

Why Ultra lightweight Foamed Glass Aggregate (UL-FGA) is Important

- Most commonly used aggregates have a unit weight of 90-150-(lb./ft³) while UL-FGA has an average unit weight of 11-13-(lb./ft³)
- UL-FGA can also provide economical benefits because the structures that hold this aggregate up can now be smaller due to the decreased force acting on the structure

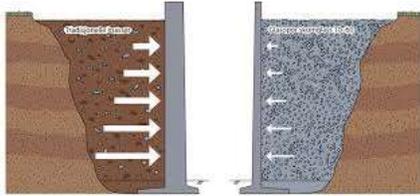


Figure 1. Example of Support Reduction

- UL-FGA is good for the environment because it is made from 100% recycled glass

Methods For Consistent Test

- UL-FGA was received from Aero Aggregate
- Samples were split using a riffle splitter to ensure a consistent grain size would be used
- Grain size consistency was checked using photogrammetry analysis with software BASEGRAIN
- Samples would be oven dried to ensure no sample contained any water which could rule out any water weight discrepancies
- Samples were weighed into half and full lifts depending on what the test called for
- Sample would undergo volume reduction before test that would either be 10, 20, or 30% reduction in total volume of the full or half lifts
- Sample would be tested one dimensionally with either an incremental load that would be applied every two hours or a constant rate load that would be applied for the entirety of the test
- Once sample was concluded in the test, it would be removed from testing area then split again to ensure consistency
- Sample would then be sieved again using photogrammetry techniques and then added to the dataset of 1D testing for UL-FGA

Background

Aggregate by definition is coarse particulate which is a rock-like material consisting of a collection of particles ranging in size from < 0.1 mm to > 50 mm. It includes gravel, crushed rock, sand, recycled concrete, slag, and synthetic aggregate.

These definitions cover a very wide range of sizes and weights. The choice of aggregate can vary project to project for specific needs that may need to be met.

Results

Photogrammetry sieve analysis

UL-FGA tends to break into smaller pieces and round its edges when sieved. As an alternative, photos and a computer software called BASEGRAIN were used in order to get a more accurate grain size analysis. To prove the accuracy of the photogrammetric methods compared to actual sieve, the comparison of similar samples had to be completed. The two graphs below represent similar samples with one having been sieved in a sieve shaker and another using photogrammetric methods.

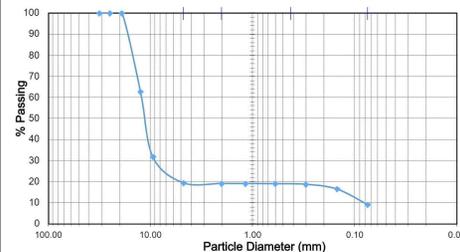


Figure 2. Sieve Shaker Grain Size Analysis

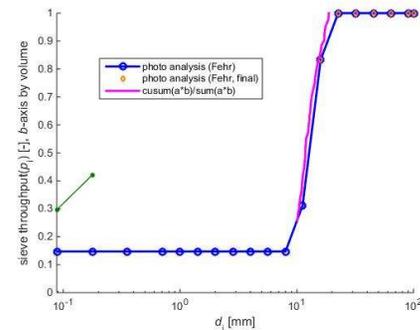


Figure 3. Photogrammetry Sieve Analysis

Expansion of Dataset

The dataset of One-Dimensional testing on UL-FGA is very minimal and our goal was to continue to expand the dataset from research that took place in 2019. The process of expanding the dataset also had a lot of repeat tests that had took place in 2019; however, these tests now had the extra purpose of identifying any tests that may have had inaccurate results that could have been caused by a number of reasons.

The test report shown below is just one of the styles of tests that had not been used before, which shows a sample that had its volume reduced by 10% and was loaded using a constant rate strain in a One-Dimensional test.

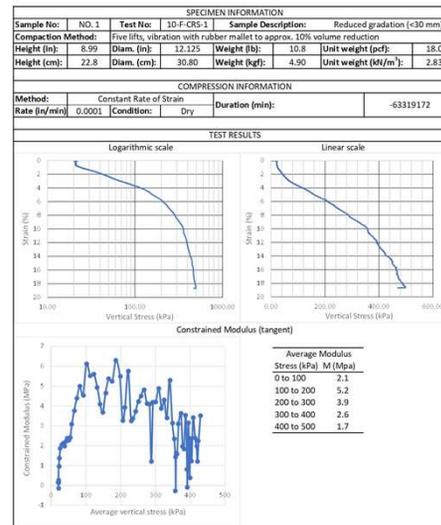


Figure 4. 10-F-CRS-1 Data Report(2020 CISE)

Conclusion

The data set of UL-FGA from Aero Aggregate has been almost doubled as part of this research. In continuation of this research, the next step would be to evaluate the data from the tests and determine any trends, which would identify any unreliable tests that may have occurred in either my research or the research conducted in 2019. Further expansion of this data set is still needed in order to compare this aggregate with other aggregate that are currently more established in the civil engineering community, such as expanded shale. UL-FGA could become revolutionary in the civil engineering community if research continues to expand for this aggregate.

The use of photogrammetry sieve analysis was proved to be an accurate way to obtain a grain size analysis for problematic aggregates. These include aggregates that may have the property to lead to rounding of corners or breaking during the running of standard sieve shaker machines.

Works Cited

Aero Aggregates(2018) Foamed Glass Aggregate (UL-FGA) Ultra Lightweight MATERIAL AND APPLICATIONS. <https://acfenvironmental.com/wp-content/uploads/2018/08AeroBrochure.pdf>, (8/18/2020).

Jamal, H. (2017, March 01). Haseeb Jamal. Retrieved August 19, 2020, from <https://www.aboutcivil.org/aggregates-types-uses-definition.html> (8/19/2020)

