



Basic Feed Manufacturing Overview

Carlos Campabadal, Ph.D. – Kansas State University



**EXCELLENCE
CENTER**

A  **SOY** program

Learning Objectives

- Understand the current world feed manufacturing industry.
- Understand how the feed manufacturing connects to the food value chain.
- Understand the basic feed manufacturing process.

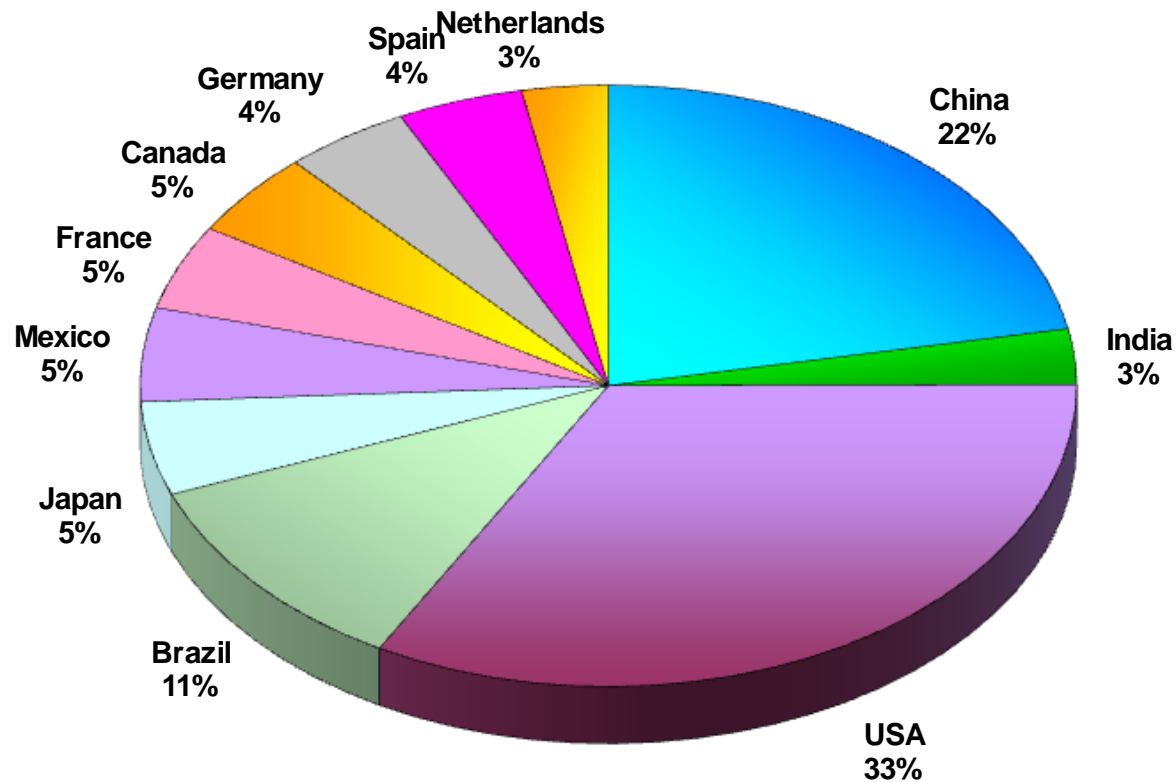
Introduction

- Production of animal and fish feed requires several important processing and quality control steps
- Quality feed ingredients will produce quality feed
- Each step-in feed manufacturing uses specific equipment in each of its processes

World Feed Industry

- World population and GDP growth driving meat consumption, more meat means more grain ... feed demand and animal feed supplements are rising
- Global customers have greater buying power and feed grain raw material prices have been favorable ... but changes are in store for the global poultry and livestock industry ... the result of the boom in ethanol and biodiesel production.
- Health and Food Safety concerns are putting pressure on better quality feed ingredients
- There is growing concern with environmental issues in animal agriculture

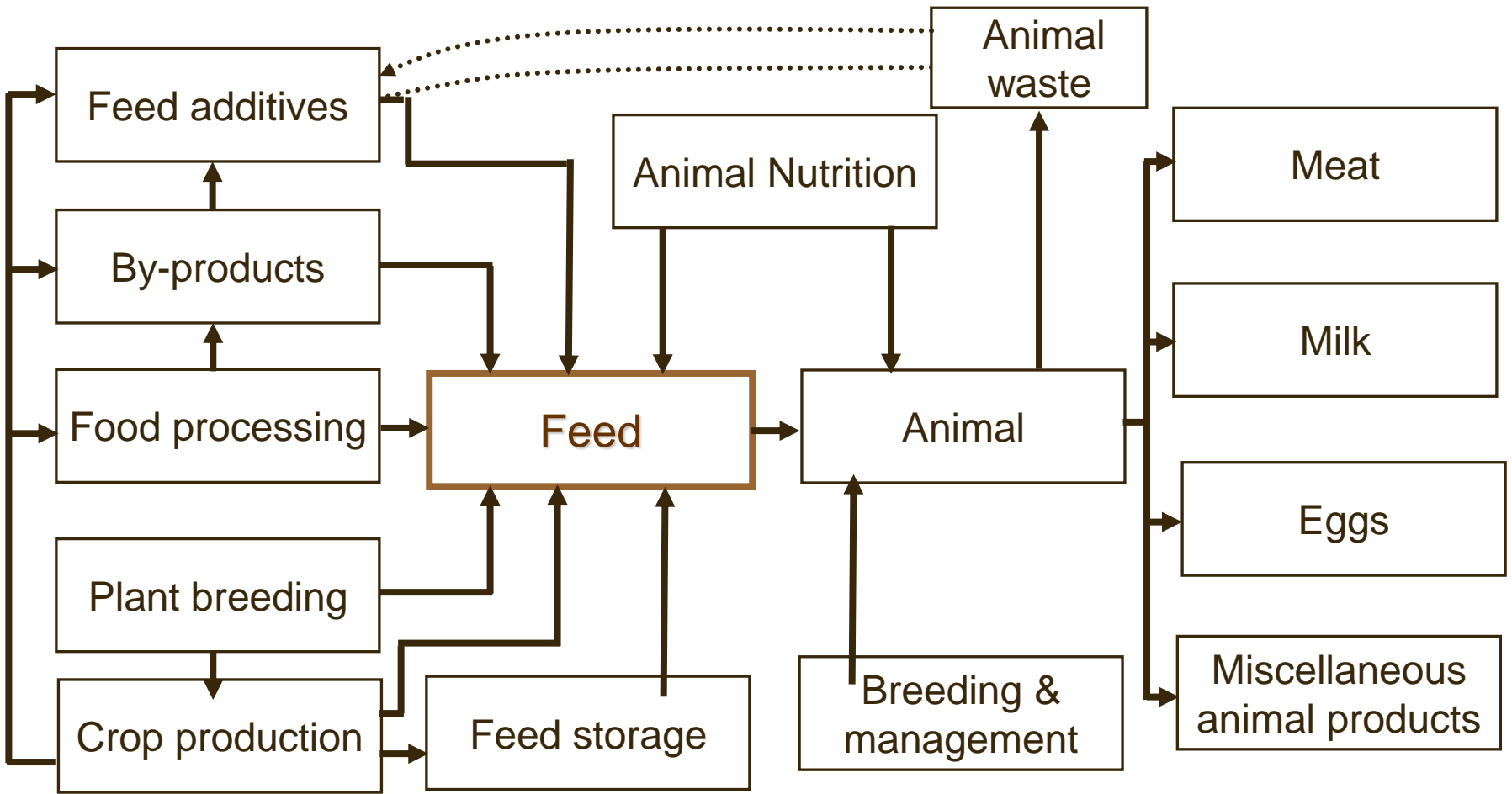
Global Feed Industry Production Leading Countries



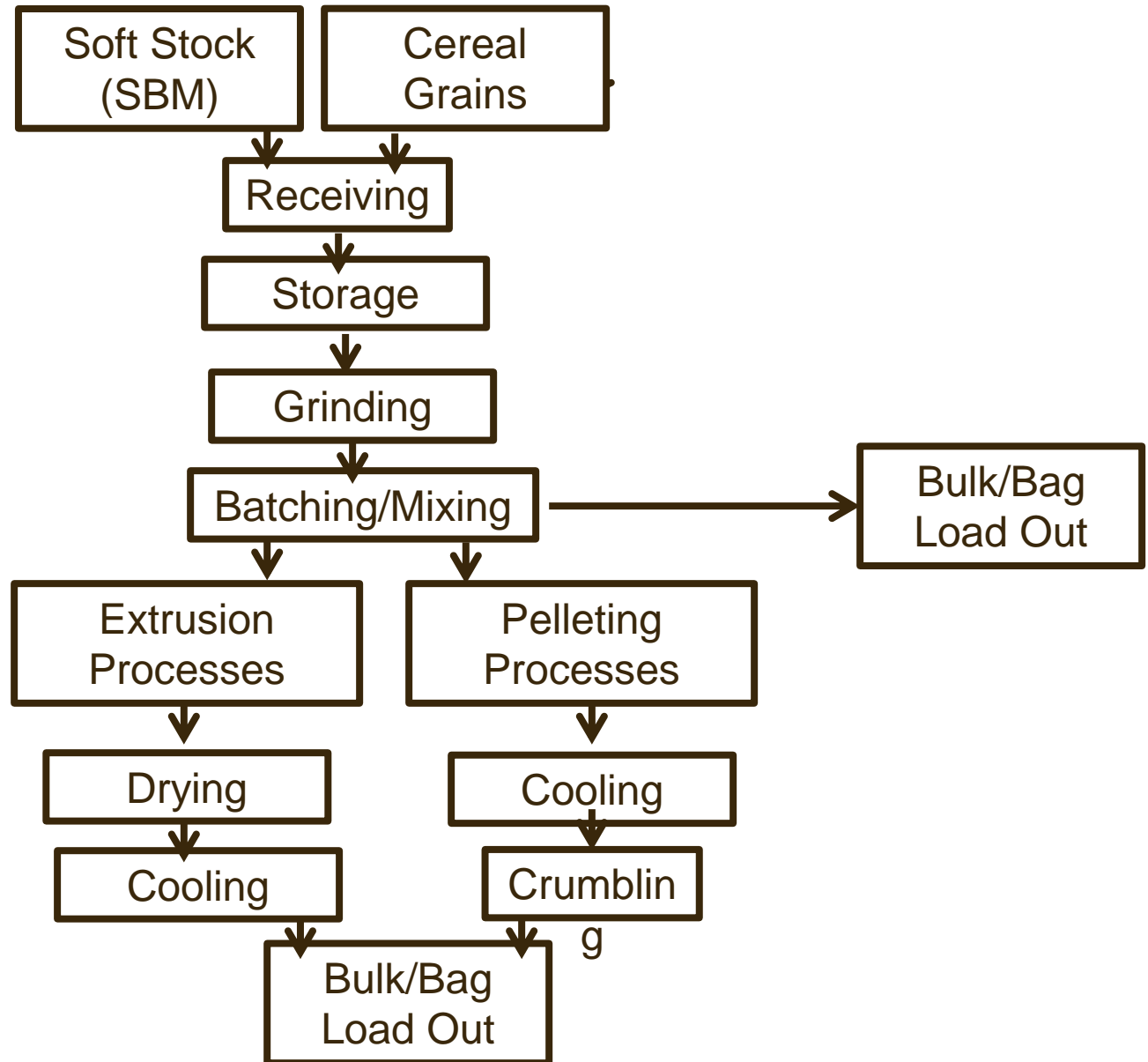
Objective of Manufacturing Feed

- Fulfill nutritional-physiological requirements
- Competitive price (\$/lb or \$/kg feed)
- Profitable cost level (\$/ lb or \$/kg meat)
- Fulfill statutory demands
- Fulfill regulations
- Control, reduce or eliminate potential hazards associated with feed

Connection of Agriculture to the Human Food Chain



Animal Feed Processing

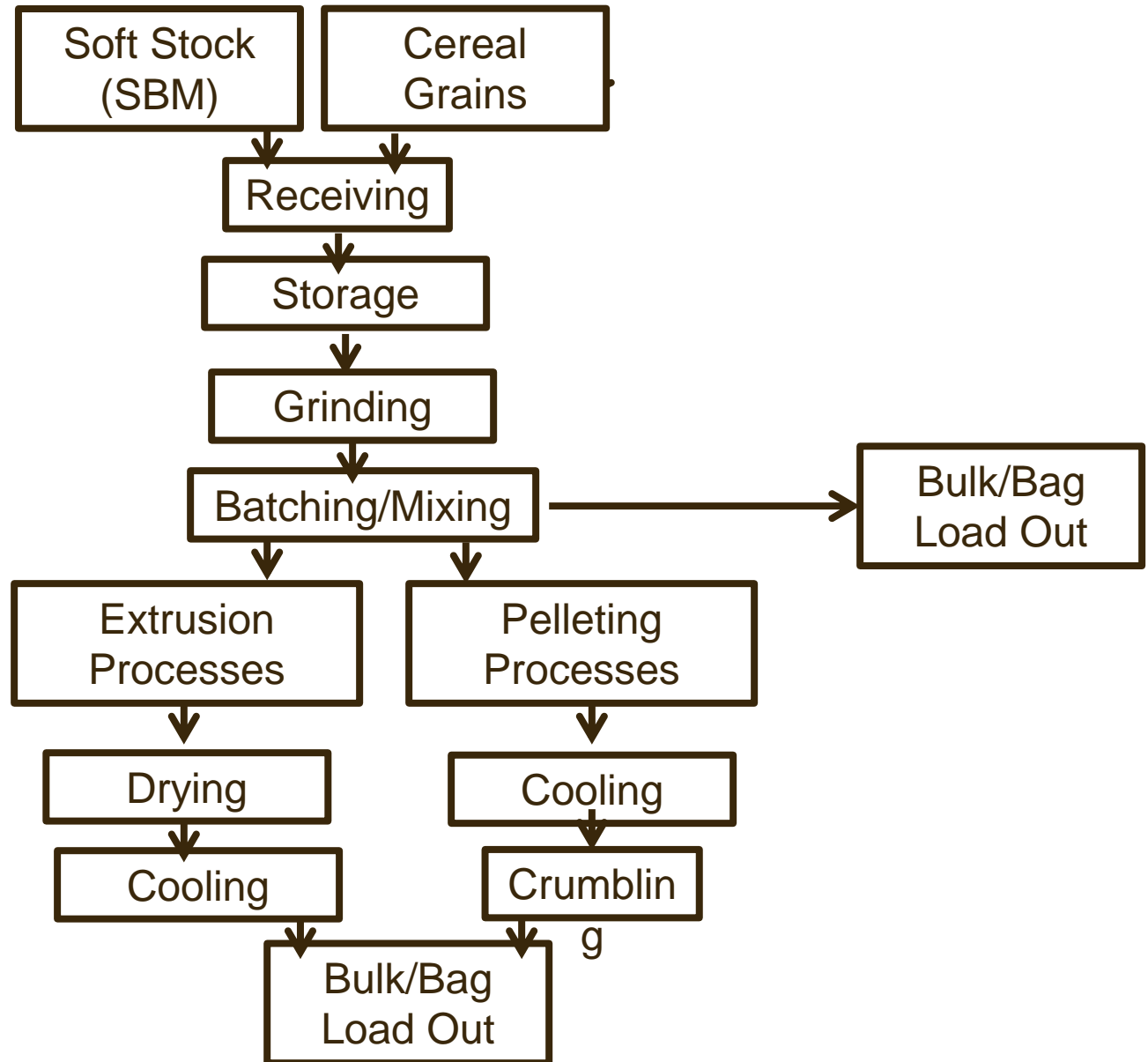




Business Objectives in Feed Manufacturing

- Commercial feed mills
 - Sell feed for profit
 - Customer service
- Integrated feed mills
 - Delivery nutrients to animals for optimal performance or meat production
 - Low cost high volume
- On-farm
 - Utilize grain grown on the farm to raise animals
 - Minimize feed input costs

