Chapter I

INTRODUCTION

1.1 Agglomeration

The term agglomeration (2) describes generally the forming of a physically larger body from a number of smaller bodies, i.e, particles, such that the larger mass becomes a permanent entity but still retains the original particles in identifiable form. Particle enlargement may directly make powdered products more useful or it may make possible their further processing. For example, agglomeration is beneficially employed to facilitate the recovery of fines, to prevent the segregation of components, to secure controlled porosities, to densify to promote fluidization, and to create definite sizes and shapes.

Industrial agglomeration of fine powders to make larger, more conveniently handled pieces was practiced with coal as early as 1842 in France. Coal fines then were mixed with soft-coal tar pitch as a binder and pressed to form briquettes. Later hard-coal tar pitch softened with steam was substituted as the binder; the latter method is still employed. As a modern case in point, the utilization of low-grade iron ores depends in large measure on processes for making a suitable blast-furnace raw material from the fine-sized concentrate produced by ore-dressing methods. To be consonant with the blast-furnace requirements, this fine material must be agglomerated into a relatively coarse product that is resistant to abrasion and impact yet one that may still be reduced in the blast furnace. The three economically feasible methods that have been developed for ore-dressing are called briquetting, sintering, and nodulizing. Other process-describing terms coming under the general heading of agglomeration are: aggregation, tableting, pelletizing, extrusion, balling, spheronizing, prilling, granulation,* spray drying, coagulation, and coalescence.

There are many definitions of agglomeration (3). An example of a concise and complete definition reads as follows. Agglomeration is the process whereby several particles are caused to adhere to each other in random fashion, resulting in a porous, open structure aggregate of greater size than the original individual particle. The porous open structure and increased size are the characteristics which are responsible for the increased flowability, wettability of the aggregated product in liquids.

Another descriptive definition has been described as follows. (4). Agglomeration consists in the formation of very small individual porticles by producing adhesive film on the surface of the individual particles and then uniting multiplicities of the particles to form a lacy network. The lacy network thereby produces voids or interstices between the original particles thereby causing very rapid permeation and absorption of water or liquids and consequently rendering the product readily soluble or dispersible.

In the conventional process of aggregation or agglomeration, the particles are subjected to a stream of warm, moist air, causing moisture to be sorbed onto the surfaces of the particle to produce surface tackiness. The air stream is of sufficient velocity to cause random collisions between the particles. The surface tackiness causes such colliding particles to be bonded together and the bonds thus formed are retained when the added moisture is removed by a stream of warm dry air. In a simplified version of this basic procedure, moisture is added as a spray while the particles are being tumbled or mixed in bulk. In such a case the moisture addition

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*Probably derived from the German " granulieren " , meaning pelletizing and unfortunate in that it conflicts with the English connotation of granulation meaning grinding or reduction in size.

is nonuniform and the tumbling action continually breaks down some of the aggregates. The general method just described is often called the wetback method which was the first method of agglomeration in the food industry. In recent years, straight through processes were developed to agglomerate during the last stages of dehydration so that it would not be necessary to add back moisture for agglomeration and then redry the mixture. It is obvious that the wet back method is more practical to be employed in small industries than the straight through processes which means a large amount of investment in order to convert nearly all of the existing operations meanwhile the wet back method is applied by investing some additional devices. With the combination of fluidization techniqe (1) which renders the ease of remote control and the absence of moving parts with attendant seals, packing, etc., make the fluid-bed calcination process attractive in the disposal of liquid radioactive nuclear reactor fuel wastes(22). The fluid-bed granulation process (23) combines granulation, blending, and drying into one operation in the production of tablet granulations in the pharmaceutical industry. Advantages claimed over conventional wet granulation include good temperature control for the processing of heat-sensitive materials, less material handling, and shorter operating cycles.

1.2 Scope and objectives

To study the esteemed benefit of agglomeration, various experiments had been succeeded to fulfil individual intention as the examples shown in the next chapter. For the time being, the phenomena of agglomeration of particles by fluidization has been obtained of-which the objectives are to study the variables behaving major factors for agglomeration and the effect of fluidization to the formation of clusters of particles. The sequences of the experiment have been conducted as follows:-

1. The fluidized bed of longitudinal shape of dimension

of 5. cm. X 100 cm. was formed

2. The theory of fluidization and particulate technology have been applied to support the experiment which looked for the simple relations of factors concerning in the agglomeration of Polystyrene Foam Drops (hereinafter would be abbreviated as PFD) which played as particles to be agglomerated and gasoline the wetting agent. Gasoline would be sprayed into the fluidized gas which hereby was air at normal temperature. The fine droplets of gasoline dissolved the foam drops until it obtained the tacky surface and randomly adhered together to different sizes of clusters.

3. The variables in the experiments were :

    3.1 Size of polystyrene foam drops ranging from 2.5 mm. to 7.5 mm. in diameter.

    3.2 Rate of gasoline sprayed into the air stream.

    3.3 Rate of the feed of foam drops into the fluidized bed.

4. Through the entire experiment, the following conditions were assumed to be constant:-

    4.1 Temperature of fluidized bed.

    4.2 Density of PFD (individually was assumed constant while the bulk density of different ranges of drop sizes varied).

    4.3 Atmospheric pressure.

    4.4 Air moisture content.

    4.5 Fluidizing air rate employed for fluidizing the foam drops in the bed.

For the advantages from the experiment, it has been expected to obtain the trends of agglomeration by fluidized bed which might be more useful in the search of optimum condition of agglomeration at first and the second was to be applied with the food or pharmaceutical substances like milk powder, dye, pigment, activated carbon, etc, for the local industries. In the final it was hoped that the simple technical relations between variables make the study of agglomeration comprehensive.