Soy Excellence Center
SEC Feed Manufacturing Track – Basic Level

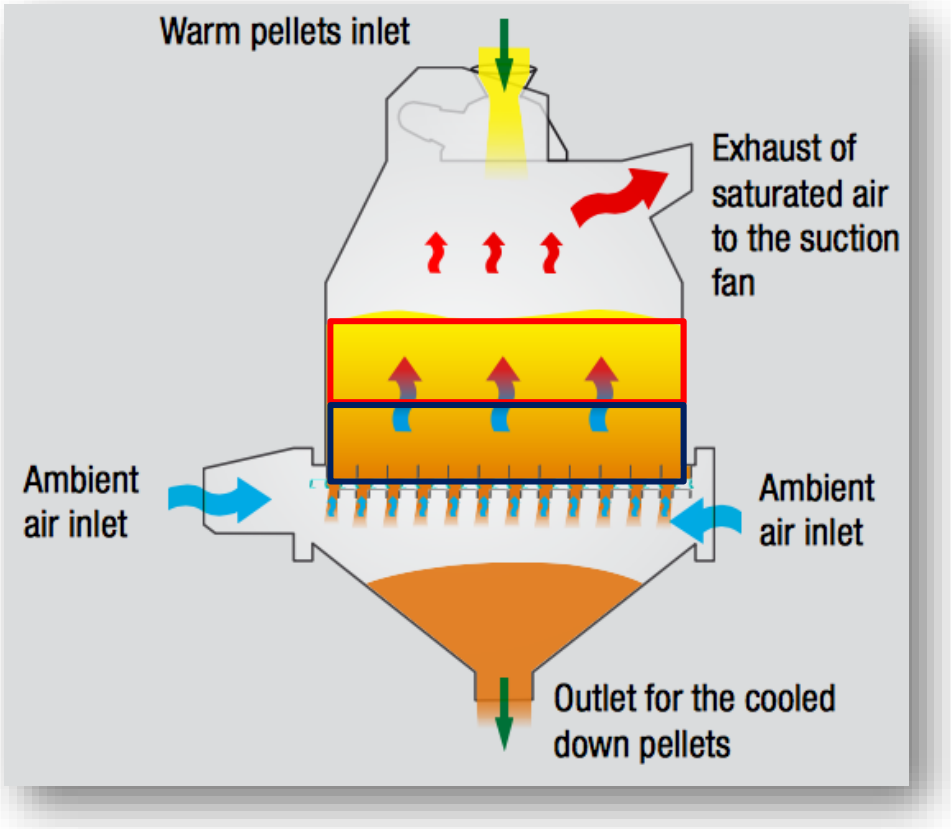
SOY EXCELLENCE CENTER
A USSOY program

Pellet Cooling and Crumbling

Carlos Campabadal, PhD

Cooling

- **Purpose:** Remove *moisture and heat* added during the conditioning and pelleting process
  - Allows for safe storage of the product
  - Hot and moist pellets:
    - Spoil, rapidly which can negatively affect birds' health
    - Poorer FCR – diluted nutrient content
    - Higher trucking costs – moving water to the farm

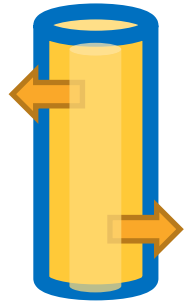


Economic Impact

- Moisture loss – increases shrink
  - Every 1.00% loss in moisture content from purchased raw materials to finished feed is a 1.00% shrink
  - 1,000 tons/week x 1.00% = 10 tons of lost product x $350/ton = $3,500
- Moisture gain – less shrink, but poorer FCR
  - 1.00% gain in moisture content from purchased raw materials to finished feed is a 1.00% gain
  - 1,000 tons/week x 1.00% = 10 tons of gained product
  - Bird have to eat more to get the same nutrition intake due to the dilution of the nutritional value
  - 1% moisture gain = 2 points of loss in FCR

