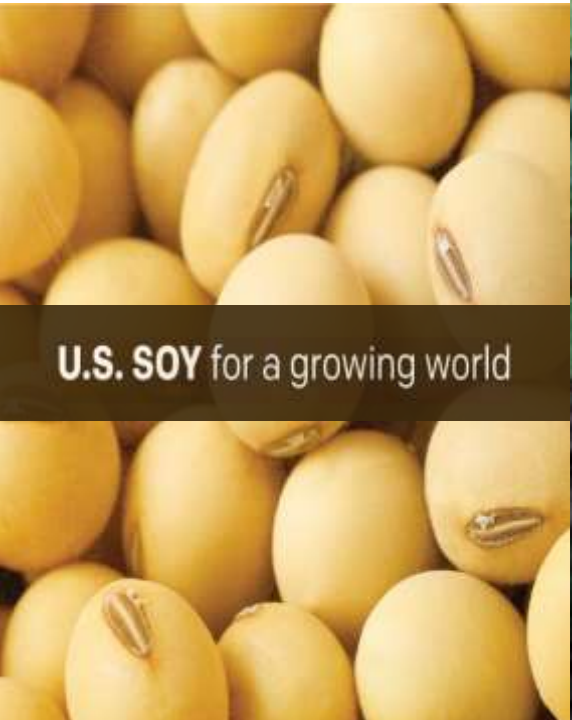


A photograph of a vast, green soybean field under a clear blue sky, serving as the background for the slide.

# **PELLETING: FACTORS AFFECTING PELLET QUALITY AND FEED VALUE**

**Keith Behnke  
Professor Emeritus  
Kansas State University, Manhattan, KS**

A close-up photograph of numerous yellow soybean seeds, filling the bottom-left portion of the slide.

**U.S. SOY** for a growing world

# Why Do We Pellet Feed?

- Decrease ingredient segregation
- Decrease refusal or choice
- Decrease wastage
- Microbial control
- Improve handling characteristics and density

**Improved feed conversion and growth rates**

# Feed Form Affects

## ■ Bird Behavior

- Aggression
- feeder height or type recommendations
- Space
- Sex
- Body weight differences

## ■ Nutrition

- Changes in requirement for limiting nutrients
- formulation restrictions for feed form
- Ingredient choice restrictions

## ■ Physiology

- anatomical changes due to genetic selection
  - Changes in physical anatomy
  - Changes in gut maturation and function
- feed intake rates
- feed passage rates

Does Pellet Quality Really  
Affect Bird Performance??

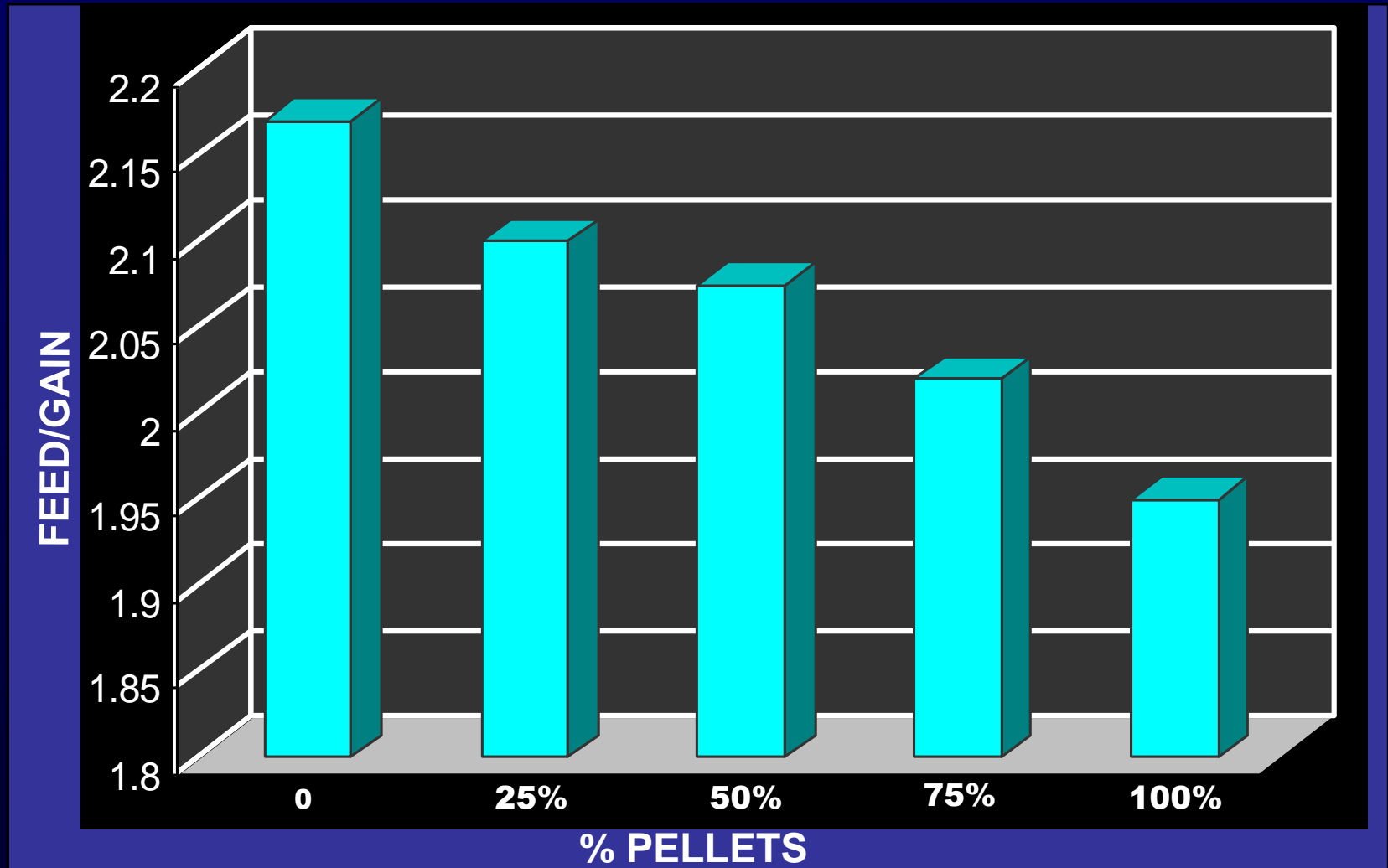


## Effects of Fines on Growth Rate of Broilers



Beyer et al. 2000

# Effect of Fines on Broiler Feed Conversion



Beyer et al. 2000

**What is the *'required'*  
PDI or percent pellets  
in a broiler/turkey  
ration?**

**IF GIVEN A CHOICE,  
WHAT DO THEY CHOSE?**

# Choice of Feed Form by Heavy Broilers

% Pellets	Feed Form Consumed (g)		
	Pellets	Fines	% Pellets
0	0	204	---
25	155	104	60
50	323	57	85
75	459	10	98
100	445	29	94

# ISSUES IN PELLETING?

**PELLET QUALITY**

**VS**

**PRODUCTION RATE**

# PELLET QUALITY

**IS:**

**...the ability of pellets to take handling  
without generating excessive fines.**

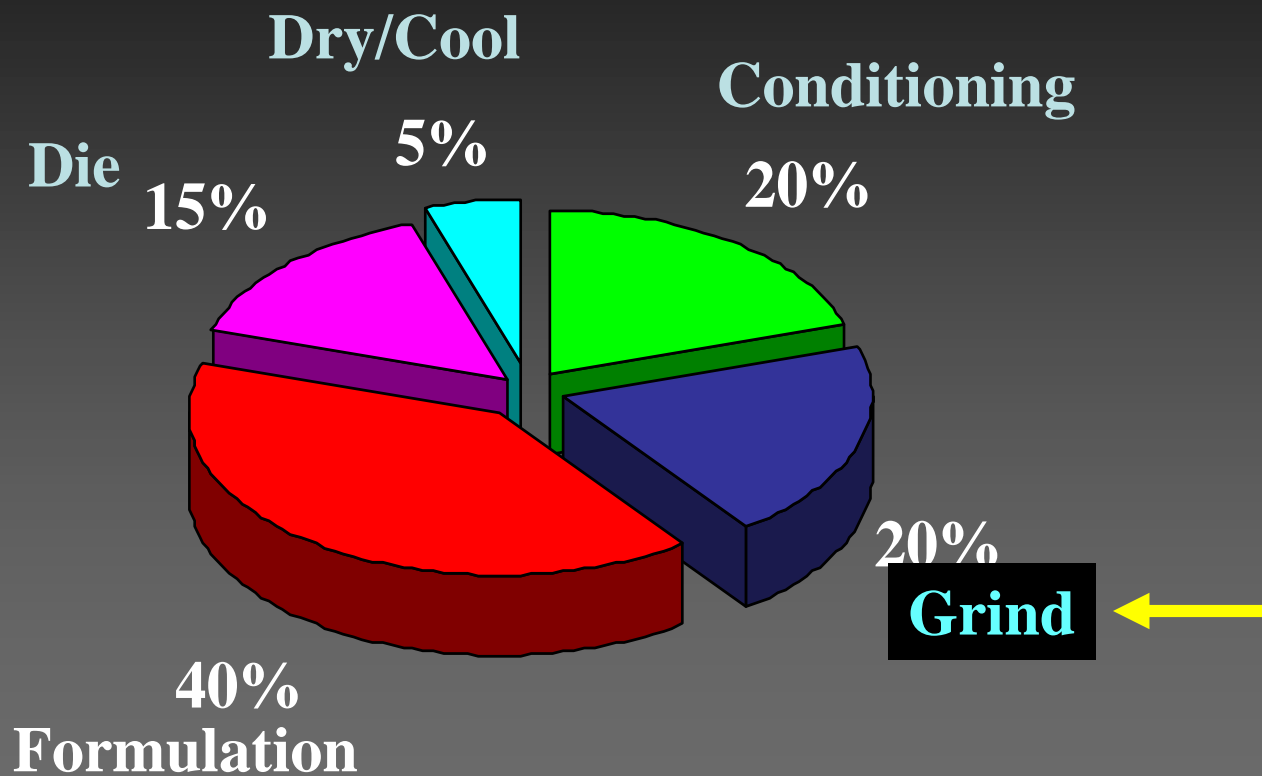
# **MEASURING PELLET QUALITY**

- \* Subjective measurements**
  - Visual appraisal of the pellets?**
  - Shiny surface????**
- \* Objective measurements**
  - Tumbling can**
  - Holman pneumatic tester**
  - Kahl Hardness tester**

# MEASURING PELLET QUALITY



# PELLET QUALITY FACTORS



# MAJOR FACTORS AFFECTING PELLET QUALITY

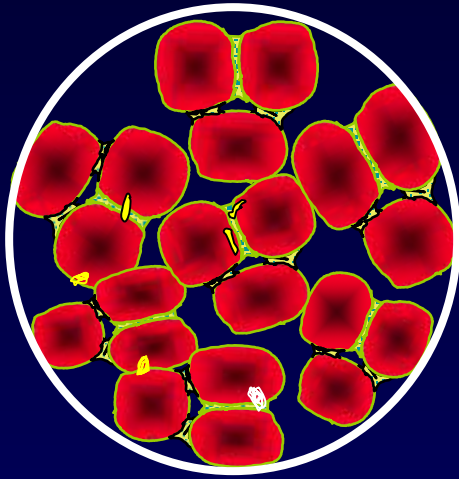
## GRIND-

As a rule, the *finer* the grind, the *better* the pellet quality.

