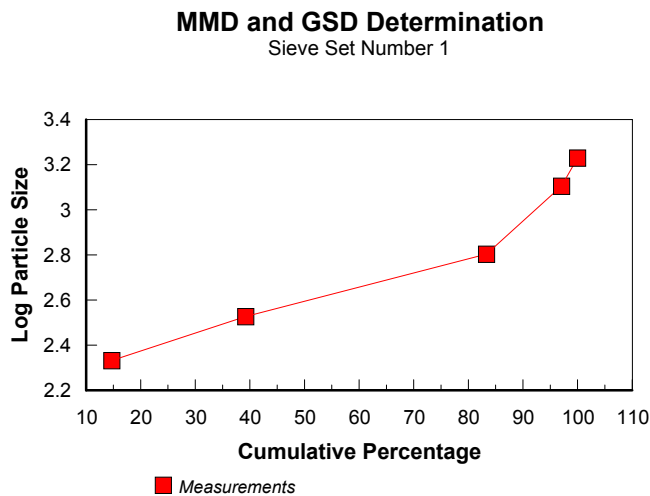


Use of Probits in the Analysis of the Particle Size Distribution of Powders

The particle size distribution of a sample of a powder to be used in the preparation of tablets may be determined using a set of sieves with different mesh sizes. The different sized particles of the powder are separated by retention on a sieve with a mesh size smaller than the size of the powder. It is assumed that the size distribution of the powder follows a normal distribution where, by definition, 68% of the particles lie within one standard deviation of the mean. One problem exists. The number of sieves and the resulting separation does not give enough data points to plot a smooth line. Depending on the method of displaying this more limited data, with imagination the shape may take the form of a traditional “bell” curve or more likely, it may appear as a sigmoid curve.

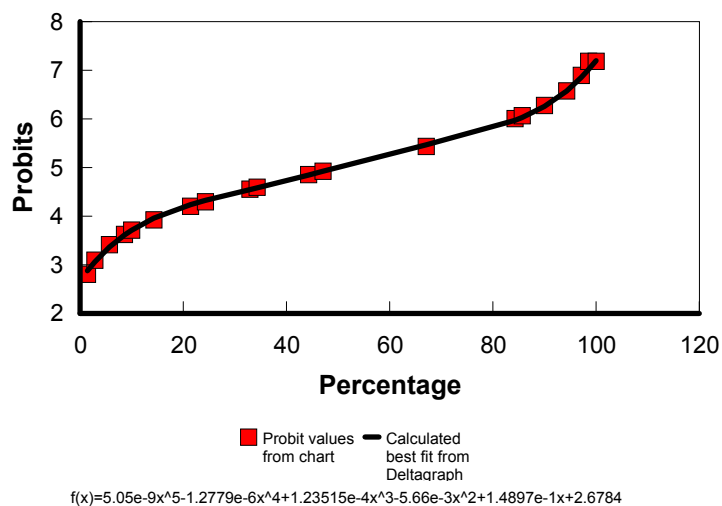
Probit analysis transforms these more complex visualizations of the data into a linear relation of probit vs particle size. It allows different powder preparations to be compared.

In the following graph compares the log particle size to the cumulative percentage of each portion of the total powder weight. Values below 15% drop while those above 84% rise sharply.



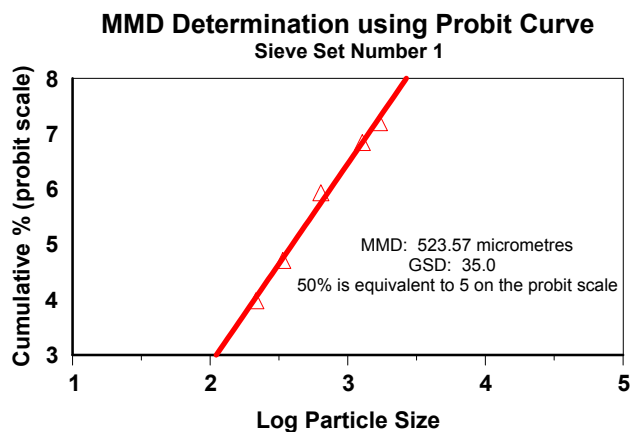
These values represent the two “tails” of the normal distribution curve. In order to transform this data to probits, a probit value is calculated for each of the “cumulative percentage values”. The values thus obtained are plotted as the Y axis vs Log Particle size. A straight line results. The following graph shows the relation between probits and percentage. Notice that 50% is the probit value of 5

Probit calculation from percentages



The spreadsheet called Probits has a cell to be used for the calculation of the probit value from the percentage. The equation of the function is placed as a note in the above graph. Note the similarity of the probit curve with that of the data in the first graph.

The spreadsheets Sieve 1 and Sieve 2 have been prepared to not only utilize the use of probits but to also save the student the need to calculate the probit values. A probit curve for Sieve 1 is shown below:



This method of calculation and display of data is also used in the measurement of very small particles in aerosol dosage forms as MMAD and perhaps more importantly in dose response calculations where Mean Mass Diameter (MMD) becomes Lethal Dose of 50% of a population (LD_{50})