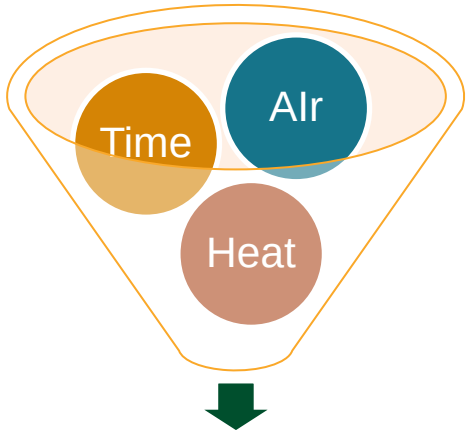
Moisture Removal

- Must take place prior to cooling of the product
  - Cooling too quickly will leave pellets cool but damp.
  - Shocking the pellets can break the capillary action and stop or slow down the moisture migration
- Around 4% of water is added in the conditioner
  - Pellet mill running at 50 ton/hr x 4% = 2 ton of water = 4000 pounds/hr
- Moisture removal is influenced by: pellet size, pellet temperature, fat content, relative humidity

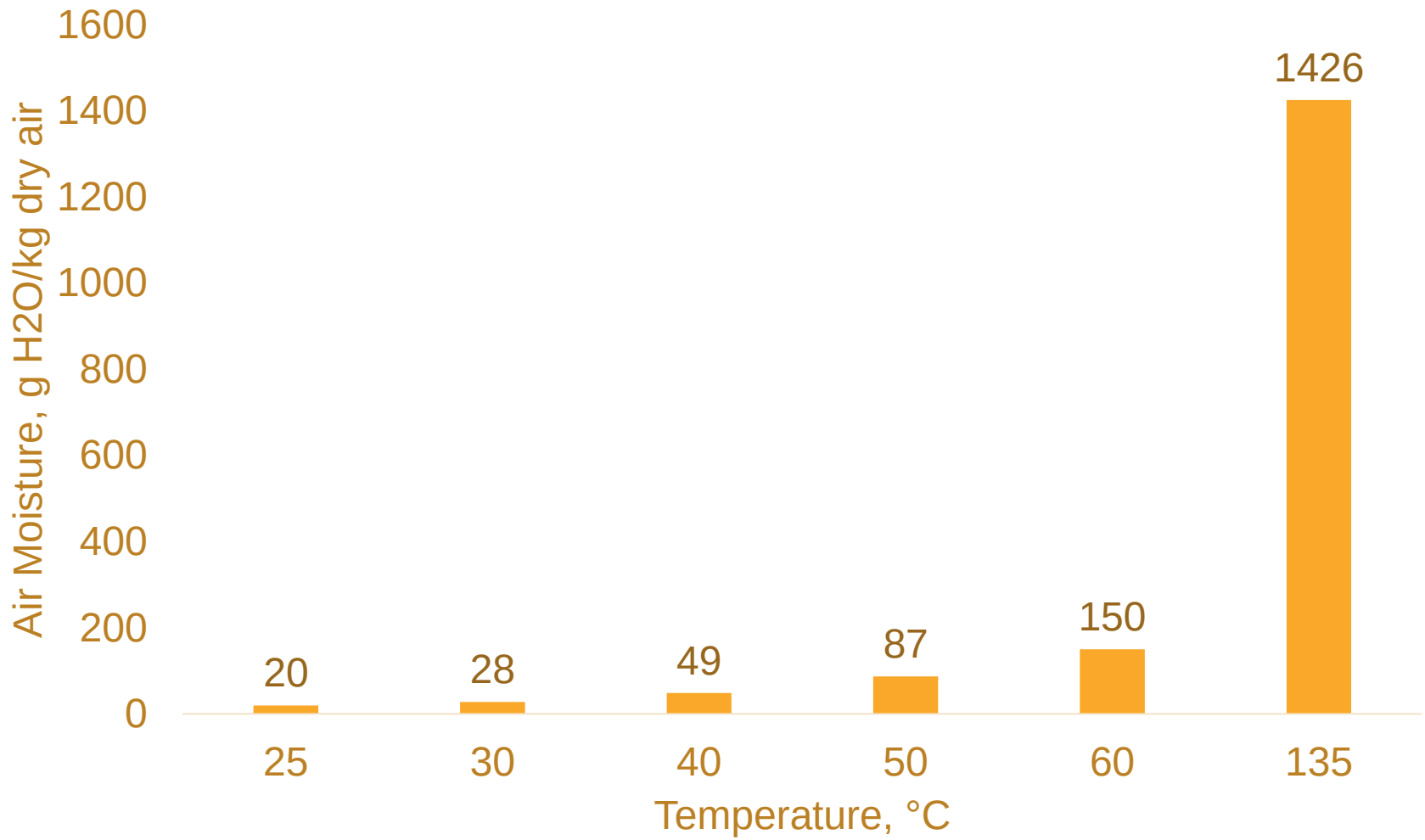


Cooling Requirements