Animal Feed Processing



Ingredients

- **Cereal Grains:**

- Corn
- Sorghum
- Wheat
- Barley

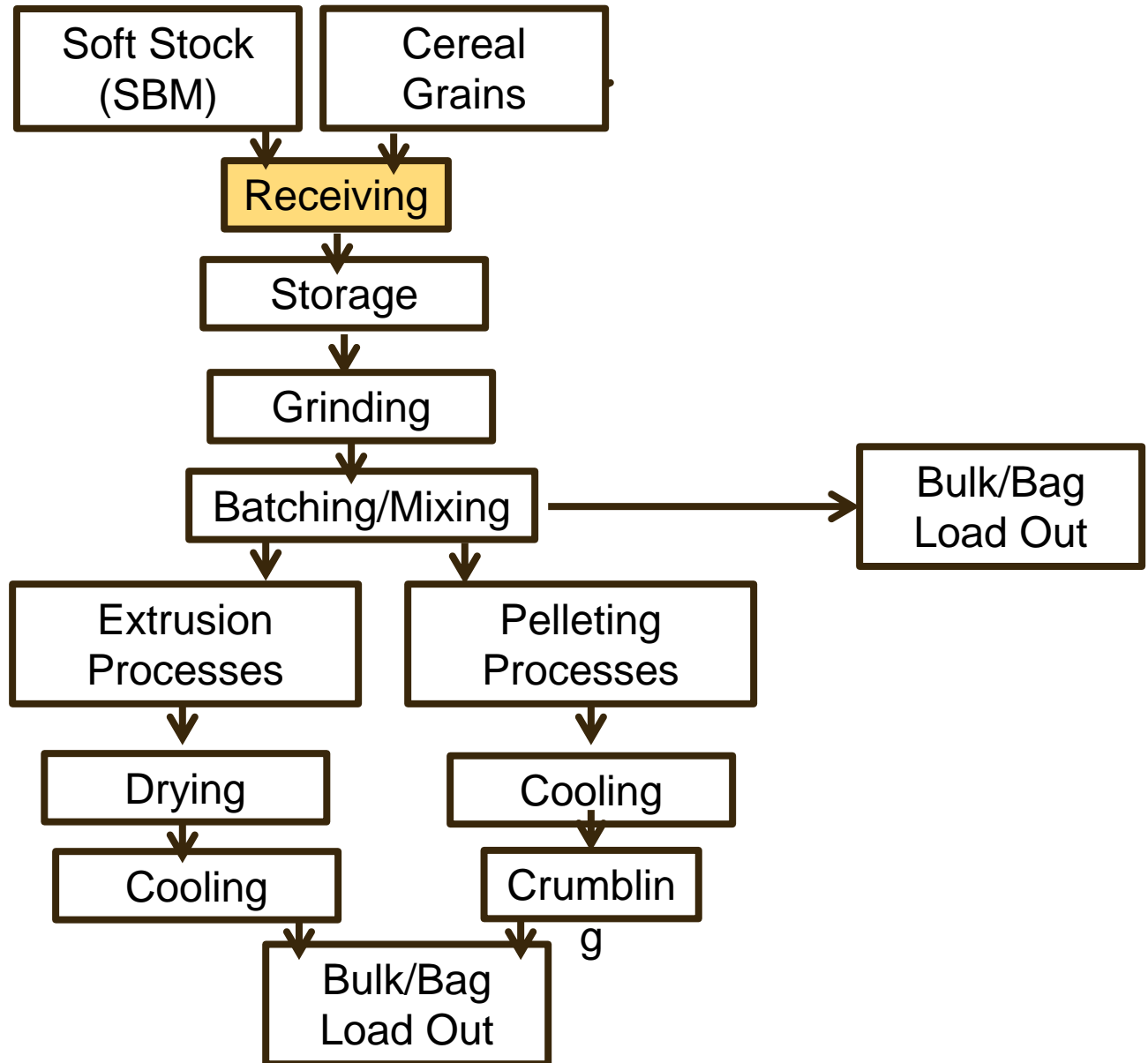


- **Soft Stock:**

- SBM
- Animal Protein (Fish Meal)
- Calcium
- Salt



Animal Feed Processing



Ingredient Receiving

- Ingredient receiving in bag
 - Additives
 - Fish Meal, SBM
- Ingredient receiving in bulk or bags
 - Cereal, soft stocks



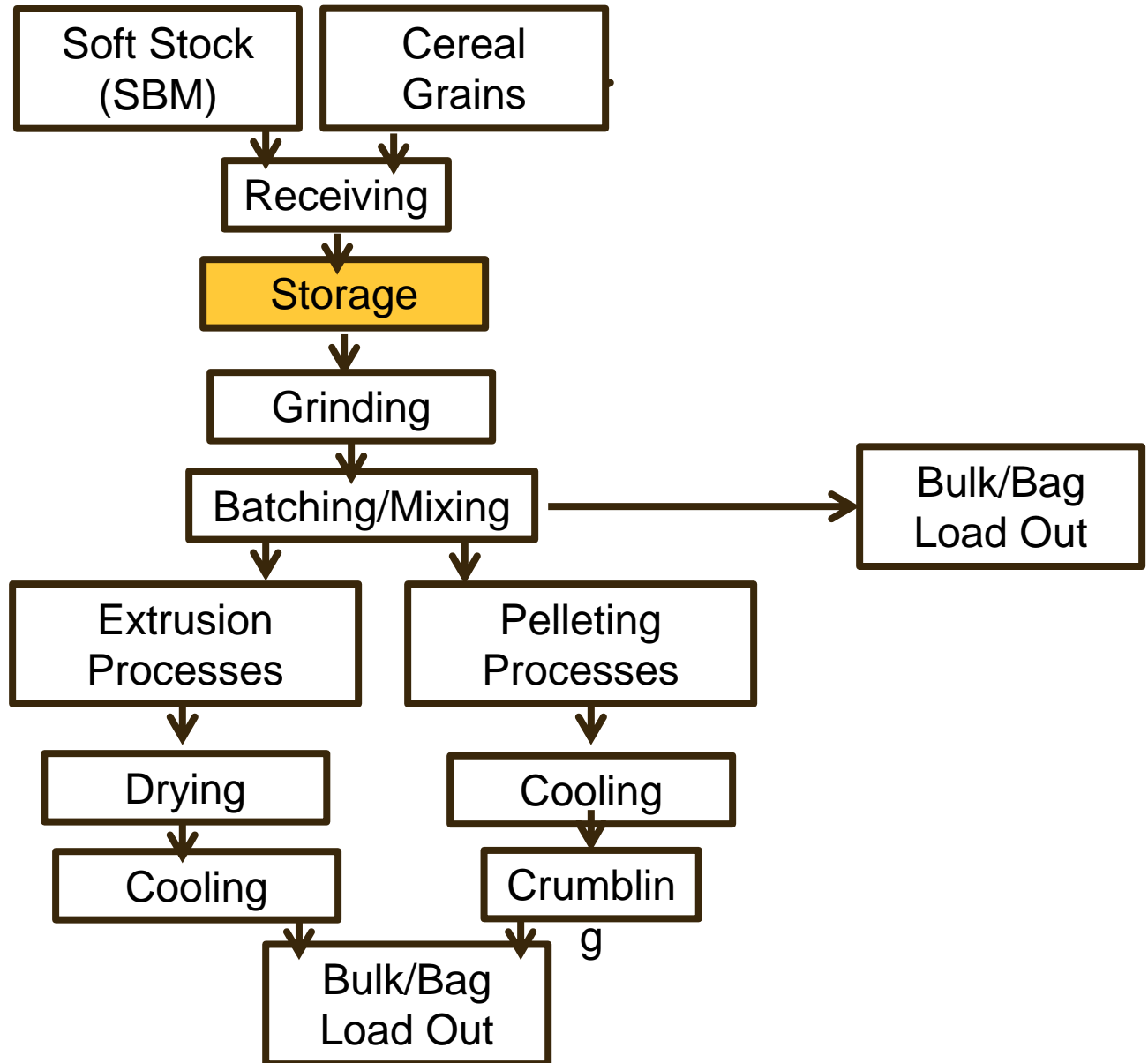
INGREDIENT ASSAY TABLE

Ingredient	Protein	Moisture	Fat	Fiber	Calcium	Phosphorous	Sodium	Magnesium	Aflatoxin	Pepsin Digest	Urease	Microscopic	M.I.U.*	Brix	Frequency**
Corn	X	X							X						W
Cereal Grain	X	X													W
Soybean Meal	X	X		X							X				E
Middlings	X	X		X											W
Alfalfa	X			X											W
Rice Mill Feed	X		X	X											W
Corn Gluten Feed	X														E
Corn Gluten Meal	X														E
Fish Meal	X		X		X	X	X	X		X		X			E
Meat/Bone Meal	X	X	X		X	X	X			X		X			E
Poultry Meal	X	X	X		X	X	X			X		X			E
Peanut Meal	X	X		X					X						E
Peanut Hulls	X			X					X						W
Cottonseed Meal	X								X						E
Cottonseeds	X		X	X					X						W
Sunflower Meal	X			X											E
Safflower Meal	X			X											E
Bakery Meal	X		X									X			E
Molasses														X	E
Fat													X		E
Limestone					X			X							W
Feathermeal	X	X										X			E

* Moisture, Impurities, Unsaponifiables

**W = Weekly, E = Every Load

Animal Feed Processing

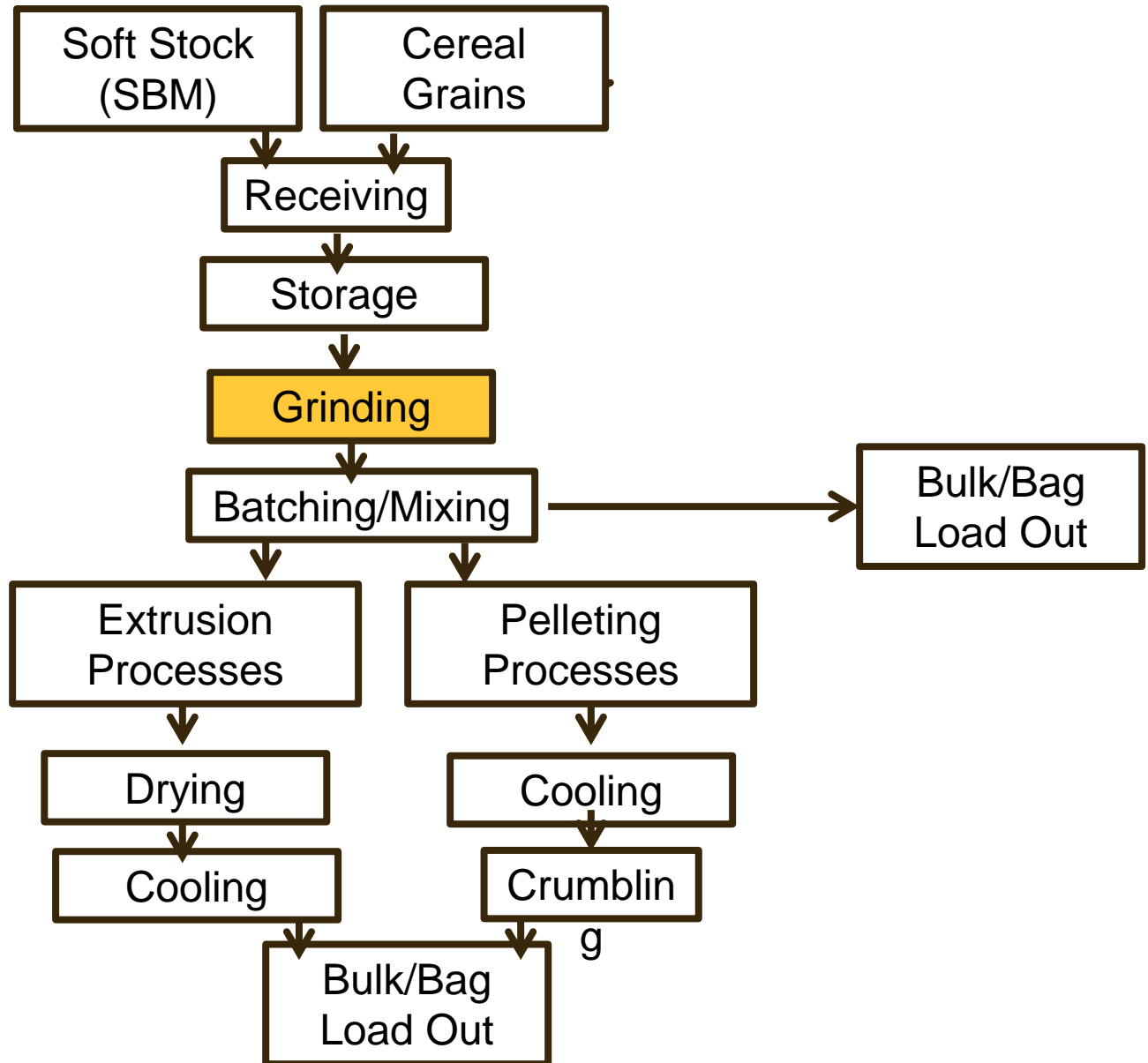


Ingredient Storage



- Ingredient Storage
 - Cereal grains in metal and concrete silos
 - Soft Stocks in bags, hoppers or flat storage
 - Additives in bags

