Chapter IV

Experiments

4.1 Raw Material

Raw Material used in this study was feldspar. In prior to be used in each experiment, it was screened to confine its size in a certain size range and then was characterized by using a powder tester. Its original shape characteristics was also analysed using procedure as mentioned in the section 4.4, chapter 1. The properties of feldspar are shown as follows:

Size range	=	1190-2000 micron
Flow index	=	82.00
Fractal dimension	=	1.0301

4.2 Apparatus

Apparatus set of experimental apparatus used in this work was mainly composed of a vibration mill and a powder tester (see their specifications in Appendix A). A schematic process diagram of the comminution system employed in this work is shown in Figure 4.1

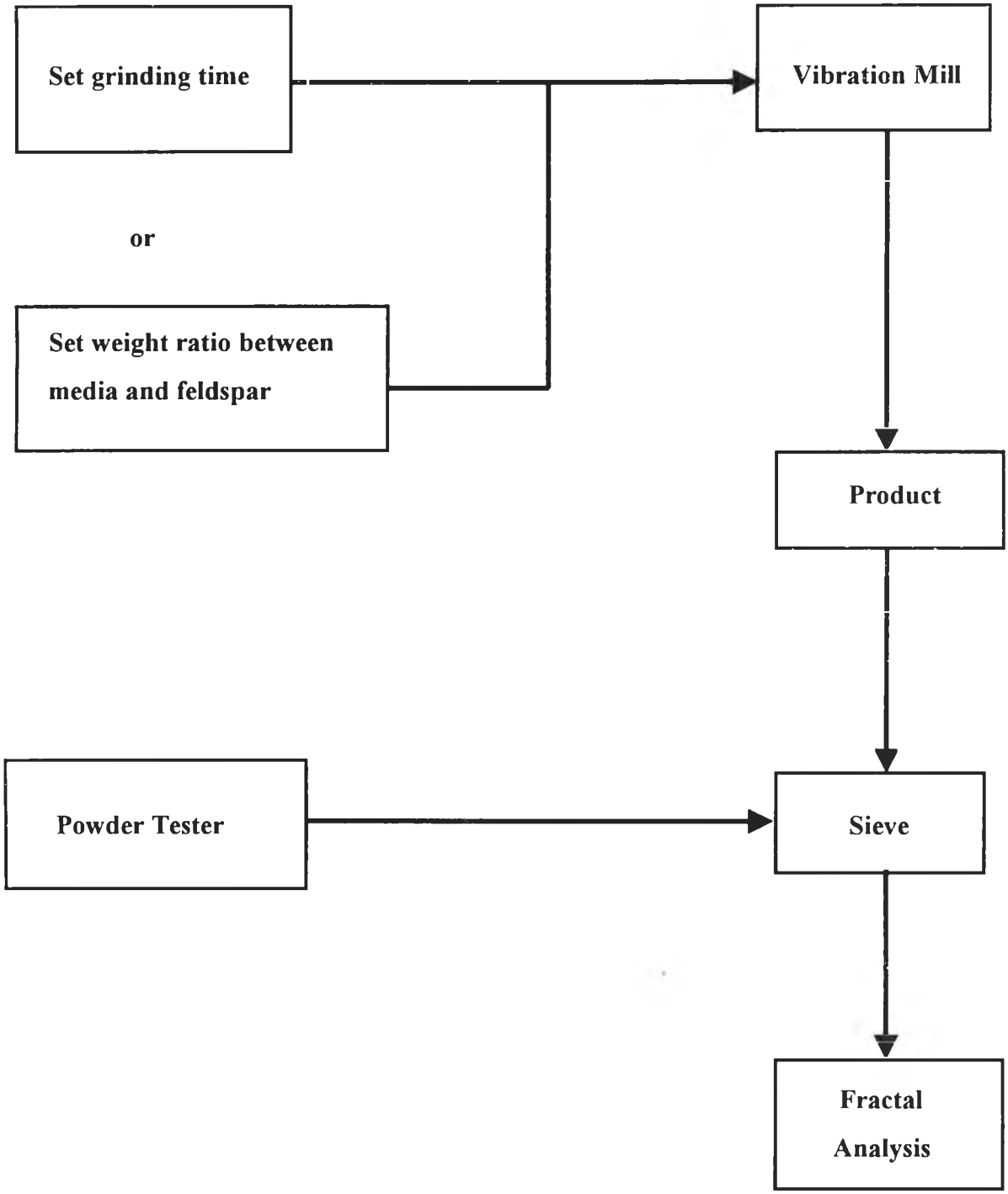


Figure 4.1 Schematic diagram of the comminution system Vibration Mill

4.2 Apparatus

4.2.1 Vibration mill

In general, a vibration mill is composed of two pots functioning as vibrating grinding cylinders. Between them lies an eccentrically supported weight connected by a flexible universal joint to a 1000-1500 rev/min motor. Rotation of the eccentric vibrates the pots to produce an oscillation circle of a few millimeters. Inside each pot, grinding medias, the ceramic balls of 25 mm diameter, are loaded with equal weight.

