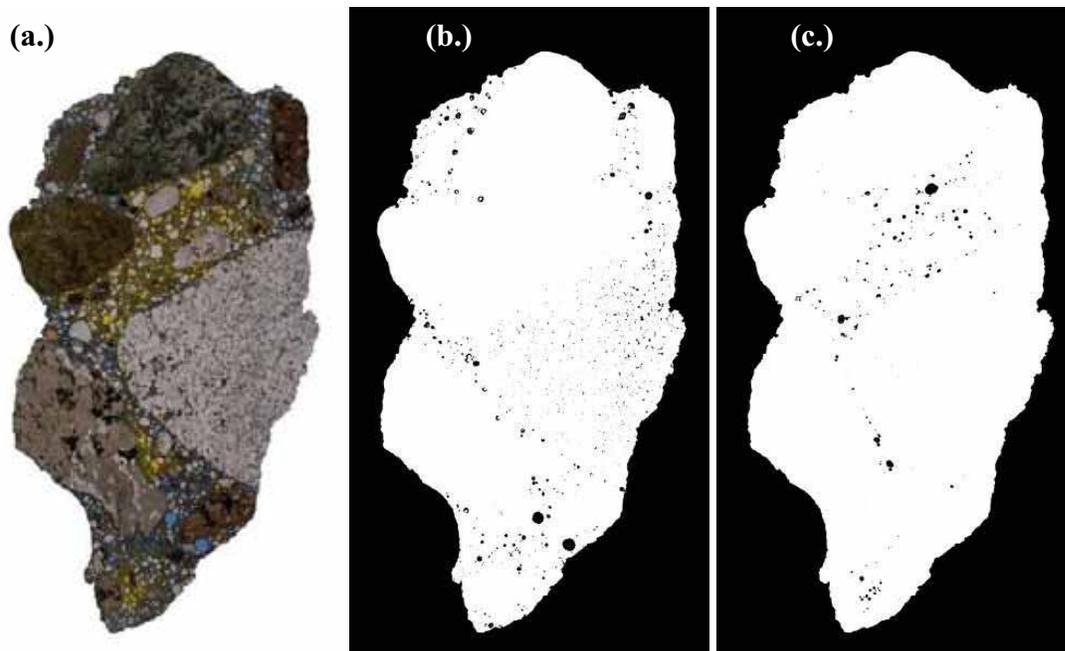


Figure A-5. Image Analysis for Crushed Gravel RCA Sample #2 for (a.) Original Image, (b.) Image Processed for Blue Resin (Surface Porosity), and (c.) Image Processed for Yellow Resin (Internal Porosity).

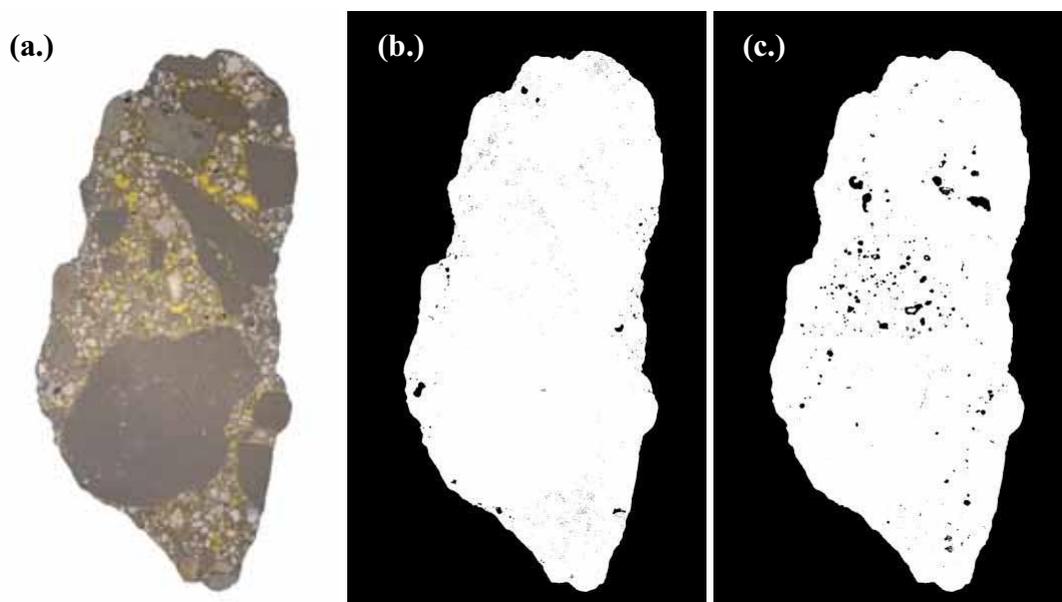


Figure A-6. Image Analysis for Crushed Gravel RCA Sample #3 for (a.) Original Image, (b.) Image Processed for Blue Resin (Surface Porosity), and (c.) Image Processed for Yellow Resin (Internal Porosity).

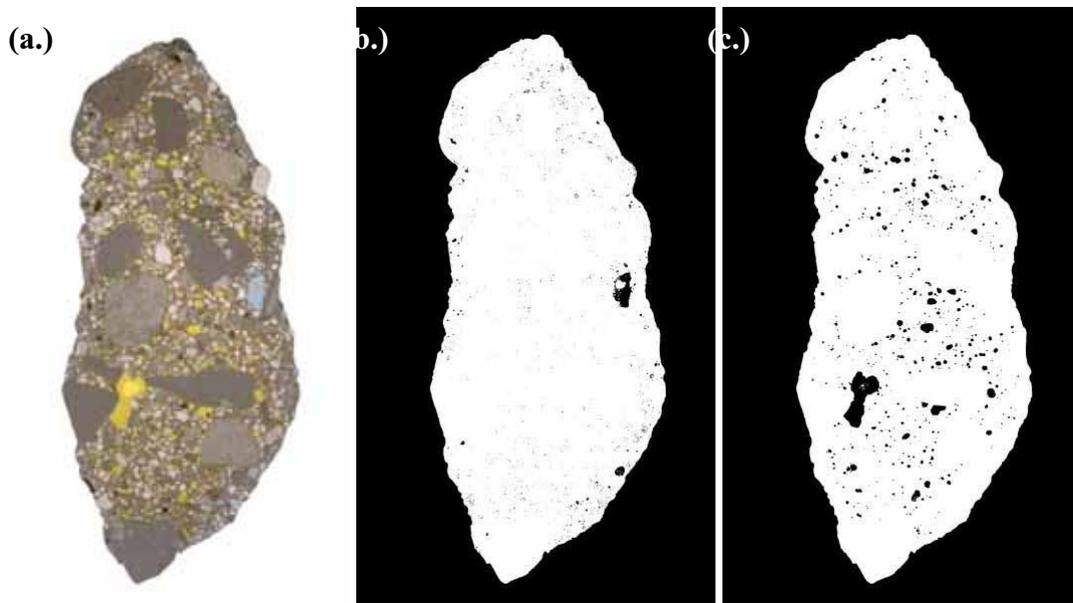


Figure A-7. Image Analysis for Limestone RCA Sample #1 for (a.) Original Image, (b.) Image Processed for Blue Resin (Surface Porosity), and (c.) Image Processed for Yellow Resin (Internal Porosity).