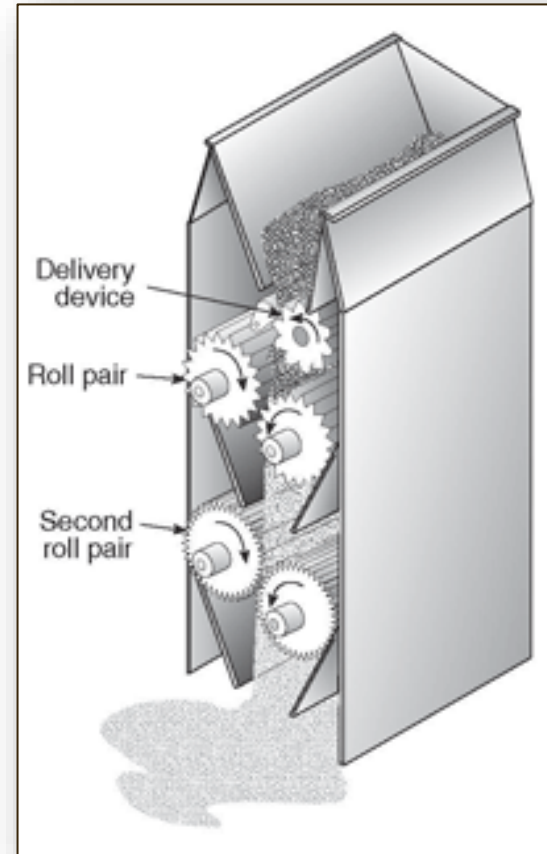
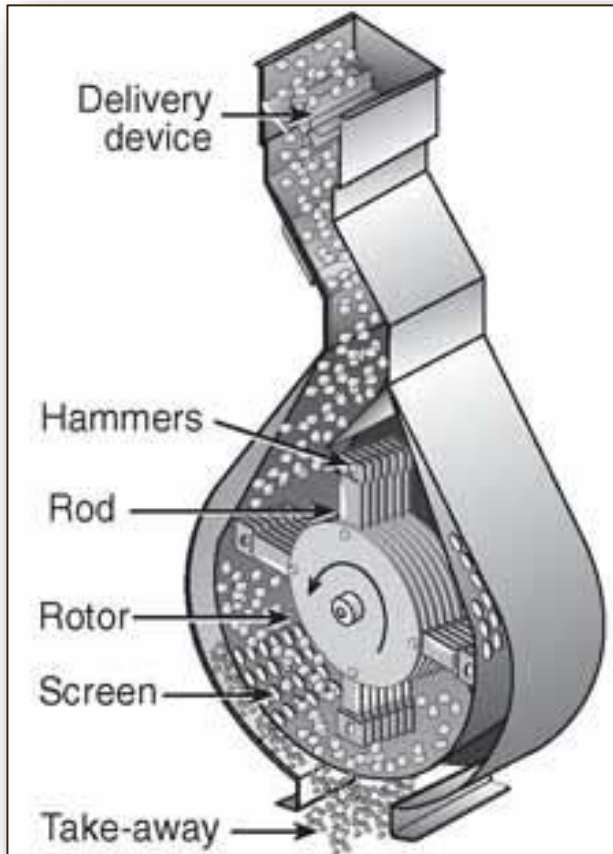
Animal Feed Processing



What is Grinding?

- Reduces particle size of feed ingredients (cereal grains)
- Increases nutrient absorption by the animal increasing digestibility
- Better mixing effect
- Increases pelleting and extrusion process efficiency

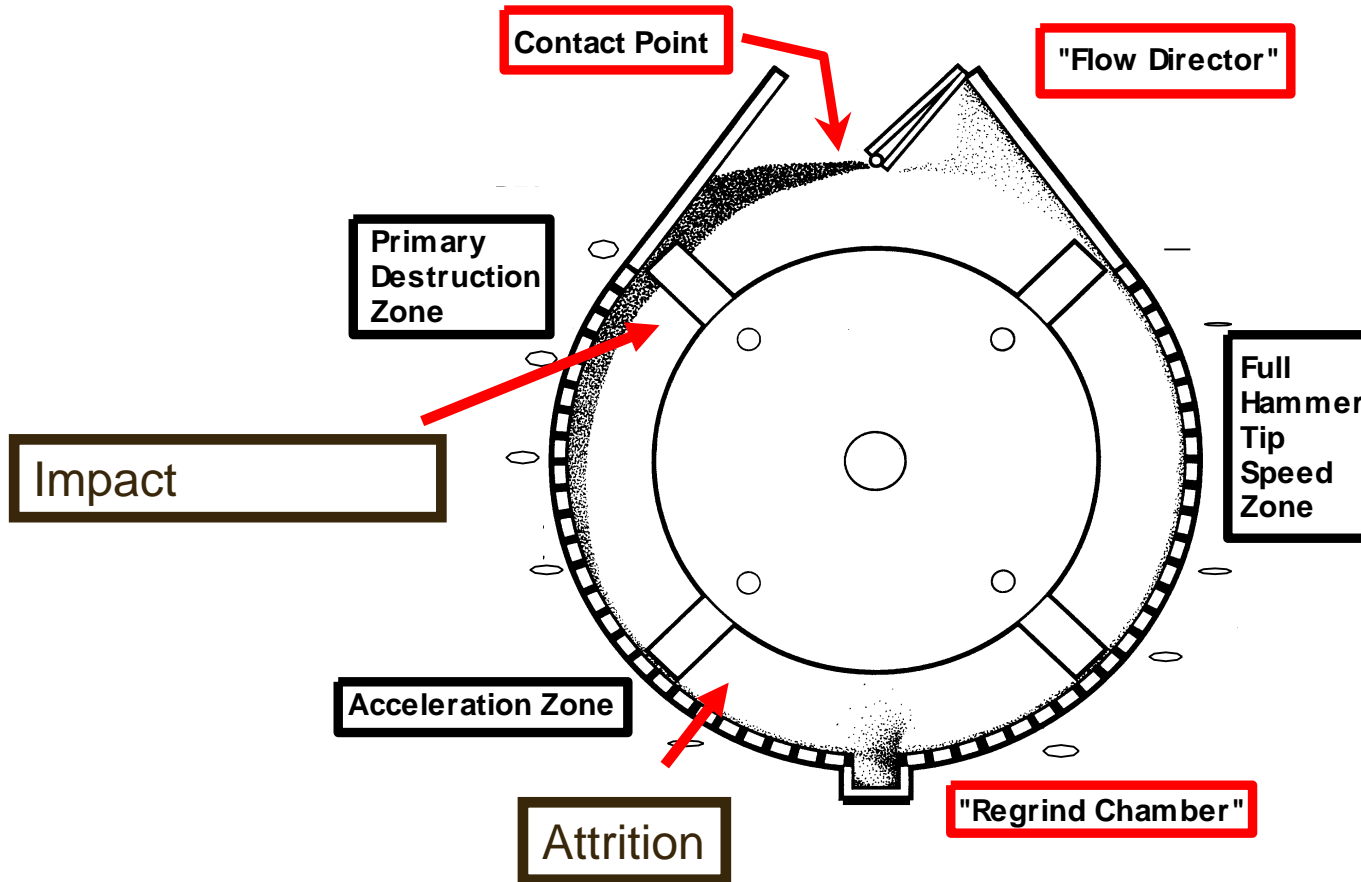
Grain Grinding



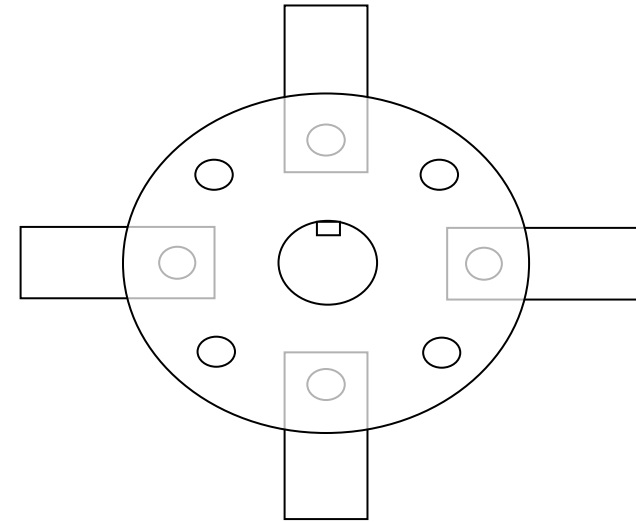
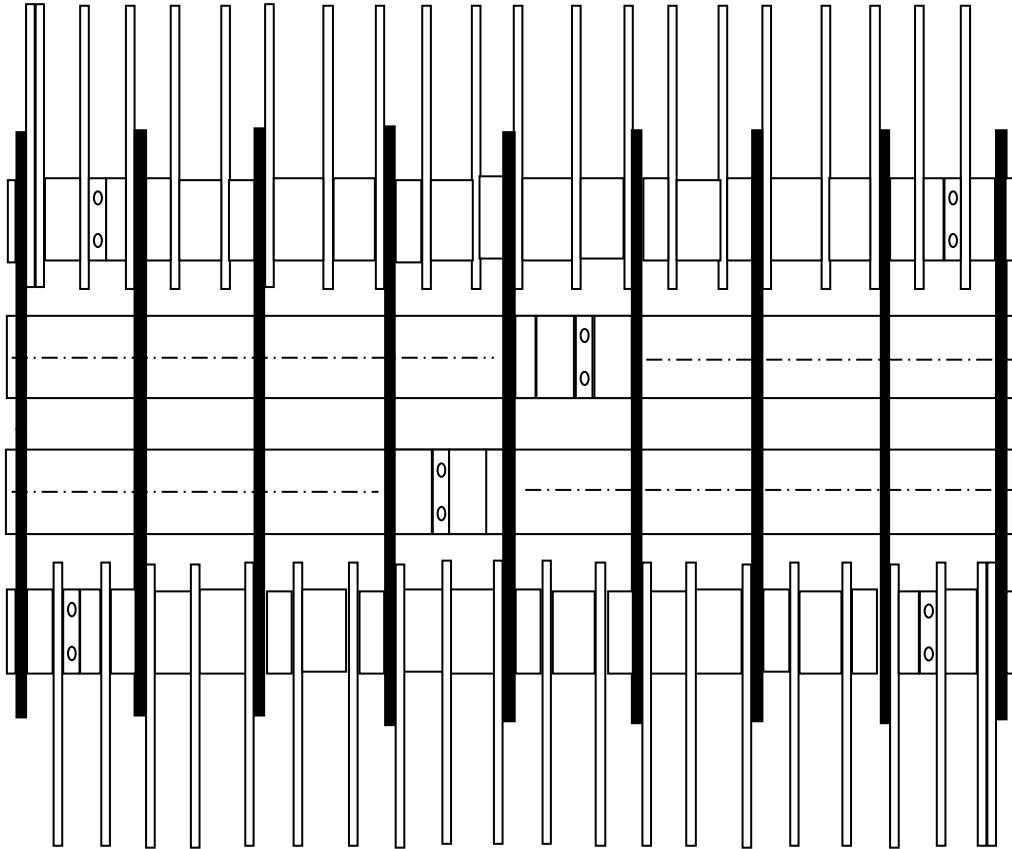
Hammer Mills