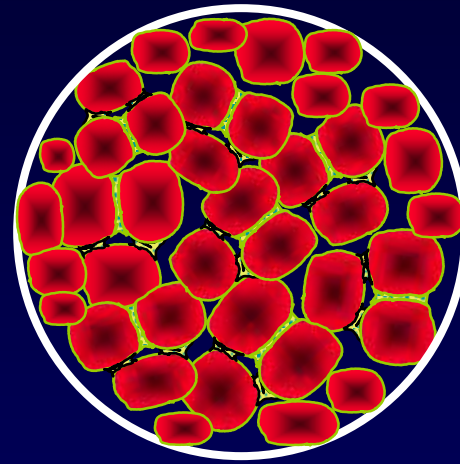
Fine grinding increases surface area and reduces particle diameter.

More surface area, better conditioning.

# GRIND AFFECTS PELLET QUALITY



**COARSE GRIND  
PELLETS**



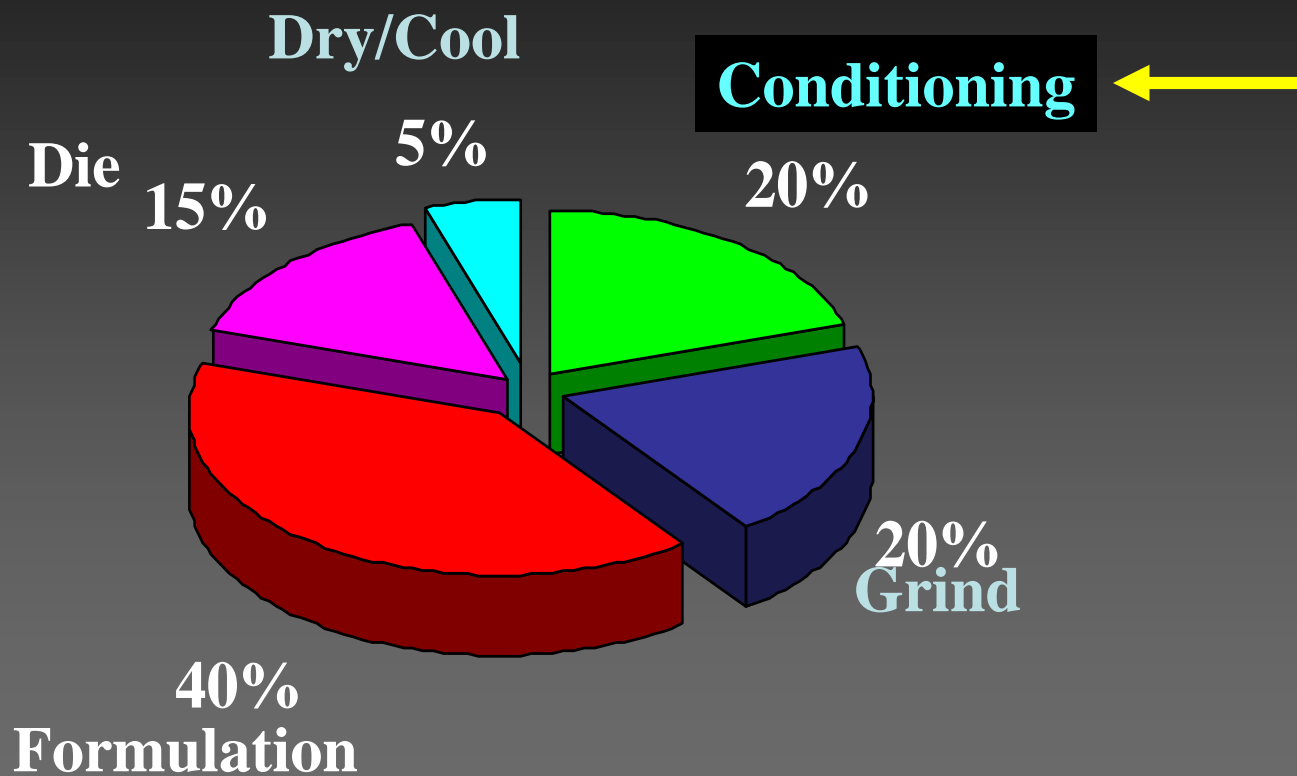
**FINE GRIND  
PELLETS**

# **MAJOR FACTORS AFFECTING PELLET QUALITY**

## **GRIND-**

**Post-Grind results in a more uniform particle distribution that often results in better pellet quality. But can be successful with either Pre- or Post grind operations.**

# PELLET QUALITY FACTORS



# PELLET QUALITY FORMATION

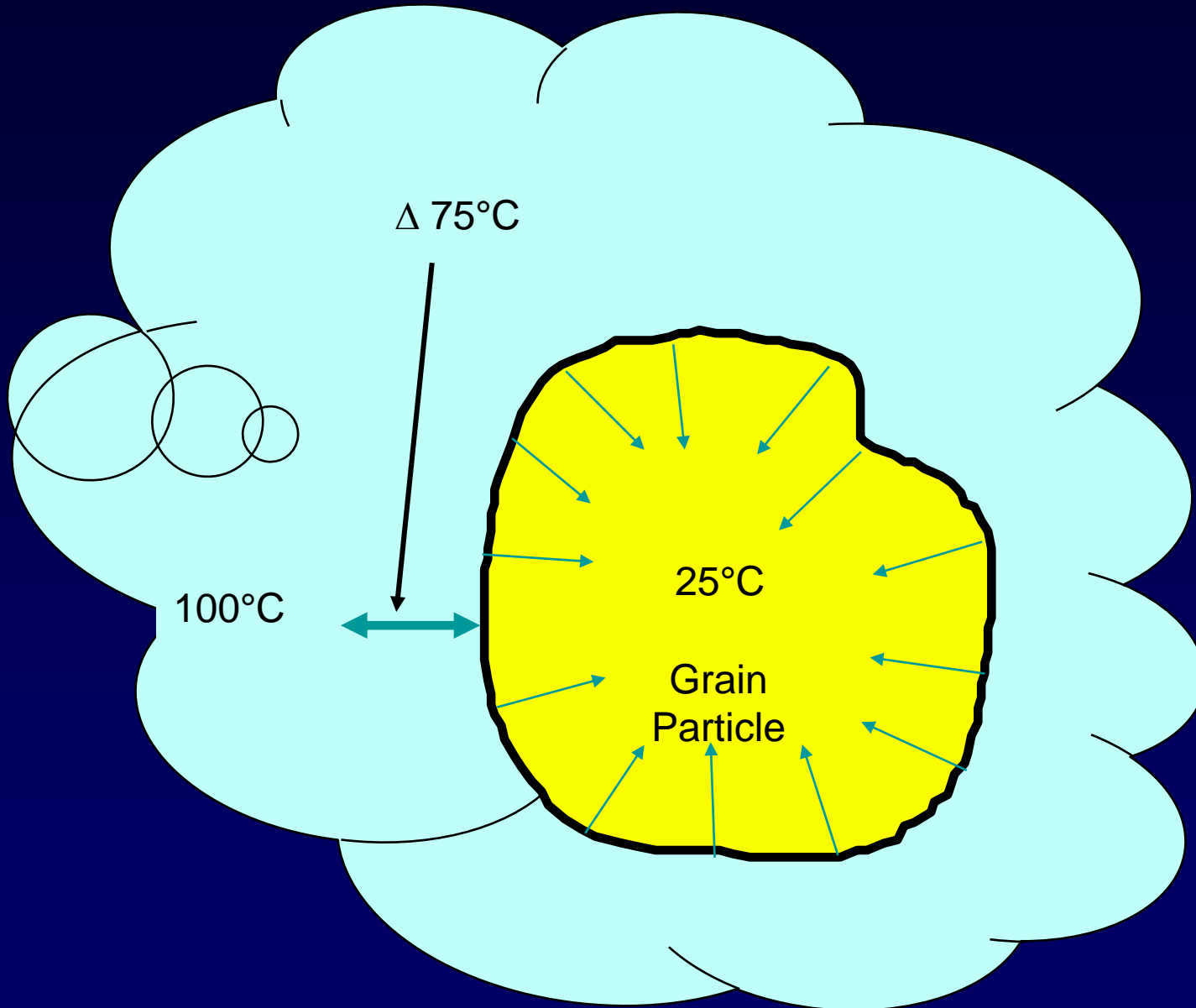
Pellet Quality is Primarily  
Established in the  
Conditioner,  
Not in the Pellet Die.

