

Unit 2

Topic 1 – Classification of size reduction equipments

Size Reduction in Food Technology

1. Definition

Size reduction in food technology refers to the **process of breaking down larger food particles into smaller, uniform sizes** using mechanical forces such as **compression, impact, shear, and attrition**. This process is essential for improving food texture, solubility, and processing efficiency in various food products.

2. Importance of Size Reduction in the Food Industry

- ✓ **Enhances Surface Area:** Increases the exposure of food particles for better **mixing, extraction, and reaction rates** (e.g., **spice grinding**).
- ✓ **Improves Texture & Consistency:** Ensures **uniform particle size** in products like flour, sugar, and powdered spices.
- ✓ **Facilitates Further Processing:** Reduces processing time in **drying, cooking, and extrusion**.
- ✓ **Enhances Solubility & Dissolution:** Useful in **instant food powders** like coffee and soup mixes.
- ✓ **Improves Shelf Life:** Helps in **reducing moisture content**, preventing microbial growth.
- ✓ **Aids in Efficient Packaging & Transport:** Fine powders and uniform granules improve **packing density and handling**.

3. Principles of Size Reduction

Size reduction in food technology is based on four major **mechanical forces**:

Force	Working Mechanism	Examples of Equipment
Compression	Material is crushed between two surfaces.	Jaw Crusher, Roller Mill
Impact	Sudden force applied to break particles.	Hammer Mill, Ball Mill
Shear (Cutting)	Material is sliced using sharp blades.	Knife Cutter, Dicing Machine
Attrition (Rubbing)	Material is ground by friction.	Burr Mill, Roller Mill

4. Equipment Used for Size Reduction in Food Processing

Size reduction equipment is classified into different categories based on their **working mechanism**:

Category	Examples	Used for Processing
Crushers	Jaw Crusher, Gyratory Crusher	Hard materials like grains, seeds
Grinding Mills	Hammer Mill, Ball Mill, Rod Mill	Spices, grains, pulses, cocoa
Fine Grinders	Pulverizers	Sugar, flour, instant food powders
Cutting Machines	Knife Cutter, Dicing Machine	Fruits, vegetables, meat
Milling Machines	Roller Mill, Burr Mill	Wheat flour, rice flour

Classification of Size Reduction Machines in the Food Industry

Size reduction machines in the food industry are categorized based on their **mechanical action** and **type of food material processed**. Below is a detailed comparison of different size reduction machines.



1. Based on Working Principle

Machine Type	Principle	Force Applied	Examples
Crushers	Crushing large food particles into smaller chunks	Compression	Jaw Crusher, Gyratory Crusher
Grinding Mills	Reducing food particles to powder or fine granules	Impact, Attrition	Hammer Mill, Ball Mill, Rod Mill
Fine Grinders (Pulverizers)	Producing ultra-fine powders	High-speed Impact	Pin Mill, Air Classifier Mill
Cutting Machines	Cutting food into slices or cubes	Shear (Cutting)	Knife Cutter, Dicing Machine, Hacksaw Mill
Milling Machines (Attrition Mills)	Reducing size using friction and compression	Compression, Shear	Roller Mill, Burr Mill

2. Based on Food Material Processed

Machine Type	Best for Processing	Common Food Products
Crushers	Hard, coarse materials	Grains, nuts, dried fruits
Grinding Mills	Medium to fine powders	Spices (turmeric, chili), pulses, coffee
Fine Grinders (Pulverizers)	Ultra-fine powders	Sugar, flour, milk powder
Cutting Machines	Soft and fibrous foods	Vegetables, meat, cheese
Milling Machines	Granular food processing	Wheat flour, rice flour

3. Based on Advantages and Disadvantages

Machine Type	Advantages	Disadvantages
Crushers	Simple operation, durable	Produces uneven particle sizes
Grinding Mills	Produces fine powders, high efficiency	High energy consumption, heat generation
Fine Grinders (Pulverizers)	Ultra-fine grinding, high-speed operation	Loss of volatile compounds, expensive
Cutting Machines	Uniform size reduction, minimal heat	Limited to fibrous foods, not suitable for powders
Milling Machines	Produces smooth granules, good texture	Requires frequent maintenance

4. Based on Energy Requirement & Cost

Machine Type	Energy Consumption	Equipment Cost
Crushers	Low	Moderate
Grinding Mills	High	High
Fine Grinders (Pulverizers)	Very High	Expensive
Cutting Machines	Low	Moderate
Milling Machines	Medium	High

5. Applications of Size Reduction in Food Processing

Size reduction is used in various food industries for processing different products:

Food Product	Application
Flour & Starches	Milling wheat, rice, and corn into fine powders.
Spices	Grinding chili, turmeric, and pepper for seasoning.
Sugar Processing	Making powdered sugar for bakery and confectionery.
Dairy Industry	Pulverizing milk powder and cocoa powder.
Instant Foods	Processing coffee, tea, and soup powders.
Meat & Vegetables	Cutting and dicing for ready-to-cook meals.

The selection of a size reduction machine depends on food material properties, desired particle size, energy efficiency, and processing cost.