STATE OF FLORIDA

EVALUATION OF THE CANTY SOLID SIZER^{TM} PARTICLE SIZE SYSTEM

Research Report
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INTRODUCTION

Canty Process Technology developed the Canty Solid Sizer^{TM} particle size system, which uses a combination of a video camera, light source, and computer to visually determine particle size (**Figure 1**). The video camera takes still shots of the material as it passes through the view area (**Figure 2**). The images are digitized and the computer calculates the number of pixels to determine the major axis, minor axis, perimeter, and area. The major axis is the largest linear dimension of a single piece of aggregate seen by the video camera, while the minor axis is the perpendicular smaller linear dimension to the major axis. Volume is then calculated by modeling each particle as a cylinder. The volume can also be modeled as other solid shapes such as a sphere. The Canty Excel program produces a gradation plot with percent passing versus sieve size. The percent passing (y-axis) is based on the modeled volume, and not mass, which is used in conventional sieve analysis. The user can choose to plot either the major or minor axis as the x-axis in the gradation plot. The minor axis was used in this study because it represents the controlling dimension in a sieve analysis. The x-axis used by the Canty Excel program is based on the actual dimensional units as opposed to the units raised to the 0.45 power. An Excel program was written to convert the information into a standard 0.45 gradation plot. The purpose of this evaluation is to determine if the Canty Solid Sizer^{TM} particle size system can accurately grade laboratory samples of aggregate.

TESTING AND RESULTS

Several gradations of material were prepared to test the particle sizing system. Gradations composed of material retained on one sieve size only were performed to determine which sizes of material the system could accurately grade (**Figures 3-10**). The system graded approximately

80 percent of the aggregate correctly based on percent passing by volume for the #4 (4.75 mm) and #16 (1.18 mm) sieves. It accurately graded around 70 percent of the material for the #8 (2.36 mm), #30 (0.60 mm), and #100 (0.15 mm) sieves. The system had difficulty grading the larger pieces of aggregate retained on the 9.5 mm sieve and the smaller sizes below the #30 sieve (< 0.60 mm) except for the material retained on #100 sieve. It was very difficult to grade half-inch material (12.5 mm) because the particle sizer does not see every piece of aggregate. It takes a random sample of the aggregate passing the camera by taking pictures of the falling aggregate about every 0.4 seconds. An unusually large amount of 12.5 mm material would have been needed to determine the gradation using the Canty system. The system is also limited by pixel size. The smallest piece of aggregate that can be seen is approximately 0.09 mm. This is larger than all of the material that passes the #200 sieve (0.075 mm). Determining the amount of material passing the #200 sieve (dust) is an extremely important gradation parameter that affects asphalt mixture properties such as air voids and voids in the mineral aggregate (VMA).

The particle sizer has a difficult time accurately grading full gradations of material ranging from 12.5 mm to 0.075 mm. The gradations in **Figures 11 and 12** show that the system could not identify the material passing the #30 sieve (0.60 mm). Therefore an aggregate mixture was produced with material ranging from 12.5 mm to the #30 sieve (0.60 mm). The finer material passing the #30 sieve was eliminated from this mixture since the particle sizing system had difficulty grading the finer aggregate. The particle sizer accurately graded this aggregate mixture (**Figure 13**).

Aggregate mixtures sometimes consist of particles with different densities. This brings up another difference in grading with sieves and with the Canty system. Gradations with sieves are based on mass while the particle sizer gradations are based on volume. This difference is not noticeable when the materials graded have approximately the same density. When materials with different densities are combined the Canty system could produce a different gradation than traditional sieve analysis. An aggregate mixture was put together that consisted of nylon spheres with a diameter of 6.35 mm and a density of about 1.150 g/cm^3. The rest of the aggregate in this mixture had a density of approximately 2.400 g/cm^3. The nylon spheres were the only particles in the mixture retained on the #4 sieve. The rest of the aggregate ranged from 12.5 mm to the #16 sieve (1.18 mm) but did not include any #4 material. The results are shown in **Figure 14**. The Canty gradation based on volume and the sieved gradation based on weight varied because of the differences in density between the two materials.

CONCLUSIONS/RECOMMENDATIONS

The Canty Solid Sizer™ particle size seems better suited for large-scale process work as opposed to laboratory analysis. The system lacks the ability to accurately grade small particles or handle combinations of large and small particles. There are also fundamental differences in a laboratory sieve analysis and the Canty system. Some of those differences include gradation based on measured mass instead of an estimated volume, weighing each particle instead of a random sample, and assuming all particles have the same density.