# STEAM CONDITIONING

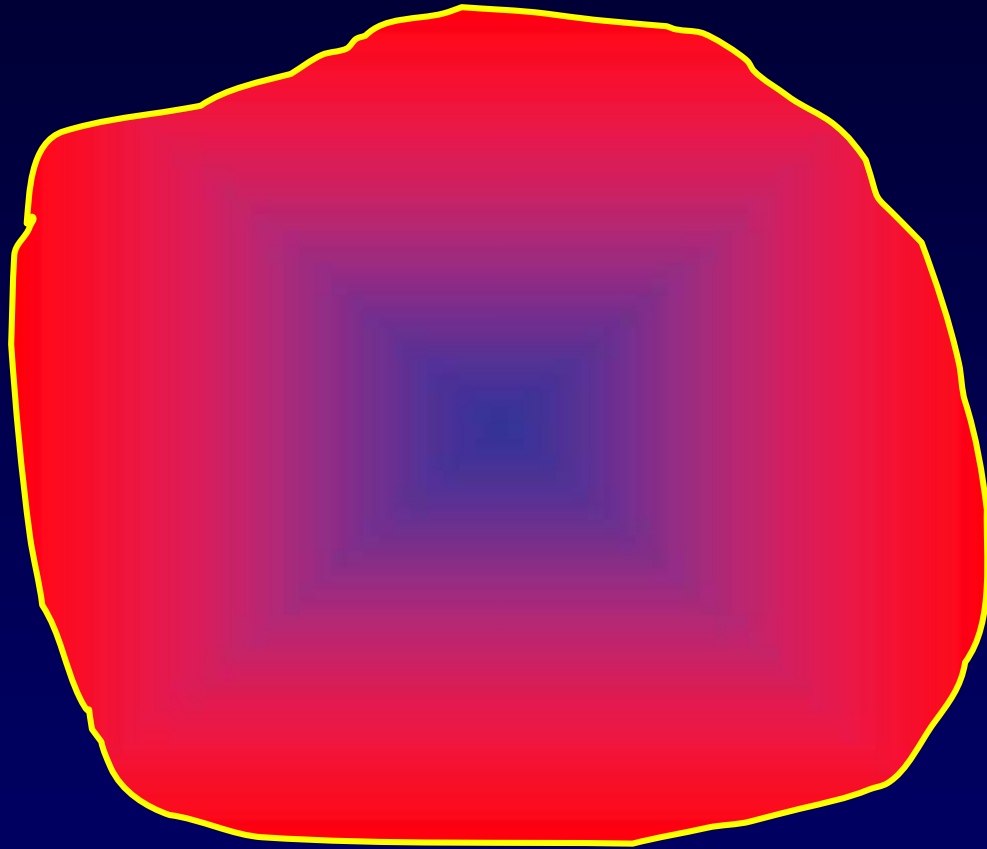
Steam has the ability to carry and transfer both heat and moisture efficiently through the process of

**“CONDENSATION”.**

# STEAM CONDENSATION



# HEAT/MOISTURE DIFUSION

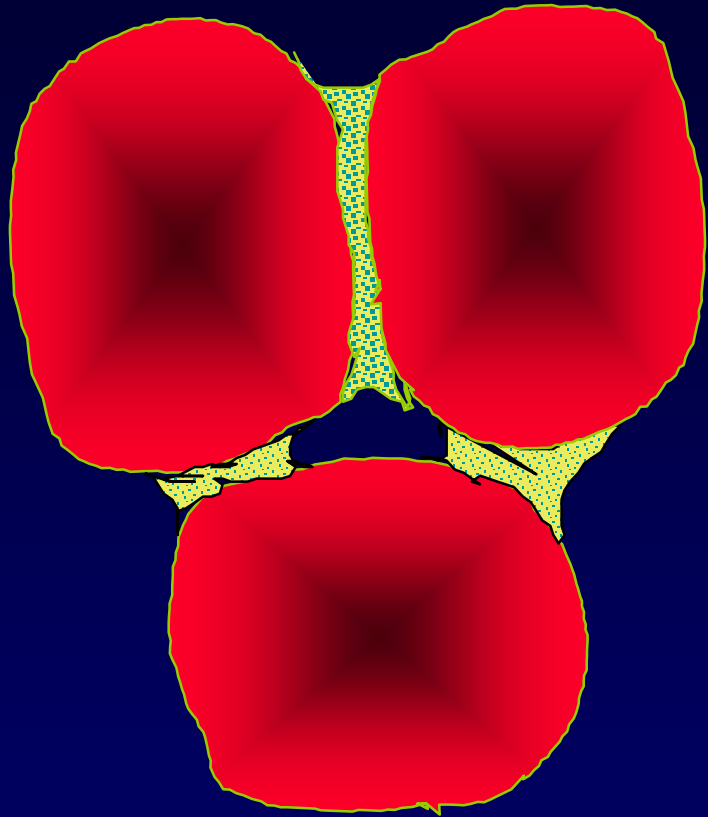


Starch at the surface of  
The particle is gelatinizes  
And becomes soluble

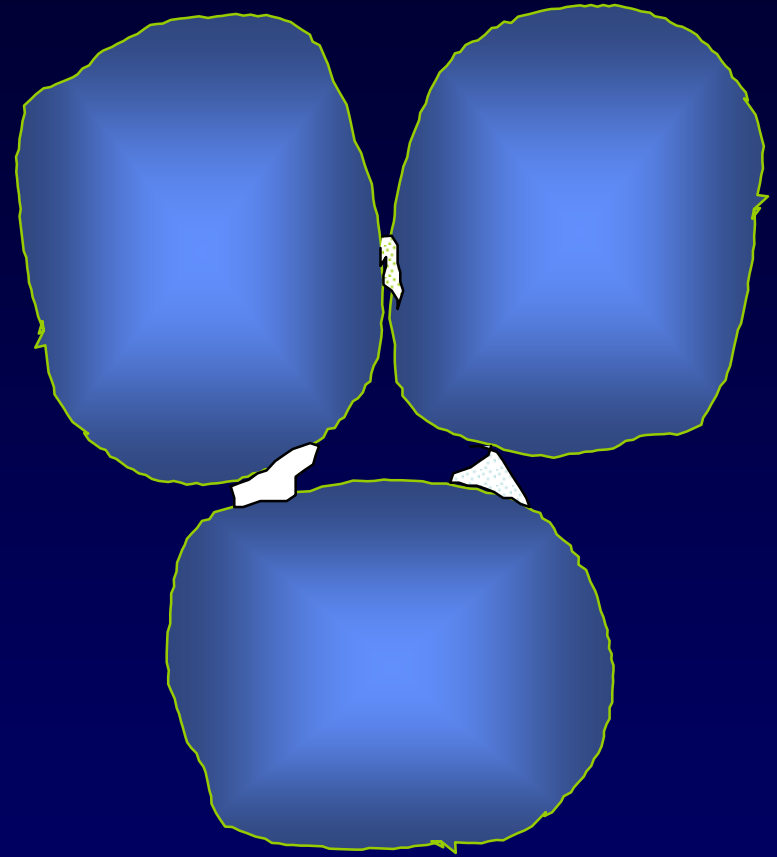


TIME!!!!

