Particle Size and Shape Distributions of New York City Municipal Solid Waste (NYC-MSW) and Residues for Combustion Camber Design

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Background

New York City generates 50,000 tons/day of MSW

The particle size and shape of MSW have not been successfully measured because

- MSW is a complex mixture of organic, inorganic, and plastic materials
- The particle size and shape can vary widely
- Traditional methods of measurement are not accurate

Objectives

This study aims to:

- Develop a new method for measuring MSW particle size and shape
- Compare the results with traditional methods

Methods

Applying image analysis for measuring MSW particles is a new approach.

Size and Shape Distributions

The gamma distribution is one of the common particle size distributions:

\[ f(D) = \frac{a^{b} D^{b-1} e^{-\frac{a}{D}}}{\Gamma(b)} 
\]

Where:

- \( f(D) \) is the gamma distribution
- \( a \) is a constant
- \( b \) is a positive parameter

- Aspect Ratio (AR) is defined as length/width (Schneider 1954)
- Roundness (Circularity) is defined as perimeter/4π*area (Wadell 1932; Cox 1927)

Results

Ash particle size distribution

\[ f(D) = \frac{1}{\beta^2 \Gamma(a)} D^{a-2} e^{-\frac{D}{\beta}} \]

MSW particle size distribution

\[ f(D) = \frac{a^{b} D^{b-1} e^{-\frac{a}{D}}}{\Gamma(b)} \]

Combustion and transport phenomena of one particle in a MSW bed on the traveling grate

Discussion - Cluster Analysis

Summary and Future Work

- Black bags were collected in New York City and MSW particles from the bags were sampled for obtaining particle size distributions and shape distributions
- Image analysis for measuring particle size and shape is carried out accurately
- Gamma function with α = 250, β = 4, b = 3.2 matches the particle size distribution of MSW collected in New York City
- The new method can be used to classify MSW particles into different categories