Figure 1 – Canty Solid Sizer^{TM} Particle Size System

Figure 2 – The Canty System Grading Aggregate

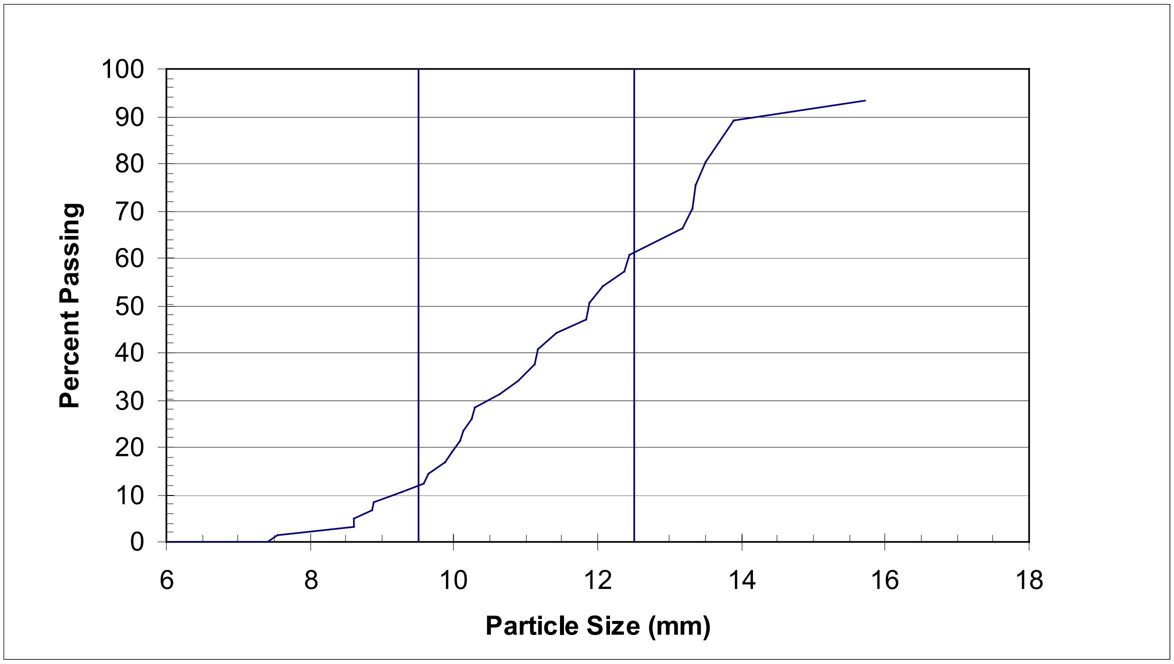

Figure 3 – Canty Gradation of 9.5 mm Material

