Model formulas

Rosin Rammler (RR) Model:

The RR model distribution function has been used to describe the particle size distributions of various minerals, powders and liquids of various types and sizes. The function is particularly suited to represent those produced by grinding, milling, and crushing operations. The general expression of the RR model is:

$$F\left(d\right) = exp\left[-(\frac{d}{\bar{d}})^{m}\right]$$

where:
$F(d)$ = distribution function (cum. passing)
d = particle size [mm]
Parameters $\bar{d}$ and m are adjustable parameters characteristic of the distribution.
$\bar{d}$ = scale paramater (mean particle size [mm])

where

$$\bar{d} = \exp\left(-\frac{intercept}{slope}\right)$$

m = slope paramater (measure of the spread of particle sizes).

The RR transformation is achieved by taking the natural log twice and simplified as:

$$\ln\left\{-\ln\left[1 - F(d)\right]\right\} = m \times \ln d - m \times \ln \bar{d}$$

Note that the RR distribution transformation is conducted on the cummulative retained distribution (thus the $[1 - F(d)]$.)

If a distribution plots a straight line after the above RR transformation, then the distrubution can be represented by the RR distribution function. This will alllow percentile interpolation according to the distribution and not a straight line between two points obatained from screening.

$$Y = mX + C$$

$$\underbrace{\ln\left\{-\ln\left[1 - F(d)\right]\right\}}_{\text{Y}} = \underbrace{m}_{\text{slope}} \times \underbrace{\ln d}_{\text{X}} + \underbrace{\left(-m \times \ln \bar{d}\right)}_{\text{C}}$$

Back-transformation (This is really the reason why we're doing the model fitting; so that we can better estimate the size at which a certain specified mass fraction will pass). The back-transform is then conducted to determine the required percentile values:

$$x = \bar{d}\left(-\ln\left(1 - Y\right)\right)^{\frac{1}{m}}$$

$$size = scaleparameter \times (-\ln(1 - percentile))^{1/slopeparameter}$$

, where the scale_parameter; is a function of the slope and intercept of the transf ormed RR model fit, as follows:

$$scaleparameter = exp(-\frac{intercept}{slope})$$

Gates-Gaudin-Schumann (GGS) Model:

The Gates-Gaudin-Schumann plot is a graph of **cumulative % passing versus nominal sieve size**, with both the X and Y axes being logarithmic plots. In this type of plot, most of the data points (except for the two or three coarsest sizes measured) should lie nearly in a straight line.

$$y = F(x) = \left(\frac{x}{k}\right)^n$$

or simmilarly: The above formula can be rewritten as: $x = k \times y^{\frac{1}{n}}$

where:
$y = F(x) =$ cumulative undersize distribution function.
$x =$ particle size,
$k =$ maximum particle size of the transformed straight line corresponding to 100 cum. passing.

Log transformation of the distribution yields:

$$\ln y = n \ln x - n \ln k$$

Applying this transformation to the measured observed distribution data points will yield near straight lines if the data fits the model, and interpolation on along a straight line is much easier than along the curved arithmetic distribution function.