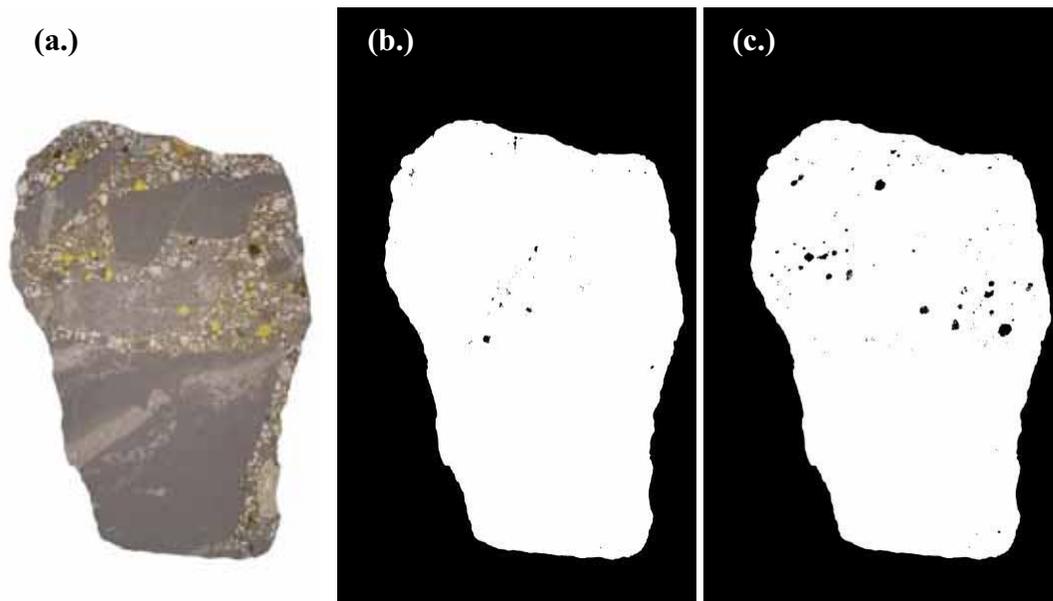


Figure A-8. Image Analysis for Limestone RCA Sample #2 for (a.) Original Image, (b.) Image Processed for Blue Resin (Surface Porosity), and (c.) Image Processed for Yellow Resin (Internal Porosity).

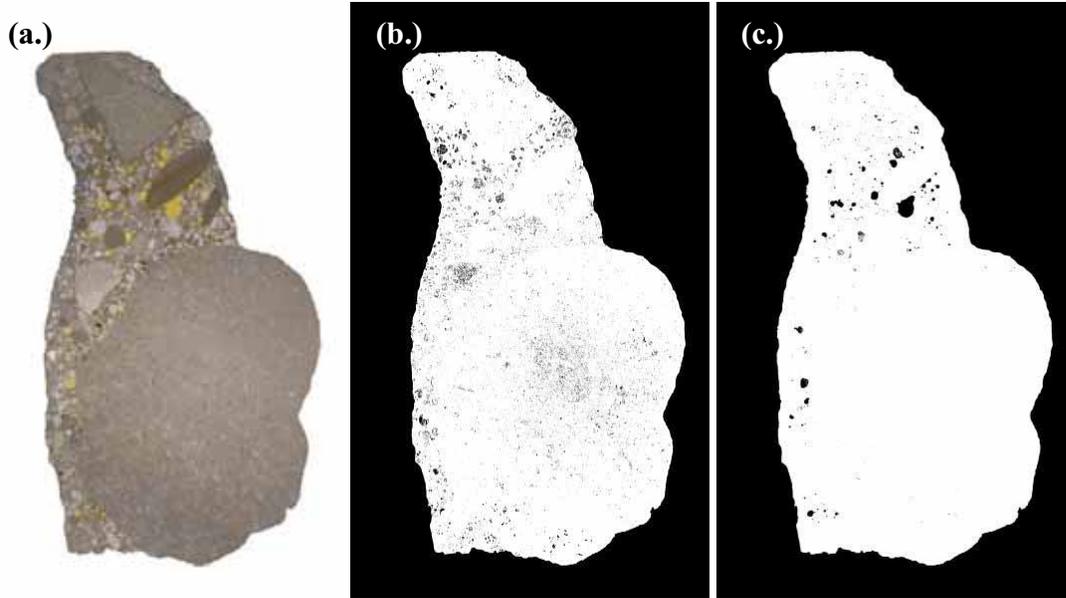


Figure A-9. Image Analysis for Limestone RCA Sample #3 for (a.) Original Image, (b.) Image Processed for Blue Resin (Surface Porosity), and (c.) Image Processed for Yellow Resin (Internal Porosity).

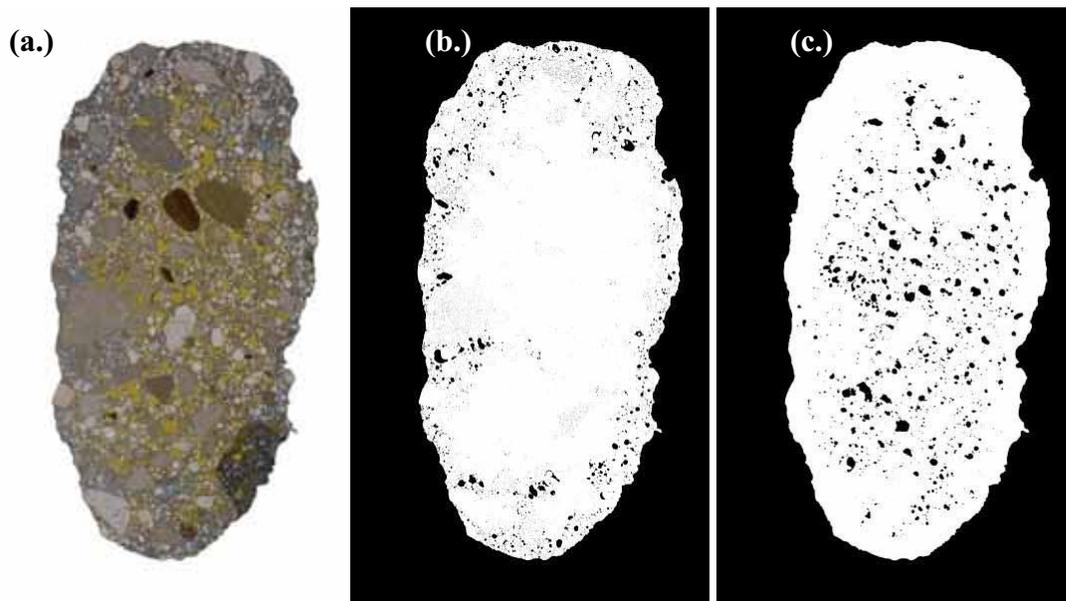


Figure A-10. Image Analysis for Blast Furnace Slag RCA Sample #1 for (a.) Original Image, (b.) Image Processed for Blue Resin (Surface Porosity), and (c.) Image Processed for Yellow Resin (Internal Porosity).