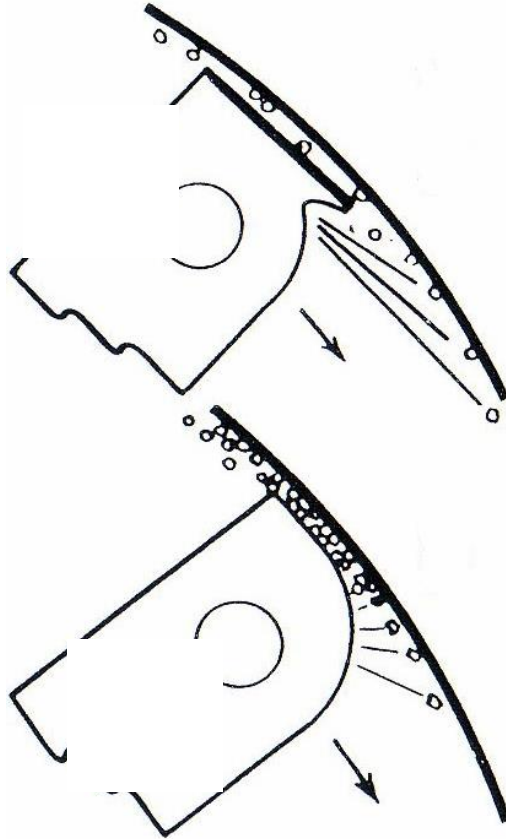
Hammer Mill System



Location of Hammers in Rotor



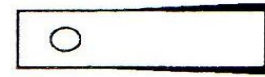
Types of Hammers



HF
ONE HOLE



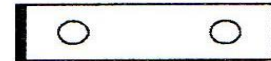
HF
TWO HOLES



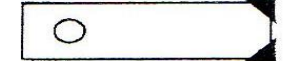
HFF
ONE HOLE



HFF
TWO HOLES



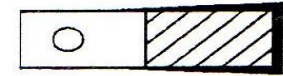
ENDS ONLY



STYLE B
CORNER CAPPED

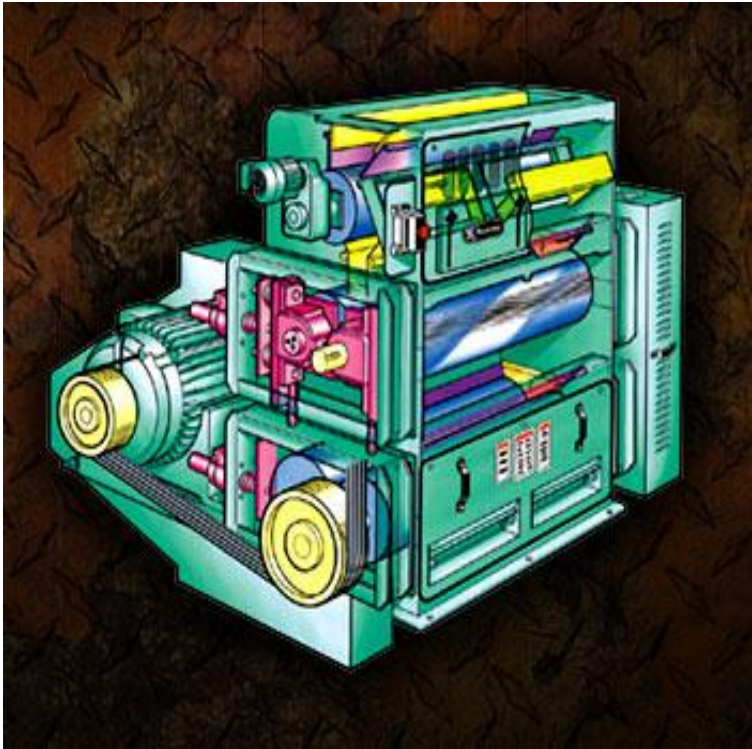


CARBIDE INSERT

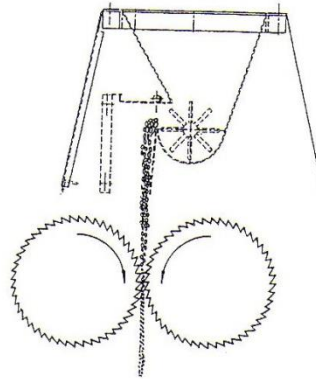
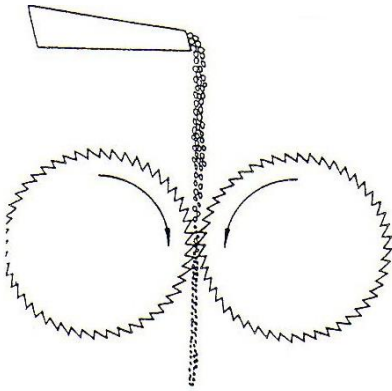
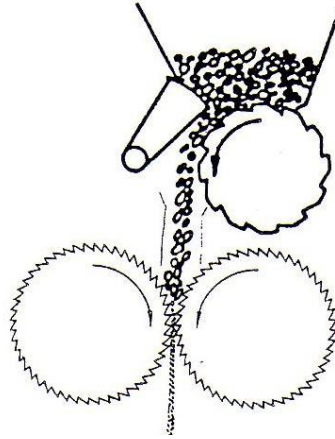
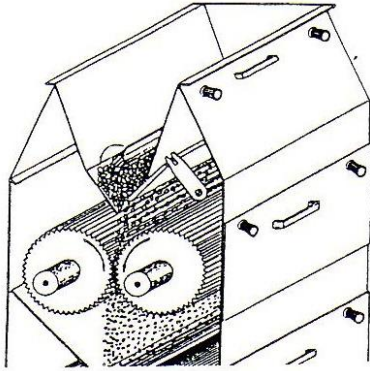


