

11. WEEK

GRINDING

What is Grinding?

- ▶ **Grinding; is the mechanical reduction of particle sizes of the solids.**
- ▶ **Another variation is that the particle sizes of the chemical and / or bituminous materials used in pharmacy are cut to erosion, crushing, precipitating and brought to the desired size with the aid of a number of tools.**

Advantages of the Grinding Process

- ▶ Making the particles the same size makes it easier to make the resultant miscibility
- ▶ By preparing more homogeneous mixtures, to provide precise and accurate dosing of the drug,
- ▶ By facilitating the drying process by increasing the surface area by shrinking the particles and increasing the total area of contact with the medium liquid, it is possible to increase the dissolution rate of the active substance and hence its bioavailability,

- ▶ **To adjust the dispersibility of the substances,**
- ▶ **To improve the shape and therefore the flow properties of non-uniform particles by grinding,**
- ▶ **To reduce the dissolution while increasing the compressibility by obtaining a more homogeneous mixed mass in the powder mixtures,**
- ▶ **After preparing the semi-solid preparations, it is necessary to obtain a more homogeneous appearance and increase the physical stability by passing through suitable mills,**

- ▶ **To prevent obstruction of the injector and tear powders used in parenteral and ophthalmic preparations,**
- ▶ **In inhalation aerosols, it is also important to determine in which region the bronchopulmonary system, especially the active substance,**

Disadvantages of the Grinding Process

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- ▶ During milling, the active substance can be transformed into an inactive and unstable polymorphic form.
- ▶ Depending on the increase in surface area, the particles can absorb moisture from the environment.
- ▶ When the particles are very fine dust, the amount of free energy in the surface increases and accordingly aggregate formation can be observed.

Theories of Grinding

- ▶ There are three basic theories that calculate the energy (E) that must be applied for the reduction of a grain:
 1. **Kick Hypothesis**
 2. **Rittinger Hypothesis**
 3. **Bond Hypothesis**

- ▶ Using these 3 hypotheses, the net energy amount required to grind the particles is reached.
- ▶ However, the Rittinger hypothesis did not take into account the deformation of the particles before grinding.
- ▶ For this reason, using these 3 hypotheses, a concept called "work index" has been developed by BOND to obtain information about the grinding energy and the performance of the tools.

Work Index (E_i)

- ▶ It is the energy required to grind 80% of a powder material in a certain weight and endless particle size to pass through a 100 μm sieve.

$$E_i = E \times \left[\frac{\sqrt{D_1}}{\sqrt{D_1} - \sqrt{D_2}} \right] \times \left(\frac{\sqrt{D_2}}{100} \right)$$

Technologies of Grinding

- ▶ Tools used in grinding generally can be classified according to the size of the particles to be grinded as follows:
 1. Rough Grinding Millers
 2. Medium Size Grinding Millers
 3. Grinders Grinding Thin Size