- Air
  - Carries away of remove heat and moisture
  - Works in the surface of the pellets
- Heat
  - Required to remove moisture
  - Heated air expands lowering relative humidity and increases the drying capacity of the air
- Time
  - Required for optimum heat and moisture to the surface of the pellet
    - Typically – 7.5 to 8.5 min are needed for proper cooling/drying



Temperature and Water Holding Capacity



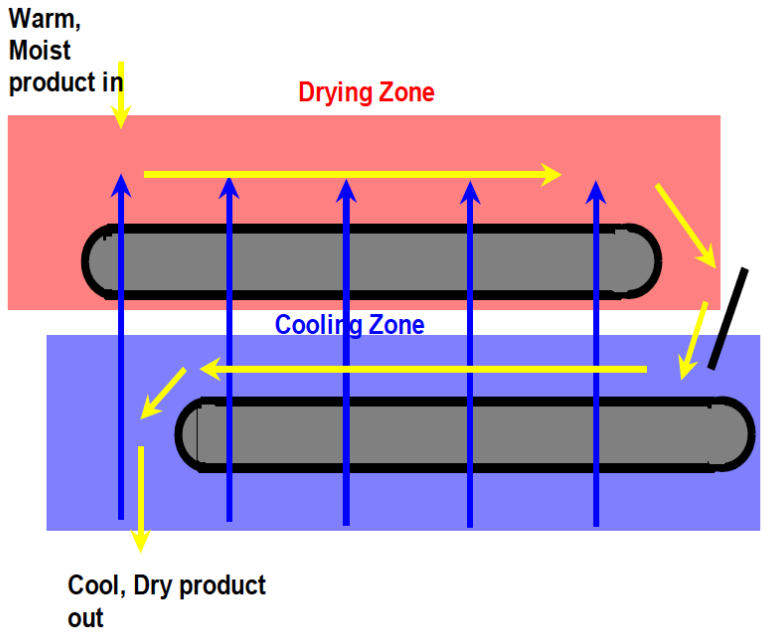
Expectative

- 10 -12 ºF (5-7ºC) above ambient temperature
- +/- 0.5% moisture compared to mash moisture