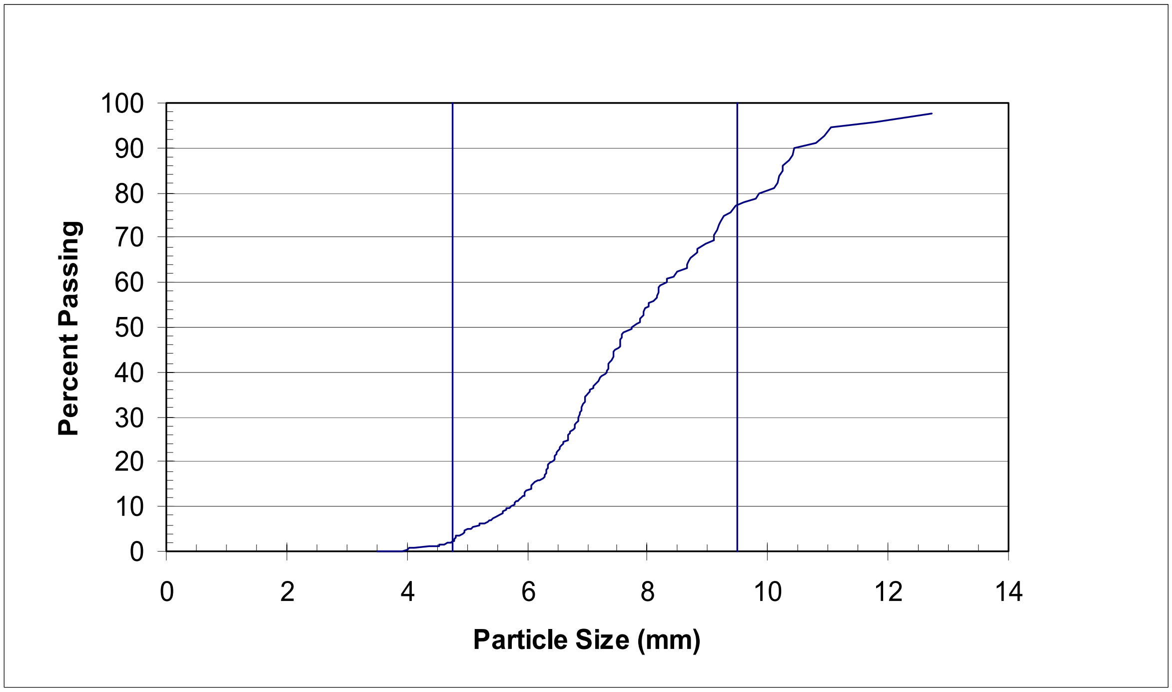

Figure 4 – Canty Gradation of #4 (4.75 mm) Material

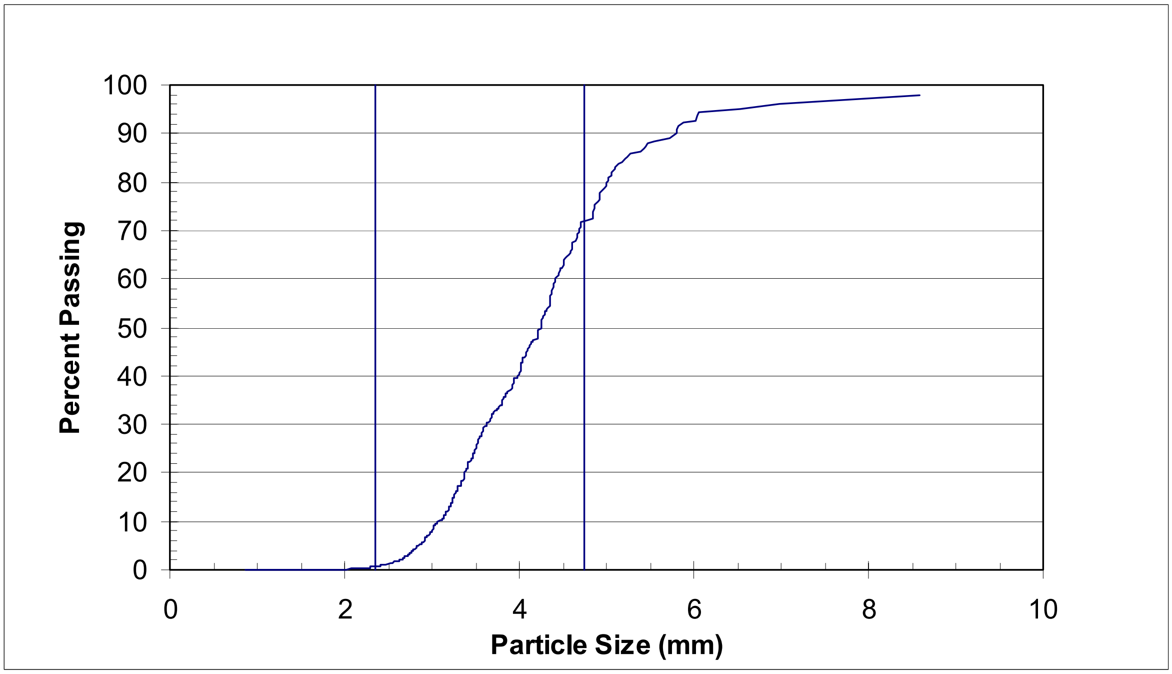

Figure 5 – Canty Gradation of #8 (2.36 mm) Material

