Important Commercial and Quality Considerations in Soybean Processing

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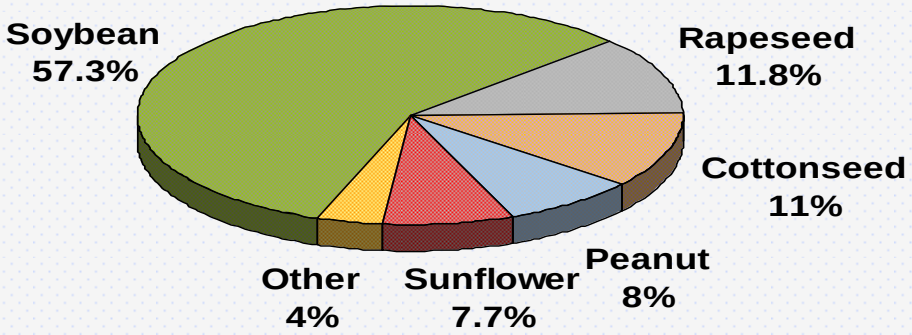
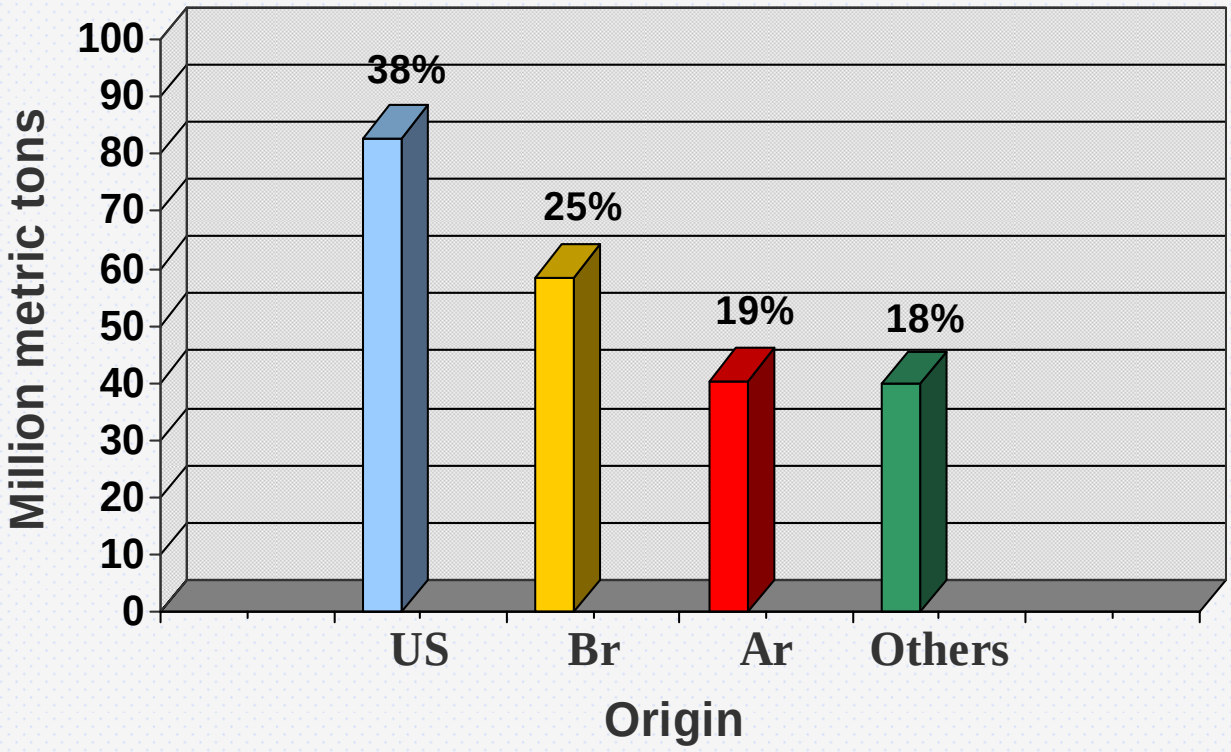
World Production of Major Oilseeds
(Crop year 2006/2007)



