

“The Effects of Variable  
Extrusion Moisture on Extrusion,  
Drying, and Fired Physical  
Properties of a Shale Body and  
How Extrusions Aids Can Effect  
the Properties”

Harold B. Newman

Pine Hall Brick

# Topics to be Discussed

- Variable Moisture Content-Factors
- Green Strength Properties
- Drying Shrinkage Properties
- Cold Water Absorption Properties
- Body Additives
  - Soda Ash
  - Lignosulfonate



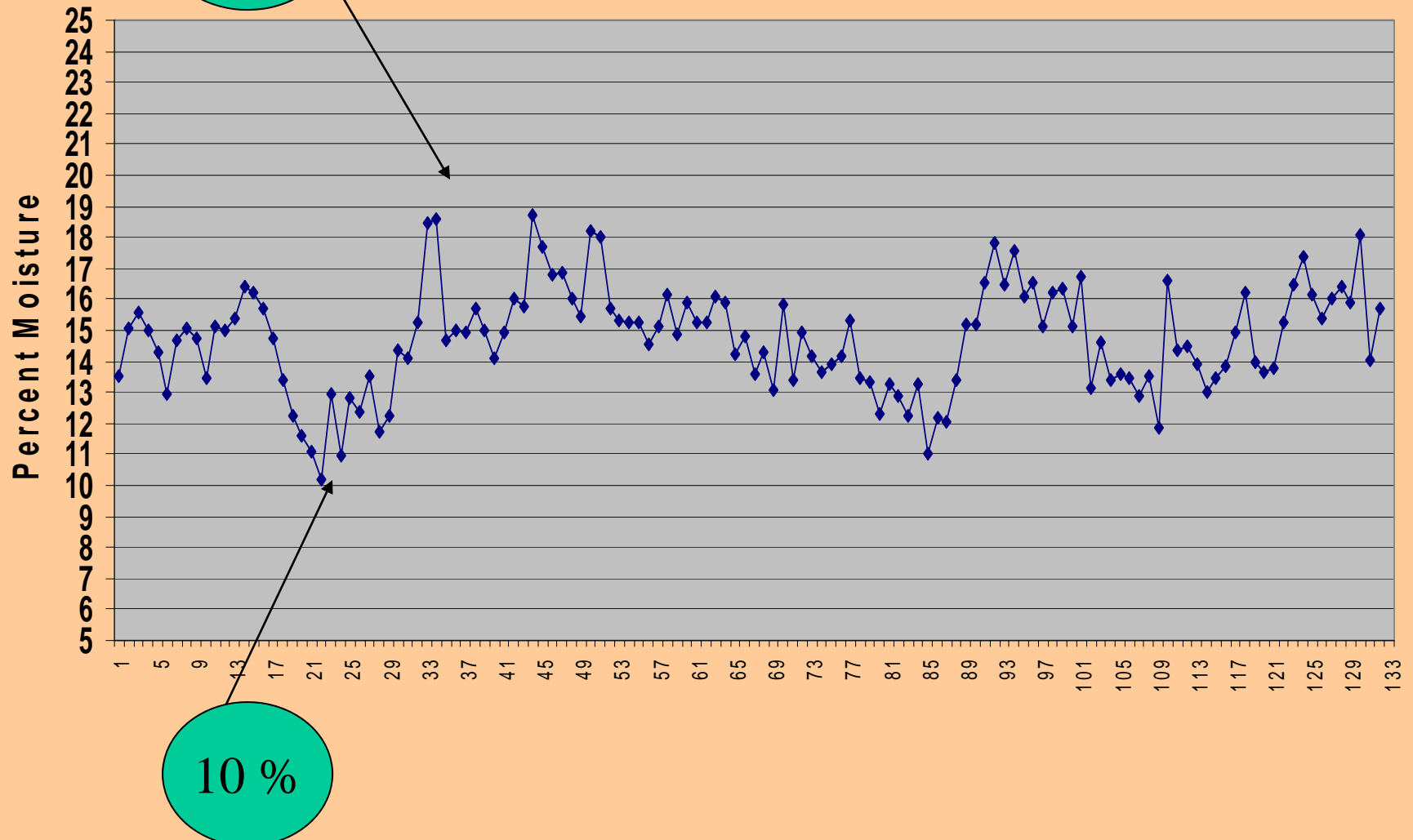




# COVERED STORAGE-Material Blending



# Ground Material Moisture Content 2008-2011



# Research Project

- Proportion Batches of Shale Variable Moisture Contents
- Mix for Constant Time Period
- Extrude Lab Test Bars-Good Vacuum
- Test Bars For Green Strength
- Test Bars for Drying Properties
- Fire Bars and Test for Shrinkage and Absorption Properties