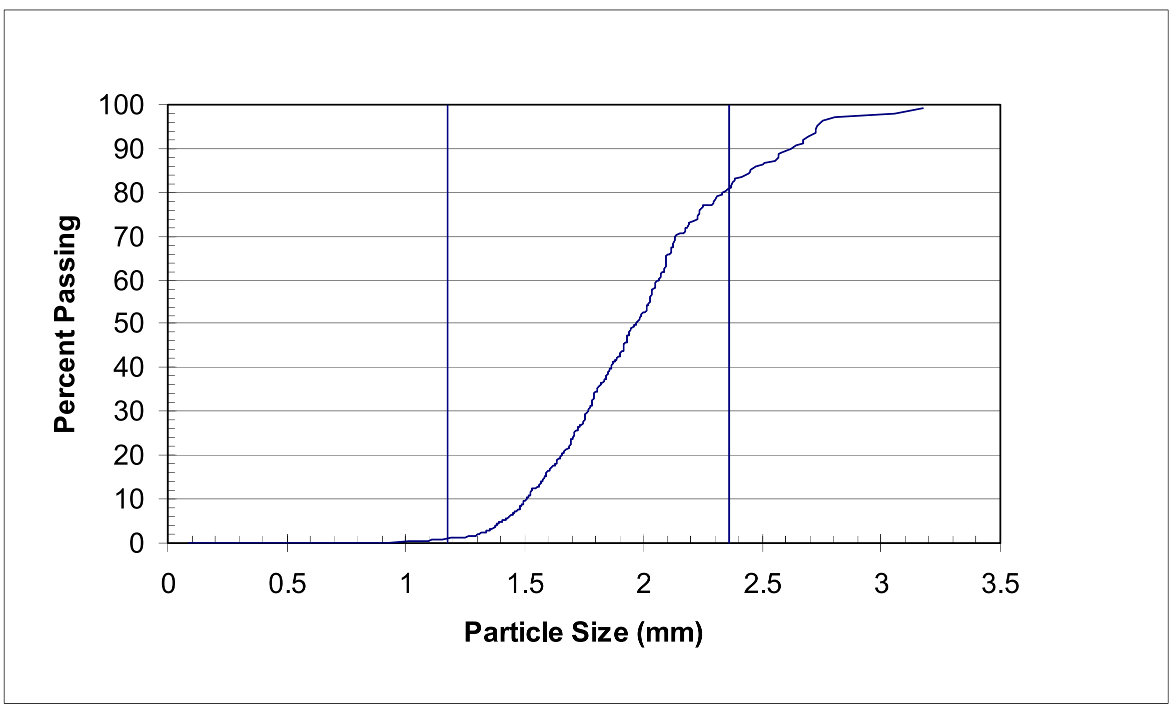

Figure 6 – Canty Gradation of #16 (1.18 mm) Material

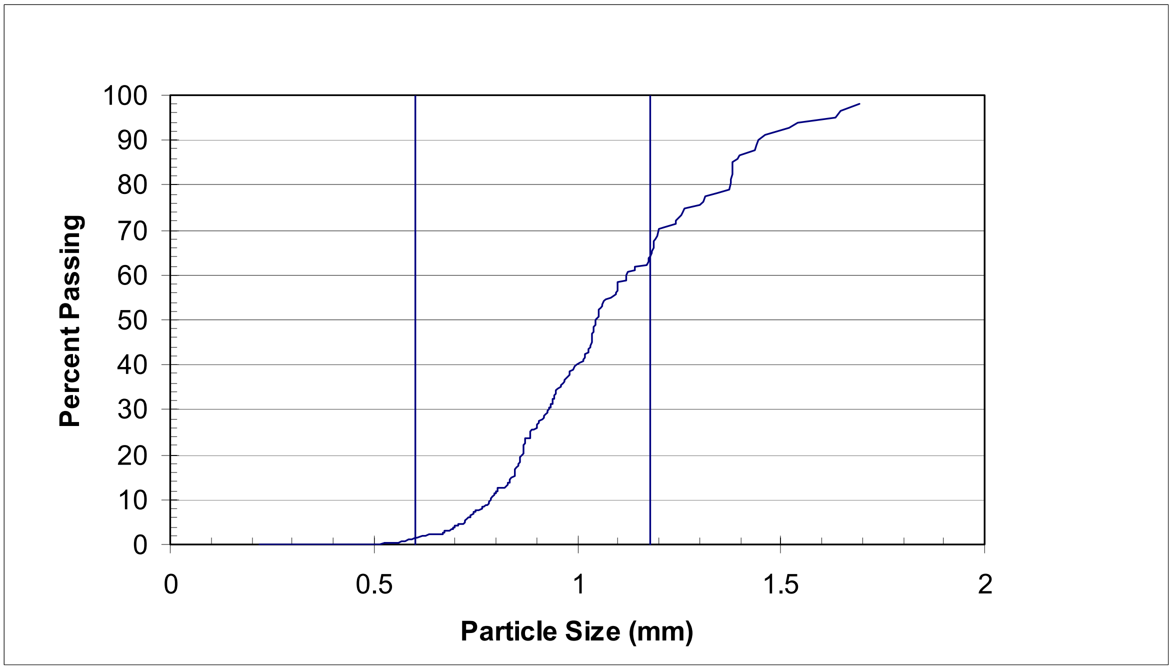

Figure 7 – Canty Gradation of #30 (0.60 mm) Material