The outstanding features of correctly designed vibratory mills are their small size and lower power consumption relative to throughput when compared with other types of mills.

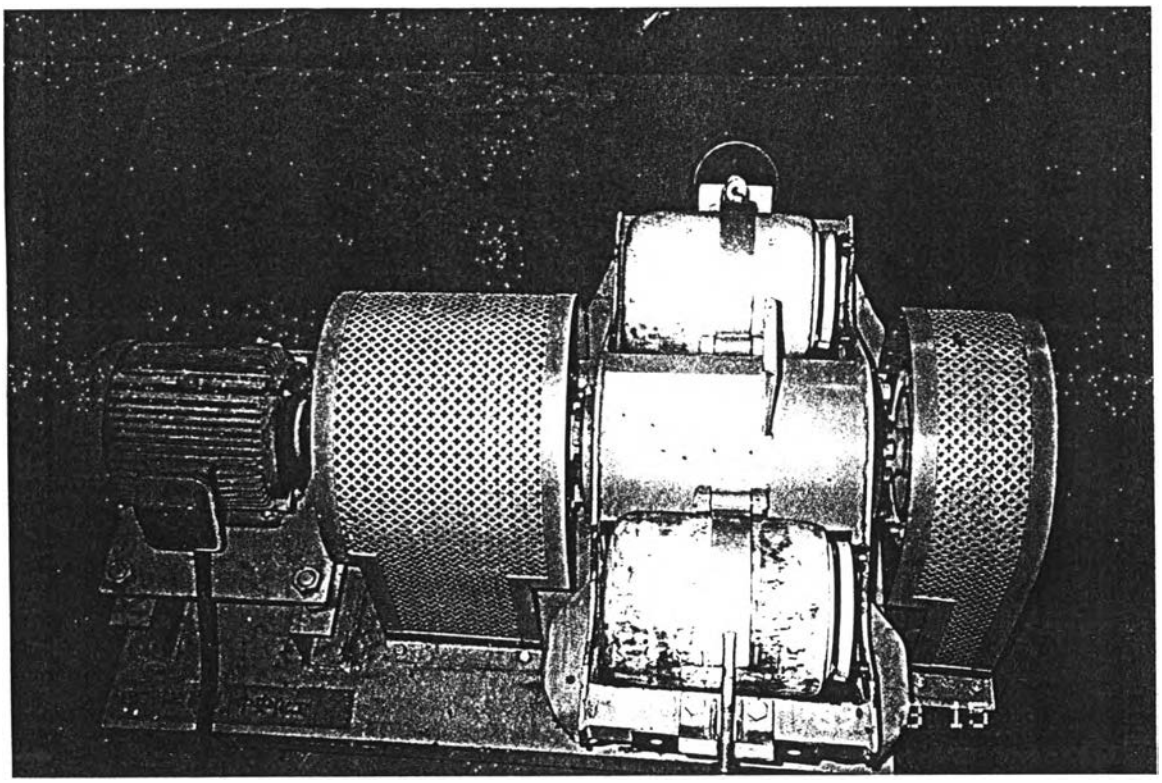


Figure 4.2 A Vibration Mill used in this present work

4.2.2 Powder Tester

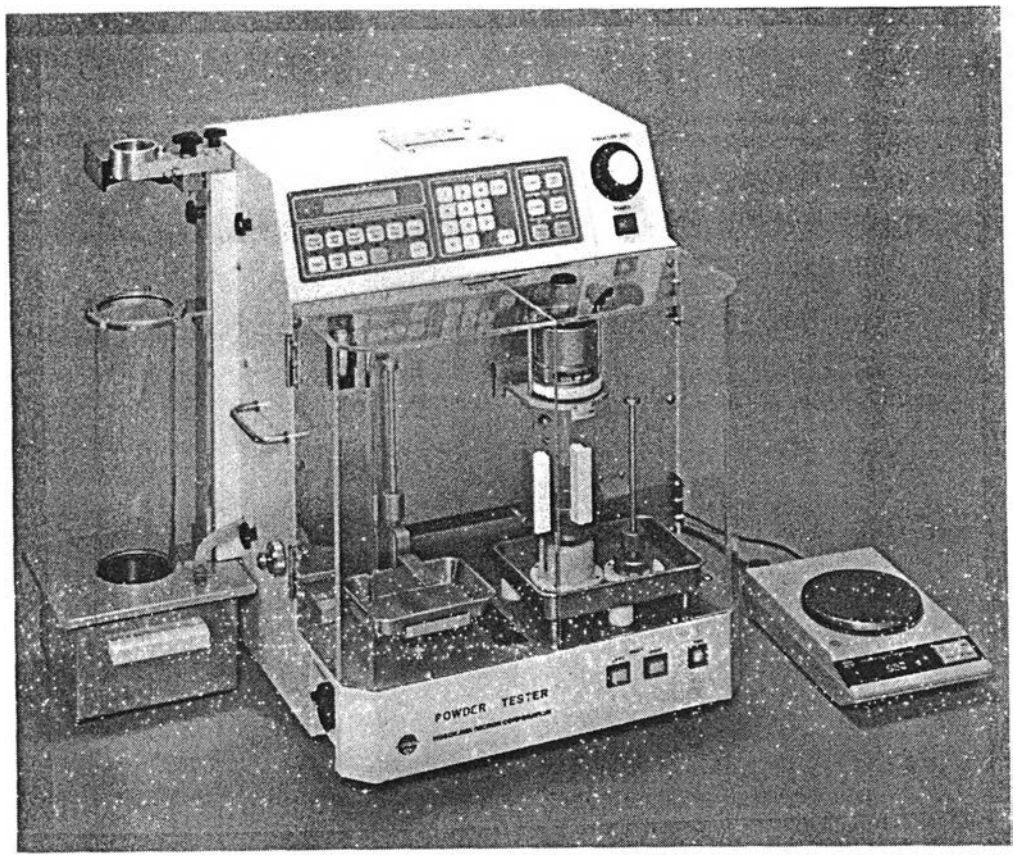
A powder tester is an apparatus which measurements obtained from its can be directly converted into an index of flowability and an index of floodability using the flowability index tables originally proposed by R.L. Carr in 1965. It provides seven mechanical measurements and three supporting measurements of dry bulk powder samples. Each characteristics, which can be grounped into two categories, is

mechanical measurement group

1. angle of repose
2. compressibility
3. angle of spatula
4. cohesiveness
5. angle of fall
6. dispersibility
7. angle of difference

and supporting measurement group

1. aerated bulk density
2. packed bulk density
3. uniformity



4.3 Experimental conditions

In the present work, operational factors, namely, grinding time and weight ratio between grinding media and substance were varied in order to investigate their effects on the particle shape and flow characteristics of ground product.

Range of the operational factors used in this work are as follows:

1.) Grinding time : 15,20,25 and 30 minutes

2.) Weight ratio between media and substance : 3:1, 4:1, 5:1 and 6:1

In each condition, the constant mass of feldspar was supplied at 200 g. in each pot.

4.4 Experimental procedure

The experimental procedure can be classified into 2 parts as follows:

Chapter 1) Comminution and Shape analysis

1. Put feldspar with constant weight of 200 g. and media with certain weight into each pot.
2. Set up the pots on vibration mill and set grinding time at a certain values.
3. Start the comminution until reaches the set grinding time
4. Take ground product out from each pot and sieve into three size ranges, which are 149-210, 210-297 and 297-420 micron.
5. Take microphotographs of ground product samples using a scanning electron microscope (SEM).
6. Analyze shape of the ground product in SEM photographs using the concept of fractal analysis. To collect data of fractal characteristics of ground product image, using cell scales for counting the perimeter of images were varied from 2, 5, 8, 10, 16, 20, 40 and 80.
7. Plot the length of perimeter of each image N(r) versus the reciprocal of counting scale r on the log-log scale and determine the slope which is the fractal dimension (D) of the image.

Chapter 2) Evaluate the Flow Characteristics of Particles

In the present work, the flow characteristics of particles after comminution have been determined using a powder characteristics tester. The characteristics are measured and then taken to determine the so-called flowability indexes of the ground particles.