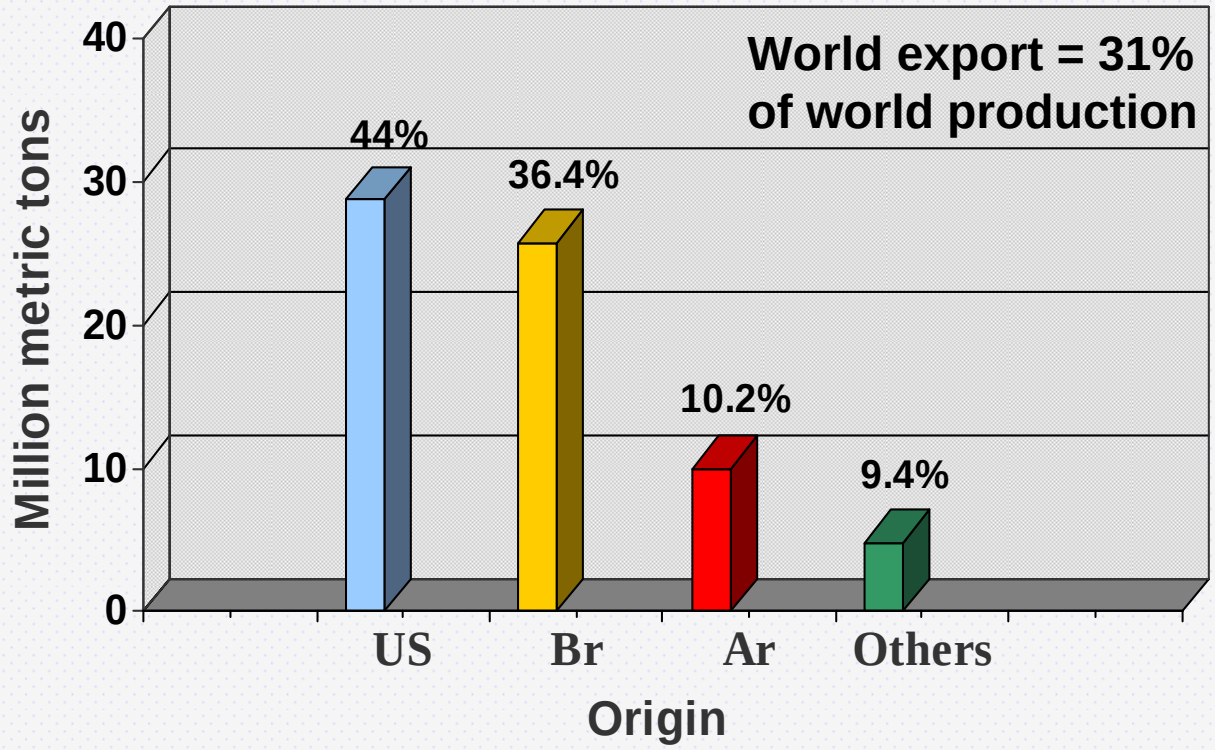
	Million metric tons
Soybeans	226.78
Rapeseed	46.78
Cottonseed	43.77
Peanut	31.59
Sunflower	30.54
Others	16.04
Total	387

World Production of Soybeans By Origin
(Crop year 2006/2007)



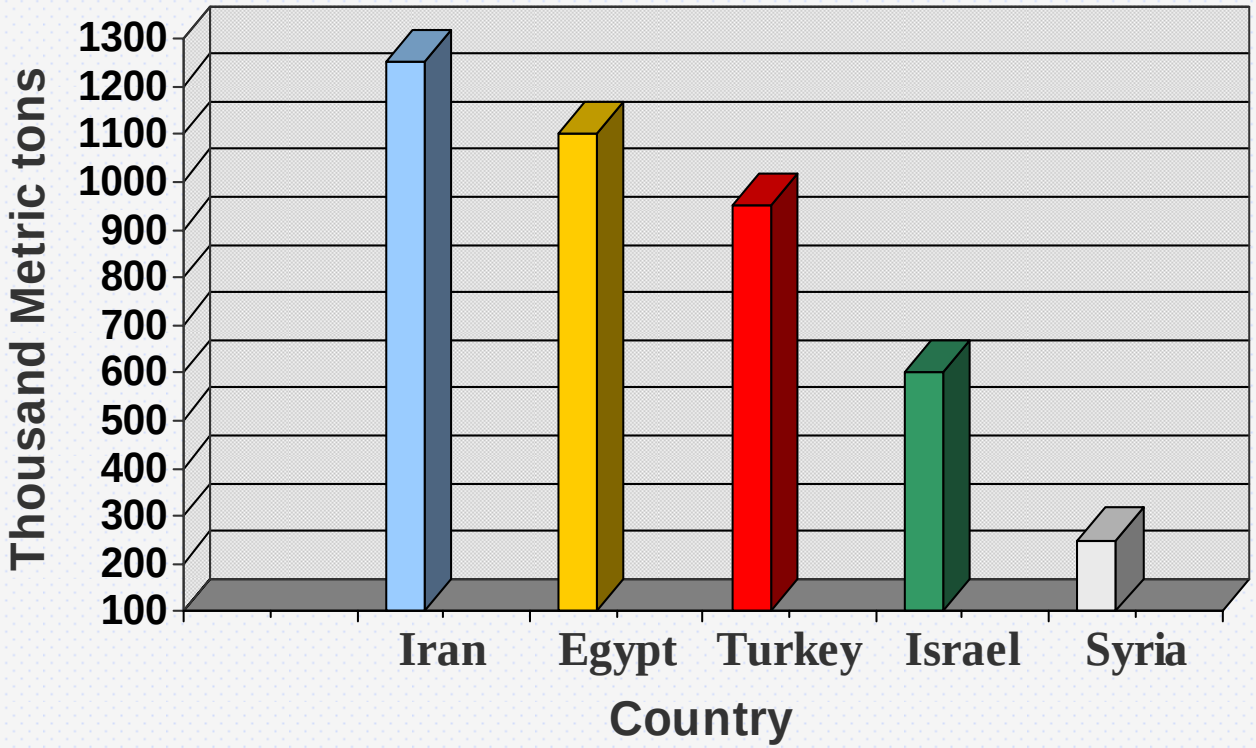
Source: Official statistics, USDA estimates