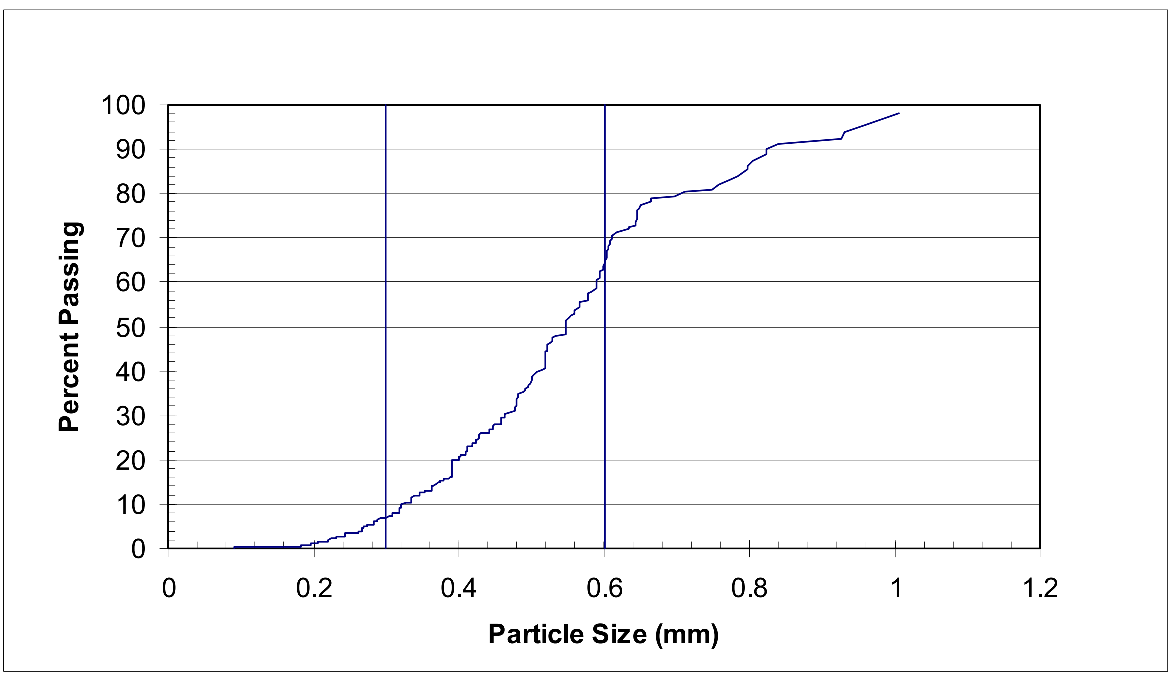

Figure 8 – Canty Gradation of #50 (0.30 mm) Material

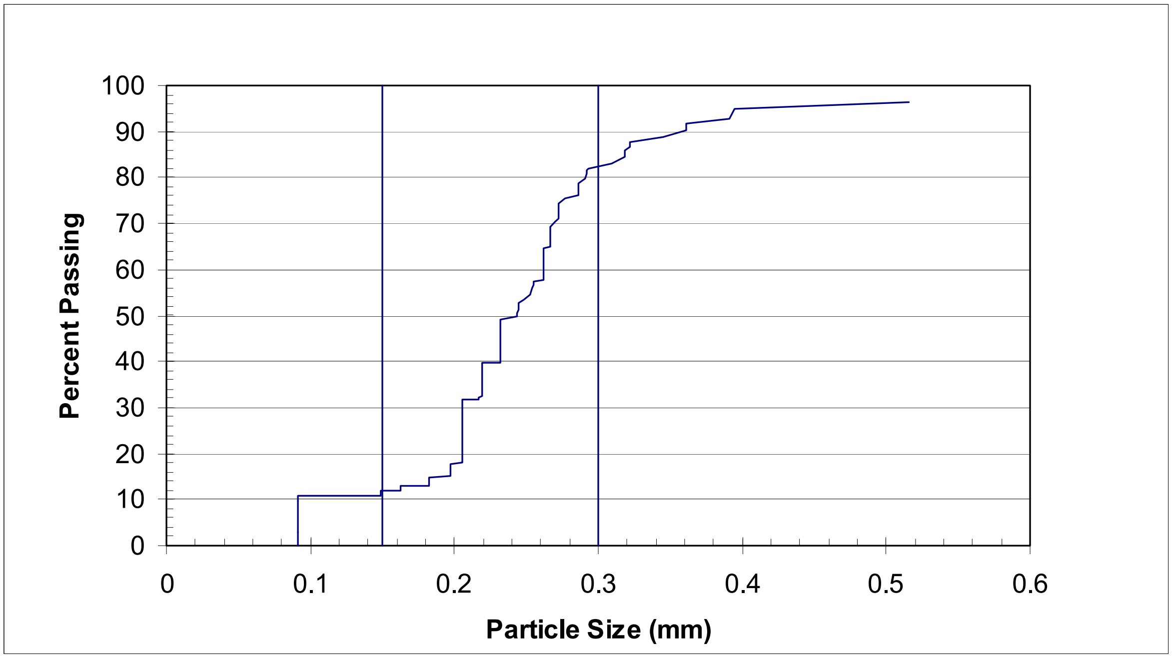

Figure 9 – Canty Gradation of #100 (0.15 mm) Material