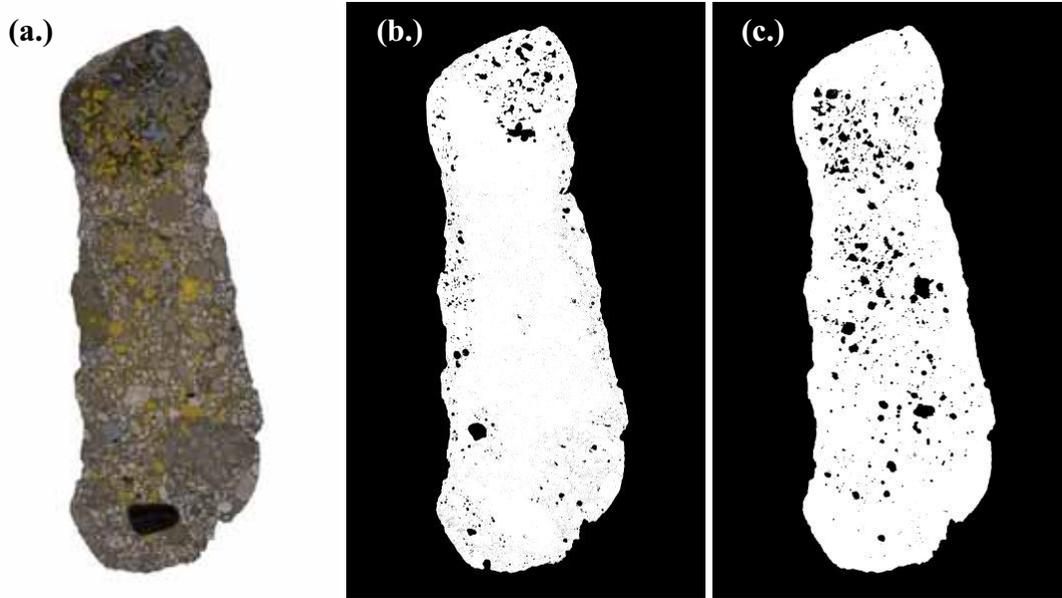


Figure A-11. Image Analysis for Blast Furnace Slag RCA Sample #2 for (a.) Original Image, (b.) Image Processed for Blue Resin (Surface Porosity), and (c.) Image Processed for Yellow Resin (Internal Porosity).

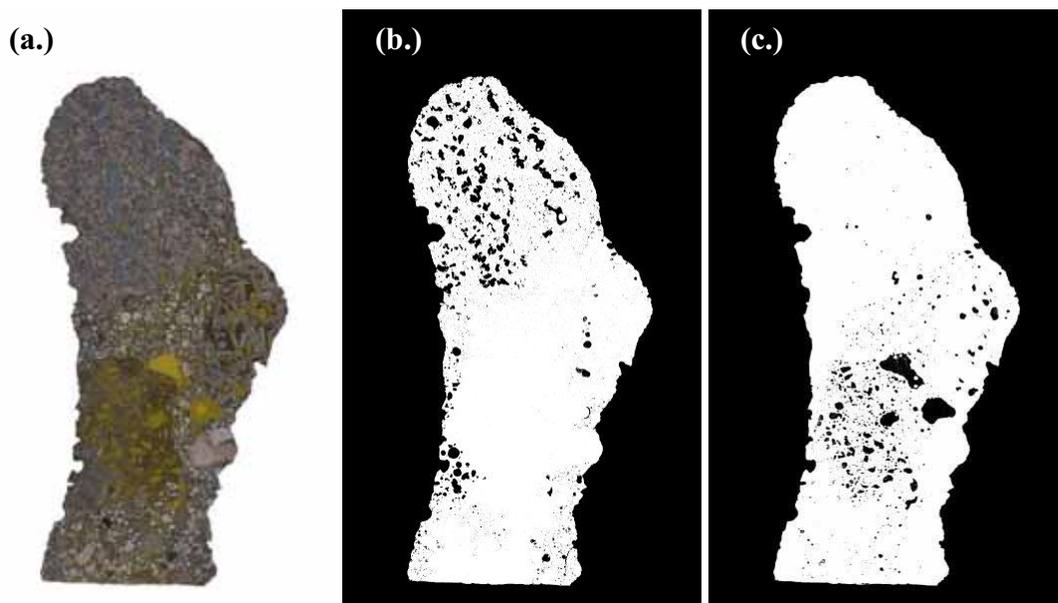


Figure A-12. Image Analysis for Blast Furnace Slag RCA Sample #3 for (a.) Original Image, (b.) Image Processed for Blue Resin (Surface Porosity), and (c.) Image Processed for Yellow Resin (Internal Porosity).

APPENDIX B

Table B-1. Helium Pyc and Geo Pyc results for Crushed Gravel for each sieve size.

Aggregate Size	Specific Gravity		Std Deviation	Porosity (%)	Std Deviation	Absorption Capacity (%)	Std Deviation
	G_s						
1"	G_s	2.8364	0.068382	0.758897	1.177397	0.639755	0.446391
	G_b	2.799995	0.122707				
	G_b (SSD)	4.009543	0.338281				
3/4"	G_s	2.736789	0.092883	2.29191	2.884529	0.302935	0.226936
	G_b	2.668667	0.20442				
	G_b (SSD)	3.83356	3.271867				
1/2"	G_s	2.775293	0.101966	1.377089	1.559343	0.209889	0.016124
	G_b	2.878297	0.143774				
	G_b (SSD)	1.539367	1.036696				
3/8"	G_s	2.885548	0.11821	1.158877	0.439422	1.18136	0.050356
	G_b	2.759323	0.069235				
	G_b (SSD)	0.742094	0.797093				

Table B-2. Helium Pyc and Geo Pyc results for Crushed Gravel for combined grading.

Test #	G_s	G_s ASTM	G_b	G_b ASTM	G_b (SSD)	G_b (SSD) ASTM	Abs cap. (%)	Abs cap. ASTM (%)
1	2.79555	2.78	2.685619	2.71	2.5789	2.73	0.848159	0.92
2	2.779237	2.81	2.84405	2.69	2.54265	2.73	0.943831	0.98
3	2.830702	2.75	2.809536	2.34	2.54865	2.42	0.64792	0.94
4	2.845663		2.827024		2.53896		0.83975	
5	2.881725		2.740047		2.56478		0.79547	
Avg	2.826575	2.78	2.781255	2.58	2.554788	2.626667	0.815026	0.946667

Table B-3. Helium Pyc and Geo Pyc results for Crushed Gravel Aggregate RCA for combined grading.