World Soybean Export
(Crop year 2006/2007)



Source: Official statistics, USDA estimates

Middle East Imports
(Crop year 2006/2007)



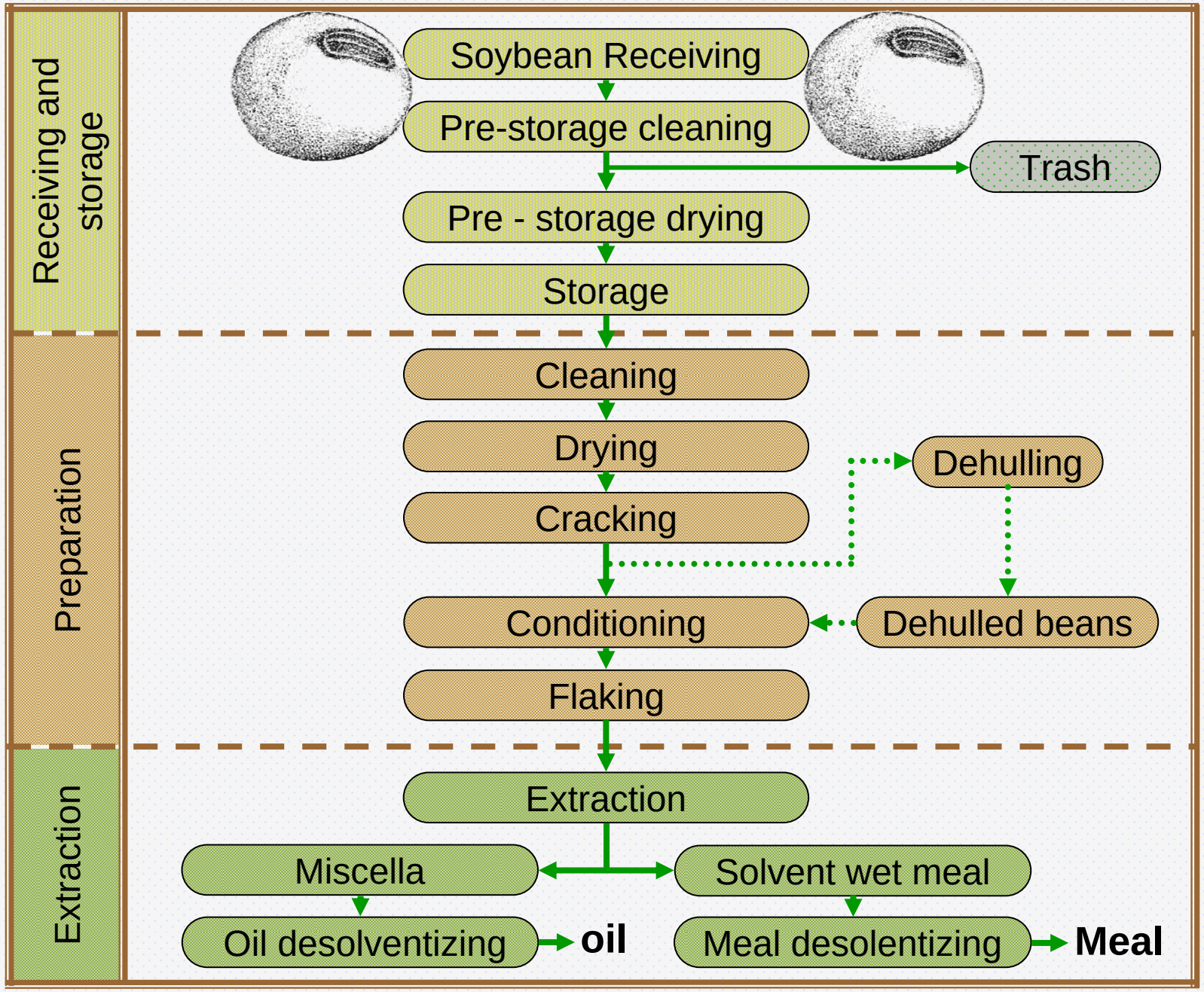
Source: Official statistics, USDA estimates

USDA Grading Standards for Soybeans

	Minimum	Maximum				
		Damaged kernel				
Grade	Test weight Lb/Bu	Heat damaged %	Total damaged %	Foreign material %	Splits %	Soybeans of other colors %
US No 1	56	0.2	2.0	1.0	10.0	1.0
US No 2	54.	0.5	3.0	2.0	20.0	2.0
US No 3	52	1.0	5.0	3.0	30.0	5.0
US No 4	49	3.0	8.0	5.0	40.0	10.0

U.S. Sample grade: comprised of beans with lower quality

Specifications may be added for oil, protein and moisture in contracts.