Types of Coolers

Hot/moist pellets In

Cold/Dry pellets out

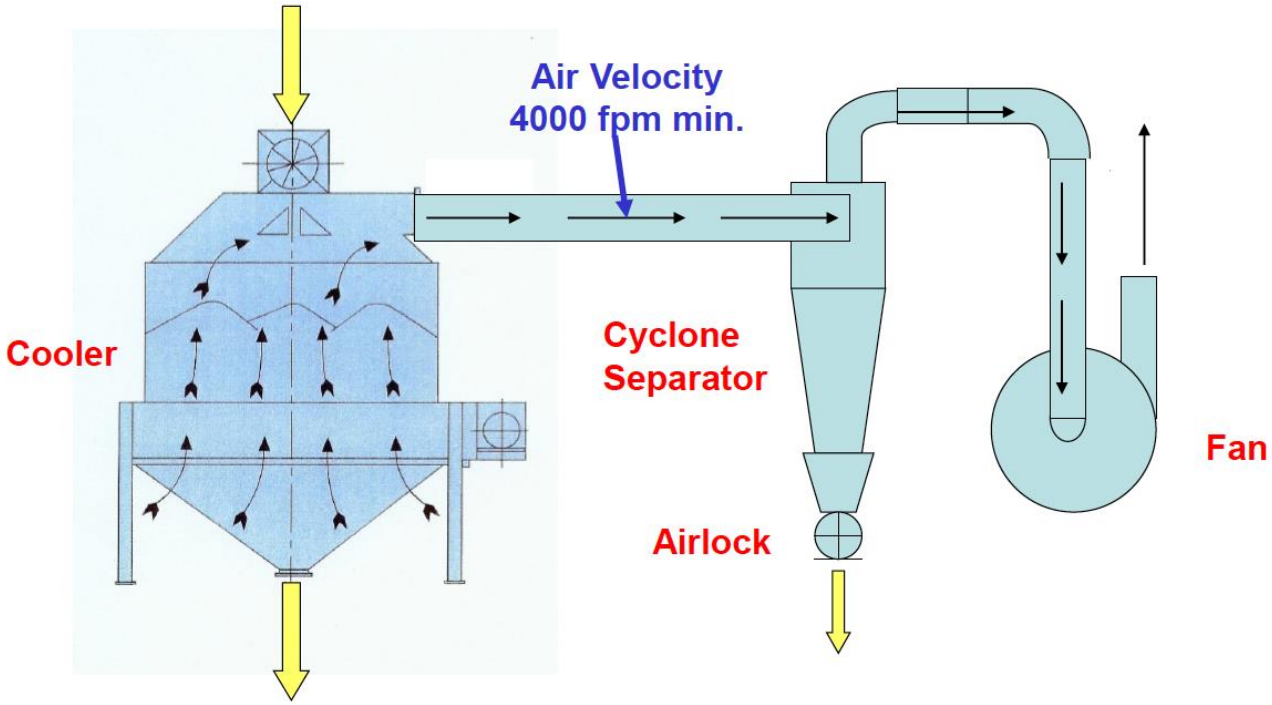


Horizontal:

- Single pass
- Double pass

Source: CPM

Types of Coolers



Counterflow:

- Round design
- Square design

Source: CPM

Counterflow Coolers

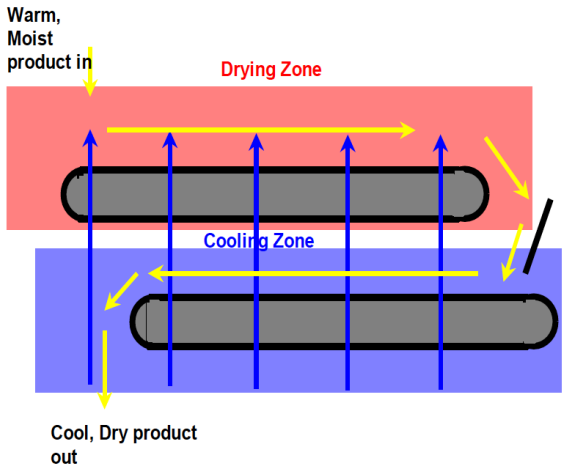
- Distribution arm helps maintain a level pellet bed depth
- The floor grid allows air to flow through the grid but when it rotates 90 degrees the cooled pellets can drop out of the cooler
- Pellet bed depth uniformity is important in the cooling process regardless of the type of cooler as air takes the path of less resistance
  - Poor pellet depth uniformity leads to variation in temperature and moisture of the final product

Counterflow Coolers

- **Advantages**
  - Minimal floor space required
  - Low air requirement
  - Lower capital investment compared to horizontal coolers
  - Mechanically simple
- **Limitations**
  - Not good for small particles
- **Performance**
  - Most effective at drying

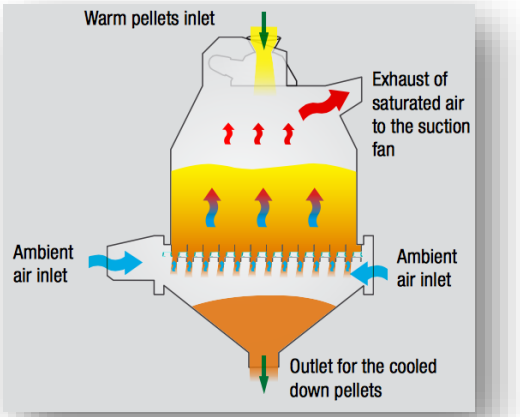
Horizontal Coolers

- Product is moved by the pans from one end of the cooler to the opposite end where it falls onto the bottom deck and then is conveyed back to the starting end.
- The bottom pass is considered the cooling zone
  - Air is pre-heated prior o going thru the pellet on the top deck where the majority of the drying occurs
- It is important to keep the bed depth level in the cooler as the air will take the path of least resistance and only cool the pellets in the shallow part of the cooler bed

