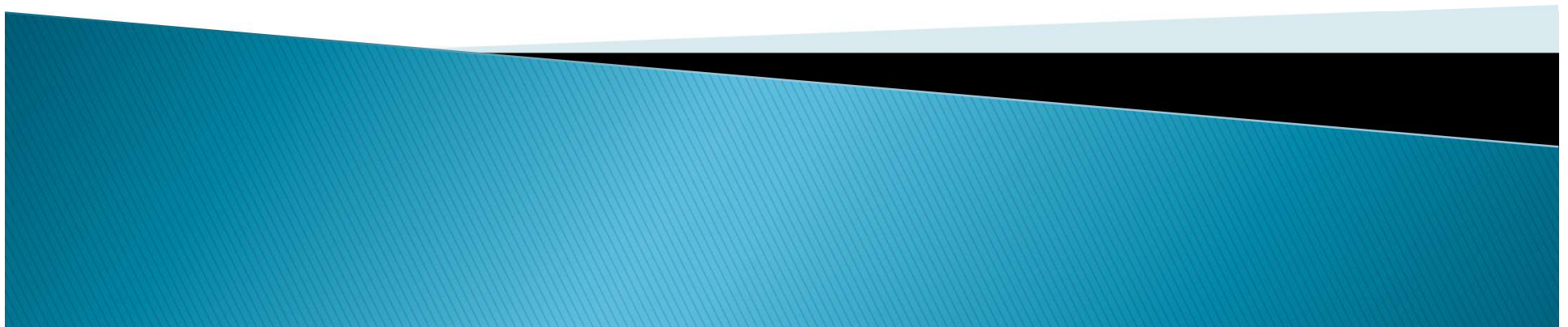


FDE 205 FLUID MECHANICS

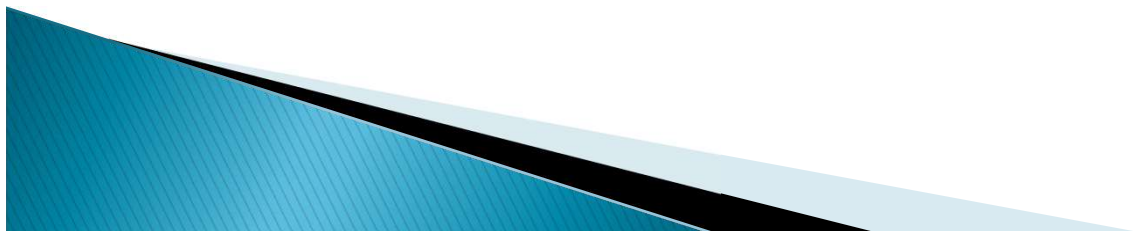


Chapter 3. Principles of Momentum Transfer and Applications

1) FLOW PAST IMMERSED OBJECTS

2) FLOW IN PACKED BEDS

3) FLOW IN FLUIDIZED BEDS



FLOW IN FLUIDIZED BEDS

Fluidized bed can be defined as a bed of small solid particles suspended and kept in motion by an upward flow of a fluid