Receiving and storage
Preparation
Extraction
Soybean Receiving
Pre-storage cleaning
Trash
Pre - storage drying
Storage
Cleaning
Drying
Cracking
Dehulling
Conditioning
Dehulled beans
Flaking
Extraction
Miscella
Solvent wet meal
Oil desolventizing
oil
Meal desolentizing
Meal

Processing Quality Factors

- Soybean quality
  - Compositional attributes
  - Physical attributes
- Processing efficiency
  - Rate of deterioration
  - Rate of extraction
  - Energy use
  - Utility use
  - Solvent and material losses

Soybean Quality Effects

- Significance of soybean quality:
  - Processing yield
  - Quality of final products
  - Processing requirements - conditions
  - Operating cost - profit
- Upgrading quality factors : Oil and protein.
- Downgrading quality factors: Moisture, damage, foreign material, splits and beans of other color.
- Minimum quality requirements:
  - Meeting the quality standards for final products

Effects of Soybean Quality Factors

a Non-Hydratable phosphatides	b Total gums
c Free Fatty Acid	d Oxidation Products
e Iron / Metal Content	f Pigments
g Lower yield	h Storability

Heat Damaged	a, d, f, g
Damaged Beans	a, b, c, d, e, f, g
Foreign Material	c, d, f, g, h
Splits	a, b, c, d, e, g, h
Soybeans of other colors	f
Moisture	a, b, c, e, g, h

Soybeans Used for Processing

US yellow grade 2 - Soybean composition

Component	Average %	Mean %
Oil	18 – 22	19.5
Protein	34.5 – 37	35
Carbohydrate	22.5	
Fiber	5 – 6	
Ash	5	
Moisture	11 - 13	
Hulls	7 - 8	

Processing Effects

- Affecting factors
  - Receiving and storage conditions.
  - Preparation and Extraction methods.
  - Operating variables.
  - Type and efficiency of the equipment being used.
  - Quality control management.
  - Plant maintenance.
  - Experience.

Effect of Processing Steps on Crude Oil Quality

a Non-Hydratable phosphatides	b Total gums
c Free Fatty Acid	d Oxidation products
e Iron / Metal Content	f Pigments
g Lower yield	h Storability

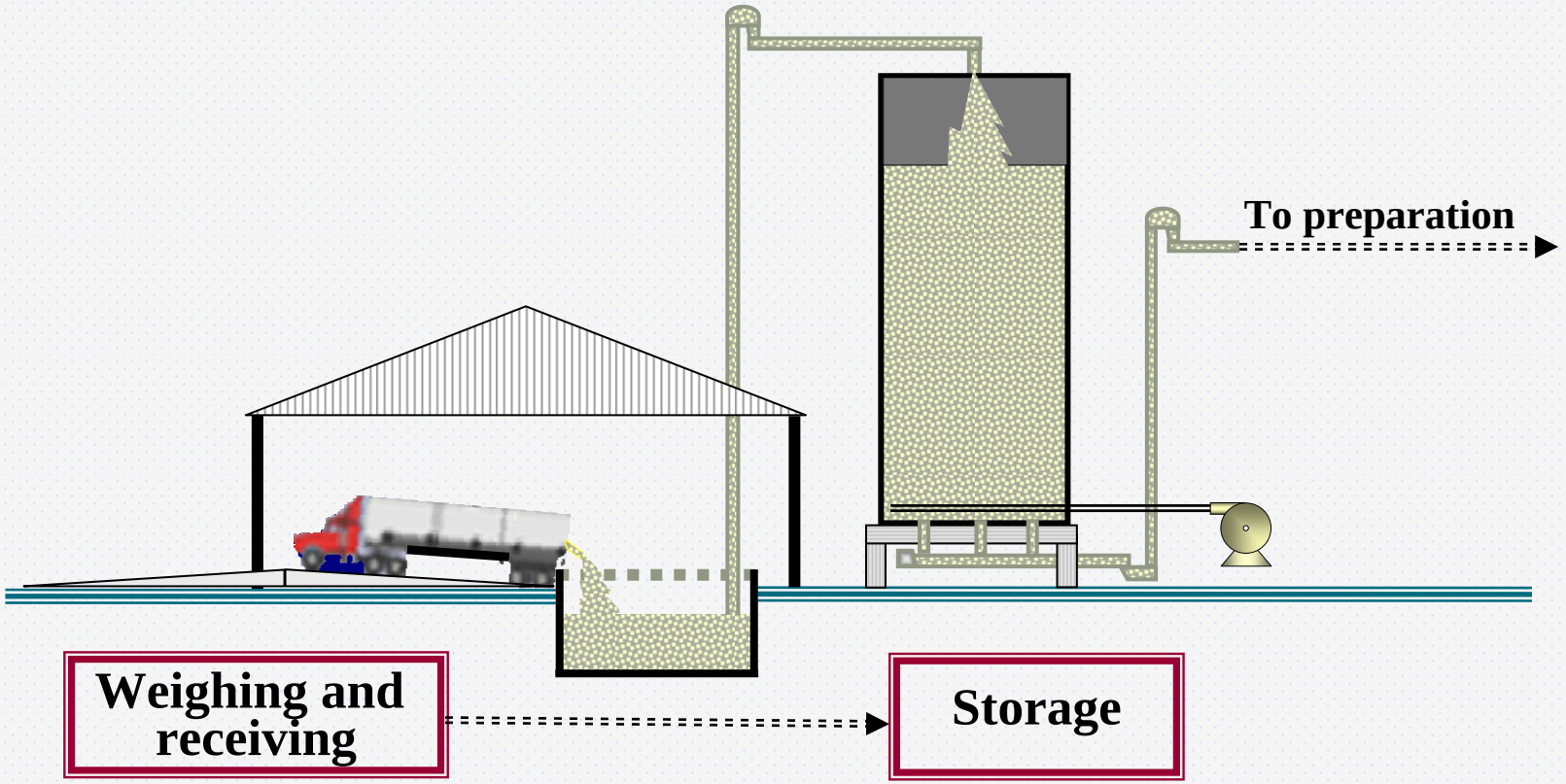
Handling (breakages)	a, b, c, h, g
Bean Storage (t / T / M)	a, b, c, d, g
Bean drying (t / T)	c, d, f
Conditioning (t / T / M)	a, b, d, e
Solvent extraction (t / T / M)	a, d, c, g
Solvent stripping (t / T / P)	a, d, f
Crude oil storage (t / T / M)	c, d, e,

