TIDC Transportation Infrastructure Durability Center AT THE UNIVERSITY OF MAINE

Development of Protocols for Determining Deleterious Material Content in Processed Glass Aggregate

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Introduction

Processed glass aggregate (PGA) studied in this project is a fine crushed recycled glass with a high potential to replace sand borrow and other free-draining fill materials. The major benefits of using PGA are that it reduces demands for limited high-quality sand borrow, which is increasingly scarce and expensive; and it keeps glass out of landfills. In practice however, PGA is not widely used in our region because of a lack of clear guidance on deleterious material content determination.

Primary objectives are to research, develop, and perform a variety of processes to determine deleterious material content in PGA; evaluate the effectiveness of individual processes using lab-manufactured PGA (LM-PGA) samples; and recommend a reliable protocol for determining deleterious material content of PGA produced by recycling facilities (RF-PGA).

Methodology

Three main tests developed: Magnet test, Float test, Furnace Test (550^{o}C). Six samples of 100g each were tested for repeatability and statistical verification.

Protocol 1: Magnet + Furnace (For determining overall deleterious content)

Protocol 2: Magnet + Float (For determining the maximum plastic content)

LM-PGA sample- LMO : 98% Glass + 2% deleterious materials (0.5% office paper, 0.5% newspaper, 0.5% sugar, 0.5% peanut butter).

LM-PGA sample- LMP : 98% Glass + 2% deleterious materials (0.5% HDPE plastic, 0.5% PP plastic, 0.4% office paper, 0.4% newspaper, 0.2% steel).

RF-PGA: One sample from Chittenden Solid Waste District, Vermont **(VT)** and one sample from New Hampshire **(NH)** recycling facility

Results

Table 1: Protocol 1 and 2 results for LMP-PGA

LM-PGA LMP SAMPLE	Protocol 1				Protocol 2			
	Magnet(%)		Furnace(%)		Magnet(%)		Float(%)	
	Mean	S.D.	Mean	S.D.	Mean	S.D.	Mean	S.D.
Operator 1	0.21	0.01	1.92	0.34	0.22	0.01	1.22	0.07
Ideal Measurements	0.2		1.8		0.2		1.0	

Table 2: Operator Dependence Evaluation: Protocol 1 and 2 results for LMO-PGA (Organics)

LM-PGA LMO SAMPLE	Protocol 1				Protocol 2			
	Magnet(%)		Furnace(%)		Magnet(%)		Float(%)	
	Mean	S.D.	Mean	S.D.	Mean	S.D.	Mean	S.D.
Operator 1	0.01	0.00	1.93	0.01	0.02	0.00	0.02	0.01
Operator 2	0.03	0.01	1.98	0.01	0.03	0.04	0.02	0.00
Operator 3	0.05	0.01	1.71	0.02	0.05	0.01	0.02	0.01
Ideal Measurements	0.0		2.0		0.0		1.0-1.8	

Table 3: Protocol 1 and 2 results for RF-PGA (VT and NH)

RF-PGA		Protocol 1				Protocol 2			
		Magnet(%)		Furnace(%)		Magnet(%)		Float(%)	
		Mean	S.D.	Mean	S.D.	Mean	S.D.	Mean	S.D.
Operator 2	VT	0.09	0.009	1.46	0.43	0.09	0.02	1.26	0.32
	NH	0.02	0.008	0.23	0.04	0.02	0.005	0.71	0.02
Ideal Measurements		Unknown		Unknown		Unknown		Unknown	

Conclusions & Planned Work

Lab-manufactured PGA

1. Protocol 1 was fairly accurate for determining deleterious material content of LM-PGA containing high organics content.
2. Protocol 2 detected no plastics in high organics LM-PGA with no added plastics.
3. Protocol 2 was less accurate on LM-PGA containing plastics, paper, and steel.

RF-PGA

1. Protocol 1 seems more accurate than protocol 2 when explored for RF-PGA samples.

Other findings

1. Protocols could be slightly operator dependent. Further evaluation is needed.
2. Deleterious material content significantly varied across RF-PGA samples.

Future work

1. Determination of protocols to determine plastic content accurately
2. Evaluation of geotechnical properties of PGA
3. Economical analysis to help catalyze use of PGA as sand borrow

Figure 1:Lab manufactured PGA (Left),CSWD(Mid),New Hampshire PGA(Right) (A penny is included in photographs to provide a sense for particle size)

Figure 2: Metals collected from clean glass (Left), RF-PGA Float (Mid) and RF-PGA post-furnace (Right)

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