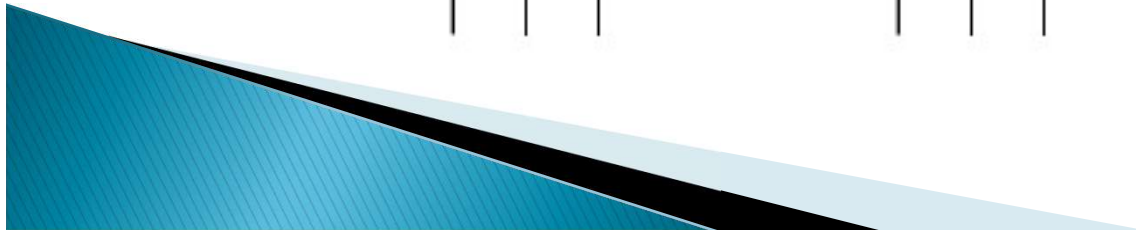
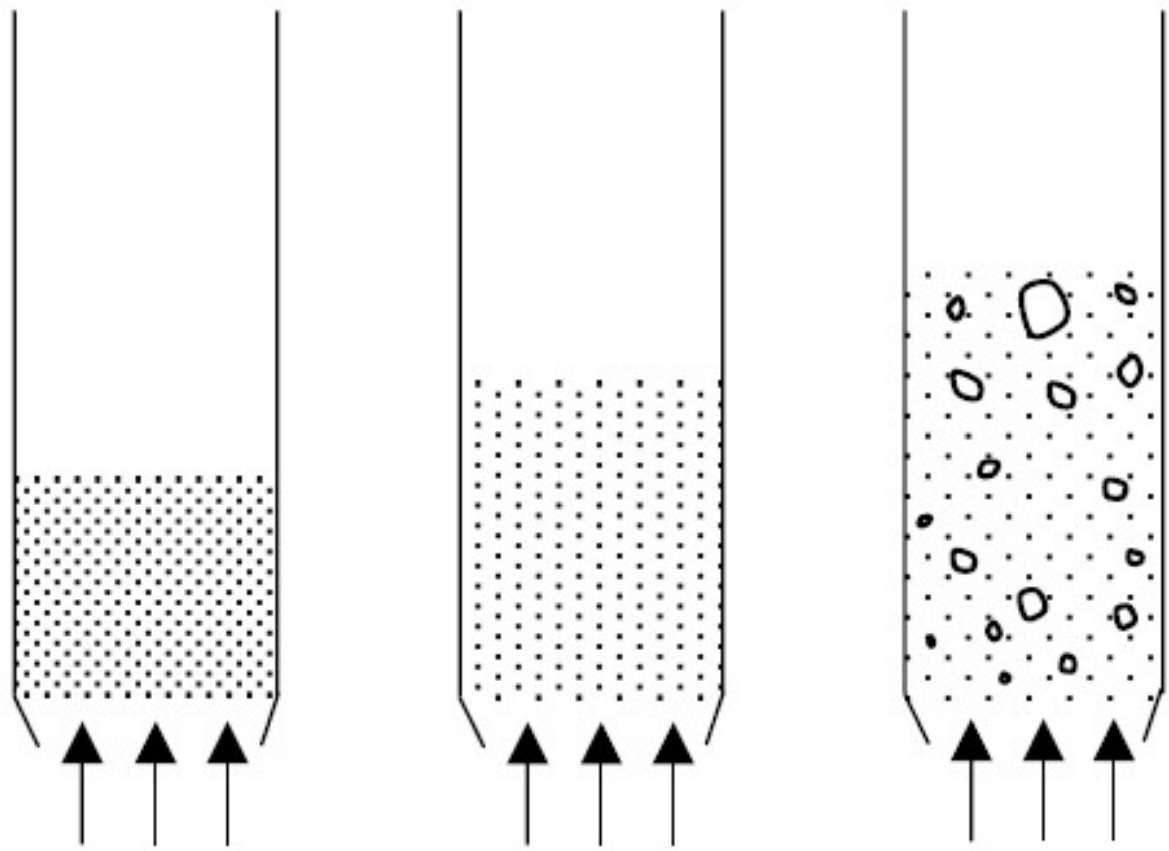
(Akışkan yatak, belli boyutlardaki katı taneciklerin akışkan gibi davrandıkları duruma verilen isimdir. Bu durumda katılar akışkan karakteristiği göstermeye başlar.)

In a packed bed of small particles, when a fluid enters at sufficient velocity from the bottom and passes up through the particles, the particles are pushed upward and the bed expands and becomes fluidized.

Küçük taneciklerden oluşan bir dolgulu yatakta, bir akışkan yeterli bir hızda tabandan girip tanecikler arasından yukarıya doğru aktığında, tanecikler yukarıya doğru itilir, yatak genişler ve akışkanlaşmış olur.

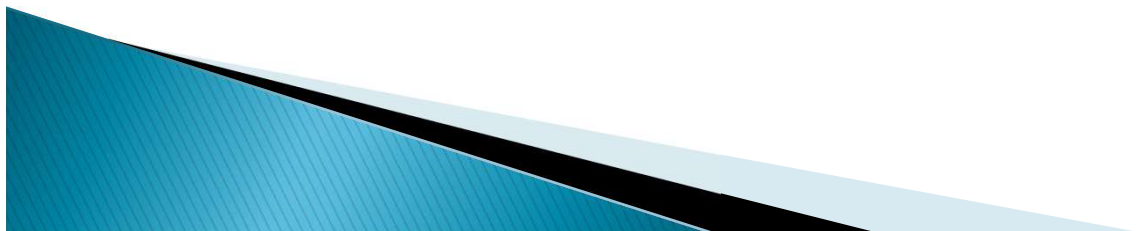
- ▶ When a fluid flows upward through a packed bed of particles at low velocities, the particles remain stationary.
- ▶ As the fluid velocity is increased, the pressure drop increases according to the Ergun Equation. Upon further increases in velocity, conditions finally occur where the force of the pressure drop times the cross-sectional area equals the gravitational force on the mass of the particles. Then the particles began to move.
- ▶ And this is the onset of fluidization.
- ▶ The fluid velocity at which the fluidization begins is the **minimum fluidization velocity** (**minimum akışkanlaşma hızı**) (v'_{mf})





Applications of Fluidized beds

- ▶ For a better contact between gas and solid phases
- ▶ Combustion technologies to obtain high combustion efficiency
- ▶ Production of hot water, steam and hot gas in industry
- ▶ Chemical reactions in reactors.
- ▶ Especially drying and freezing in food industry.