# PARTICLE ADHESION



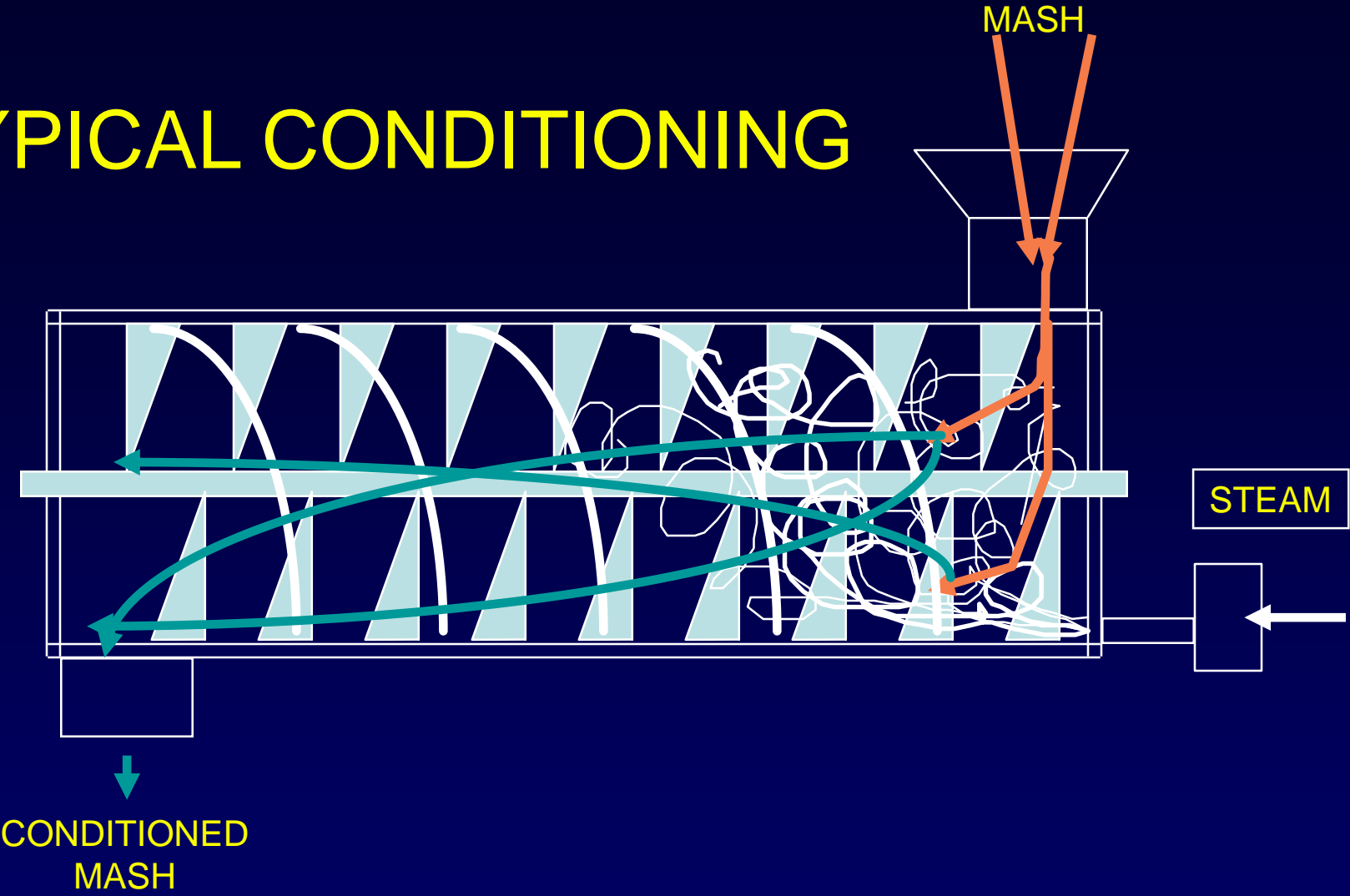
HOT/MOIST  
CONDITIONING



COOL/DRY  
CONDITIONING

**CONDITIONER  
DESIGN, SELECTION AND  
OPERATION**

# TYPICAL CONDITIONING



# CONDITIONER OPTIONS

## *RETENTION TIME*

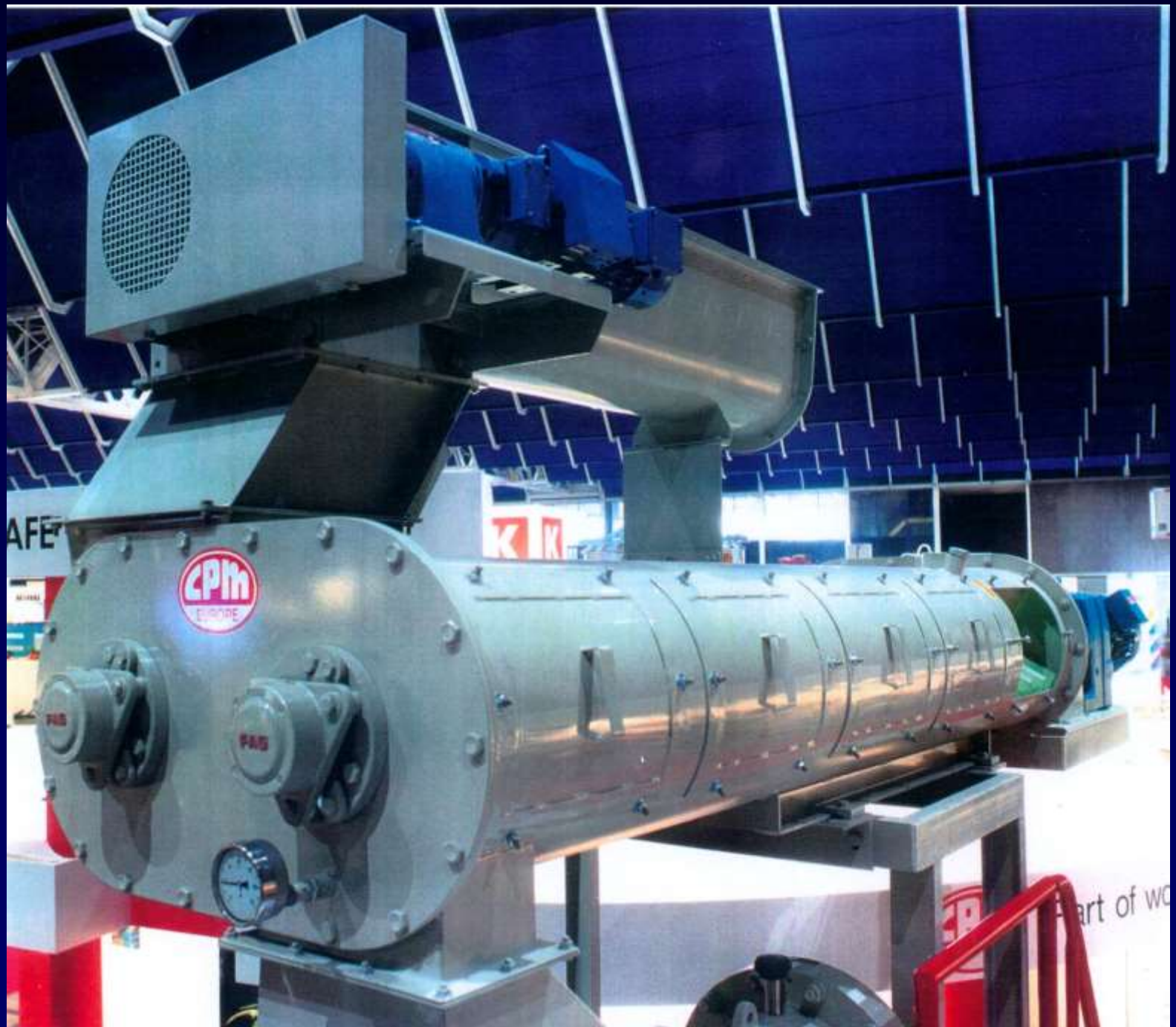
1. Conditioner Volume (single pass vs. double pass)
2. Pick (paddle) Angle.
3. Shaft Speed.

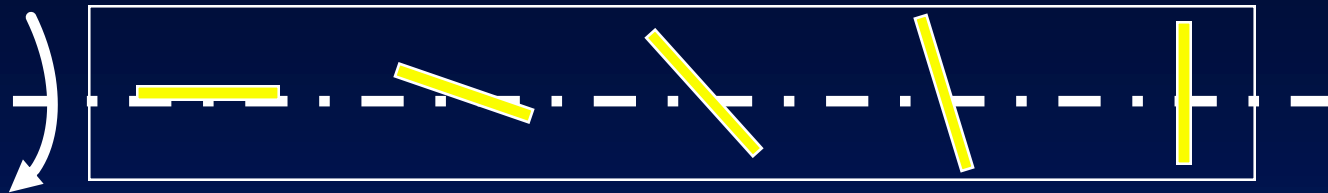
# **CONDITIONER OPTIONS**

## ***RETENTION TIME***

**Conditioner Volume  
(single pass vs. double  
pass)**



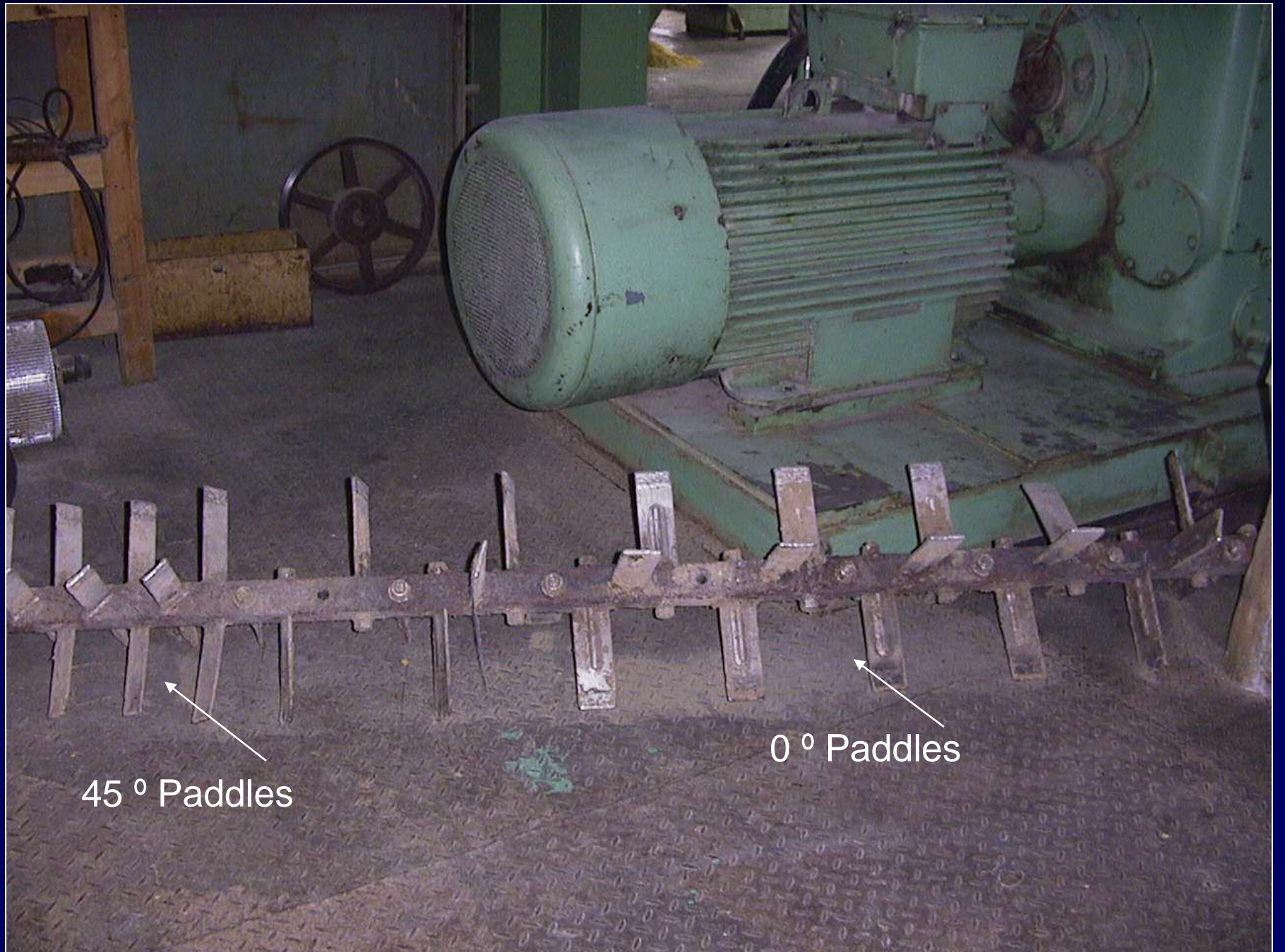




0 15 45 75 90

Pick Angle (degrees)