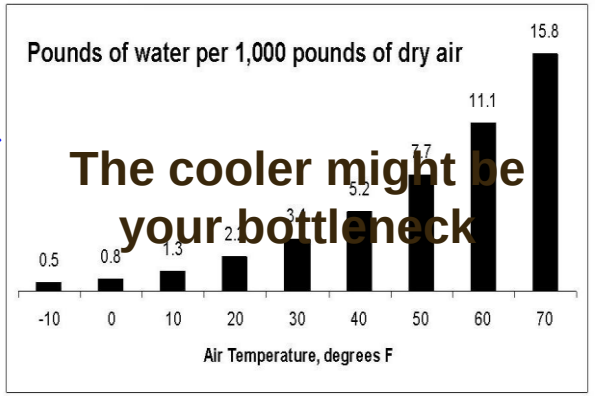


Cooler Management

- Considerations:
  - Airflow
  - Bed depth and uniformity
  - Retention time
- Monitor temperature and moisture content of finished feeds



Temperature[1]	Moisture[2]	Corrective Action	
		Air Flow	Bed Depth
OK	High	↓	↑
High	High	↑	↑
OK	Low	↑	↓
Low	High	↓	↑
Low	Low	↓	-

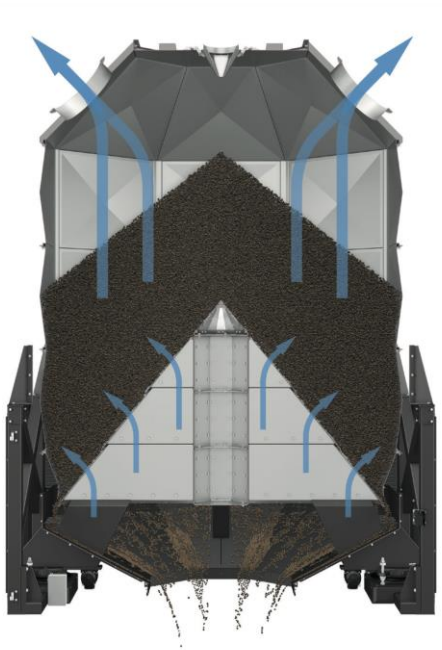


Adapted from Fairchild, 2015 (IGP Institute, Basic Feed Manufacturing Short Course, Manhattan, KS)

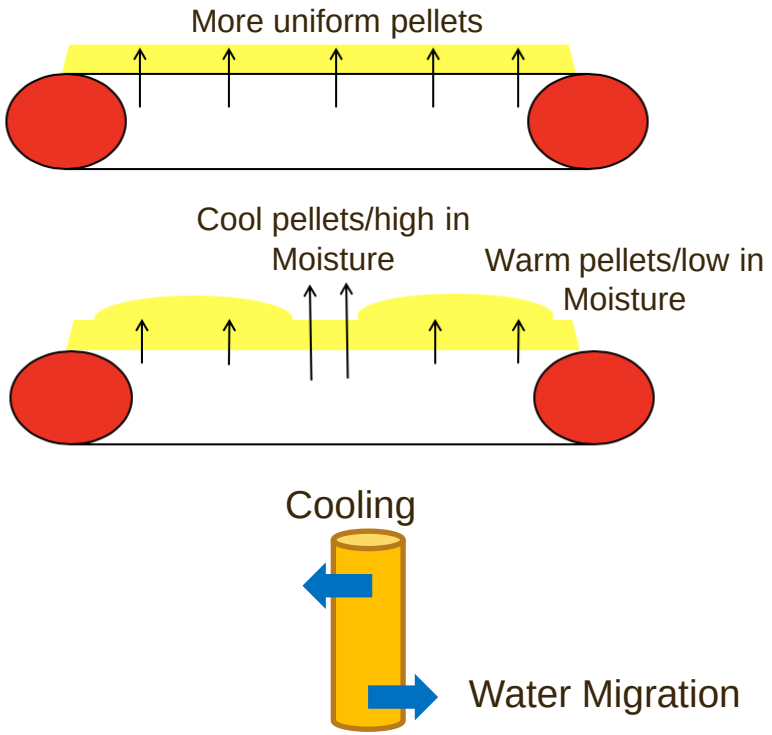
[1] Pellet temperature should be 5-10°F above ambient temperature