Test #	G_s	G_s ASTM	G_b	G_b ASTM	G_b (SSD)	G_b (SSD) ASTM	Abs cap. (%)	Abs cap. ASTM (%)
1	2.7353	2.61	2.473285	2.45	2.569535	2.53	3.934408	3.07
2	2.65095	2.65	2.366208	2.45	2.473631	2.51	4.541488	2.44
3	2.7062	2.63	2.327844	2.45	2.467733	2.52	6.021586	2.75
4	2.69535		2.324422		2.460498		5.839631	
5	2.7933		2.531278		2.625819		3.81163	
Avg	2.69535	2.63	2.404607	2.45	2.519443	2.52	4.829748	2.753333

Table B-4. Helium Pyc and Geo Pyc results for Limestone RCA for each sieve size.

Aggregate Size	Specific Gravity		Std Deviation	Porosity (%)	Std Deviation	Absorption Capacity (%)	Std Deviation
	G _s	G _b	G _{b (SSD)}				
1"	G _s	2.5814	0.043875	10.02877	3.651461	3.081578	0.302924
	G _b	2.32376	0.132161				
	G _{b (SSD)}	2.424047	0.09578				
3/4"	G _s	2.57248	0.036691	10.66216	2.039843	4.387265	0.304824
	G _b	2.298422	0.071046				
	G _{b (SSD)}	2.405044	0.053334				
1/2"	G _s	2.6174	0.037575	7.081939	2.840027	3.865391	0.348489
	G _b	2.432721	0.104683				
	G _{b (SSD)}	2.50354	0.077039				
3/8"	G _s	2.63018	0.015254	11.43089	0.788958	4.913128	0.476111
	G _b	2.329568	0.029179				
	G _{b (SSD)}	2.443877	0.022267				

Table B-5. Helium Pyc and Geo Pyc results for Limestone RCA for combined grading.

Test #	G _s	G _s ASTM	G _b	G _b ASTM	G _{b (SSD)}	G _{b (SSD)} ASTM	Abs cap. (%)	Abs cap. ASTM (%)
1	2.625025	2.6	2.378841	2.34	2.472583	2.44	3.947618	4.25
2	2.587725	2.51	2.289214	2.33	2.40485	2.4	5.101922	3.84
3	2.59145	2.56	2.356086	2.34	2.446856	2.42	3.864307	3.65
4	2.6029		2.357573		2.357573		3.864307	
5	2.594725		2.348875		2.444004		4.120029	
Avg	2.600365	2.56	2.346118	2.34	2.425173	2.42	4.179636	3.913333

Table B-6. Helium Pyc and Geo Pyc results for Slag RCA for each sieve size.

Aggregate Size	Specific Gravity		Std Deviation	Porosity (%)	Std Deviation	Absorption Capacity (%)	Std Deviation
	G_s						
1"	G_s	2.59378	0.033185	15.35324	2.60047169	7.077312	0.754825
	G_b	2.195217	0.058734				
	G_b (SSD)	2.348749	0.036758				
3/4"	G_s	2.68698	0.127911	17.45802	5.31841799	9.835884	0.196991
	G_b	2.217081	0.164497				
	G_b (SSD)	2.391661	0.126608				
1/2"	G_s	2.66414	0.070437	18.10533	3.17925025	7.512502	0.283715
	G_b	2.181943	0.10623				
	G_b (SSD)	2.362996	0.081594				
3/8"	G_s	2.72924	0.066494	17.40831	3.26448093	7.798466	0.854701
	G_b	2.252791	0.059076				
	G_b (SSD)	2.426874	0.038124				

Table B-7. Helium Pyc and Geo Pyc results for Slag RCA for combined grading.

Test #	G_s	G_s ASTM	G_b	G_b ASTM	G_b (SSD)	G_b (SSD) ASTM	Abs cap. (%)	Abs cap. ASTM (%)
1	2.652825	2.5	2.309564	2.23	2.439447	2.34	5.68472	4.76
2	2.612475	2.42	2.142345	2.22	2.321826	2.3	8.490692	3.84
3	2.717325	2.46	2.189361	2.22	2.382853	2.32	8.829337	4.3
4	2.671075		2.169462		2.255981		8.829337	
5	2.688975		2.248058		2.411896		7.287032	
Avg	2.668535	2.46	2.211758	2.223333	2.362401	2.32	7.82442	4.3