t = time, T = temperature, M = moisture, P = absolute pressure

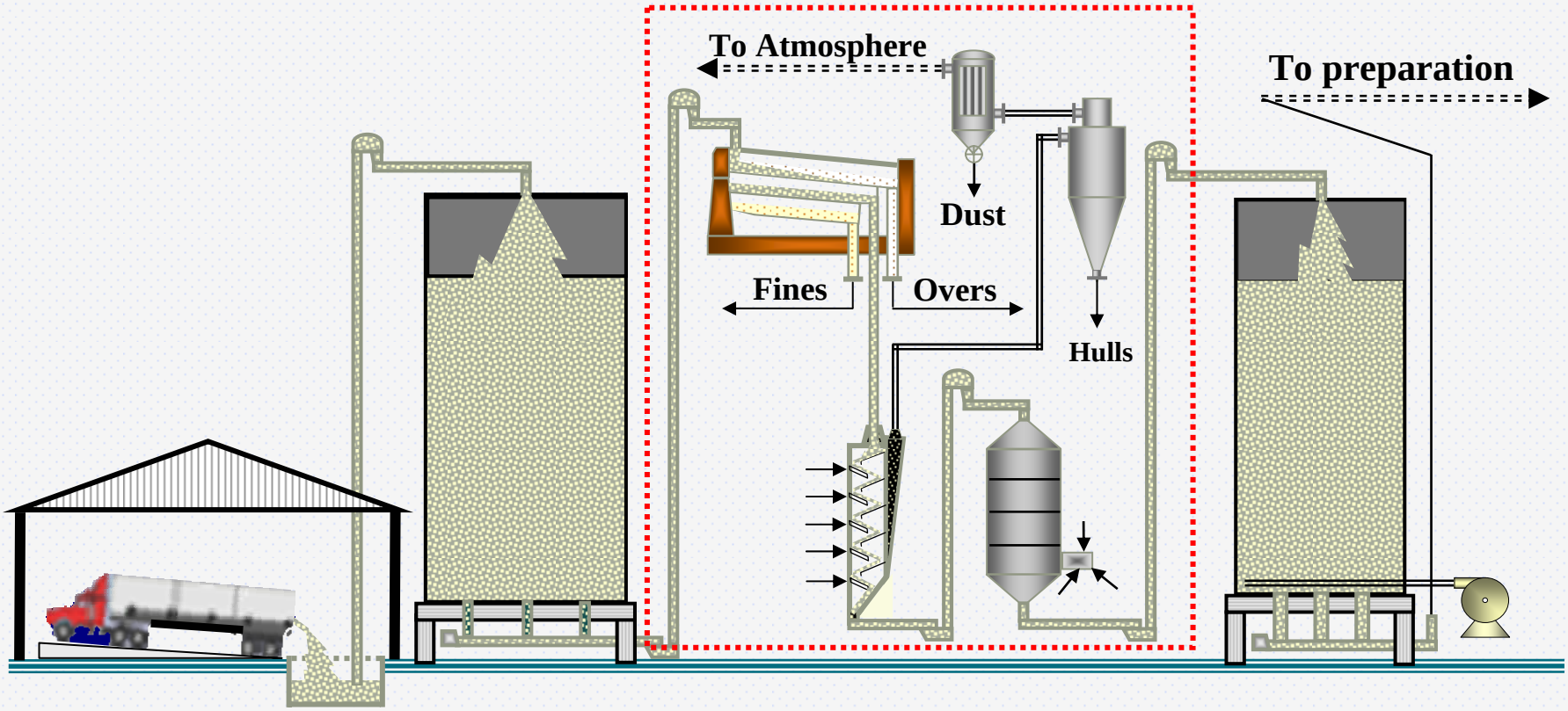
Quality Maintenance of Soybeans During Processing (Soybean receiving and storage step)

