

# **Industrial Pharmacy**

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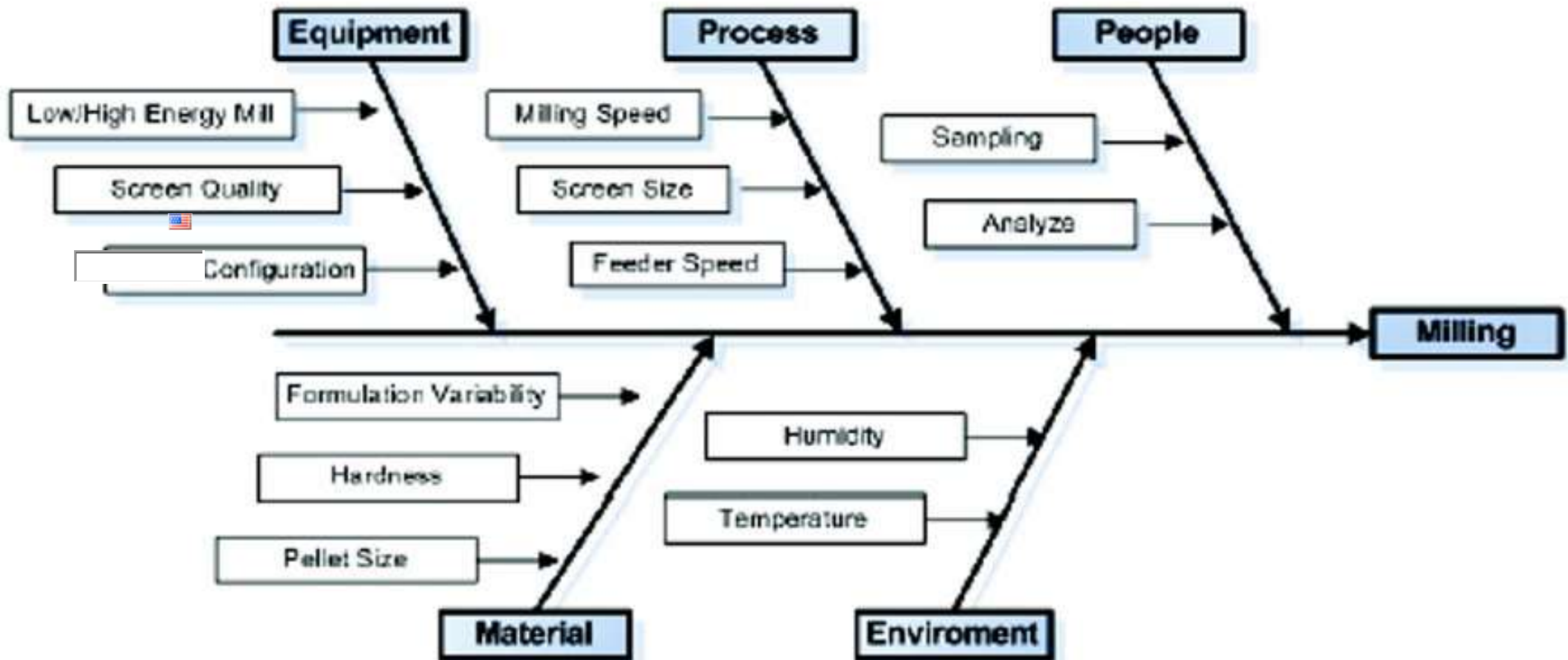
## Milling Science

- **Size reduction is one of the most common unit operations for both active pharmaceutical ingredient (API) and drug product manufacturing. The resulting particle size distribution (PSD), in most cases, is believed to have great impact on bioavailability and/or downstream processes. However, the fundamental understanding of the process is still limited.**

- **Size reduction is a common technique used in various industries.**
- **Generally, size reduction and size separation are combined to obtain powder with the desired particle size distribution (PSD) for acceptable flow and compressibility for downstream processing.**
- **Impact on solubility, mixing, bioavailability, etc.....**