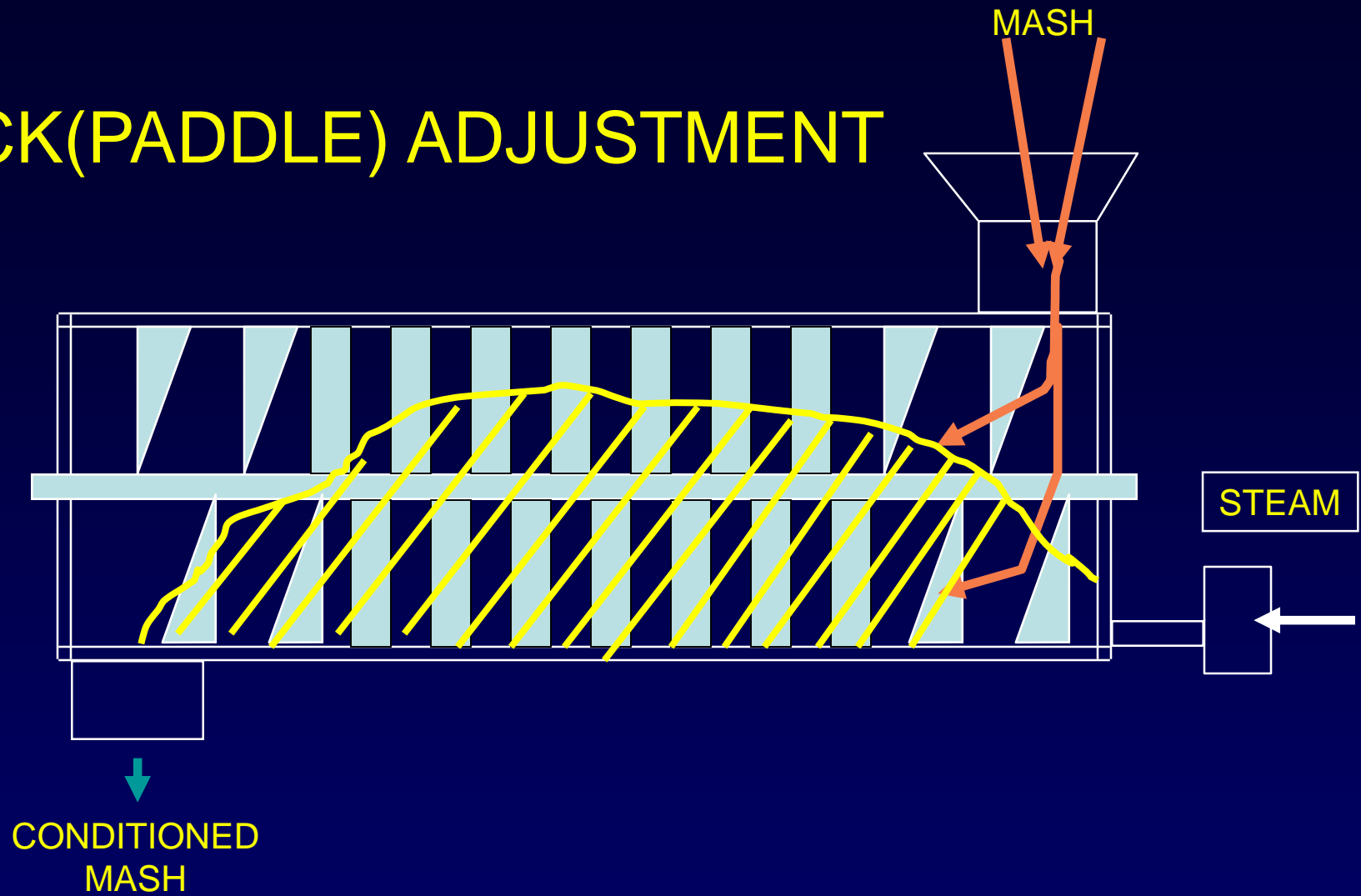
# PADDLE ANGLE ADJUSTMENT



45 ° Paddles

0 ° Paddles

# PICK(PADDLE) ADJUSTMENT

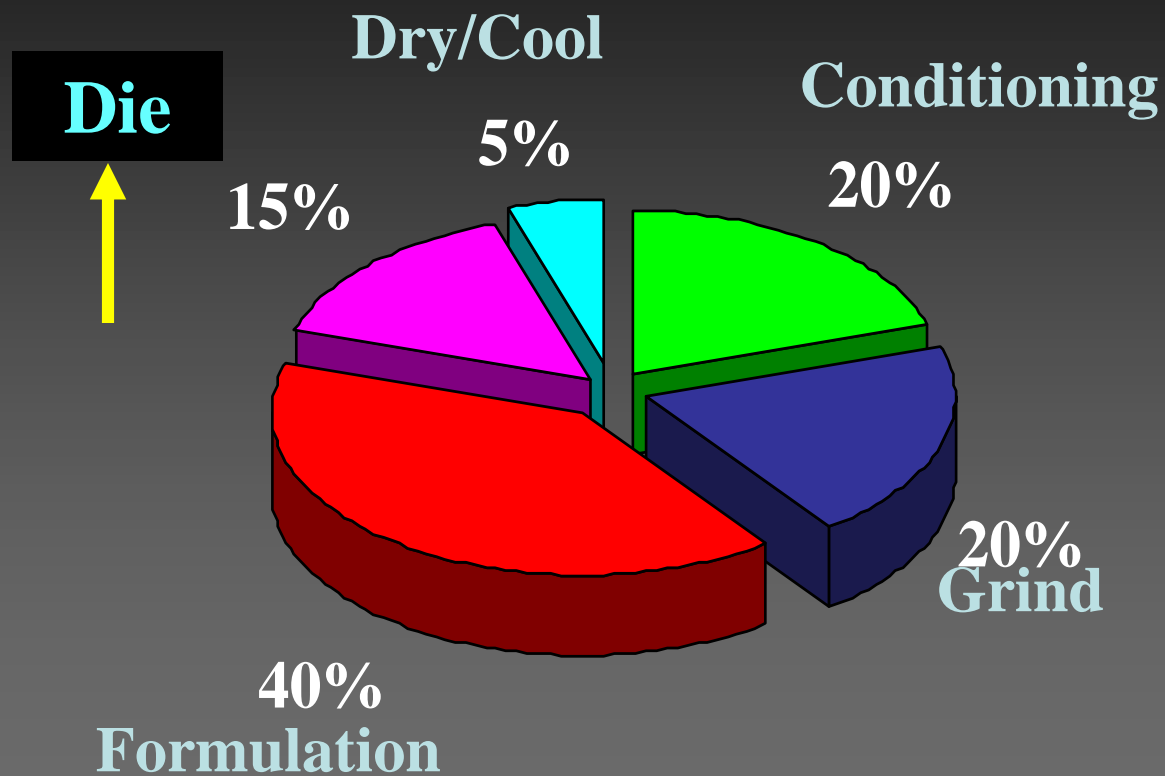


SHAFT SPEED

VFD on both drives

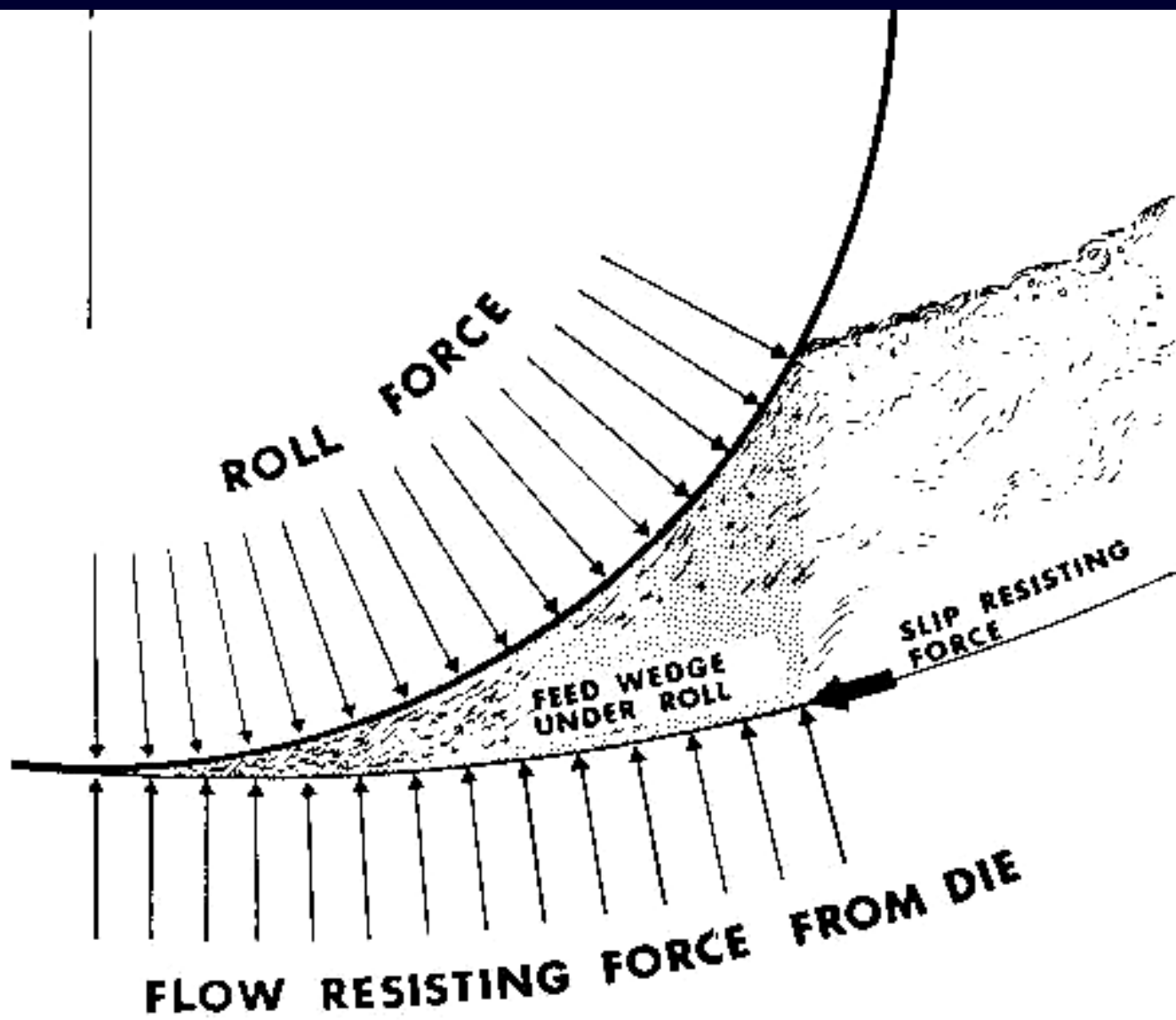


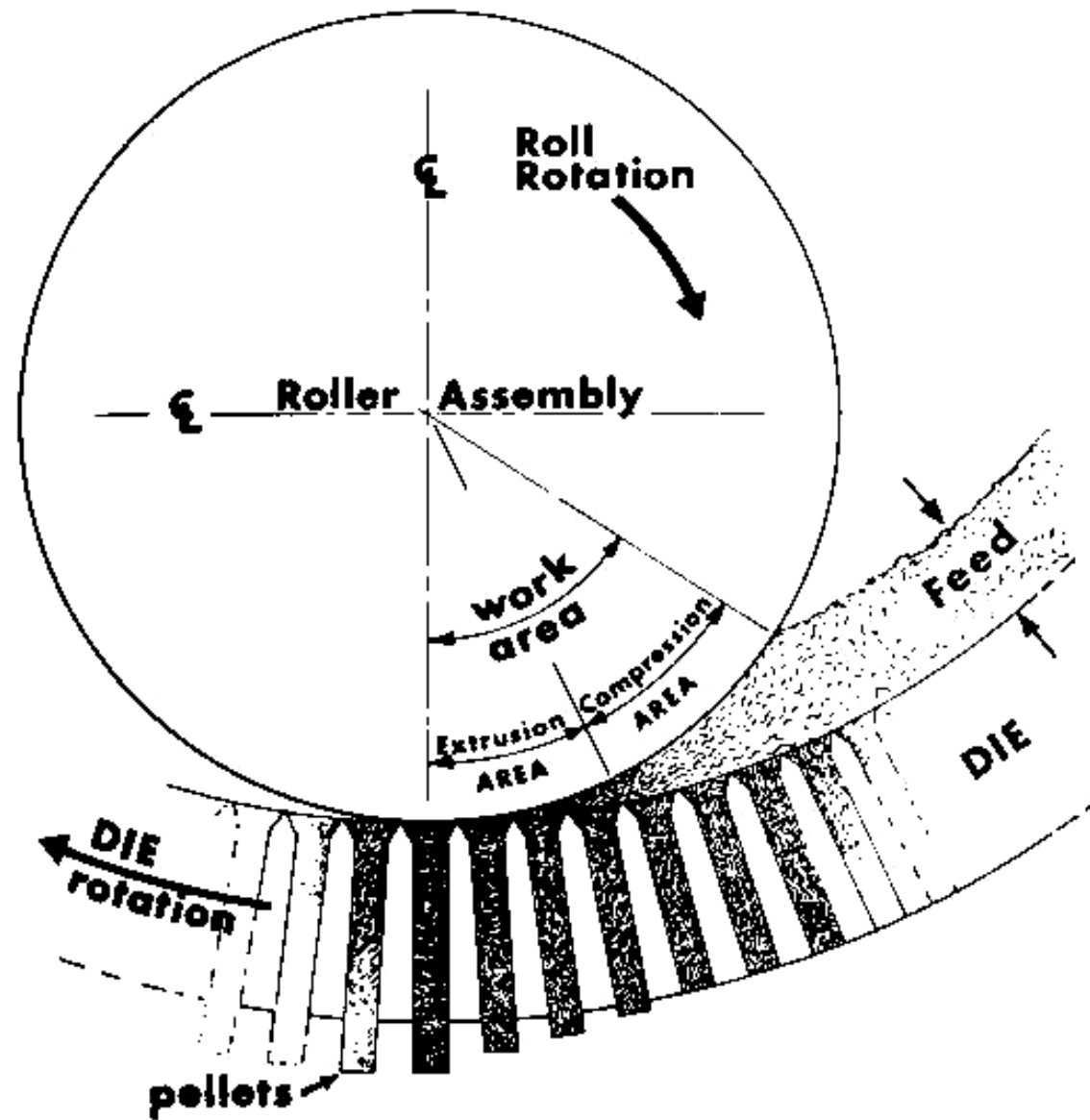
# PELLET QUALITY FACTORS



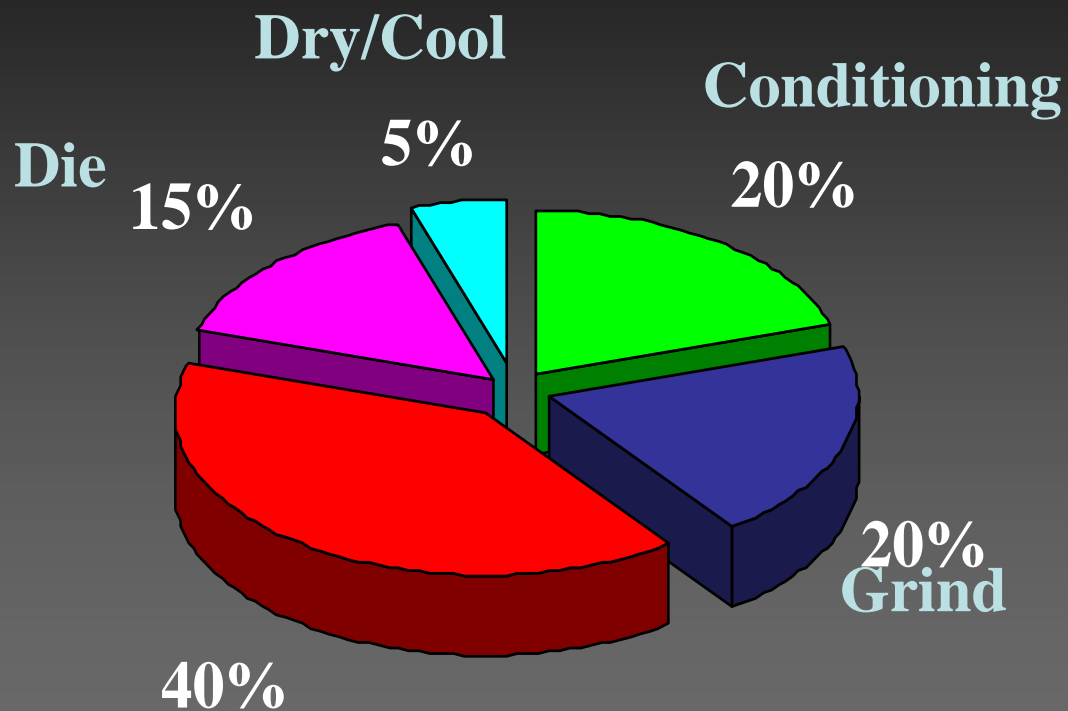