APPENDIX C

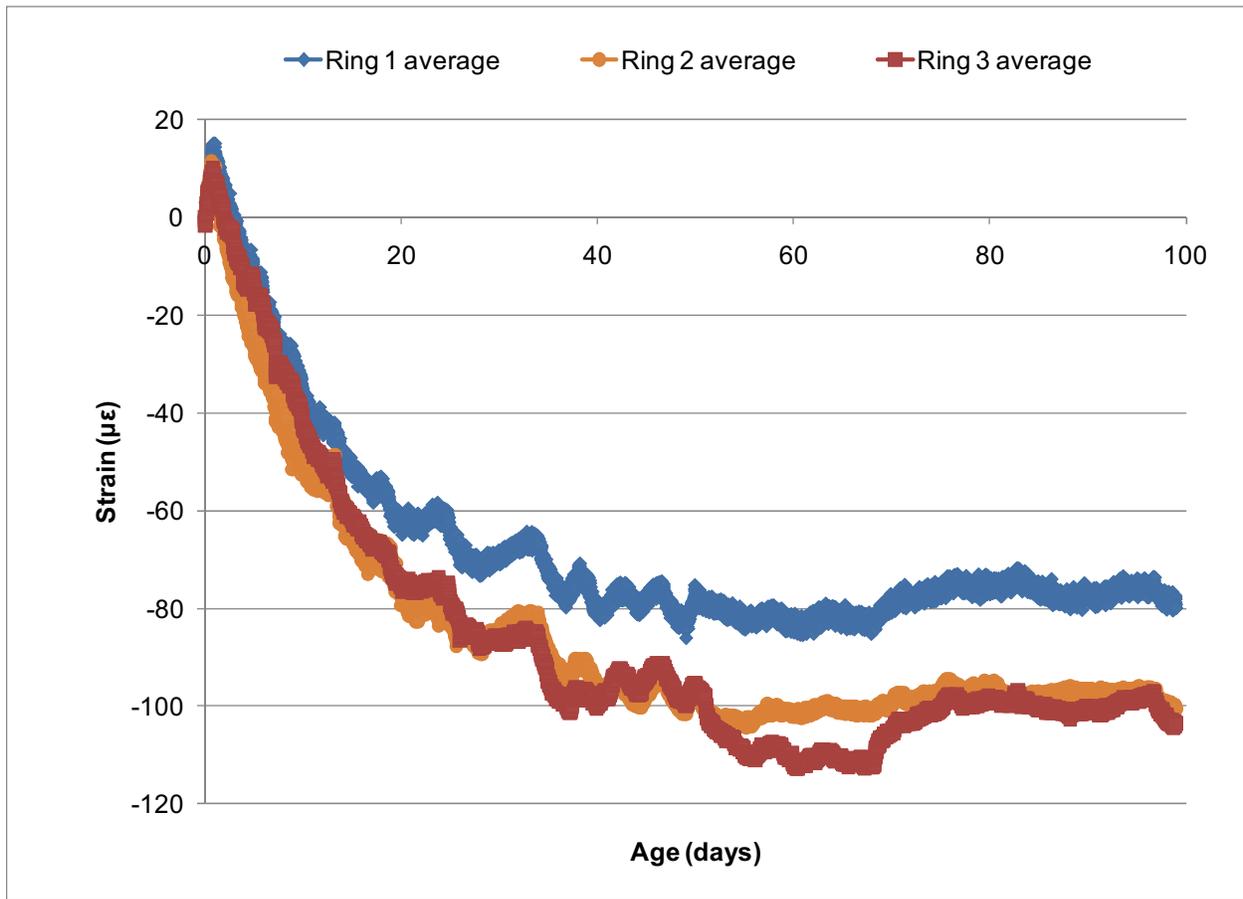


Figure C-1. Restrained Ring Shrinkage Strain for Crushed Gravel (ASTM) MDOT P1 Concrete.

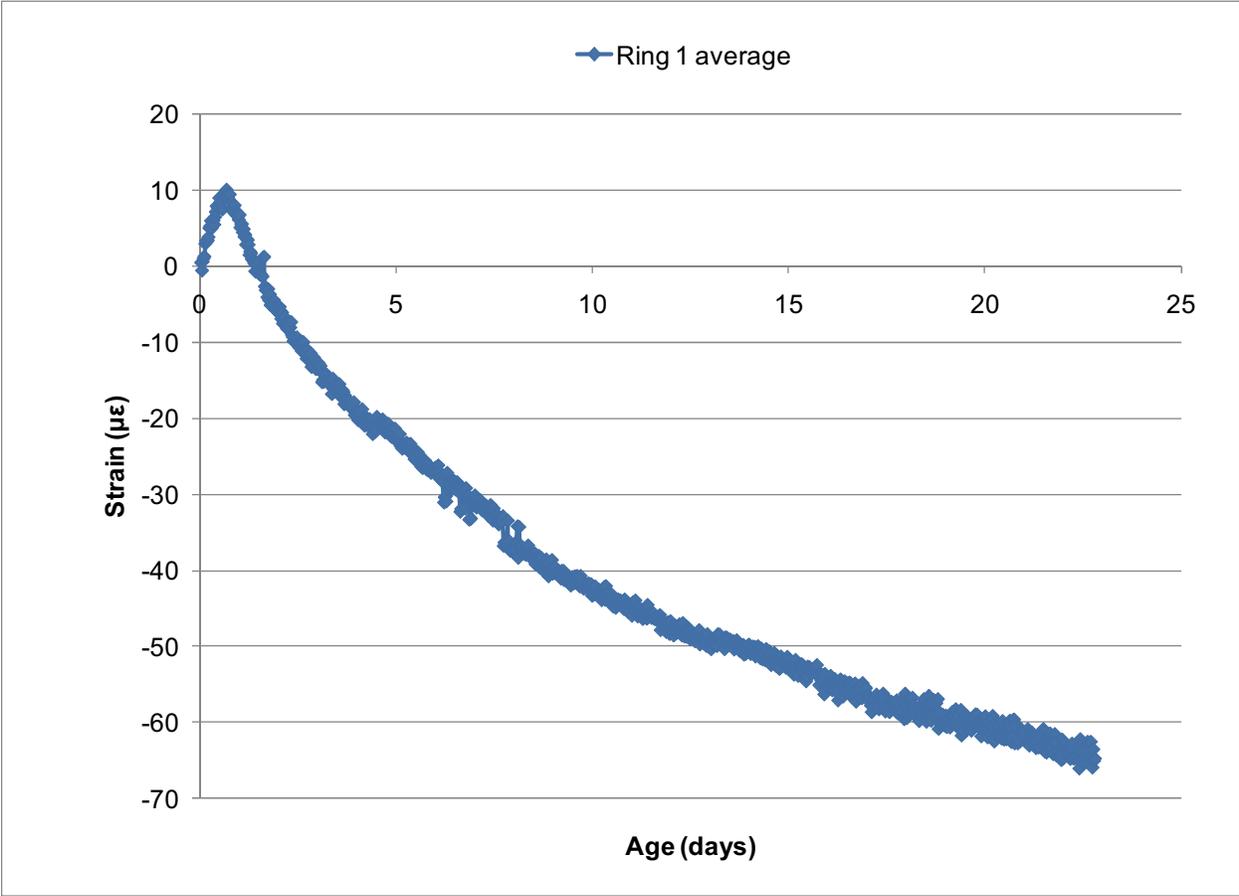


Figure C-2. Restrained Ring Shrinkage Strain for Crushed Gravel (He Pyc) MDOT P1 Concrete.