- Avoid breakages in the beans and contamination with foreign materials.
- Remove the foreign material and splits prior to storage.
- Control the storage conditions of moisture, temperature, hermetic and aeration.
- Check the grain conditions regularly for sign of deterioration (off-odors, moldy condition, discoloration, heating, and presence of live insects).

Process Requirements and Operating Conditions (receiving, handling, storage)



Soybean Conditioning Prior to Storage



Weighing and receiving → Short-term storage → Pre-Cleaning → Drying at 60-70 C' → Long term storage 11-12% M.< 30 C'

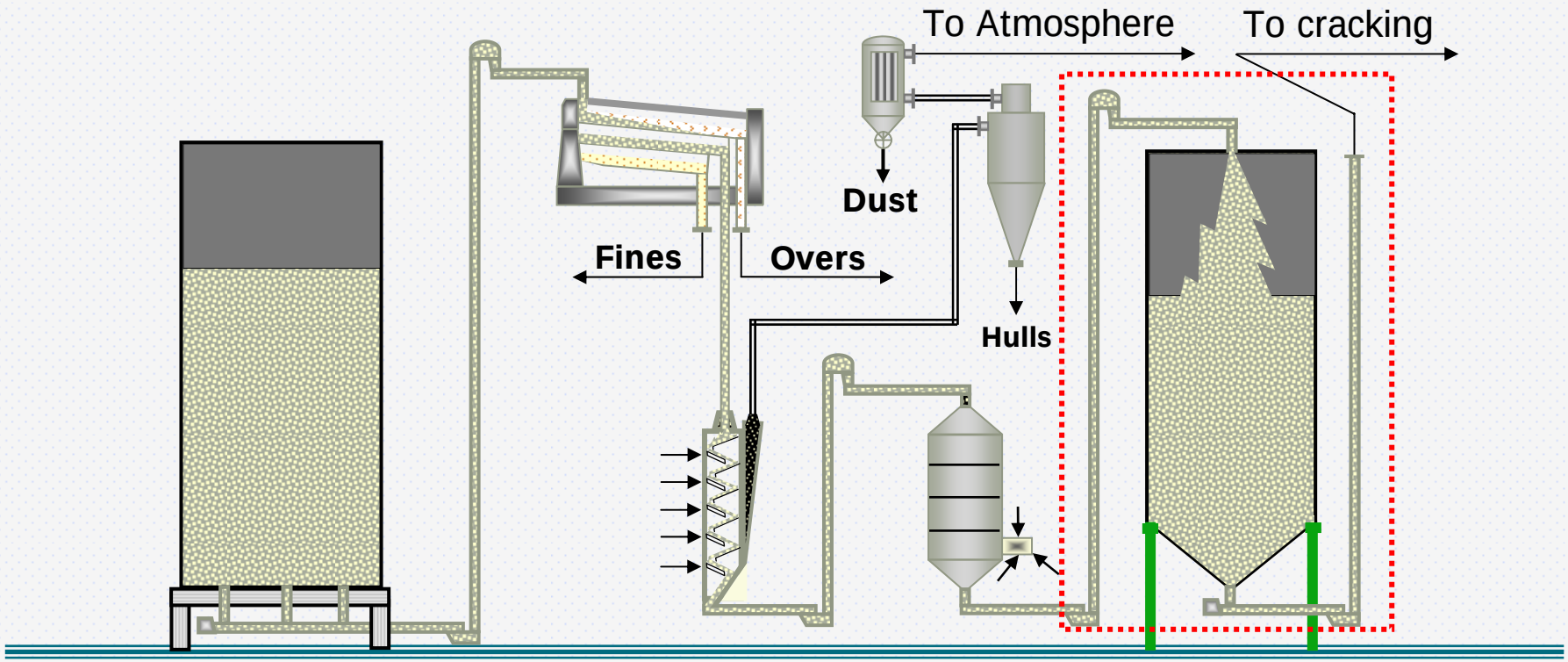
Pre-Cleaning → Trash separation → Non-metallic materials to mill feed