STYLE H-S
FLARED

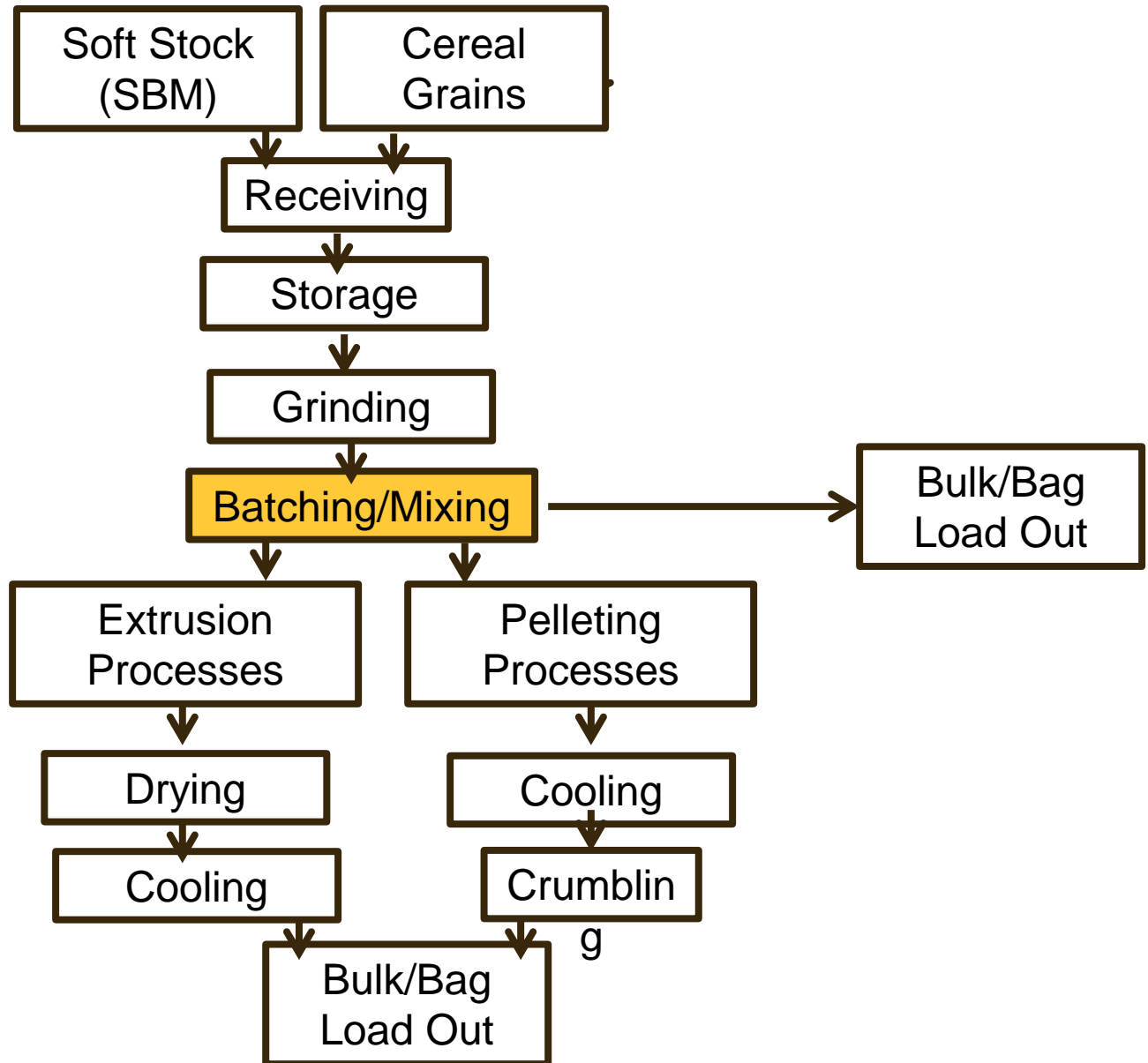
Roller Mills



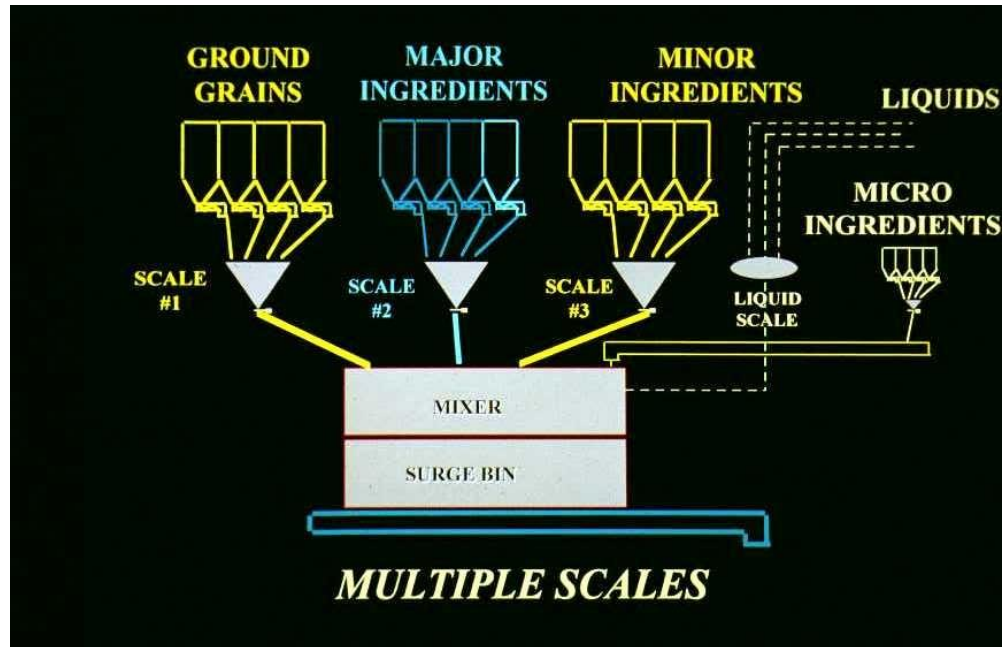
Roller Mill Feeding System



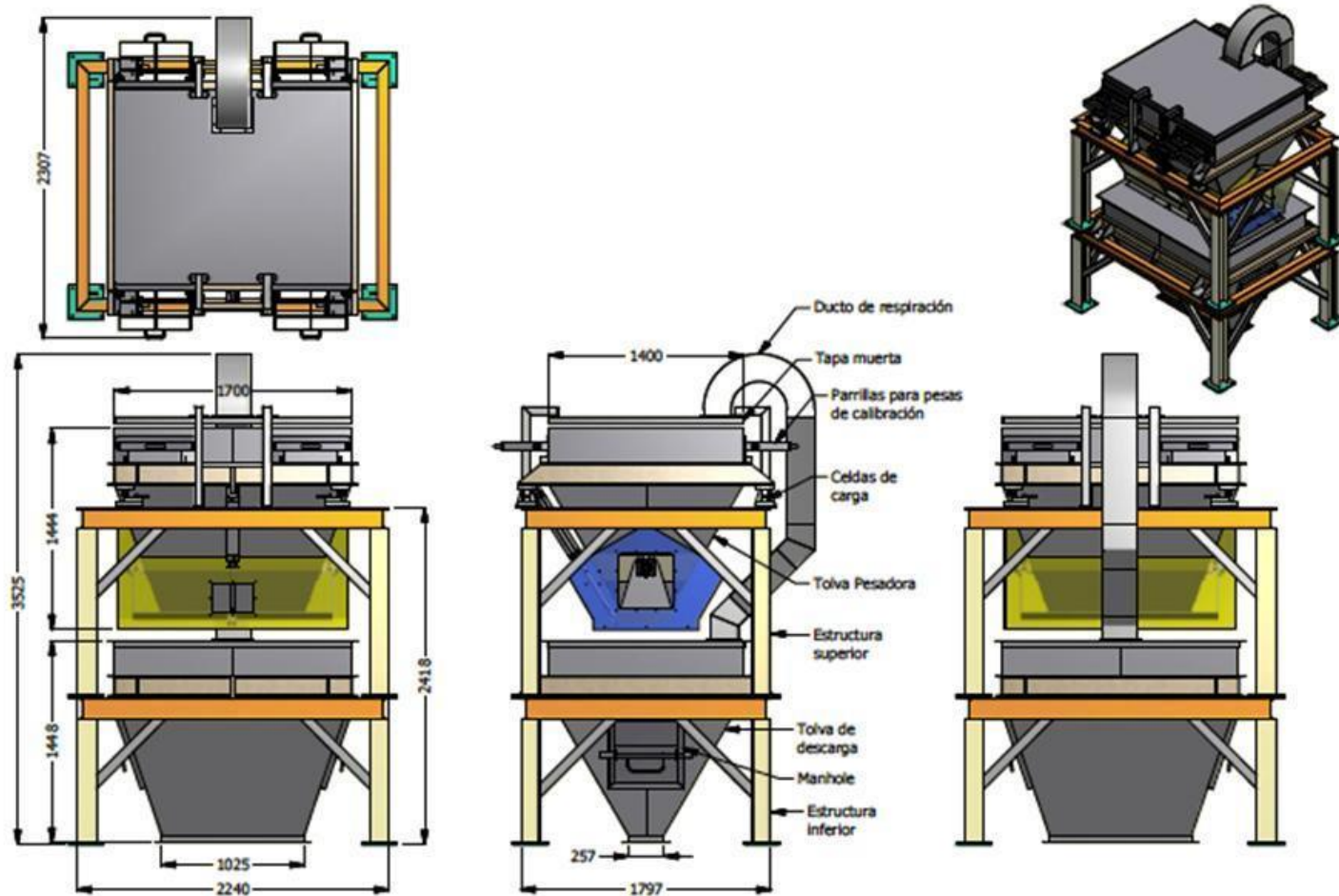
Animal Feed Processing



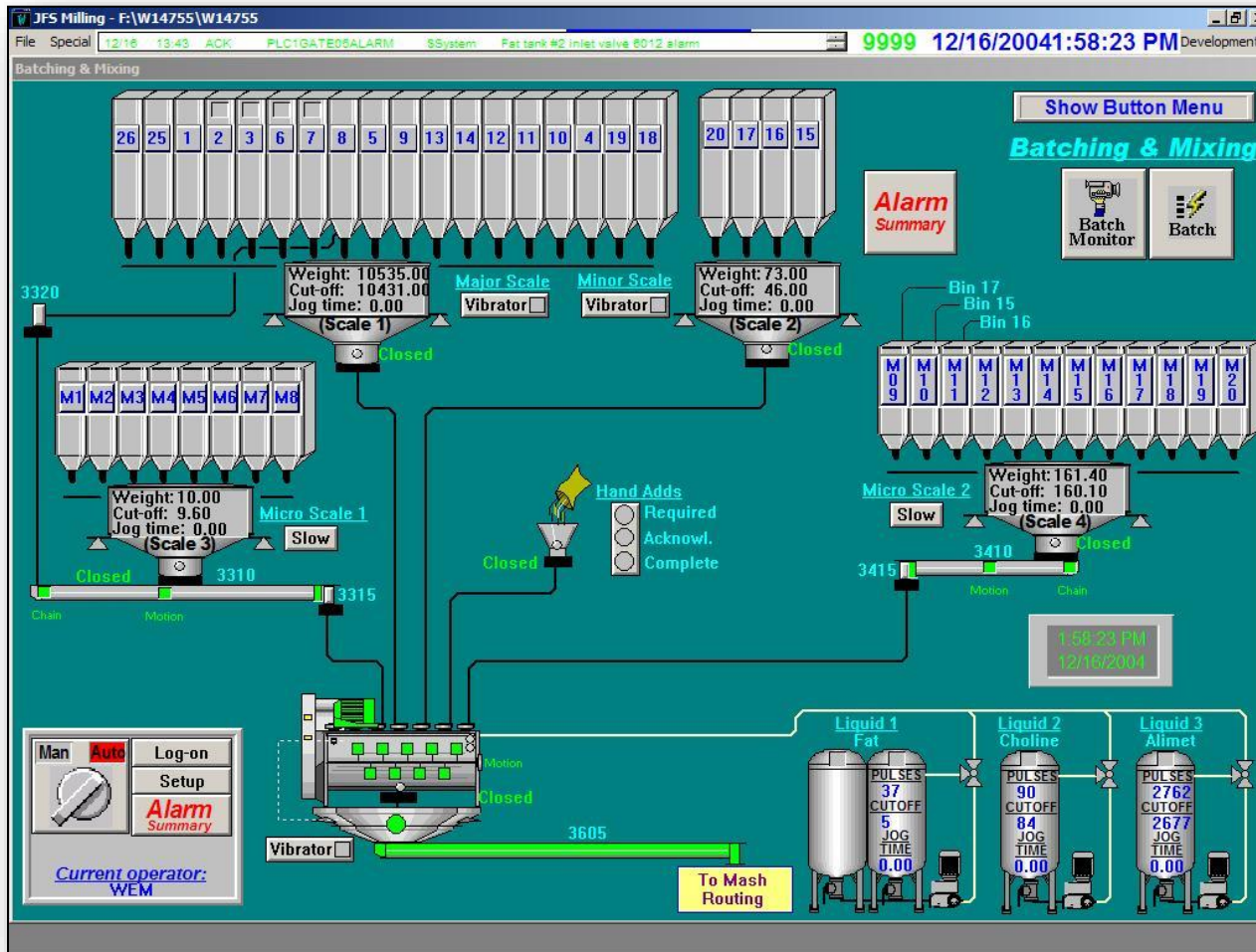
Batching System



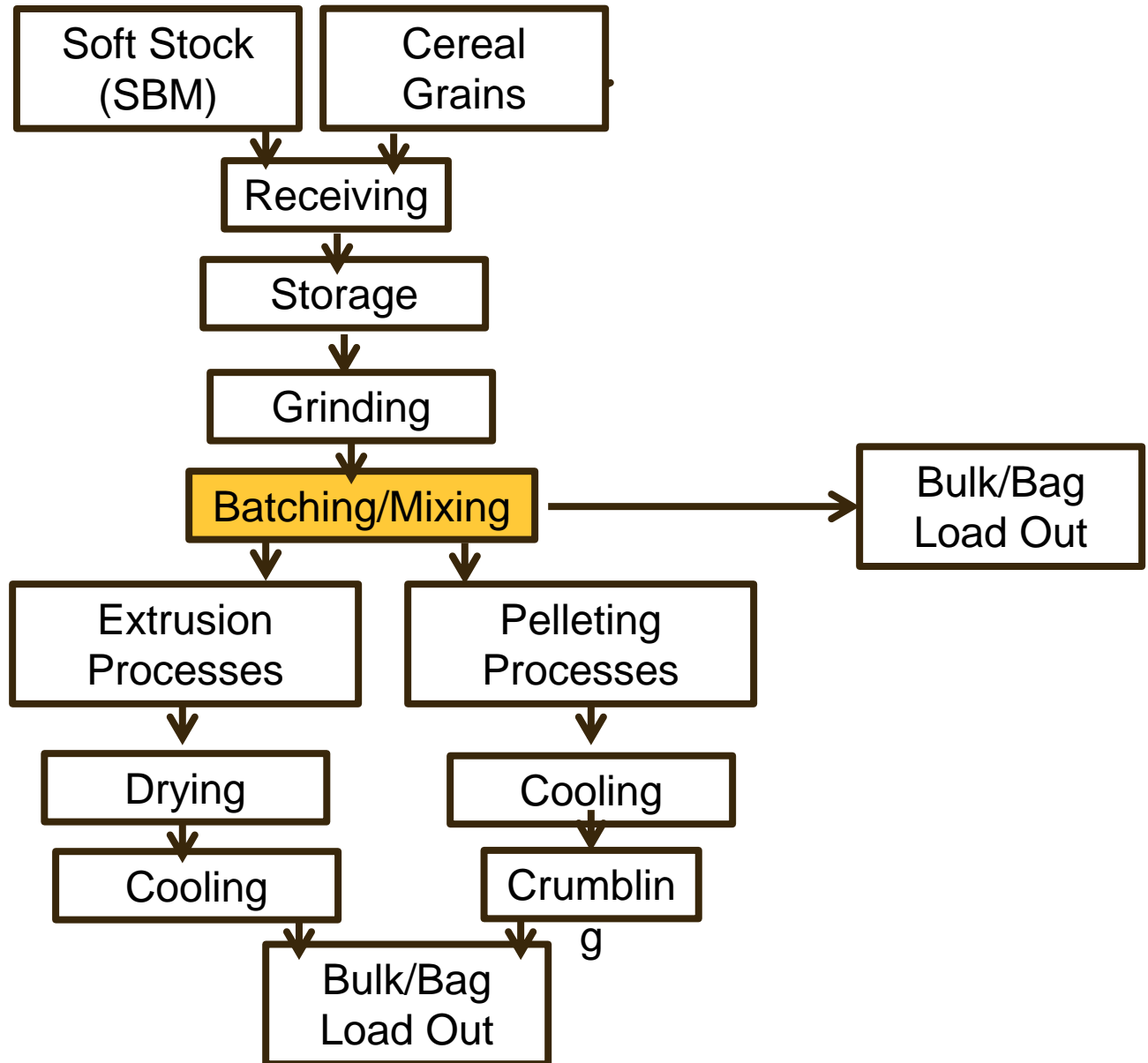
Ingredient Scale to Hopper before Mixer



Batching



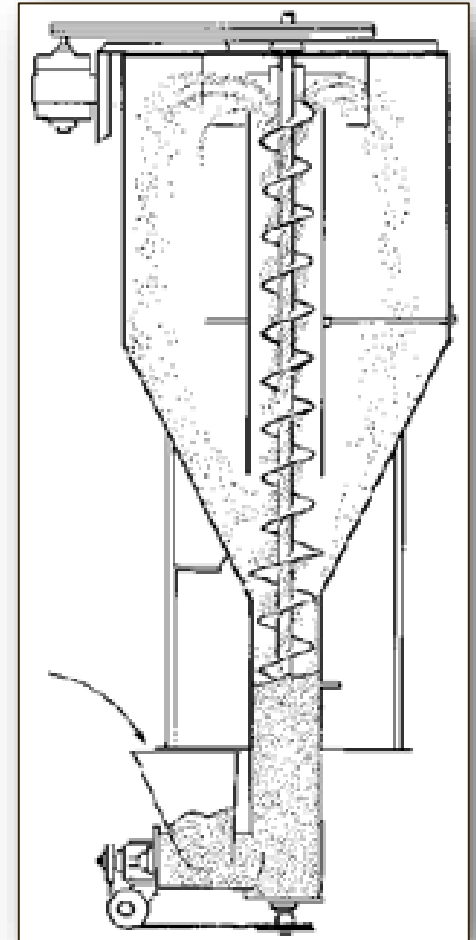
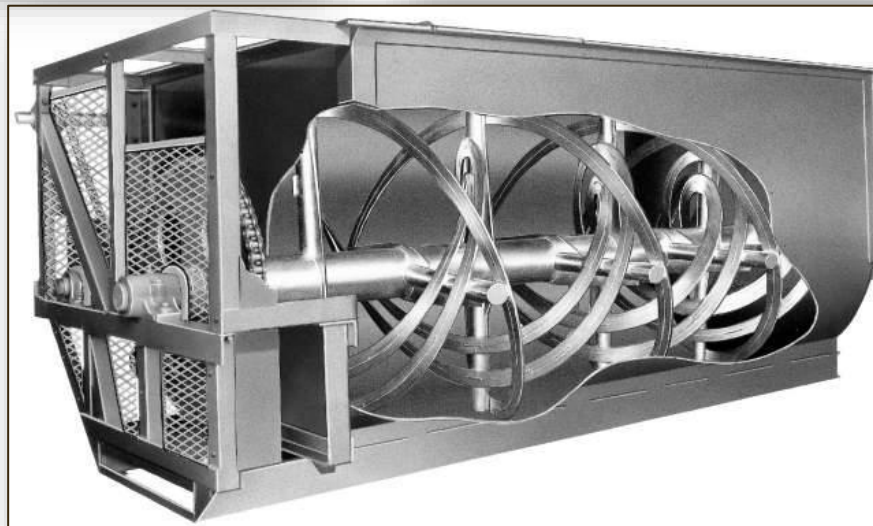
Animal Feed Processing



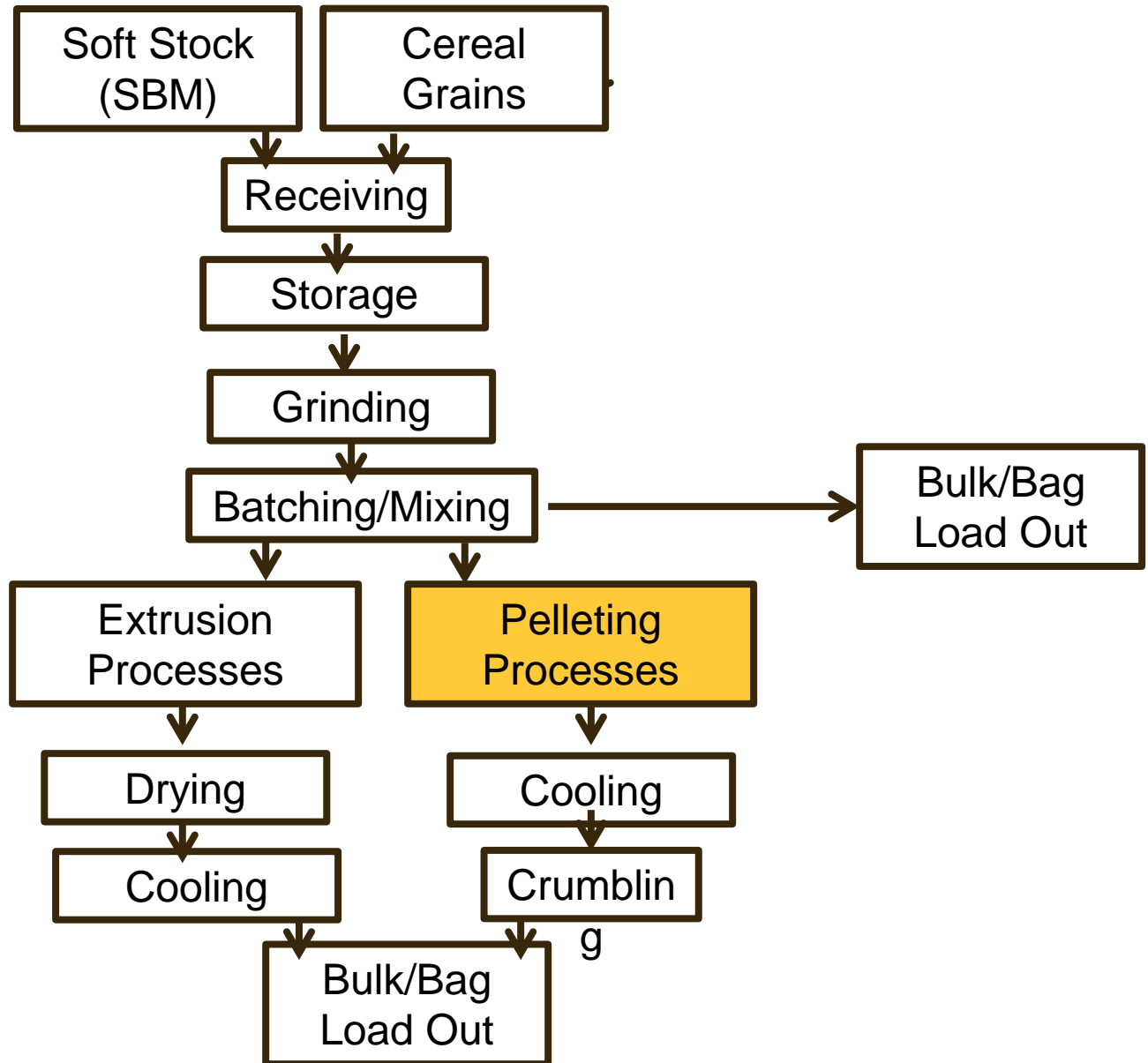
What is Mixing?