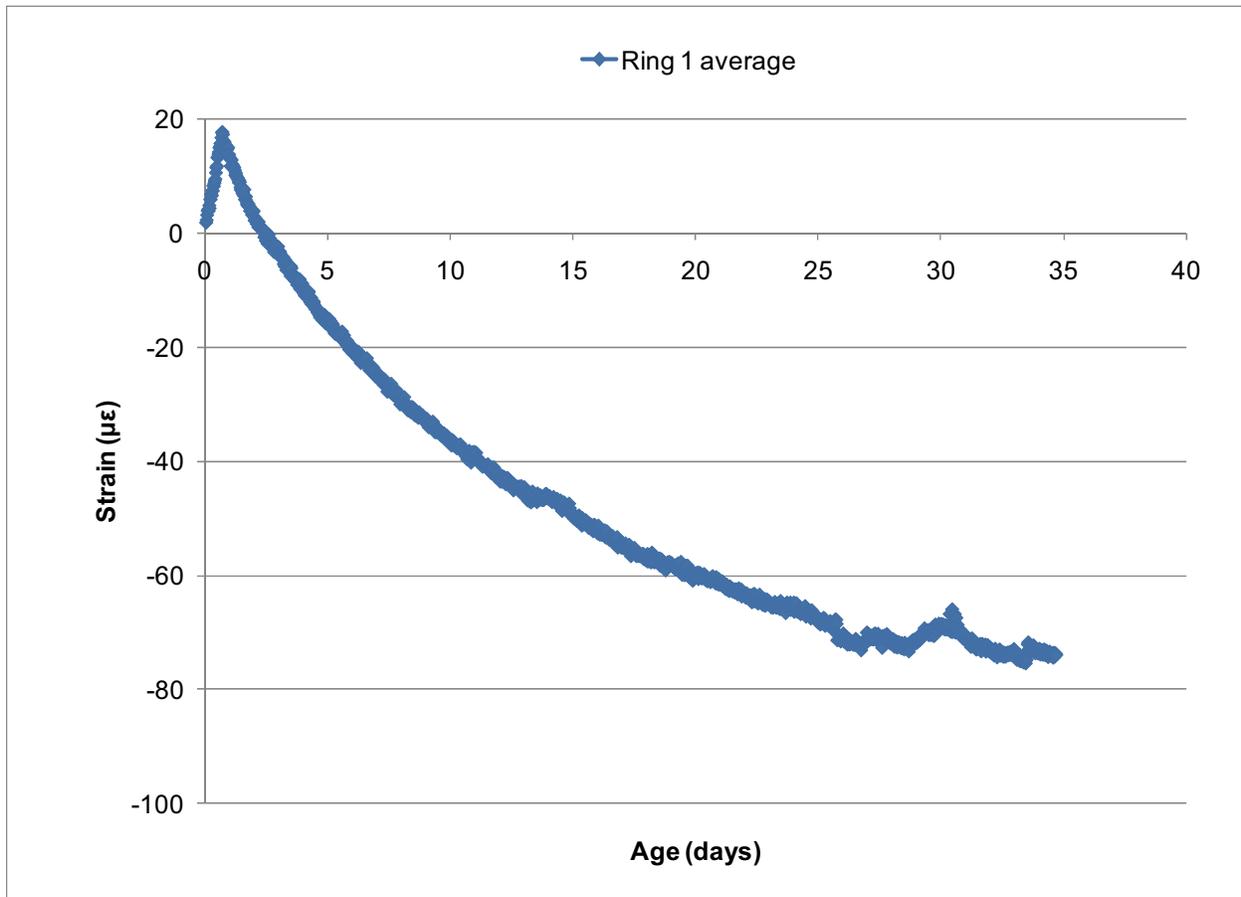


Figure C-3. Restrained Ring Shrinkage Strain for Crushed Gravel RCA (ASTM) MDOT P1 Concrete.

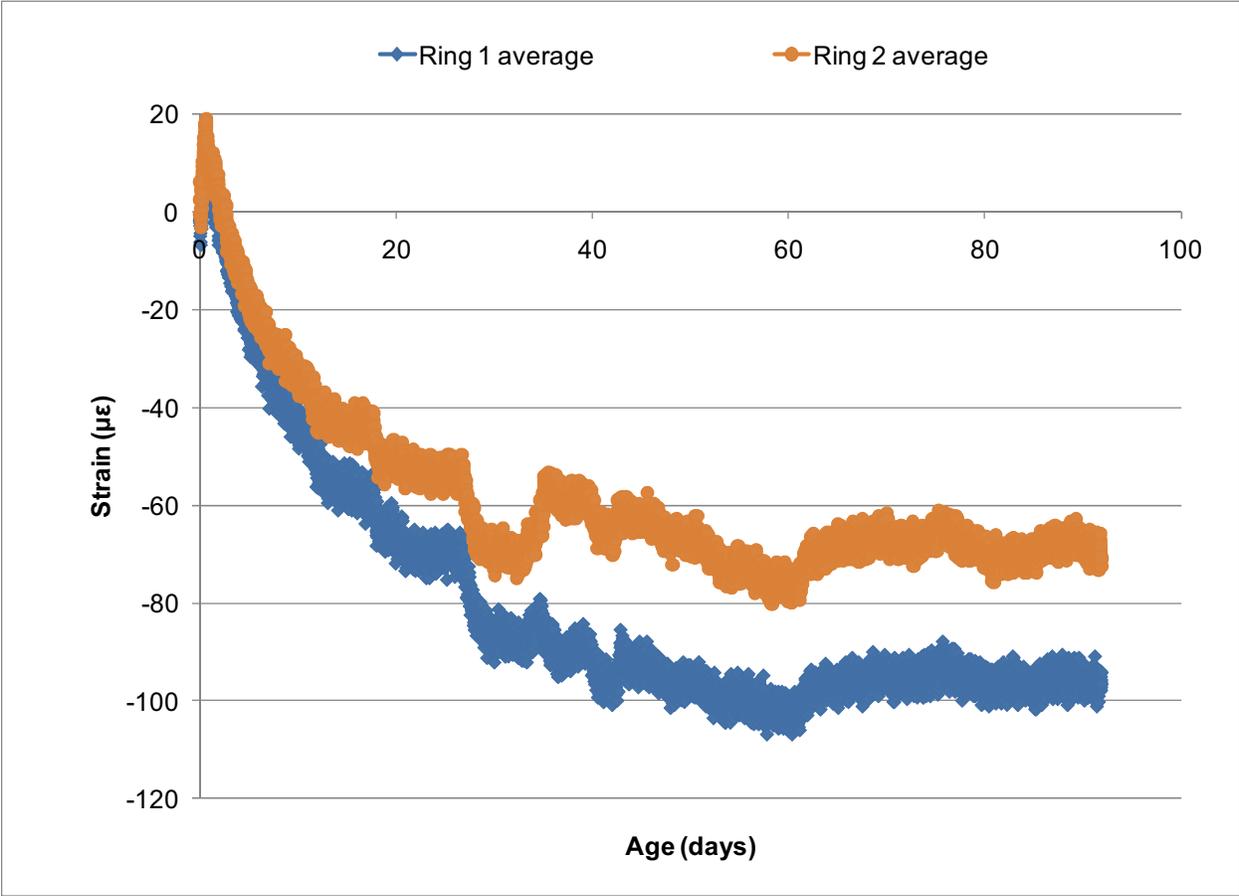


Figure C-4. Restrained Ring Shrinkage Strain for Crushed Gravel RCA (He Pyc) MDOT P1 Concrete.