# PELLET QUALITY FACTORS



**Formulation**



# MAJOR FACTORS AFFECTING PELLET QUALITY

## Formulation

- Fat/Oil content
- Animal Protein
- Grain Type
- Grain Moisture
- Phosphate Source

# FORMULATION

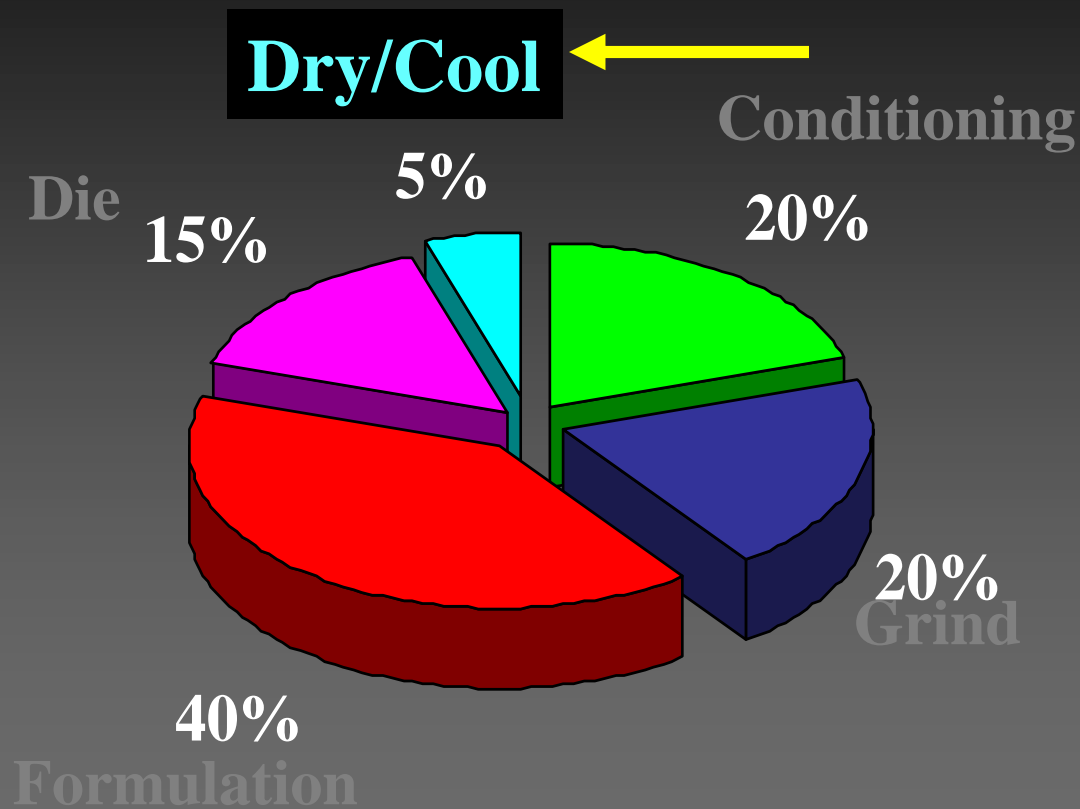
Diet formulation is based on meeting the nutrient requirements of the animal at the least possible cost per ton.

