The Ohio Department of Transportation Office of Research & Development Executive Summary Report

A Comparison of Optical Gradation Analysis Devices to Current Test Methods – Phase 1

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Problem:
Gradation analysis of aggregates, commonly known as 'sieve analysis', is routinely performed by the aggregate technicians to determine compliance with design, production control requirements, verification of specifications, relationships between various blends and to develop mix designs for paving jobs. Traditionally, gradation analysis is done using a stack of sieves. Typically, each test consumes 30 to 60 minutes of technician time. In the recent years, optical devices for gradation analysis are being developed to deliver accurate gradation results with less labor and greater reliability. The goal of this research program was to review the available optical devices to determine when and where such devices are appropriate from the standpoint of both economies and performance. The basic focus of this study was two issues:

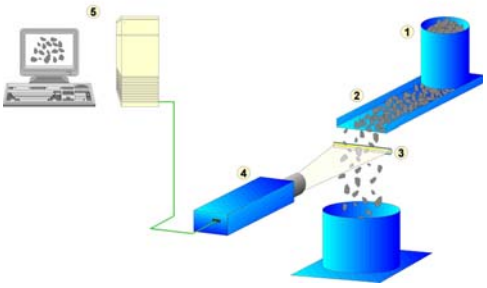
- What types of optical devices are in use or under investigation by other agencies?
- Do these new devices have potential applicability to Ohio's conditions?

If a device is found suitable, it can help the Ohio Department of Transportation (ODOT) improve operational, financial and technical outcomes by allowing labs to standardize the testing process without sacrificing quality, while increasing the speed and efficiency, and subsequently reducing cost.

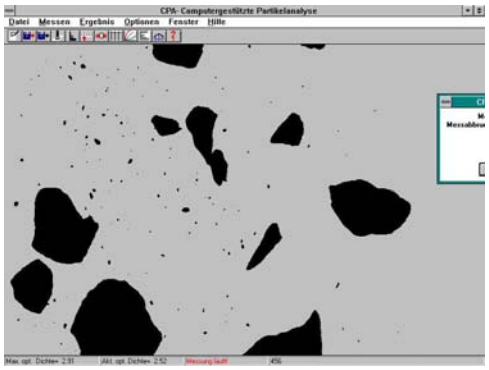
Objectives:
The specific objectives of the study are to:

1. Conduct a review and evaluation of available optical gradation analysis devices that are in use and/or being investigated by other agencies.
2. Prepare physical samples and conduct gradation tests on a range of aggregate samples using current ASTM/AASHTO procedures.
3. Repeat tests on physical samples using the optical devices that become available to the researchers.
4. Analyze the data.
5. Identify the specific tasks Phase-2 evaluation for a comprehensive evaluation of optical devices.

Description:
First, a review of available optical devices was conducted. An optical device called Computerized Particle Analyzer (CPA) was selected for laboratory evaluation to determine its suitability for gradation analysis. This device has been designed to examine particles as they freely fall in front of a light source, while a sophisticated camera capable of making 10,000 scans per second captures images.



Aggregate samples were collected from 46 different sources in Ohio. These sources included various sizes of lime stone and gravel with varying amounts of crushed faces. Gradation tests were first performed according to the standard AASHTO procedure.



The samples were then tested in CPA. The initial test results showed considerable variation between the two test procedures. However, after continued evaluation of the device that included over 100 tests on various types and sizes of aggregate samples, researchers were able to identify and implement appropriate modifications to the computer algorithm and narrow the differences.

Conclusions & Recommendations:
Based on the efforts, test results, and experience gained, it is observed that the CPA device has the potential to produce gradation results comparable to the traditional AASHTO procedures. The device is capable of producing consistent and repeatable test data. It is computer-controlled and user-friendly. Two primary benefits noted during the evaluation are: (i) time savings, and (ii) generation of additional information. One gradation test can be completed in less than five minutes, compared to 30 to 60 minutes for the conventional procedure. More importantly, the same data can also be used to obtain additional information about elongation index and angularity.

While the results so far show promise, they should only be deemed preliminary. Additional efforts are needed to ascertain the preliminary findings and truly establish the capabilities of CPA. The researchers recommend that ODOT initiate a Phase 2 program to comprehensively evaluate the CPA device. Upon completion of the Phase 2 investigation, conclusions about the capabilities of the CPA device and recommendations to ODOT on specification changes, capability, precision, durability and cost of the equipment can be made.

Implementation Potential:
The outcome of this study is important to various agencies including Ohio's paving contractors, private test labs, and the Office of Materials Management. While the Phase 1 study reported here has shown the potential of an optical device for gradation analysis, a definitive determination of the suitability of the device for use in Ohio will require further research.