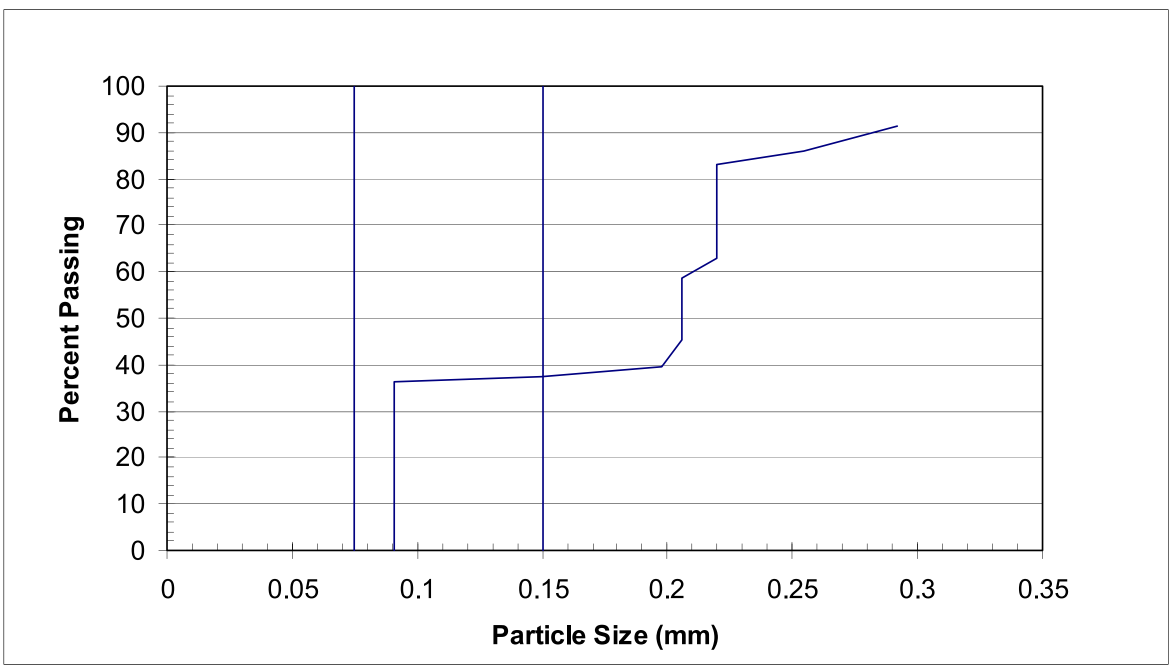

Figure 10 – Canty Gradation of #200 (0.075 mm) Material

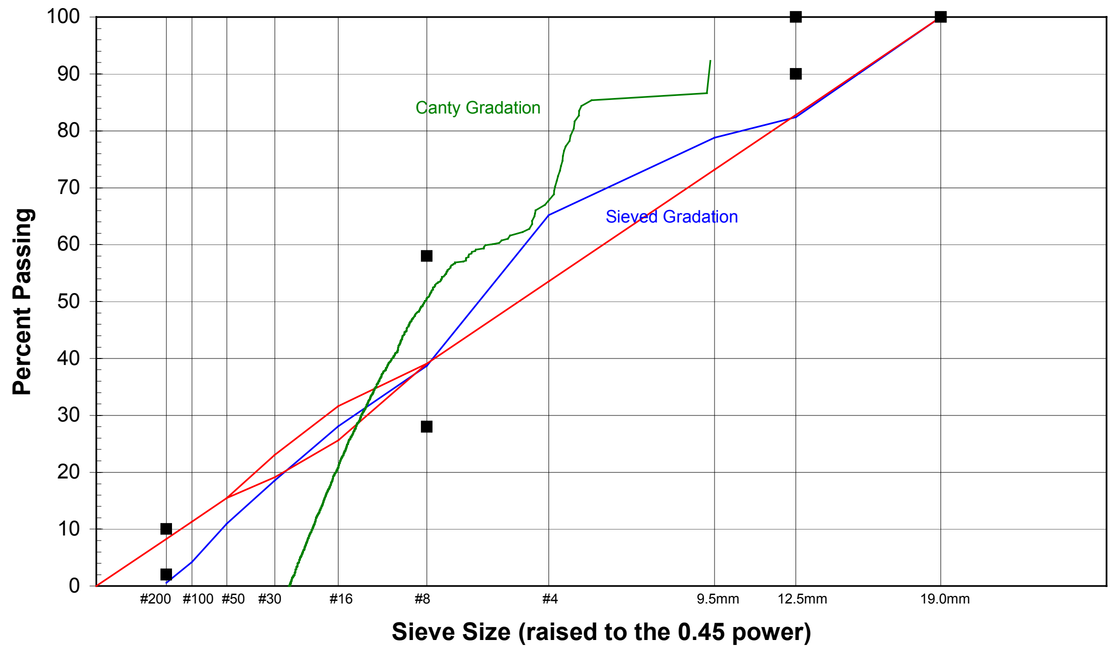