Little consideration for:

- Pellet Quality

- Production Rate

# PELLET QUALITY FACTORS



# **COOLING/DRYING**

**Without proper cooling/drying, pellets will not be mechanically strong and stable.**

**Moisture must equilibrate with ambient conditions.**

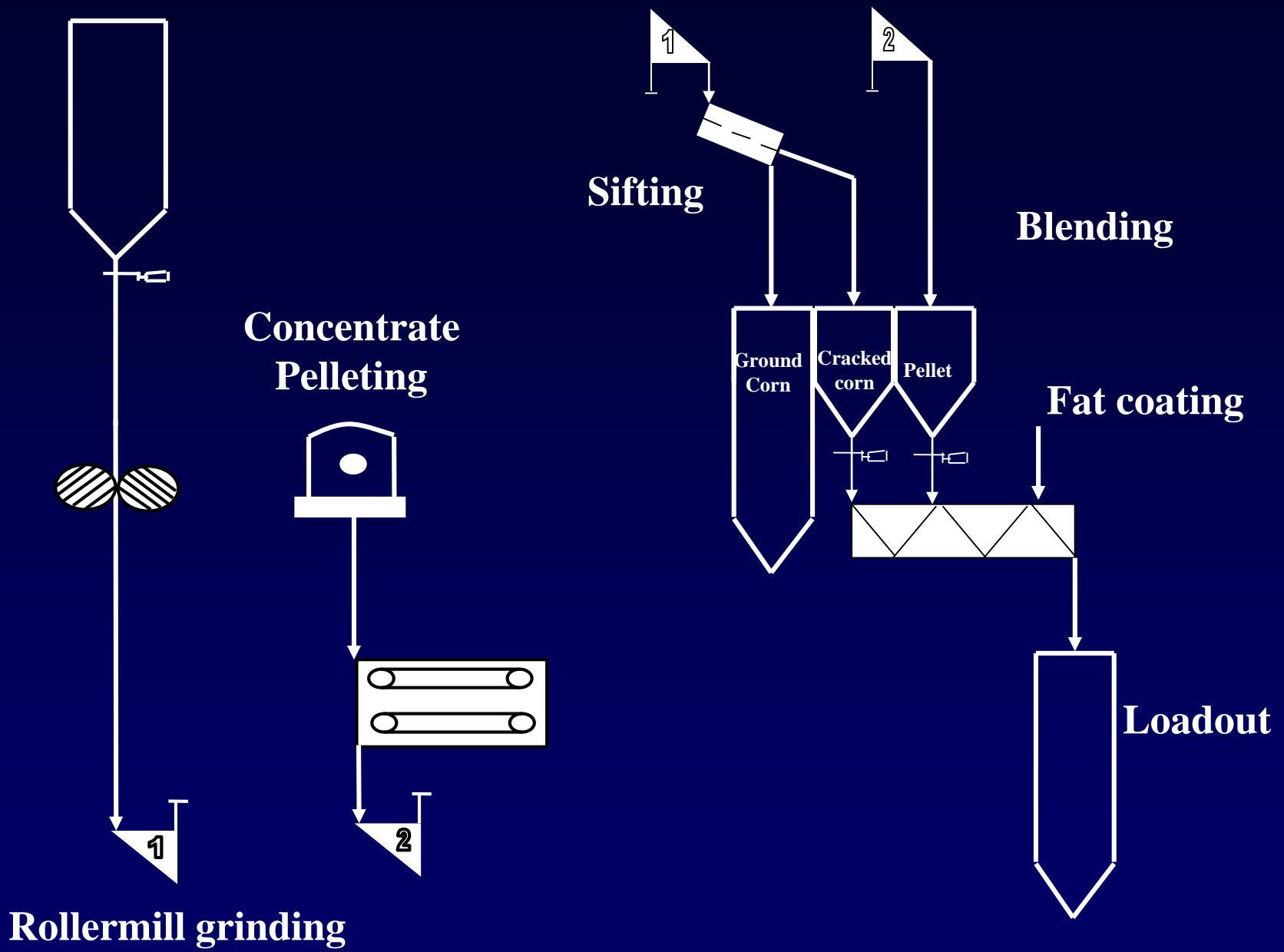


# Bliss Counter Flow Pellet Cooler

**The effects of feeding cracked corn  
and pelleted concentrate protein  
pellets on broiler performance and  
feed manufacturing costs**

# Procedures (Exp 2)

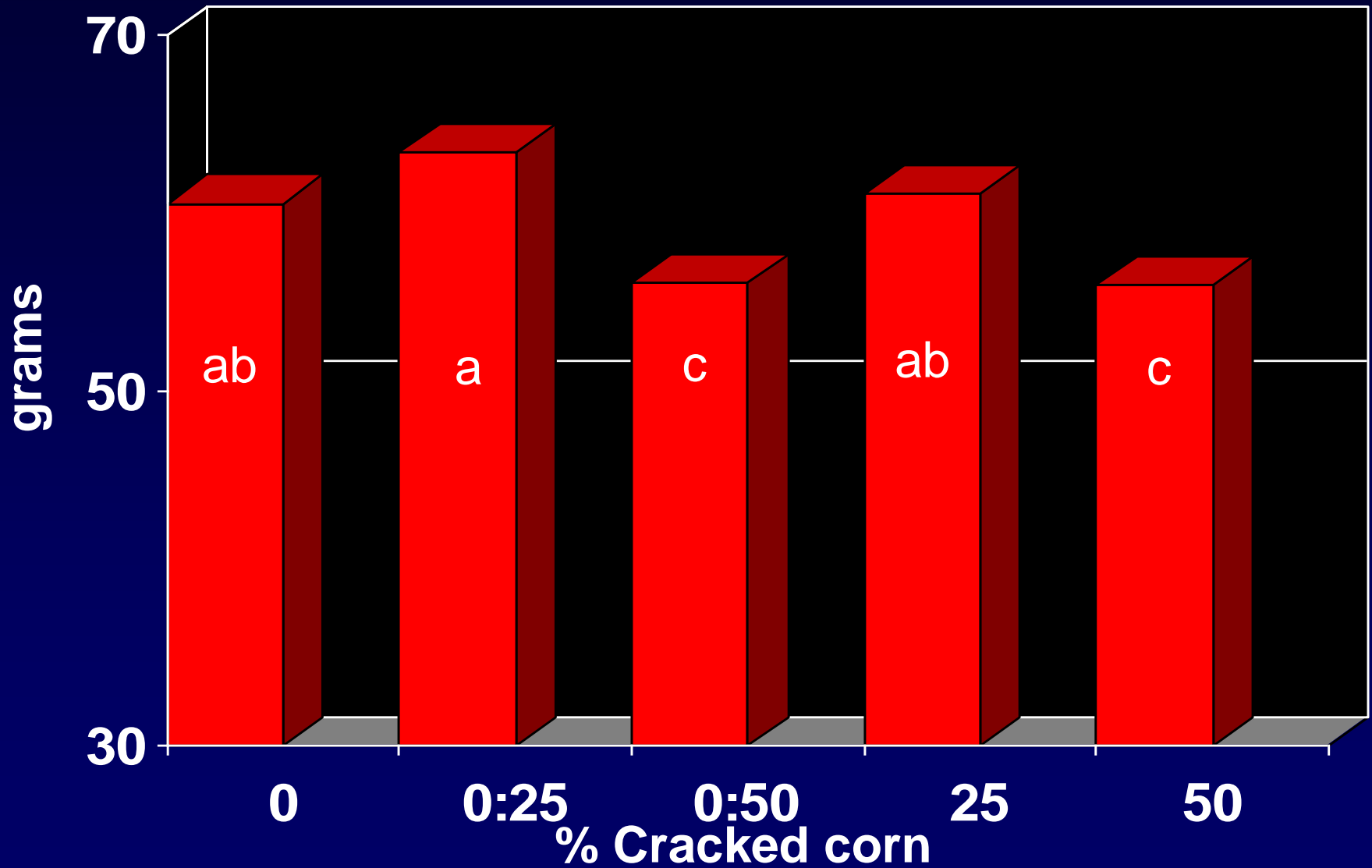
- Cracked corn was added in place of the ground corn fraction on a wt:wt basis at levels of 0, 25%, and 50%.
- Treatments included:
  - 1) Control
  - 2) 0% d 0 to 18; 25% d 19 to 41
  - 3) 0% d 0 to 18; 50% d 19 to 41
  - 4) 25% d 0 to 41
  - 5) 50% d 0 to 41