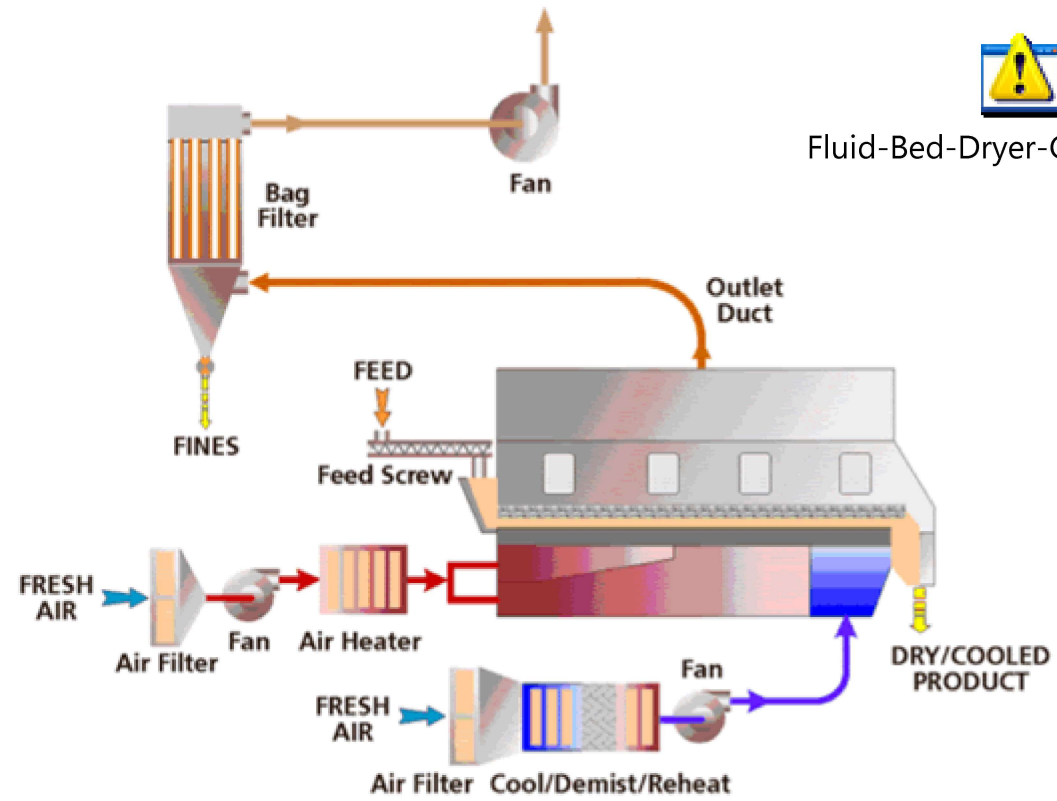
FLUIDIZED BED DRIERS

- ▶ Bisküvi Unu
- ▶ Hububatlar
- ▶ Rendelenmiş Kökler
- ▶ Bitki Ve Hayvan Özleri
- ▶ İnce Parçalanmış Patates
- ▶ Sakaroz
- ▶ Buğday Unu
- ▶ Jelâtin
- ▶ Çay
- ▶ Kahve
- ▶ Soya
- ▶ Kahve
- ▶ Süt Şekeri
- ▶ Dekstroz
- ▶ Kalsiyum Karbonat Ve

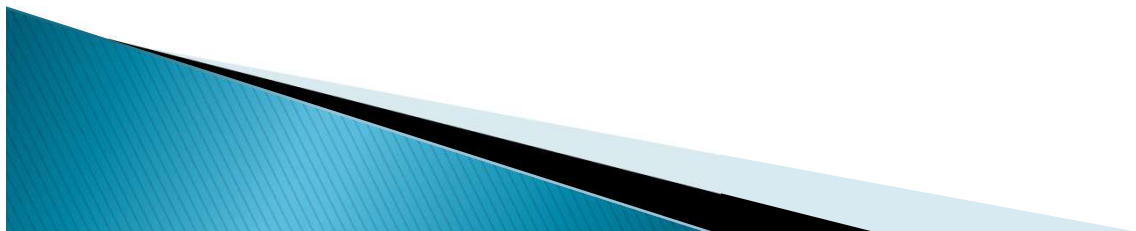
Bikarbonat
Süt Tozu
Diyatomit
Şeker
Doğal Otlar
Laktoz Granülleri
Tahıllar
Ekmek Kırıntısı
Meyan Kökü
Tohum
Fındık
Nişasta
Toz Ve Granül Baharat
Filizlenmiş Arpa
Otlar Ve Baharatlar
Tuz