[2] Moisture content ±0.5% of the original mash moisture

Better Cooling = Better Quality



Coolex™



Exhaust System

- Maintain the correct velocity to accommodate coolers' production
  - Poor design can lead to condensation and particle accumulation in the air duct system
    - Air leaving the cooler has a high humidity –
      - Moisture picked up from the pellets
    - Condensation of moisture also leads to accumulation of wet particles in the duct work
    - Air speed in the duct system should be 4,000 CFM or higher

Wellhausen, 2018

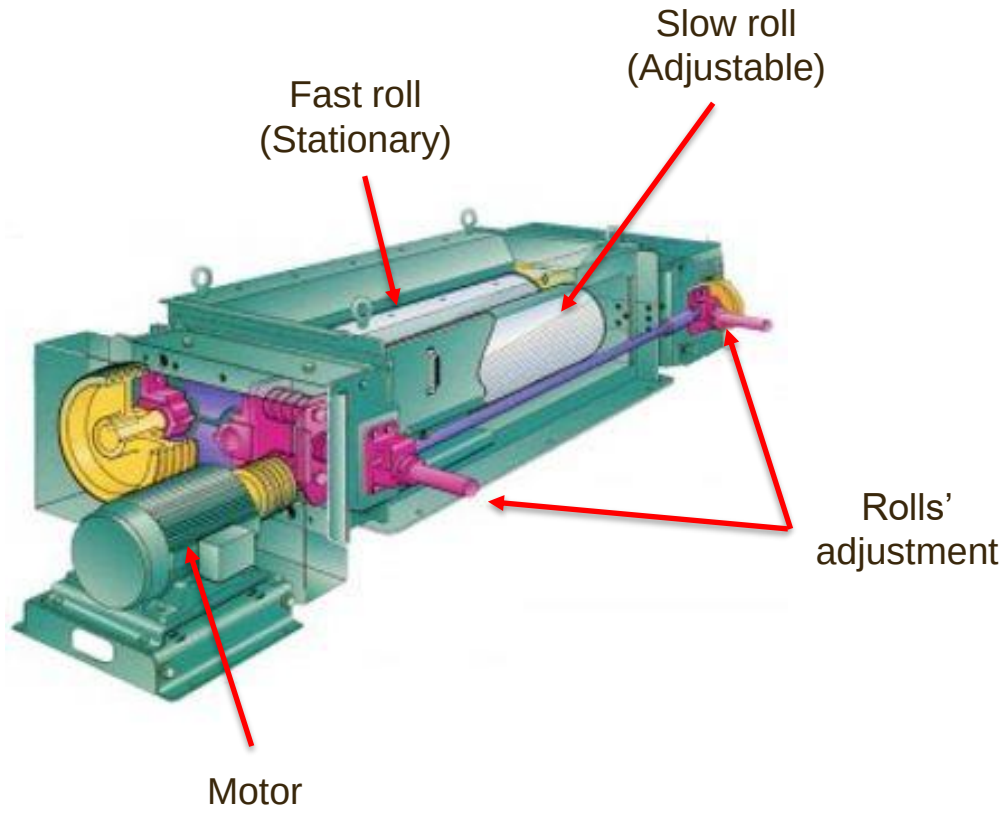
Exhaust System

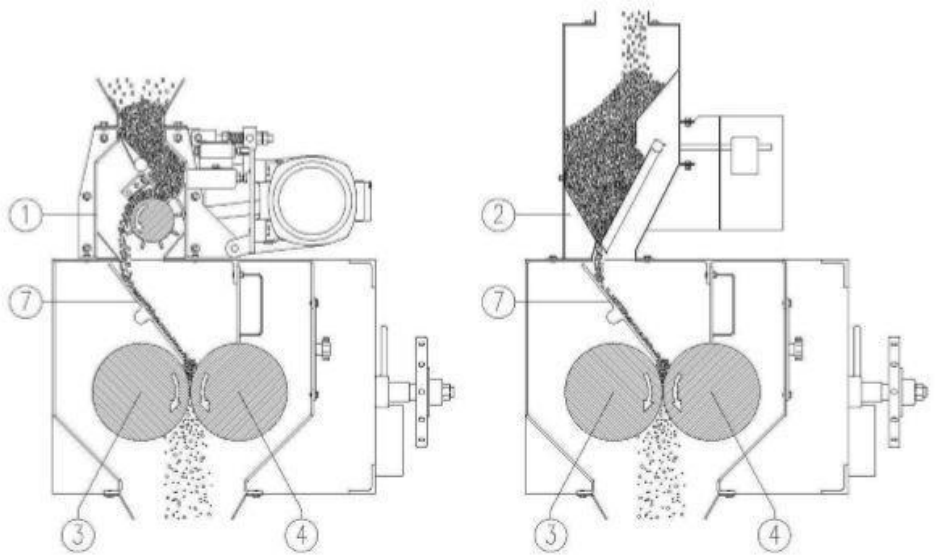
- 120º to 130F (48.8ºC) in duct for double deck horizontal cooler (lower bed level and higher cfm's)
- 130º-140ºF (54-57ºC) in duct for counterflow cooler (thicker bed depth and lower cfm's)

Crumbling

- Accomplish by cutting/shearing of whole pellets into smaller pieces
- More efficient than changing to a smaller hole size die as pellet mill capacity drops significantly with smaller pellet diameters
- Small chicks cannot consume whole pellets, particularly those with more than 4 mm in diameter