- Process to obtain maximum mixing of the feed ingredients (liquids and solids)
- No damage to ingredients
- Shortest possible mixing time

Mixing



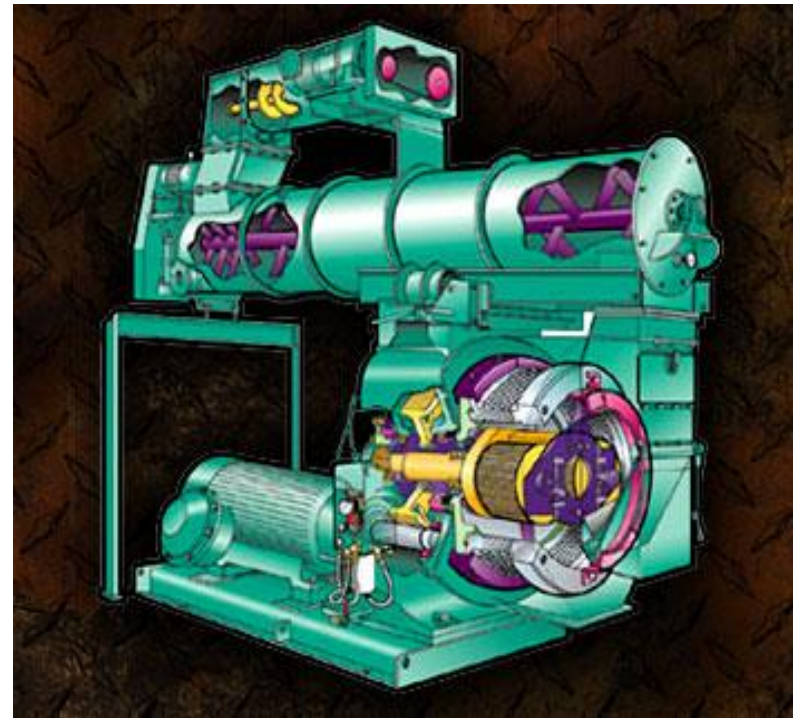
Animal Feed Processing



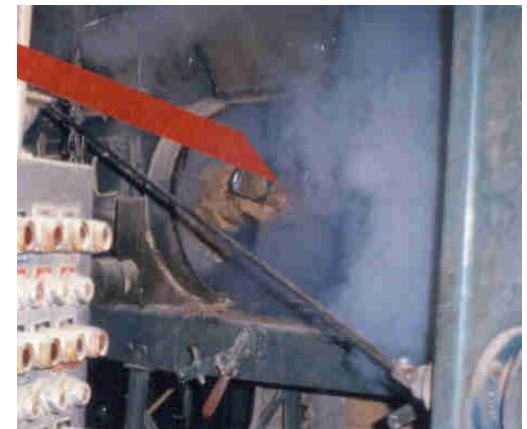
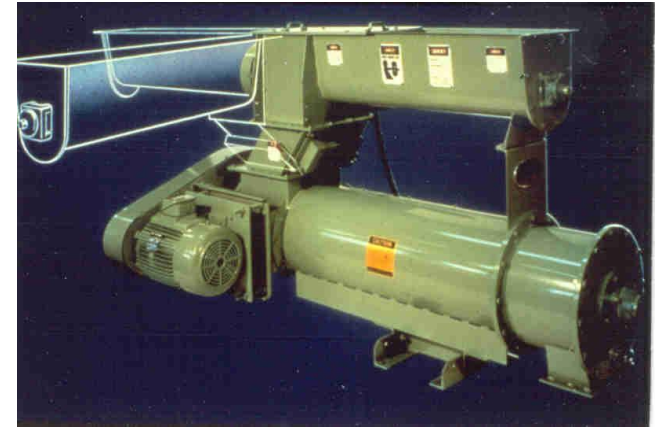
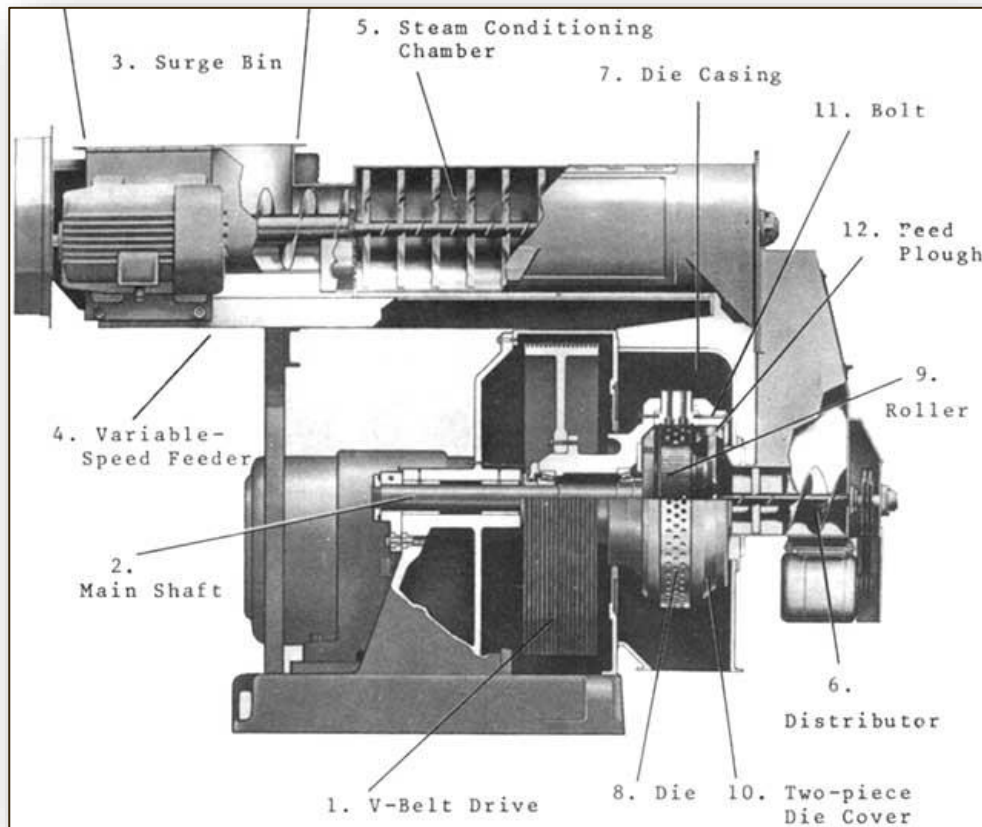
What is Pelleting?

- It is the process of agglomerating ingredients into compress and dense pellets. It has the following advantages:
 - Less feed waste
 - Reduces animal selection of feed
 - Improves feed efficiency
 - Degrades some microorganisms
 - Increases density of the feed