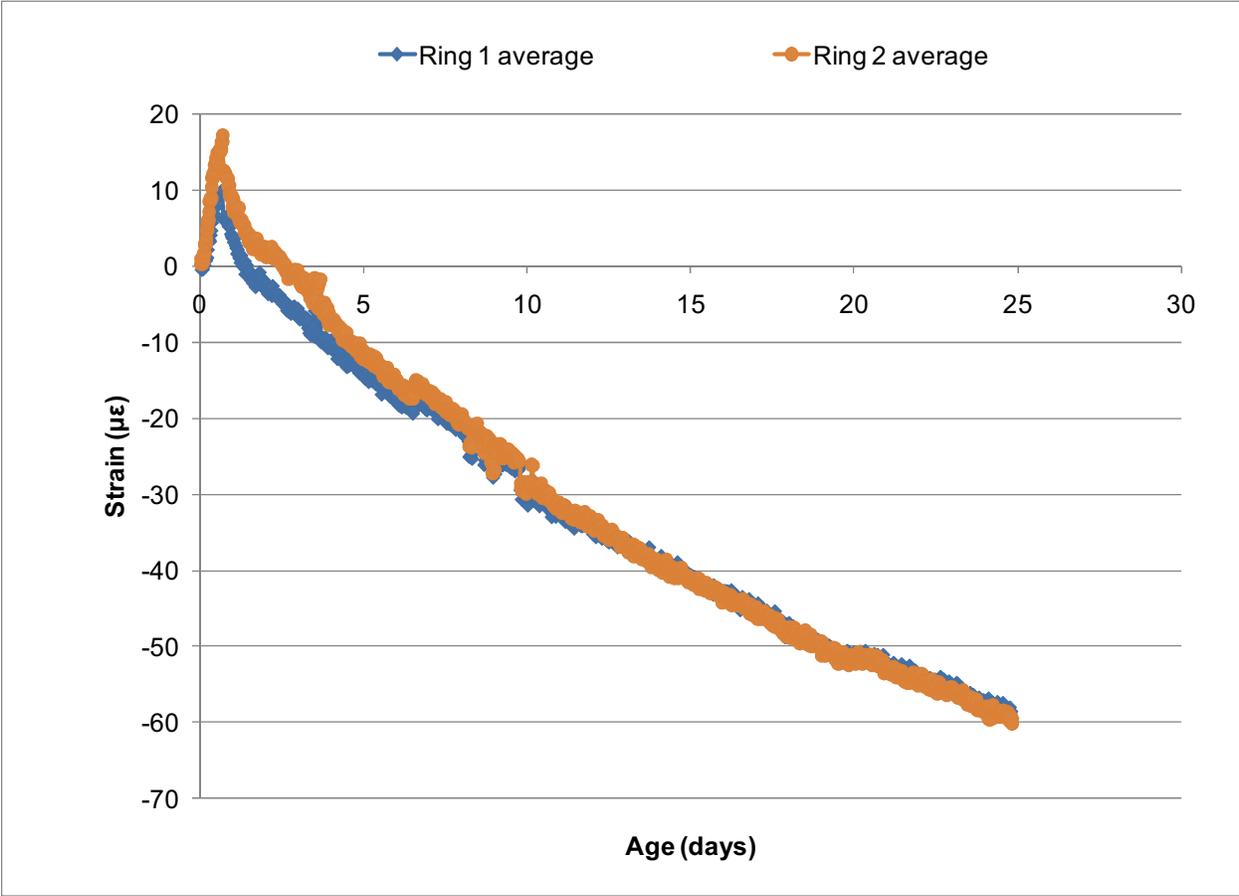


Figure C-5. Restrained Ring Shrinkage Strain for 3rdGen RCA MDOT P1 Concrete.

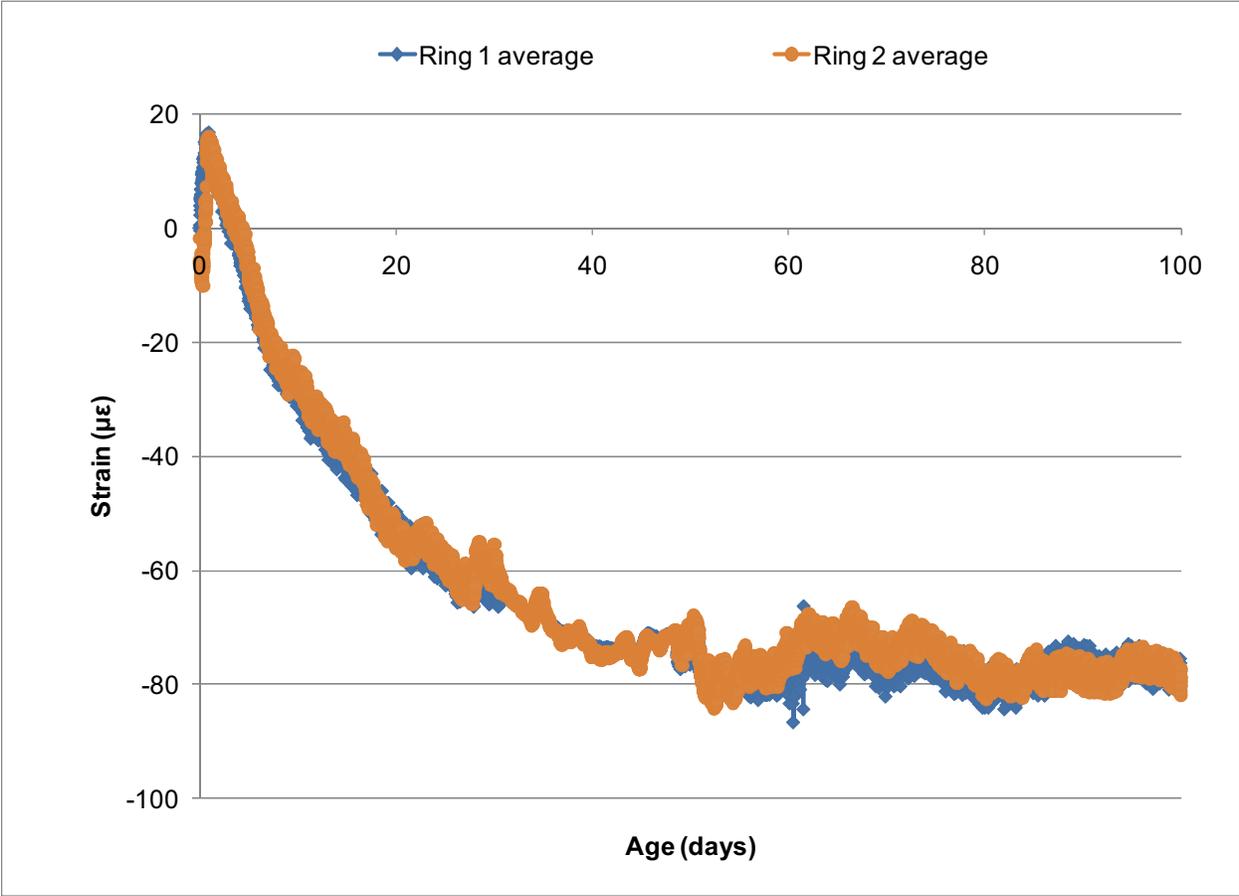


Figure C-6. Restrained Ring Shrinkage Strain for Limestone RCA MDOT P1 Concrete.