Früktoz
Tütün
Gdl
Pektin Tozu
Un
Vitamin A
Gıda Katkı
Maddeleri
Pirinç
Vitamin C
Gıda Koruyucu
Maddeleri
Protein Tozları
Yer Elması
Havuç
Yer Fıstığı





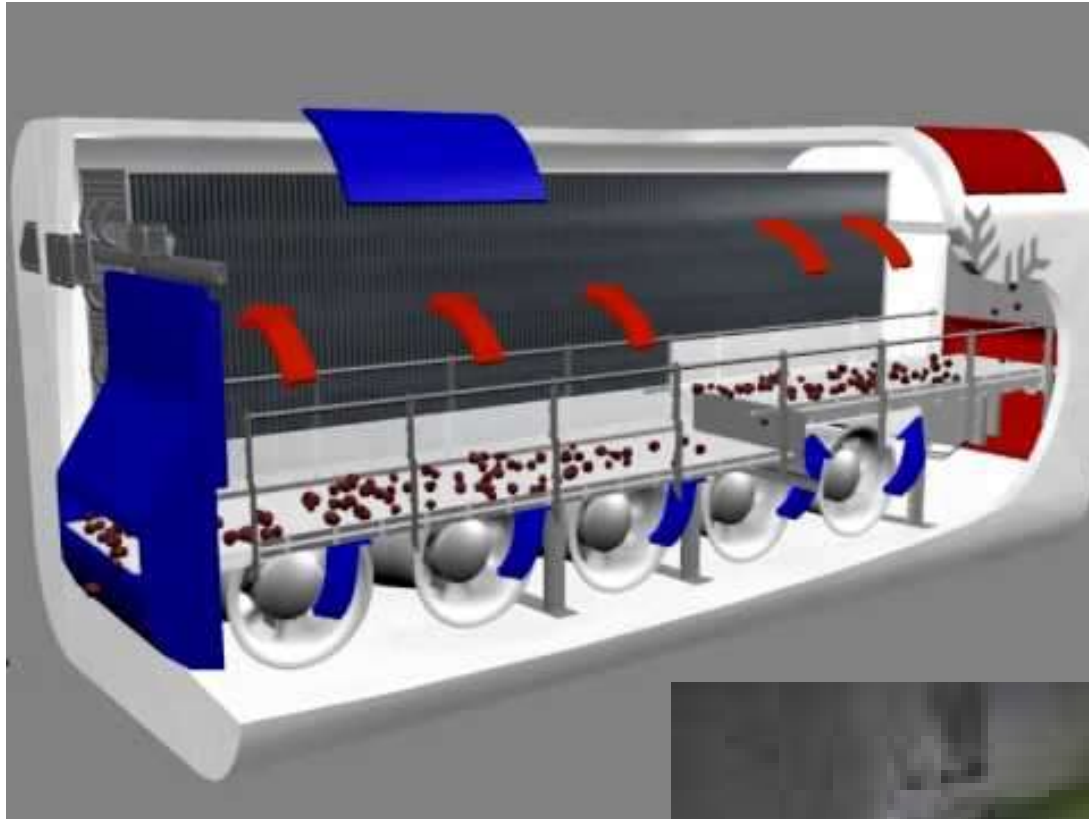
Fluid-Bed-Dryer-GEA-Niro.exe



IQF Freezers

- ▶ Fluidized bed are used in IQF (Individually Quick Frozen) freezers.
- ▶ Pea, shrimp, small vegetables and fruits
- ▶ The freezing operation is faster with IQF freezers. ($-30, -40^{\circ}\text{C}$)





- ▶ <http://www.youtube.com/profile?user=octofrost#p/u/3/ZS54Jtwl1UU>



Example 3.1–6

- ▶ Solid particles having a size of 0.12mm, a shape factor of 0.88 and a density of 1000 kg/m³ are to be fluidized using air at 2.0 atm abs and 25 °C. The voidage at minimum fluidizing condition is 0.42.
- A) If the cross section of the empty bed is 0.30 m² and the bed contains 300 kg of solids, calculate the min. height of the fluidized bed.
- B) Calculate the pressure drop at minimum fluidizing conditions
- C) Calculate the minimum velocity for fluidization.



Example

- ▶ A fluidized bed contains ceramic spheres with a diameter of 1 inch and density of 162 lbm/ft³. Both the diameter and the height of the bed is 2 ft. The fluid (water) is flowing at minimum fluidization velocity.
 - a) If ϵ_{mf} is 0.35, calculate v'_{mf}
 - b) Calculate the pressure drop in the bed.