- **The mechanical process of reducing the particle size of a solid is also called milling.**
- **Among different types of milling equipment, high energy mills (such as impact mill) and low energy mills (such as screen mills) are frequently used in pharmaceutical manufacturing.**
- **In general, the lower energy mill is mainly used for de-agglomeration purposes**

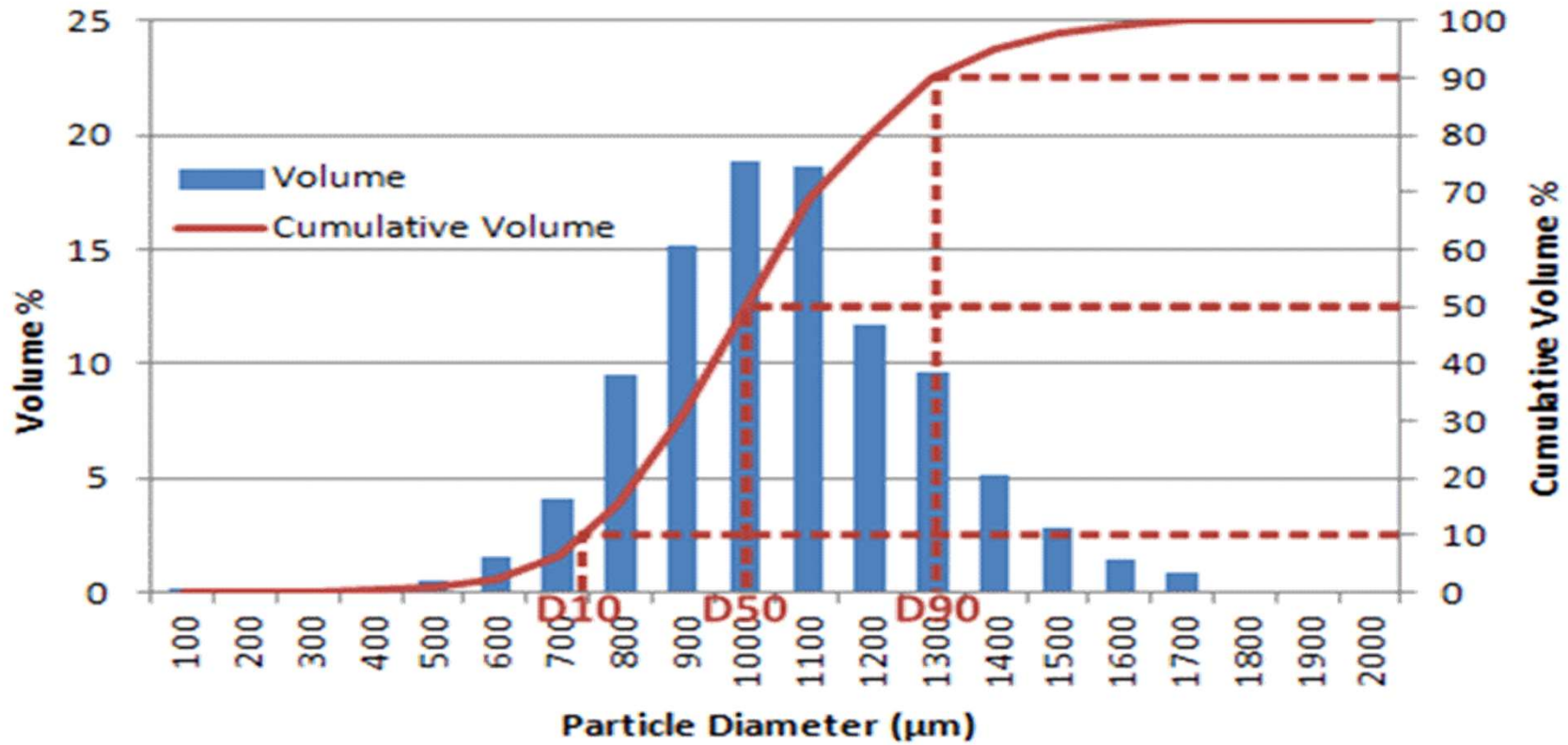
