Development of Protocols for Determining Deleterious Material Content in Crushed Recycled Glass

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TIDC
Transportation Infrastructure Durability Center
AT THE UNIVERSITY OF MAINE

CSWD
Chittenden Solid Waste District

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What is Processed Glass Aggregate (PGA)?

Crushed recycled glass

Contains some **deleterious materials** (e.g. paper, plastic, metal, ceramics)

Gradation and composition of PGA may vary across production facilities

What do we know?

Similar geotechnical properties to typical sand borrow

It can be used as a sand borrow or high quality fill

No major concerns of dangerous contaminants

Strong interest in using recycled materials, but how much deleterious content (and plastic) is in PGA?

Current method – visual counting

PGA use in Northeast

20 out of 22 U.S. states had specific specifications for deleterious material content

- In Northeast: CT, MA, NH, NY, PA, VT

0.05% to 10% deleterious material

Current Vermont specification

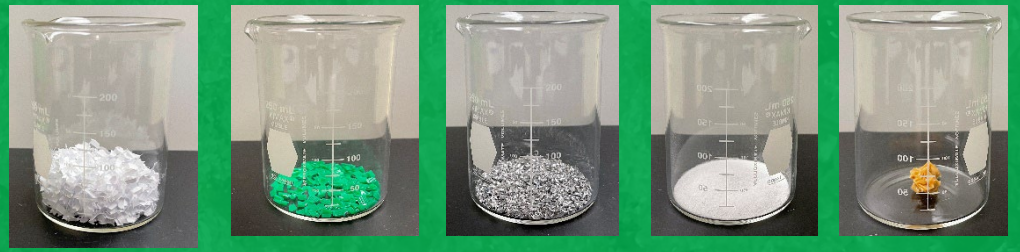
- **Contaminants greater than 1% by weight shall be grounds for rejection**
- “Small amounts” (less than 5% total) of china dishes, ceramics, plate glass, or other glass products
- No more than trace amounts of screw tops, plastic cap rings, or other contaminants

Our Goals:

1. Develop simple processes to determine deleterious material content
2. Assess engineering properties
3. Economic analysis to catalyze use of PGA

Lab-Manufactured PGA (LM-PGA)

Recycled Facility PGA (RF-PGA)



Methods:

Magnet

Provided accurate measurements of ferrous metal content

Trace amounts measured due to impurities in glass

Furnace (550°C)

Worked accurately for plastics, newspaper, food

Relatively less accurate for office paper

Float

Worked well for plastic

Not that well for paper

Acid Washing for aluminum - did not work well

Testing Protocol Development

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

Protocol 2: Magnet + Float (for determining upper limit on plastics content)

LM-PGA sample LMO: 98% glass + 2% deleterious organics
(0.5% office paper + 0.5% newspaper + 0.5% sugar + 0.5% peanut butter)

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

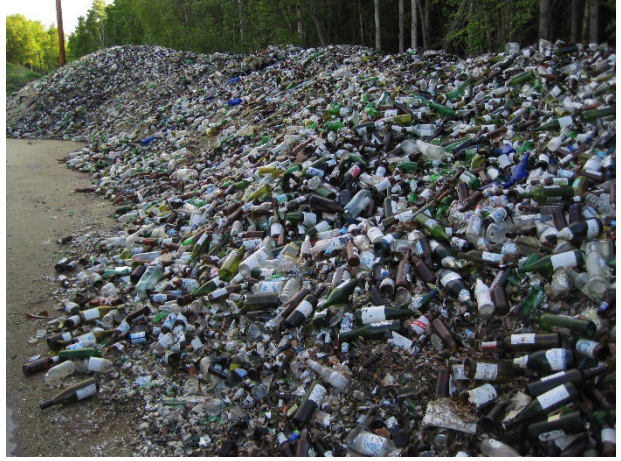
RF-PGA: Four samples – three from three different locations from a pile; one sample produced on a different date

6 samples of 100 g each tested for repeatability and statistics.

Results

LM-PGA	Protocol 1		Protocol 2	
	Magnet	Furnace	Magnet	Float
LMO	**0.01%**	**1.93%**	**0.02%**	**0.02%**
Ideal Measurement	0%	2%	0%	0%
LMP	**0.21%**	**1.92%**	**0.22%**	**1.22%**
Ideal Measurement	0.2%	1.8%	0.2%	1%
RF-PGA 1	0.07%	3.50%	0.07%	6.51%
RF-PGA 2	0.09%	2.41%	0.07%	3.99%
RF-PGA 3	0.07%	1.85%	*0.78%	0.94%
RF-PGA 4	0.01%	0.90%	0.07%	0.24%

Conclusions



Lab Manufactured PGA:

Protocol-1 was accurate

Protocol-2 was fairly accurate

Recycling Facility PGA:

The exact deleterious content was unknown

Protocol-1 worked well

Protocol-2 was not reliable

Additional findings:

- Added ceramics did not impact any measurements.
- Magnet process did a good job in picking steel, but it also picked a very small amount of impurities in glass.
- Acid washing process for aluminum did not produce good results. However, aluminum is less of a concern.

Future work:

- Determine plastics content accurately.
- Once the maximum allowable deleterious content is selected, evaluate engineering properties.
- Economic analysis to help catalyze use of PGA as sand borrow.