Trash separation → Broken beans-to process

Quality Maintenance of Soybeans During Processing (Soybean preparation and oil extraction steps)

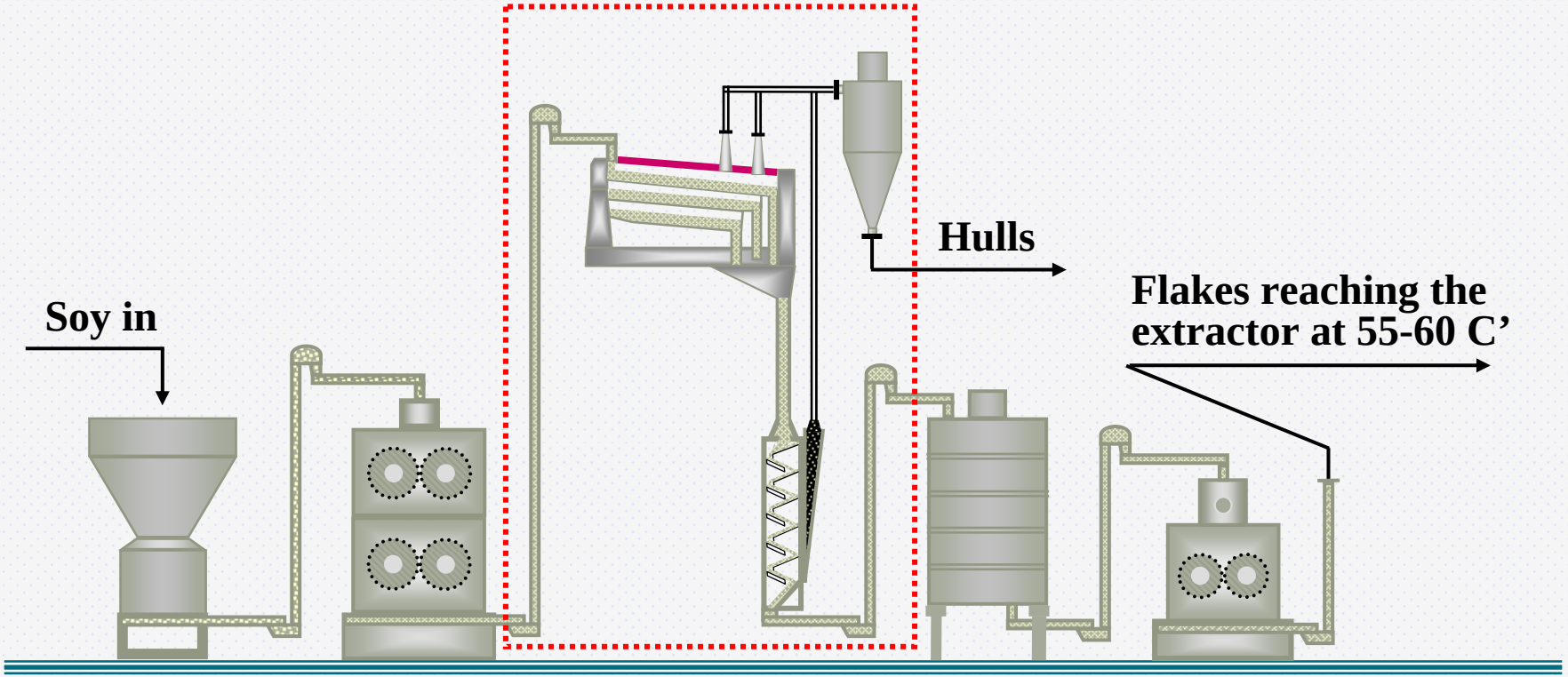
- Use continuous and rapid processing methods. The crushing equipments should be capable to produce a high yield of quality oil.
- Prevent interruptions in operations.
- Remove the foreign material from the beans.
- Dry the beans at optimum combination of temperature and time.
- Inactivate enzymes by proper conditioning of cracked soybeans. (correct Mst/T/t combination)
- Control the moisture and temperature of flakes sent to the extractor.
- Avoid overheating in the desolventizing steps..