Pelleting Equipment

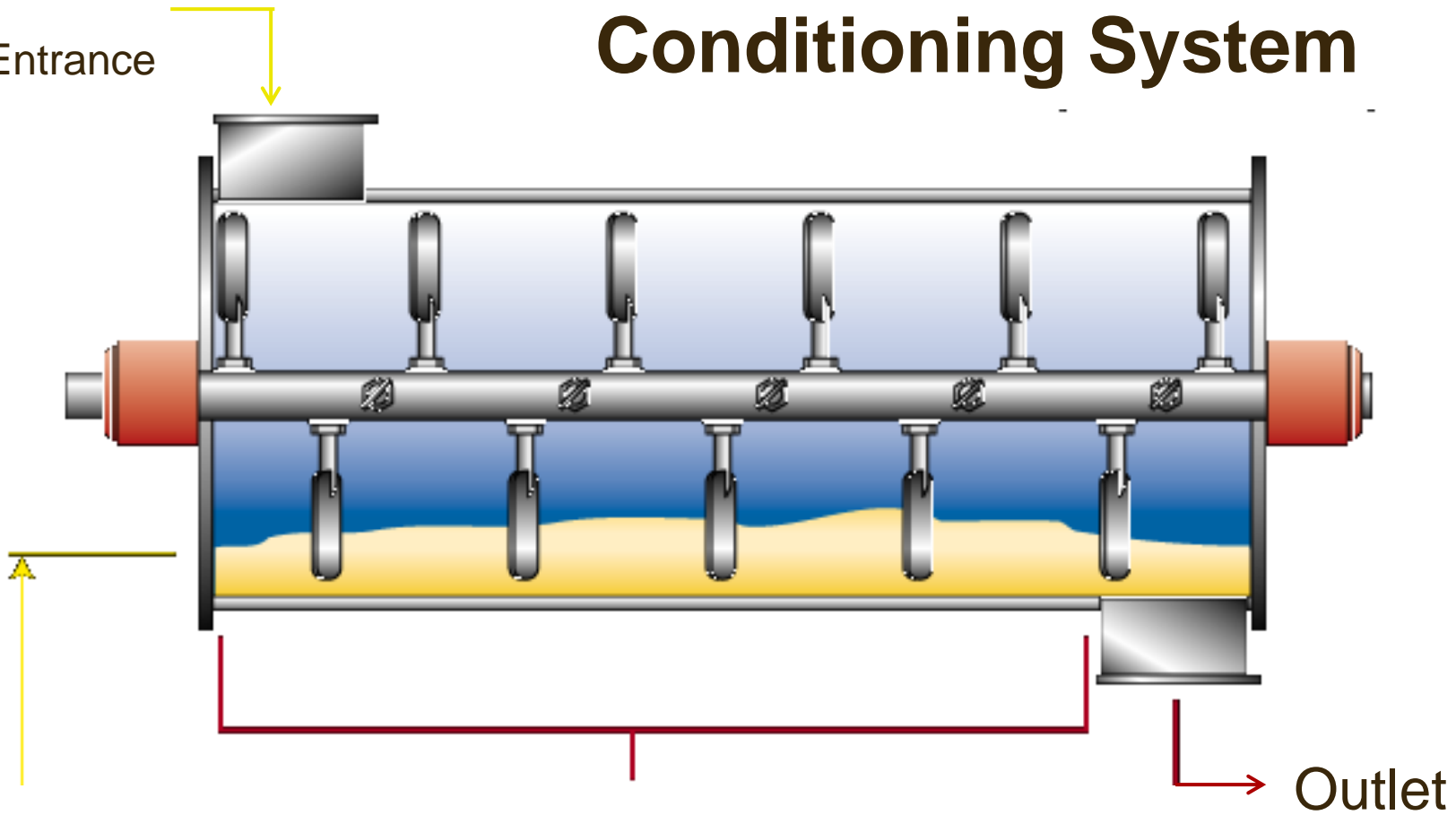


Conditioning & Pelleting Process



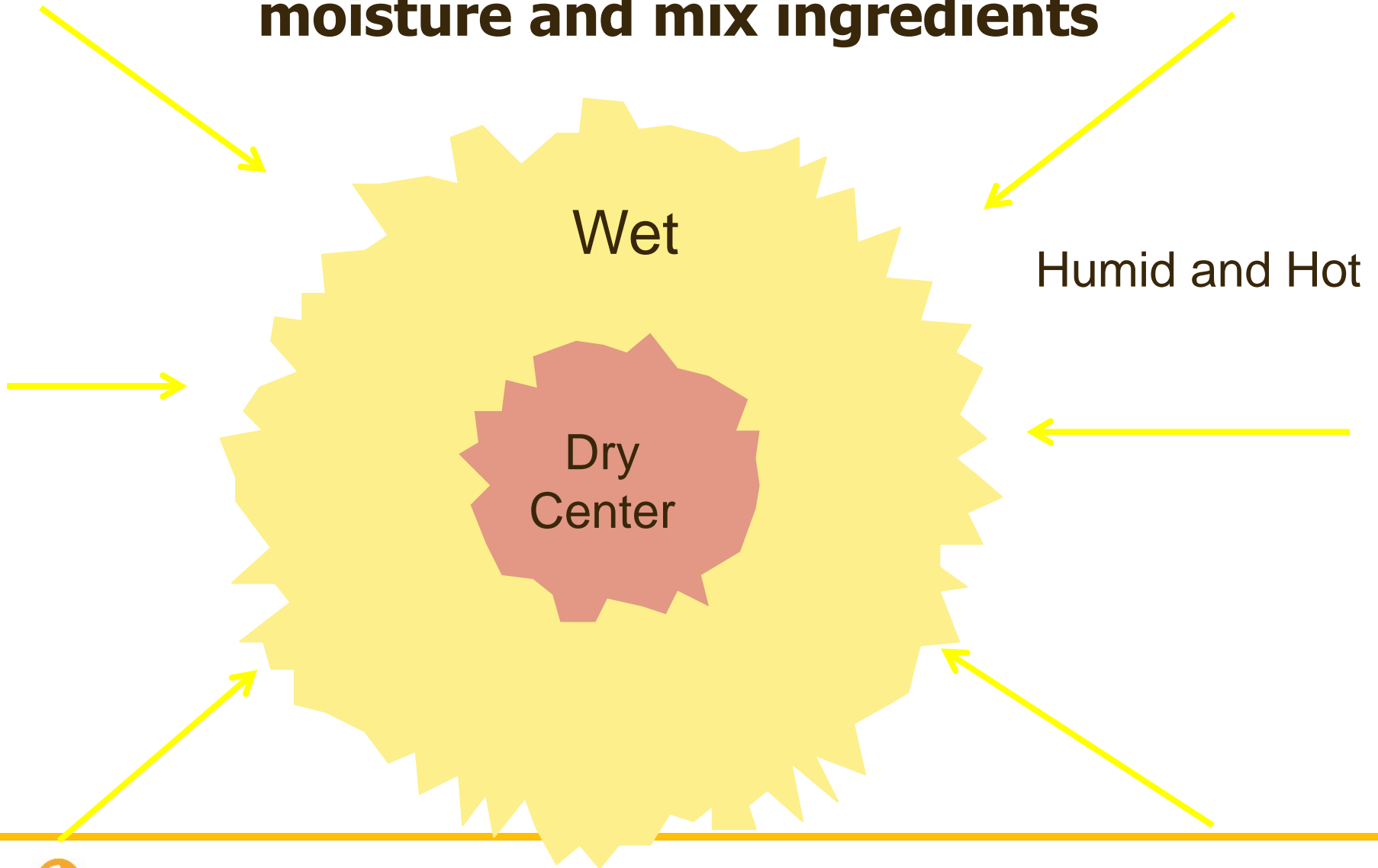
Conditioning System

Entrance

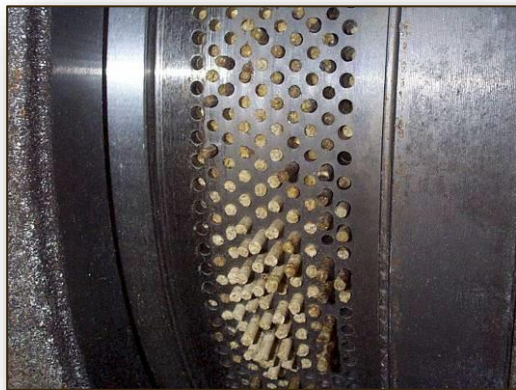
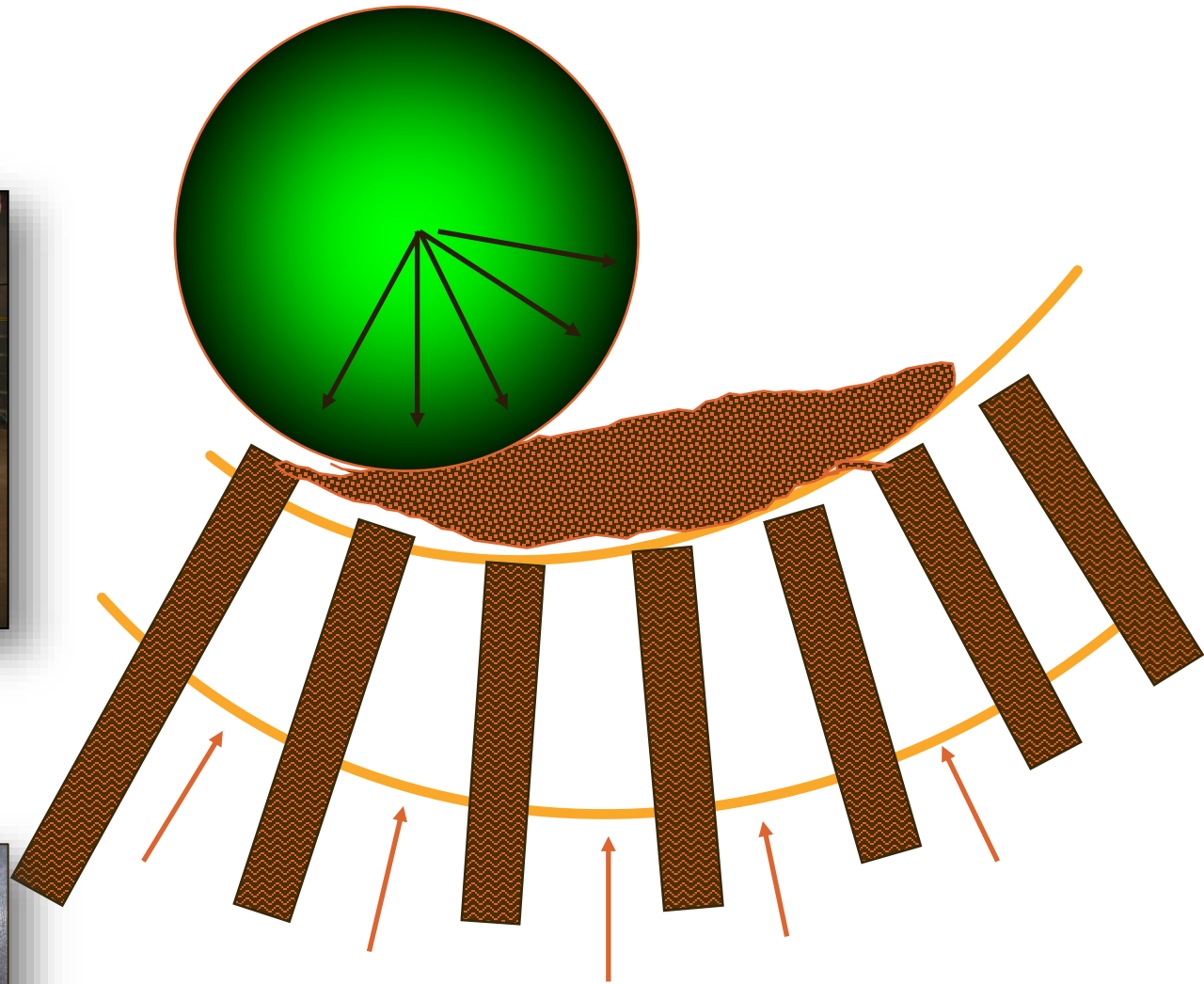


Outlet

Objective of Conditioning: Add heat, moisture and mix ingredients



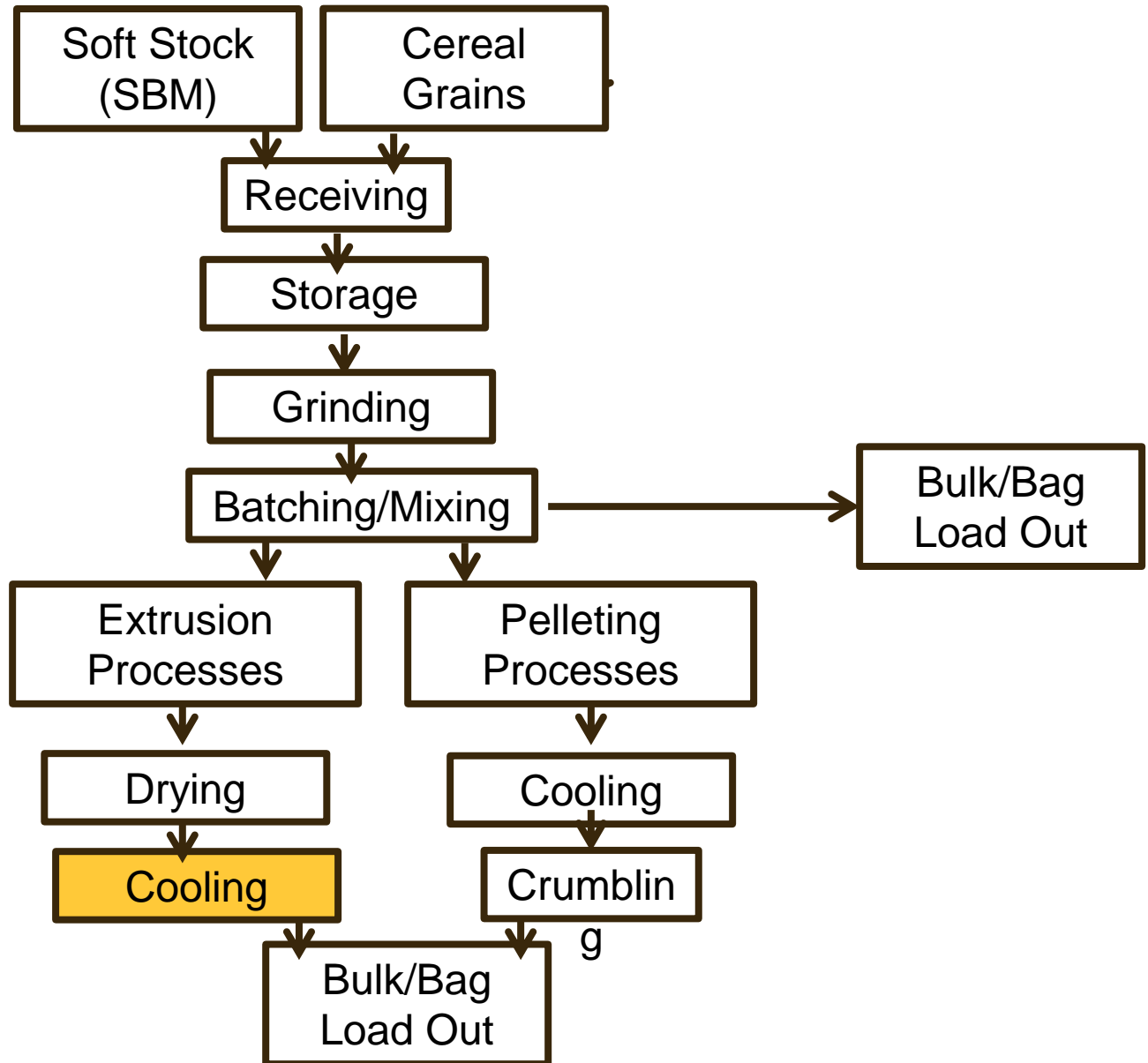
Roll & Die



Pellets



Animal Feed Processing



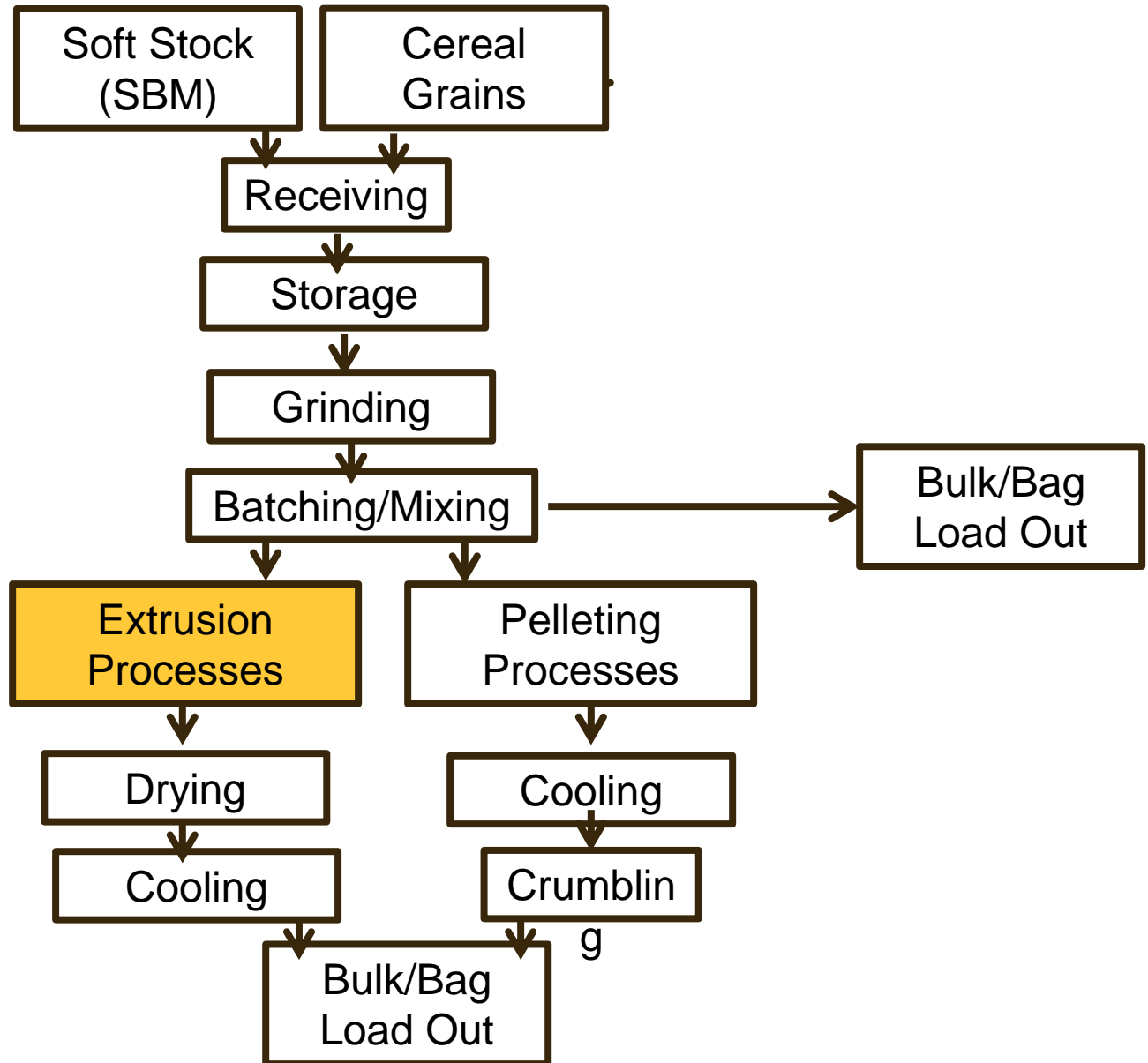
Pellet Cooling

- Pellets come out hot, need to be cool down for proper storage.
- Usually cooling until 2°C above ambient temperature
- Uses ambient air
- Several types of cooling systems
- Measure pellet quality after cooling

Pellet Cooling Equipment

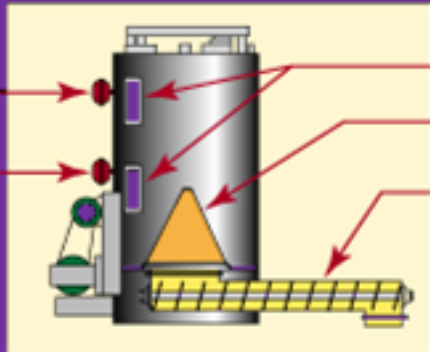


Animal Feed Processing



What is Extrusion?