Figure 11 – Comparison Gradation Using Granite Material

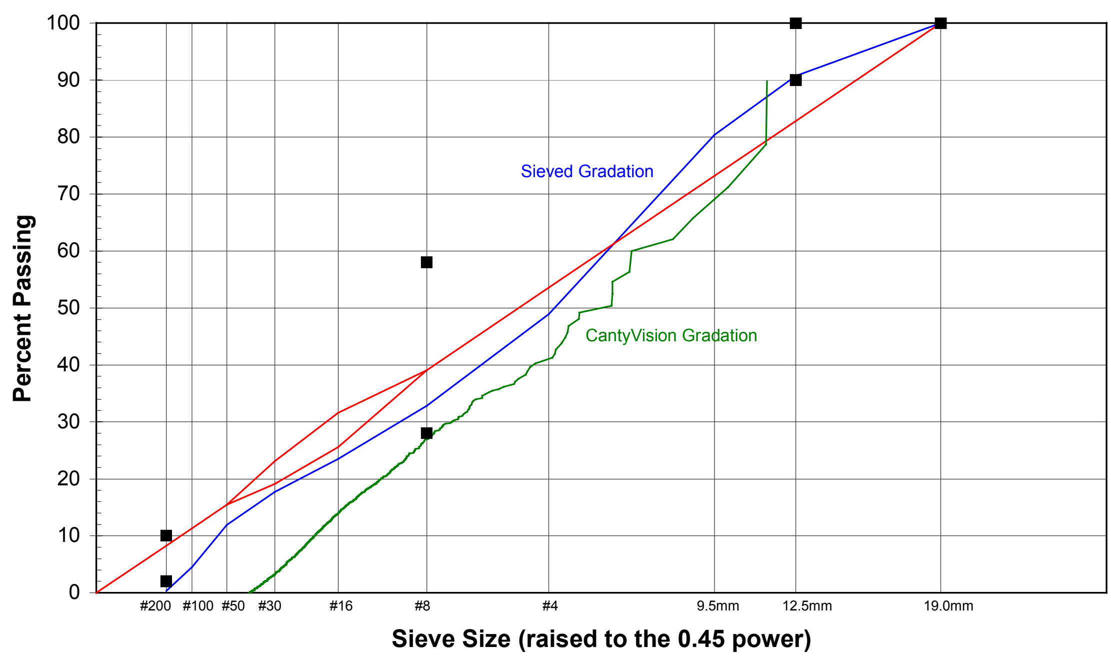

Figure 12 – Comparison Gradation using Limestone Material

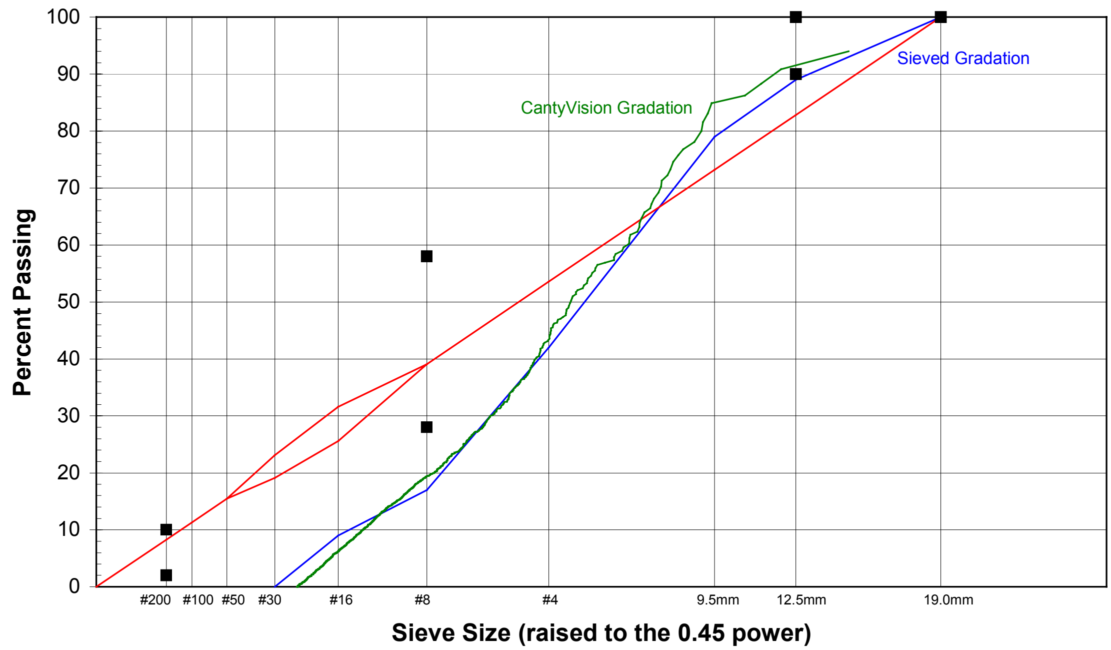