Crumbler

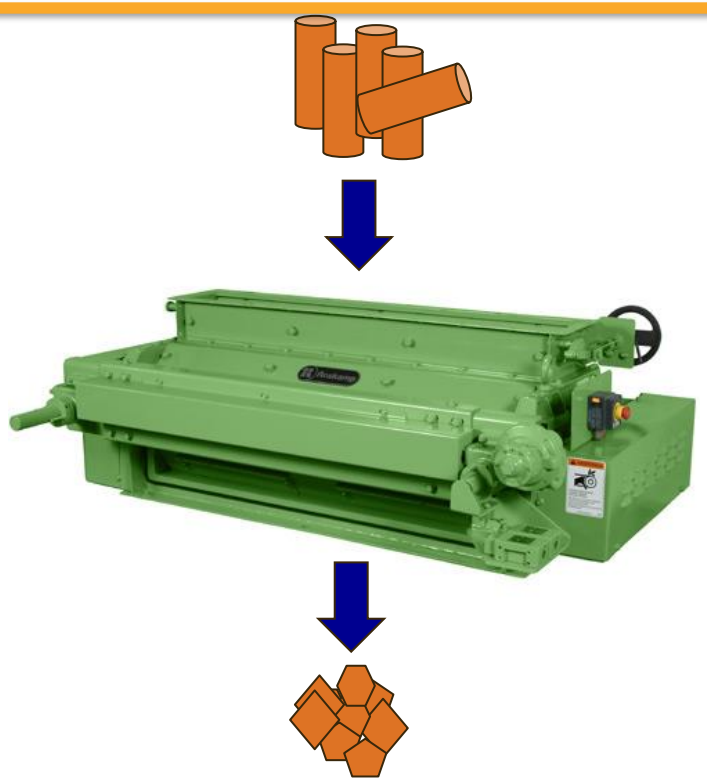

Slow roll
(Adjustable)
Fast roll
(Stationary)
Rolls'
adjustment
Motor

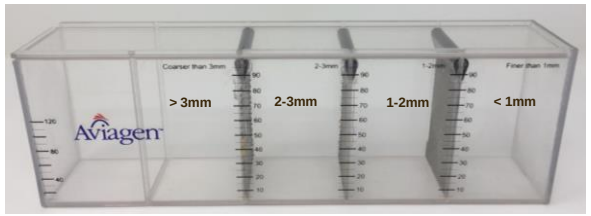

1
7
3
4
2
7
3
4

Crumbler

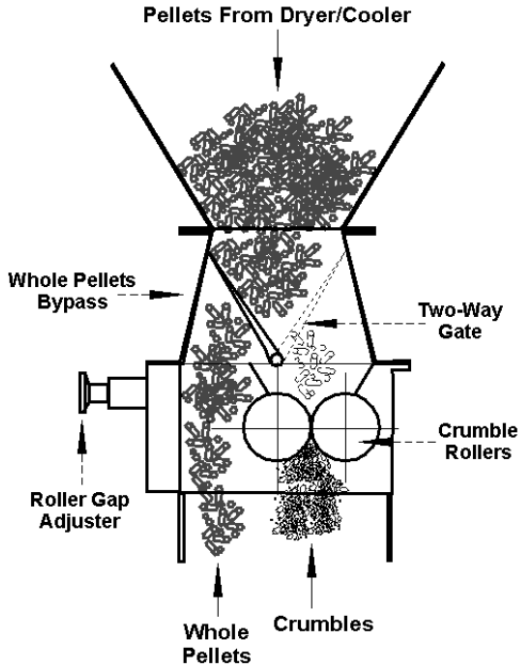
- **Crumbling action**
  - Passing whole pellets between a pair of rolls
- **Cutting action**
  - Turning one roll faster than the other.
- **Speed differential**
  - Typically is 1.5:1 ratio
- **Considerations:**
  - Feeding across entire length of rolls
  - Adjusting the rolls for uniform roll gap

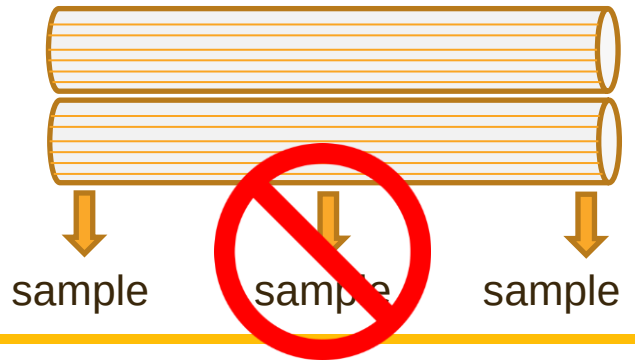
Crumbler Quality





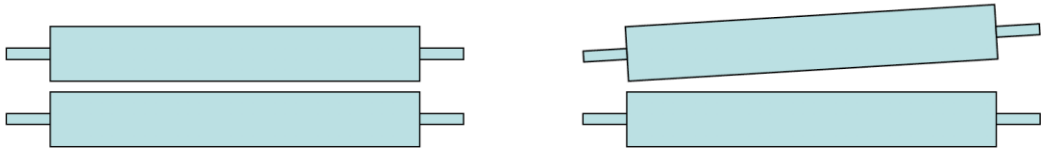
15% 40% 35% 10%





Rolls Adjustments

Roll Gap
(looking down from above)

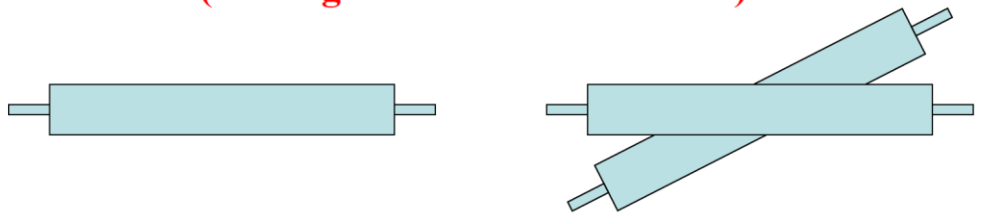


Correct
(Uniform Spacing)

Incorrect
(Varied Spacing)

Rolls Must Be Parallel

Roll Tram
(looking from front of machine)



Correct
(Rolls Aligned)

Incorrect
(Rolls Not Aligned)

Rolls Must Be In Alignment (Tram)

Pellet Quality

Summary

- **Cooling and drying is influenced by:**
- **Air temperature:**
  - Cold Air – Low water holding capacity
  - Warm Air – Higher water holding capacity
- **Pellet bed depth**
  - Horizontal – 12 to 15” level across the pans
  - Counterflow – 2/3 to 3/4 full
- **Air volume**
  - Must be adjusted based on ambient temperatures, humidity, and bed depth in order to achieve a balance between the drying and cooling of the pellets.

Wellhausen, 2018

Thank You!

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