Process Requirements and Operating Conditions (cleaning, drying, tempering)



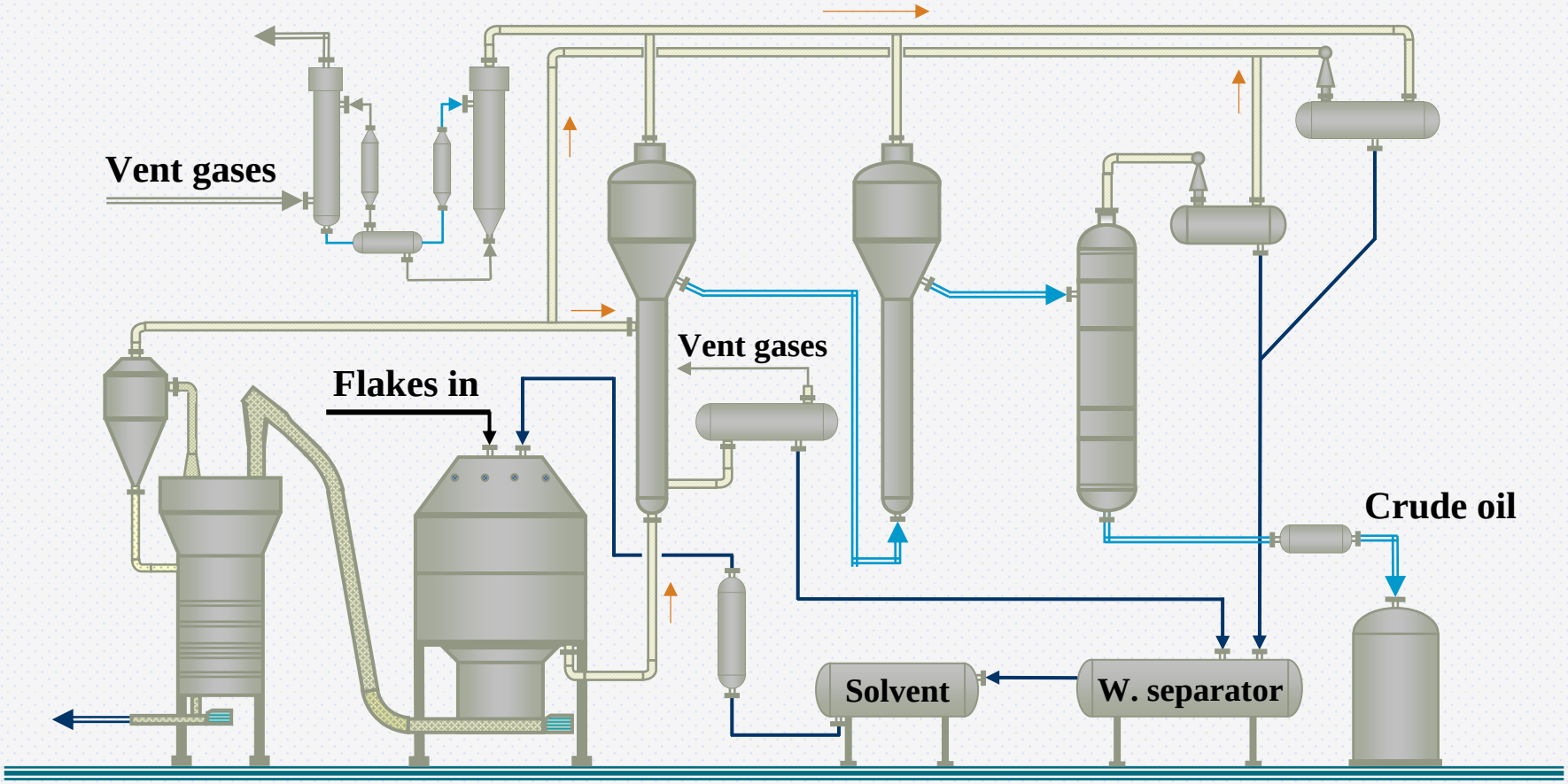
Long term storage	→	Cleaning < 0.5 % FM	→	Drying 60-70 C' to 10-11 % M.	→	Tempering 48-72 hrs 10 % M.

Process Requirements and Operating Conditions (cracking, conditioning, flaking)



Weighing → **Cracking**
4-8 pieces
10-11% M
→ **Dehulling**
10% M
→ **Conditioning**
SB in < 12.5% M
out = 10-11% M
process:65-70 C'
20-30 minutes.
→ **Flaking**
10-11% M
(0.25-035 mm)

Process Requirements and Operating Conditions (solvent extraction and desolventizing)



DTDC	Extractor	1st Evaporator	2nd Evaporator	Striper
Slight vacuum	55-60 C’ 40-60 min. Sl. vacuum	57 C’ 430-460 mm Hg	96-110 C’ 460-550 mm Hg	99-100 C’ max. 710-720 mm Hg

Crude Oil Storage

- Purify the extracted crude oil from fines and solid impurities prior to storage.
- Fill the tank completely from the bottom to reduce the contact with air.
- Keep the oil below critical temperature, moisture and storage time to avoid deposits and oil degradation.
- Provide food grade inert coating to prevent contacts with iron.

Crude Oil Quality

Basic quality parameters for good quality crude soybean oil

- **Moisture < 0.2 %**
- **Peroxide value < 5 meq/kg**
- **Anisidine value < 3**
- **5-10 % of total phosphatides as NHP**
- **20-40% of the FFA will be removed by degumming**

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