1. Angle of Repose is the direct indication of the potential flowabilities of a material and is measured from the heap carefully built up by dropping the material from a vibrating screen and glass funnel above the horizontal plate.
2. Angle of Fall gives the indication of floodability of a material and is measured from a heap to which a certain shock has been given.
3. Angle of Difference is the difference between the angle of repose and the angle of fall.The material has the characteristics of flushing when this figure is large.
4. Aerated Bulk Density, obtained by dropping the sample through a vibrating chute.
5. Packed Bulk Density, obtained by tapping the sample 180 times.
6. Compressibility is a very important flow characteristic of a material and is determined by the measurement of aerated and packed bulk density.
7. Cohesiveness or Uniformity
    - Cohesiveness indicates flowability of a material for a powder which have higher cohesion.
    - Uniformity, obtained by measuring dispersibility or by sieving.
8. Angle of Spatula is an easily determined property that gives a relative angle of internal friction of a dry material. A spatula is inserted into the heap parallel to the bottom, and then is lifted up and out of the material.
9. Dispersibility indicates the flushing characteristics of a powder.

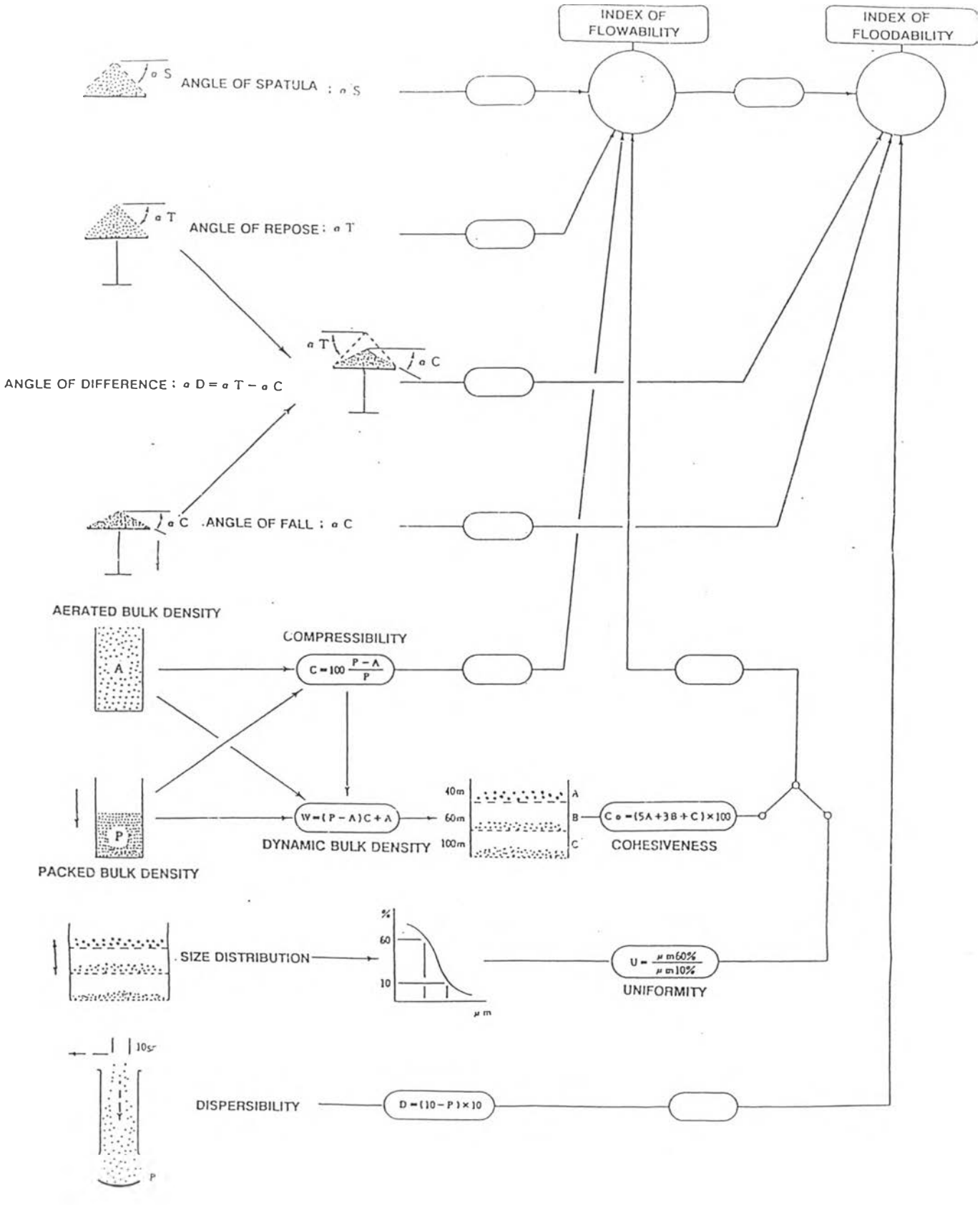


Figure 4.4 Measurement, Calculations and Indexes