# Milling fish bone



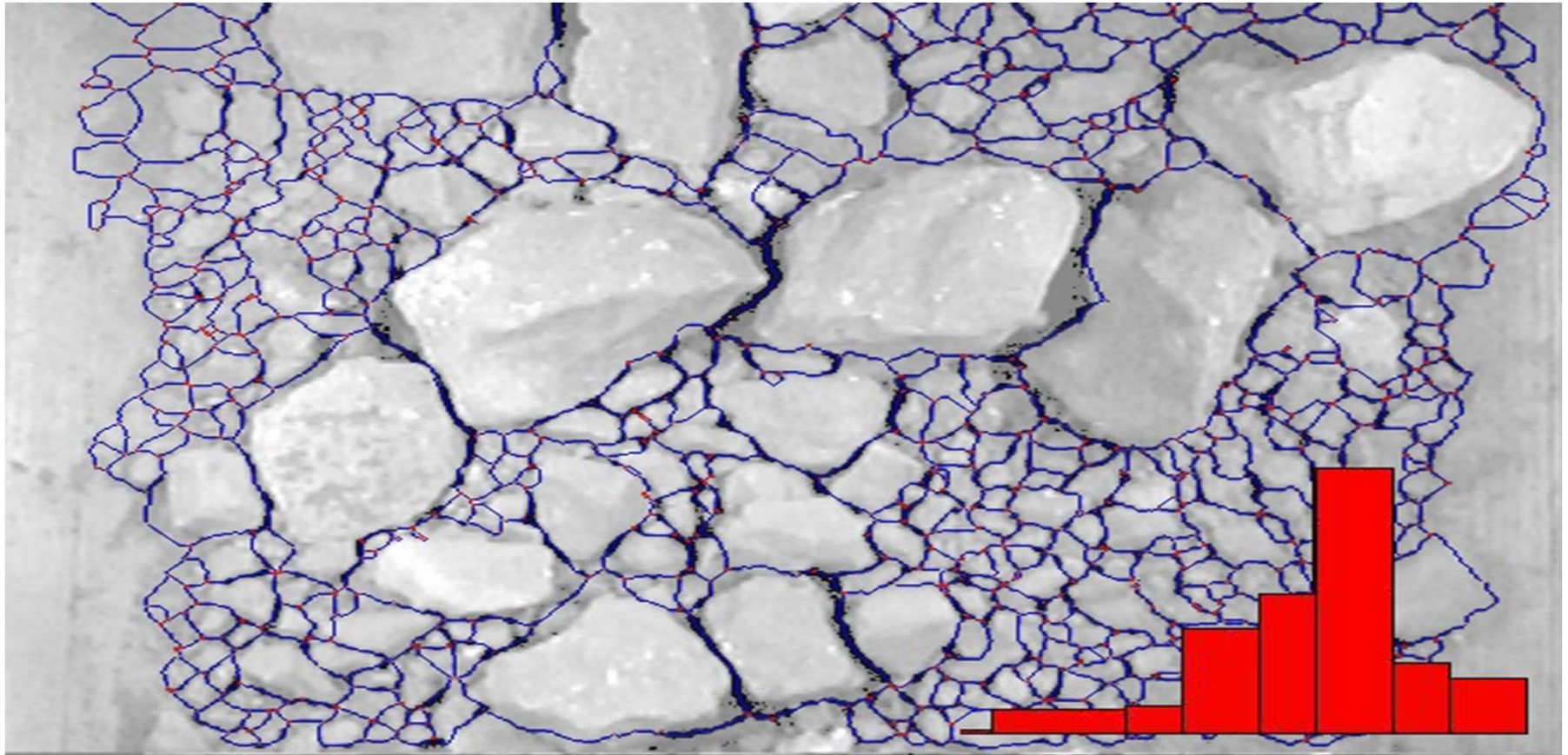
- **Size reduction in pharmaceutical processes is used to increase surface area and improve formulation dissolution properties.**
- **It is also used to maintain a consistent average particle size distribution (PSD) for the formulation, thus allowing for a better quality mixture when creating solid dosage forms such as tablets and capsules.**