Figure 13 – Comparison Gradation of Limestone Material (#30 sieve-12.5 mm)

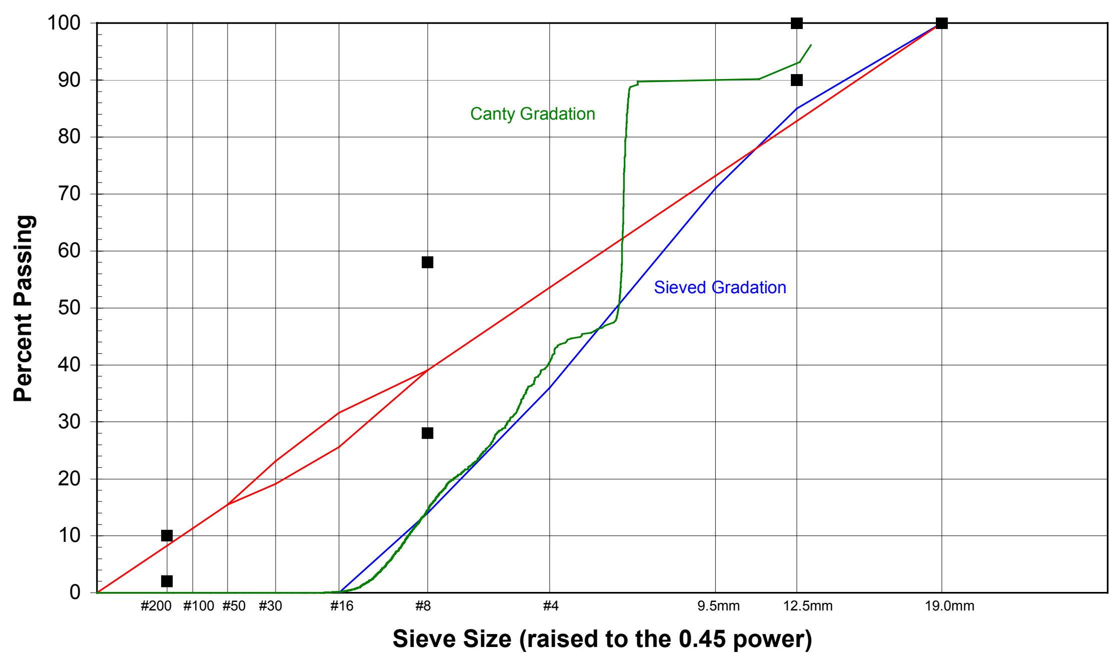

Figure 14 – Comparison Gradation of Limestone Material and Nylon Spheres