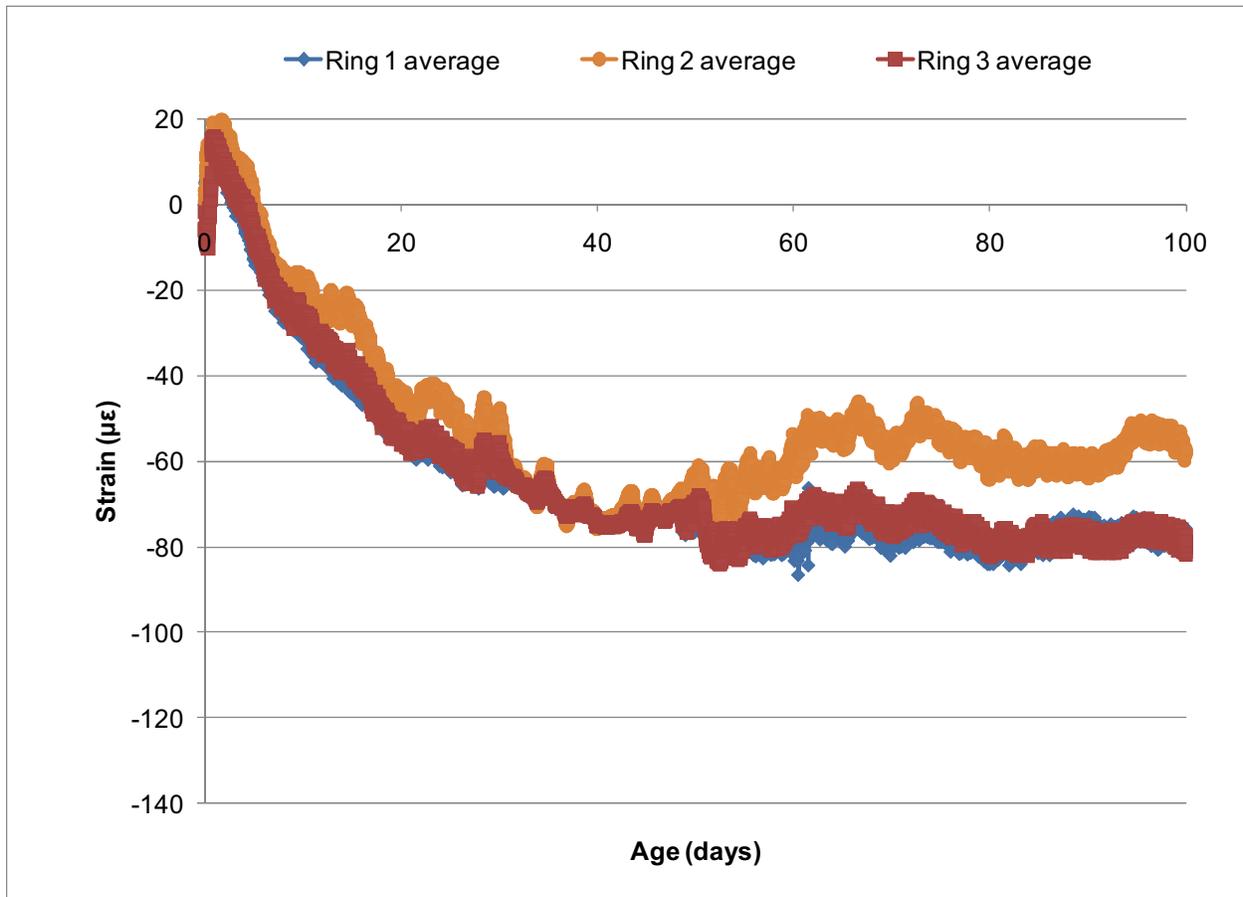


Figure C-7. Restrained Ring Shrinkage Strain for Blast Furnace Slag RCA MDOT P1 Concrete.

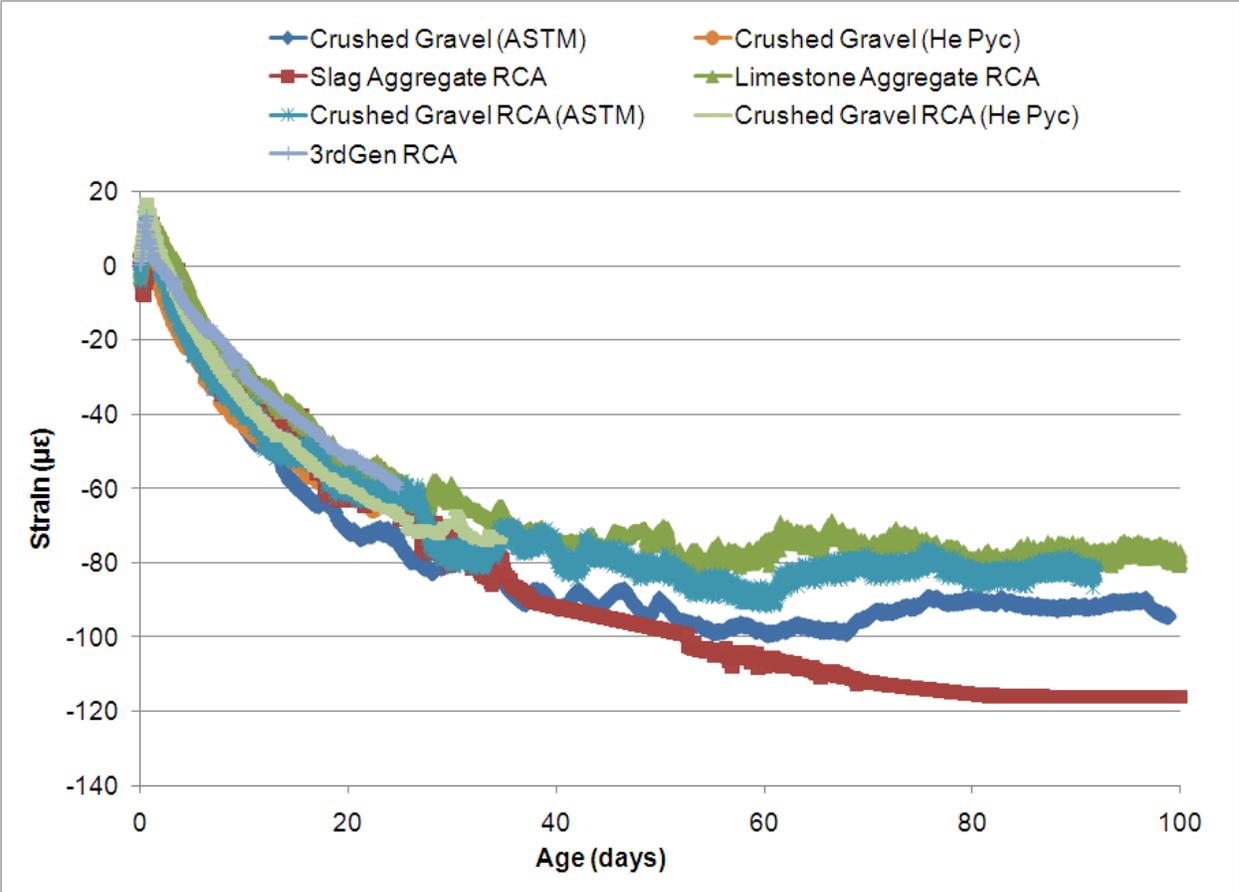


Figure C-8. Restrained Ring Shrinkage Strain for All Virgin and RCA MDOT P1 Concretes.