- It is a continuous process where the feed ingredients are cooked to form a plasticized shape by using temperature, pressure, mechanical force and, water. Its advantages:
 - Cooks the starches making feed more digestible
 - Can produce different shapes and forms
 - Sterilizes the feed ingredients with the high temperatures
 - Increases feed efficiency



SIGHT GLASS

CONE BREAKER

VARIABLE SPEED SCREW

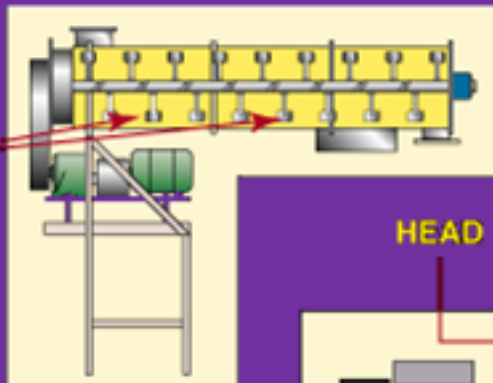
FEED DELIVERY SYSTEM

LO-LEVEL INDICATOR

HI-LEVEL INDICATOR

PRECONDITIONING PHASE

BEATERS



EXTRUDER BARREL COMPONENTS

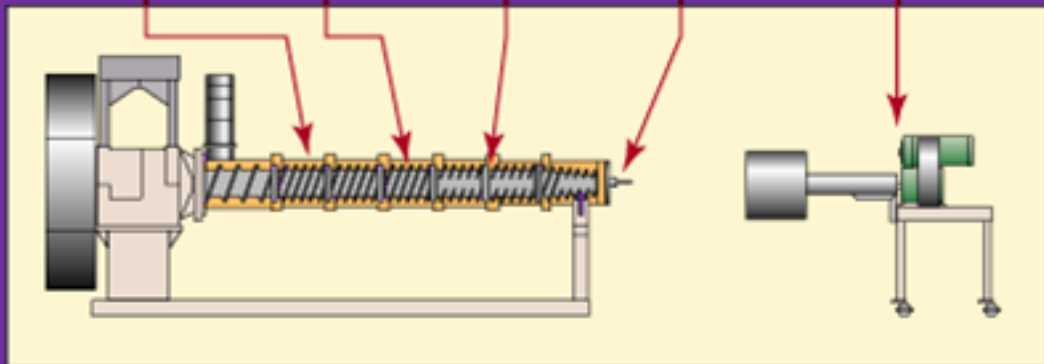
HEAD

SCREW

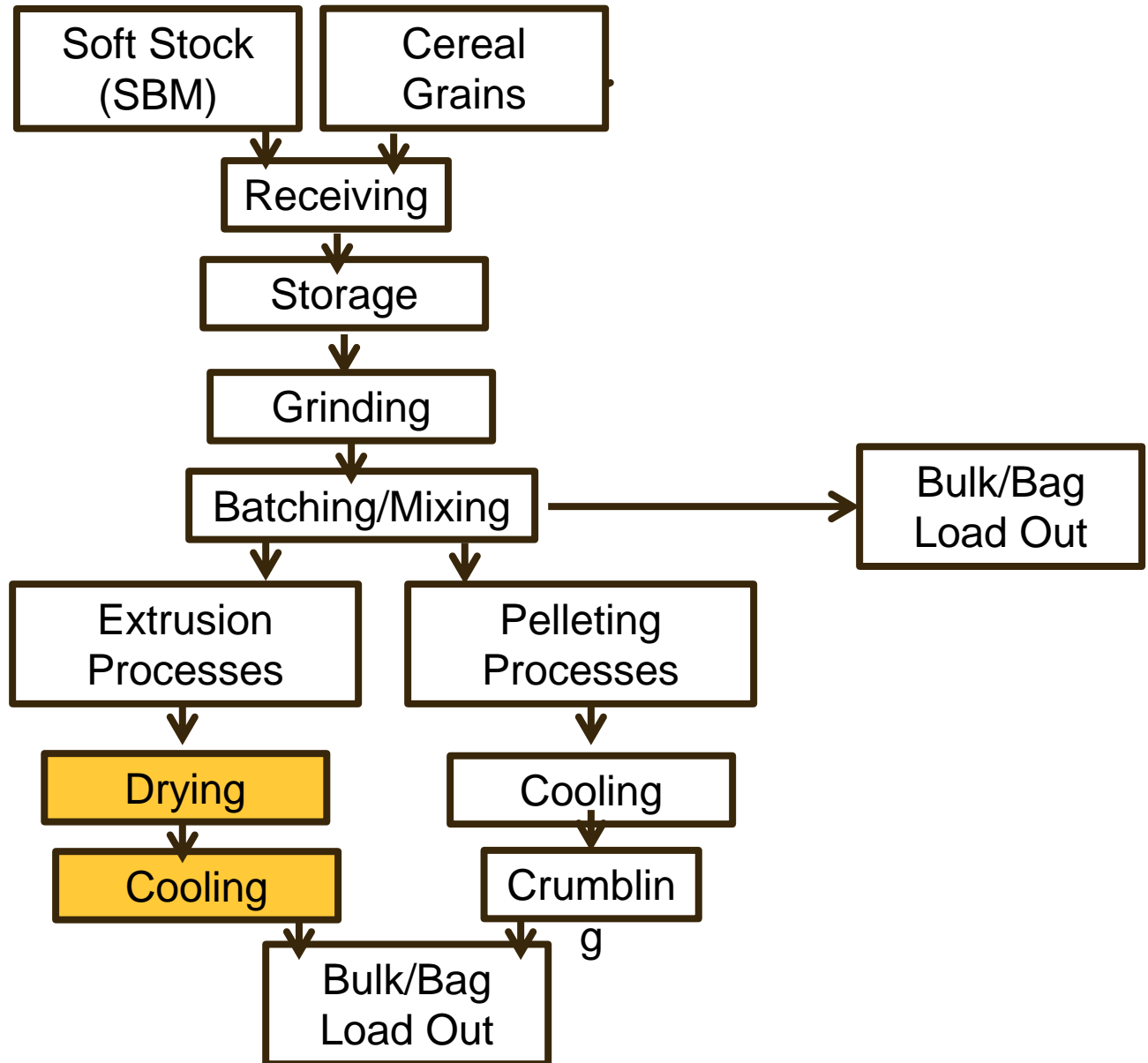
SHEARLOCK

DIE

KNIFE ASSEMBLY



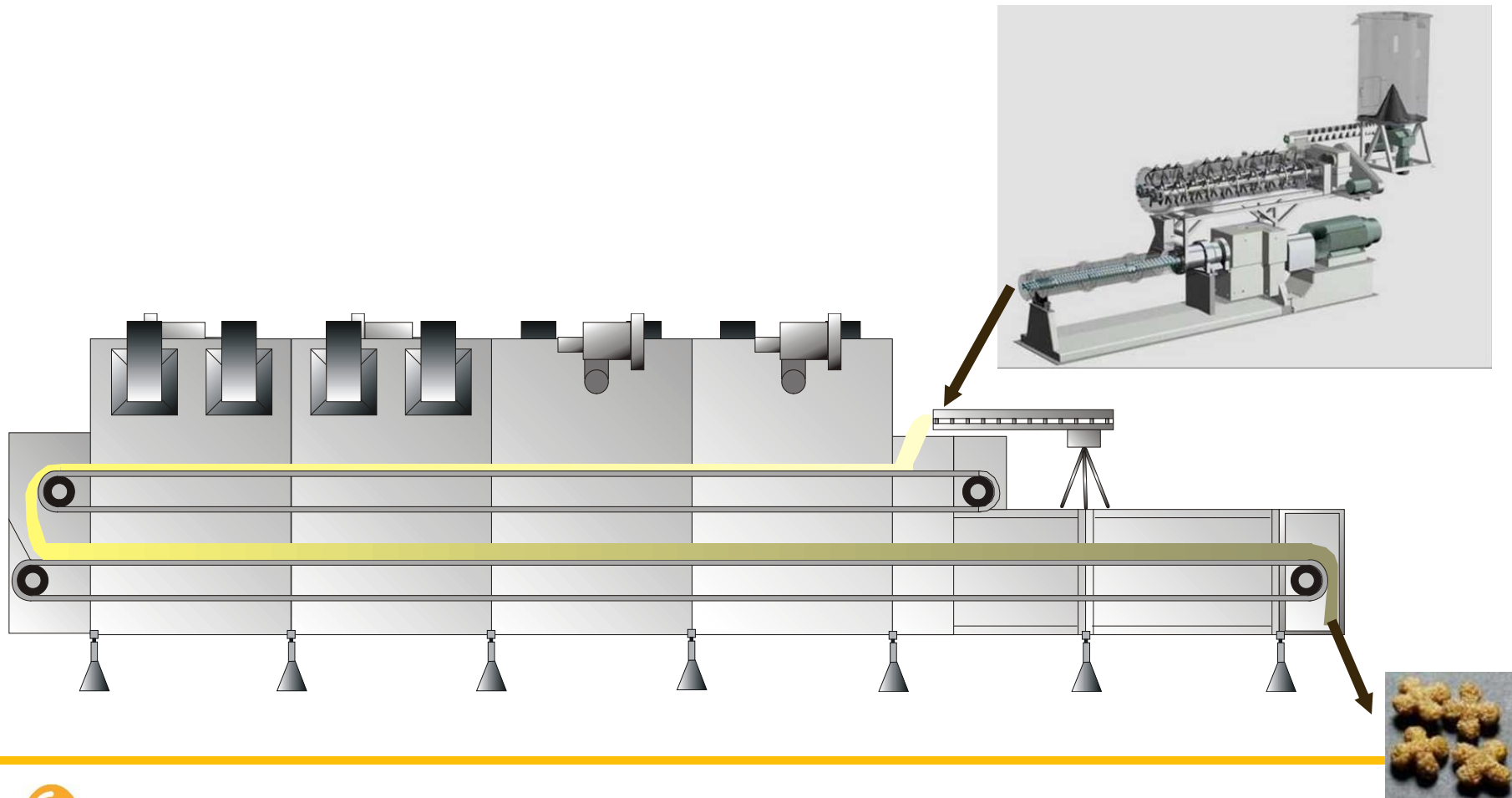
Animal Feed Processing



Drying of Pellets at 150°C for 20-25 Min with Cooler



Dryer with Two Stages



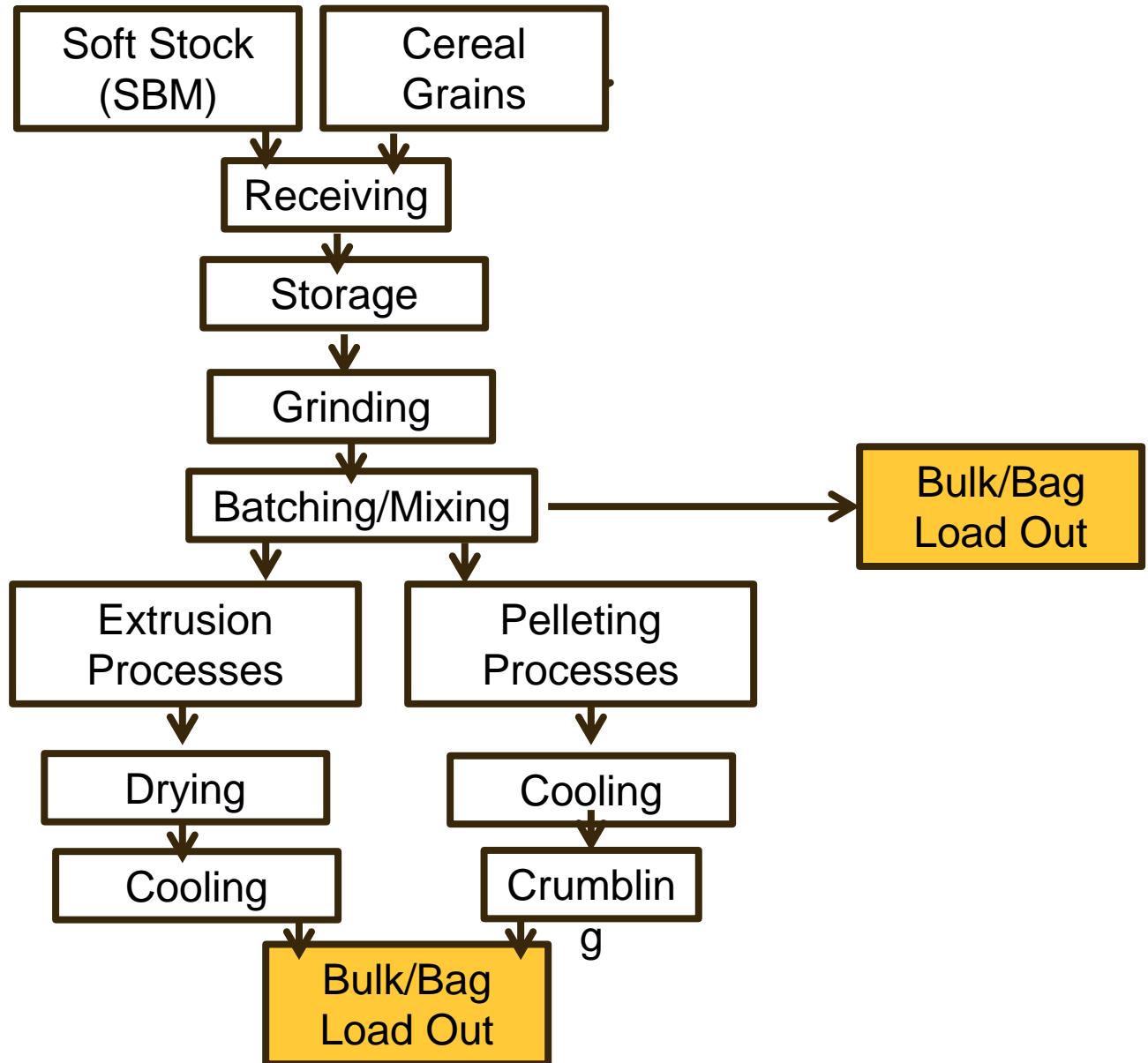
Rotary Dryer



Extrusion Cooling System



Animal Feed Processing



Bag and Bulk/Load Out



Conclusions

- It is important to develop your feed manufacturing process based on your needs, logistics, and economical conditions.
- Feed mills can be developed as combination of manual and automatic systems when needed.
- Feed manufacturing processing is fairly simple and is the same to everybody, but all feed mills are different.

Carlos Campabadal
Email: campa@ksu.edu
Phone +1.217.721.1025

Thank you!