**Conventional dry size reduction in the pharmaceutical industry is accomplished by impact.**

# Particle size distribution (PSD)

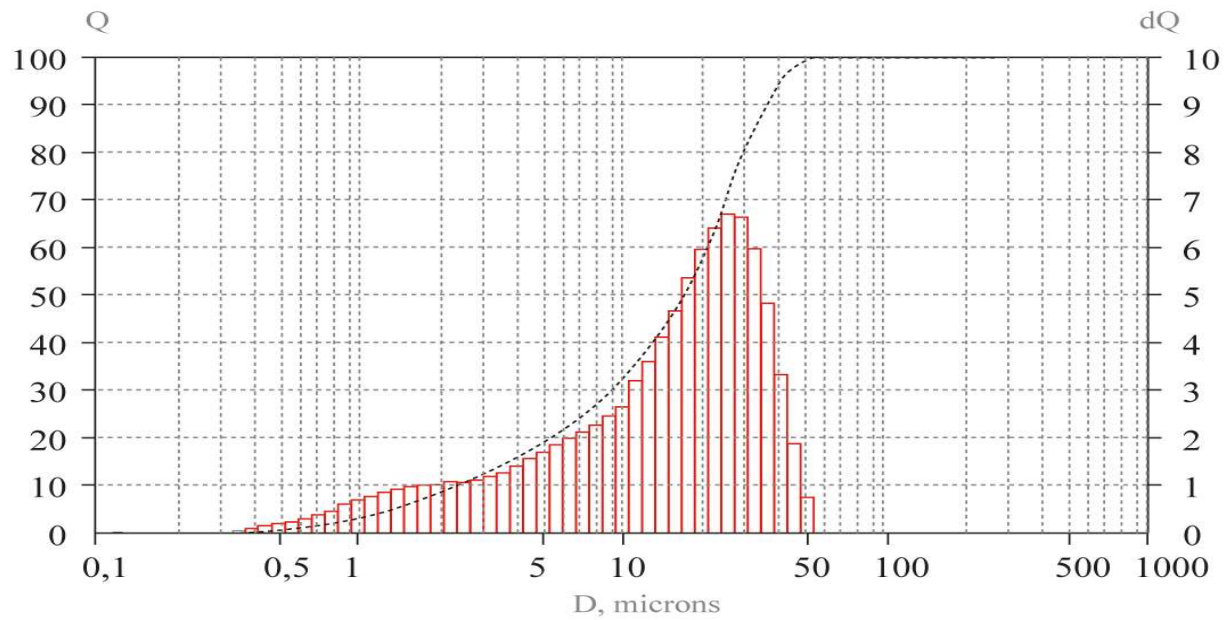


# Bad distribution



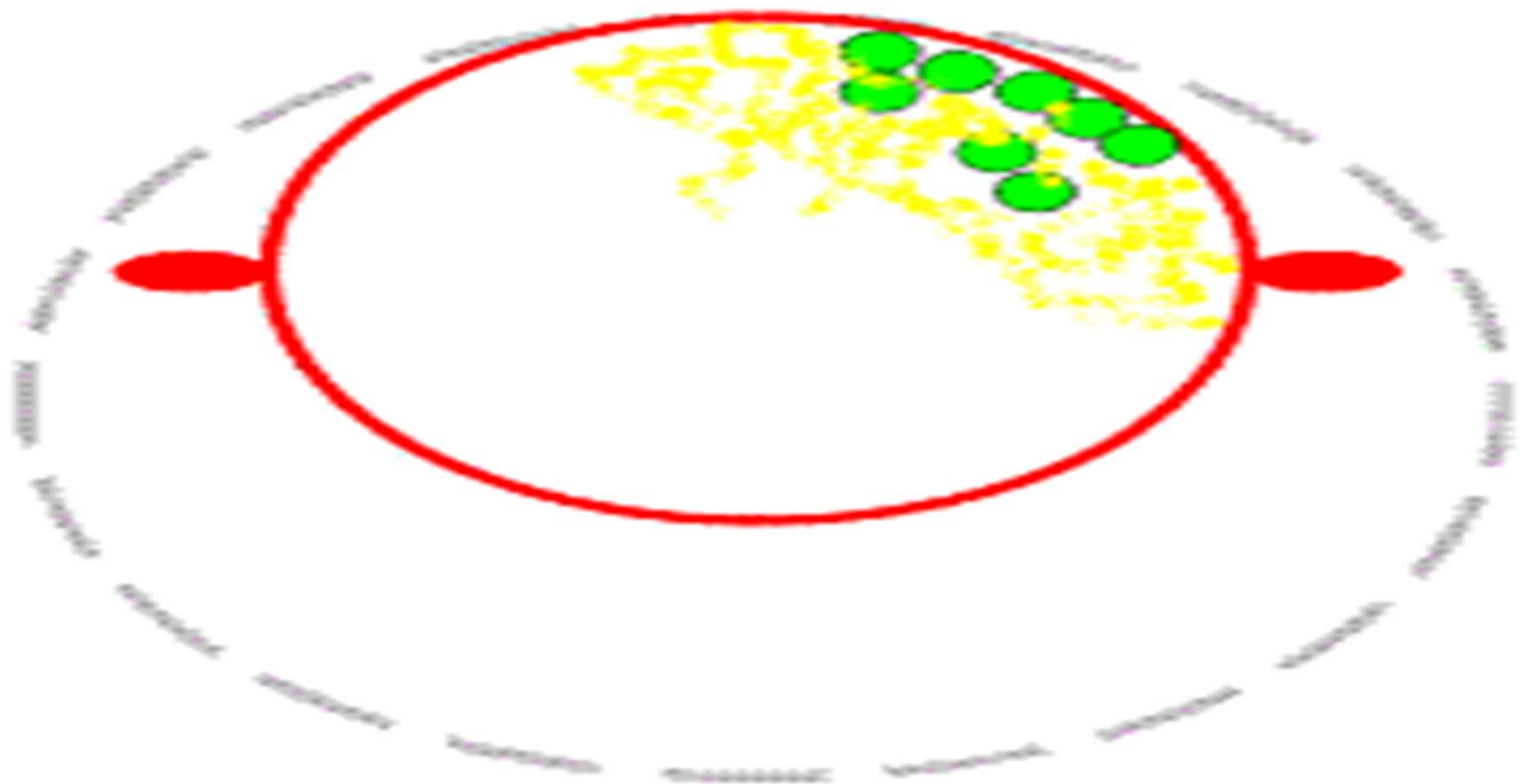


# Example for bad distribution



# Ball Mill





# Sieves





# Jaw Crushers

- **Jaw crushers consist of a rectangular frame with a fixed jaw plate and a jaw stock carrying the moving jaw. The moving jaw swings toward the fixed jaw in the forward stroke, material is crushed, and discharge takes place during the backward or freeing stroke. The jaw crusher pictured below can be used to crush items from large objects such as demolition debris or broken concrete to smaller objects such as asphalt or river rock.**

# PULVERIZERS

- **Pulverizers, also known as fluid energy mills, are used for fine grinding and close particle size control. They are primarily used when contamination-free products are desired.**

## **ADVANTAGES**

- Air needed is free.
  - Large range of sizes available.
  - Homogeneous blend.
- Pulverizers are commonly used for chemicals, pigments and food processing. The microscale air impact pulverizer is used in laboratories, where small samples are needed.

## **DISADVANTAGES**

- Energy consuming



- **ATTRITION MILLS**

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**Size reduction in attrition mills occurs through the scraping of one surface against another. Particles scrape against each other or against a rigid face.**

**ADVANTAGES**

- **Finely ground products.**
- **Large range of sizes available.**

**DISADVANTAGES**

- **Energy consuming.**
- **Needs specific input size.**

# Attrition Milling