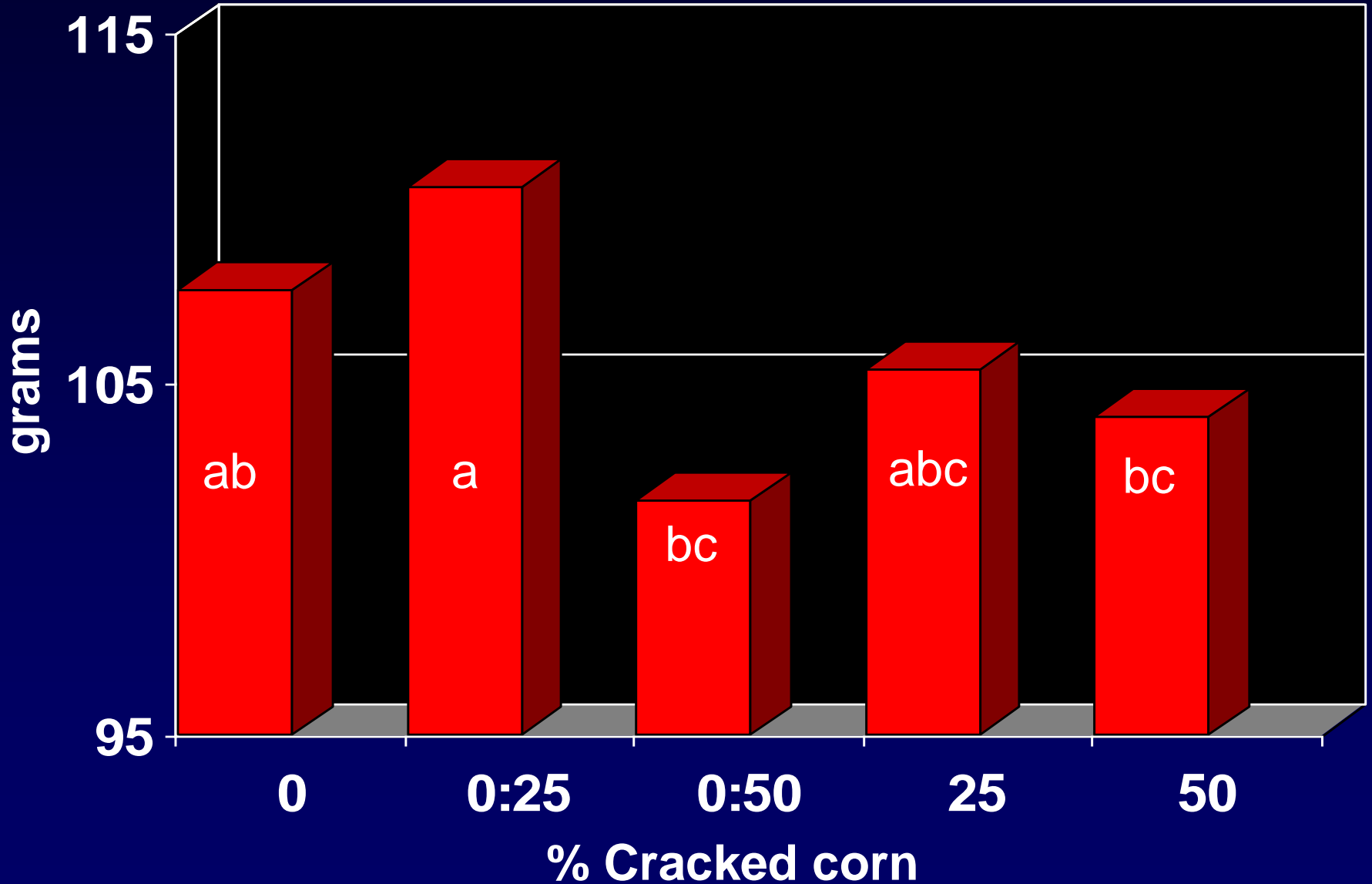


# Results

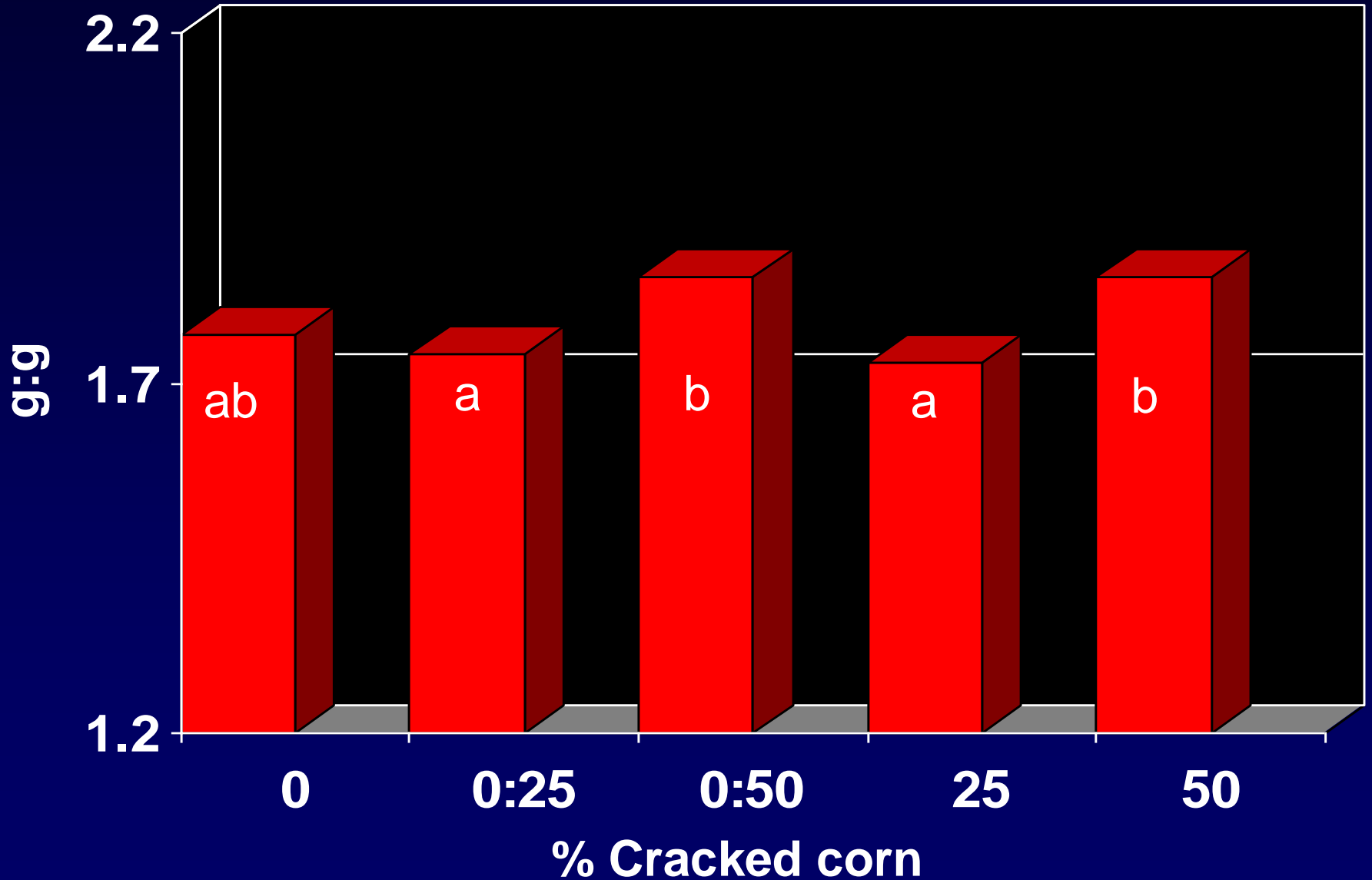
# Cracked Corn and ADG (*d 0 to 41*) (Exp 2)



# Cracked Corn and ADFI (*d 0 to 41*) (Exp 2)



# Cracked Corn and F:G (d 0 to 41) (Exp 2)



**PELLETING  
AND  
FEED SANITATION**

# THERMAL PROCESSING FOR MICROBIAL CONTROL

Temp °C	Number Samples	Enterobacteria Log <sub>10</sub> CFU/gm
<60	18	3.3
60-65	17	3.4
65-70	33	3.0
70-75	44	2.5
75-80	34	1.7
>80	24	1.1

# THERMAL PROCESSING FOR MICROBIAL CONTROL

Location	Incidence* (%)
Cereal Grain	3
Protein Meals	4
Animal Protein	67
Batch Mixer	69
Pellet Conditioner	32
Pellet Die	4
Cooler	7
Finished Feed	13
Truck	13
Farm	19

\* Percentage of samples contaminated with Salmonella

# Pellet Quality Issues

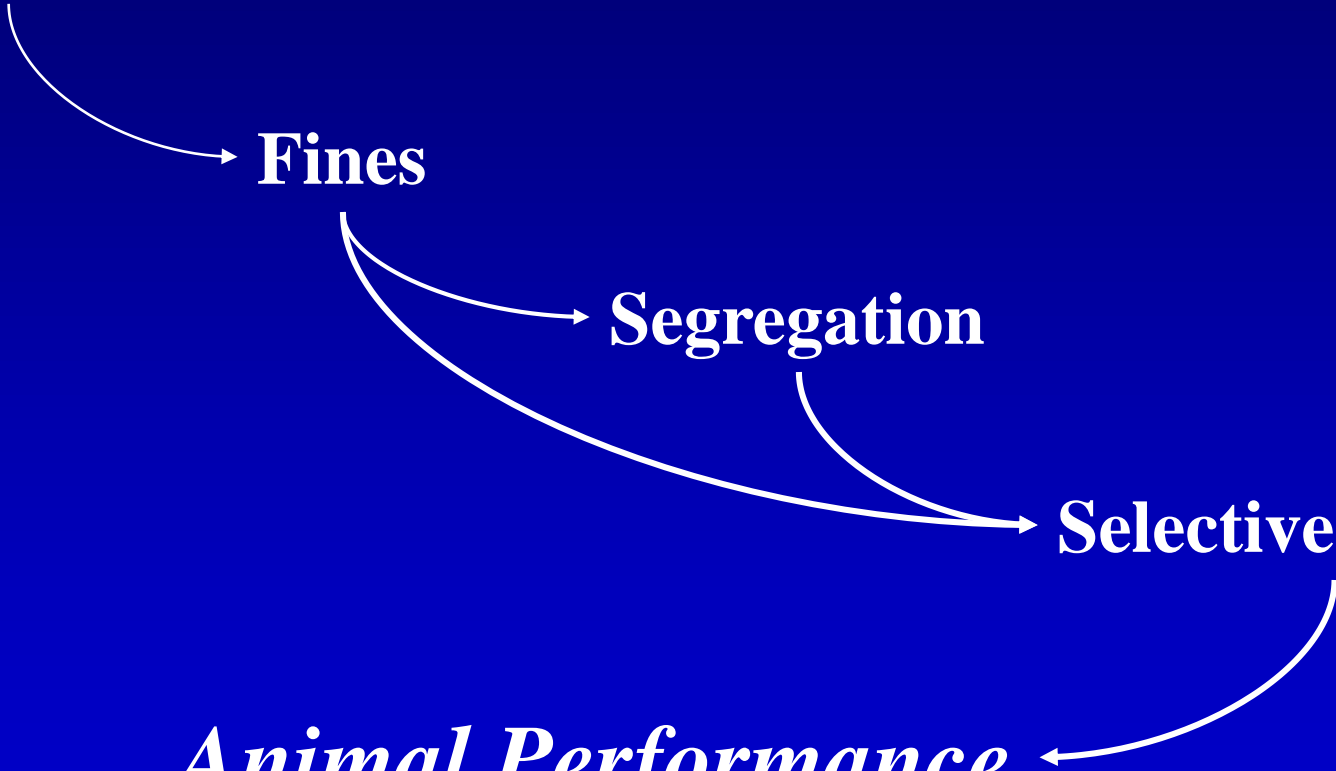
**Durability**

**Fines**

**Segregation**

**Selective Feeding**

**Animal Performance**



# Conclusions

- **The physical form of feed is important to maximize performance**
- **It may be possible to monitor feed moisture levels and make adjustments to improve manufacturing parameters and bird performance**
  - **need to know mash moisture %, maximum safety level, safety level with preservatives**

# Conclusions

- Gelatinization percent of the starch may not be all that critical for bird nutrition
- Gelatinized starch may interact with particle size to affect broiler chick performance
- Treatment may have affected appetite, feed passage rate, gut morphology, etc.

# SUMMARY

- Formulation is the most important factor affecting both pellet quality and production rate
- Of the pellet mill components, conditioning is much more important than the die selection on quality but have similar effects on production rate.
- Pellet quality has a direct effect on animal performance.



# THANK YOU



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