Add to Mixer



## Add Controlled Amounts of Water





Constant Mixing Time 5 Min

## Discharge Mixed Material



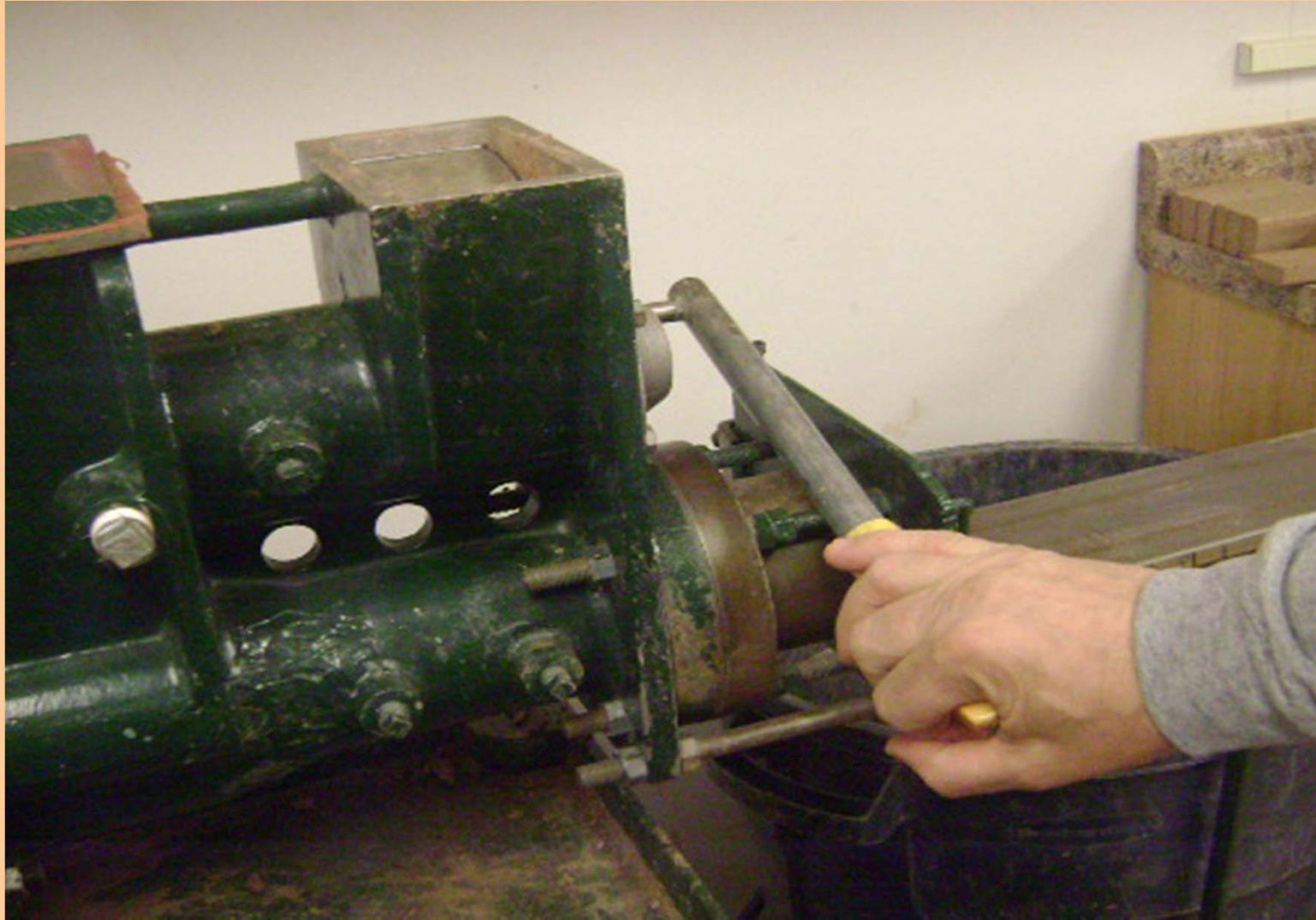
# Check Consistency





Maintain Good Vacuum

## Extrude Bars with Good Vacuum



# Extruded Column



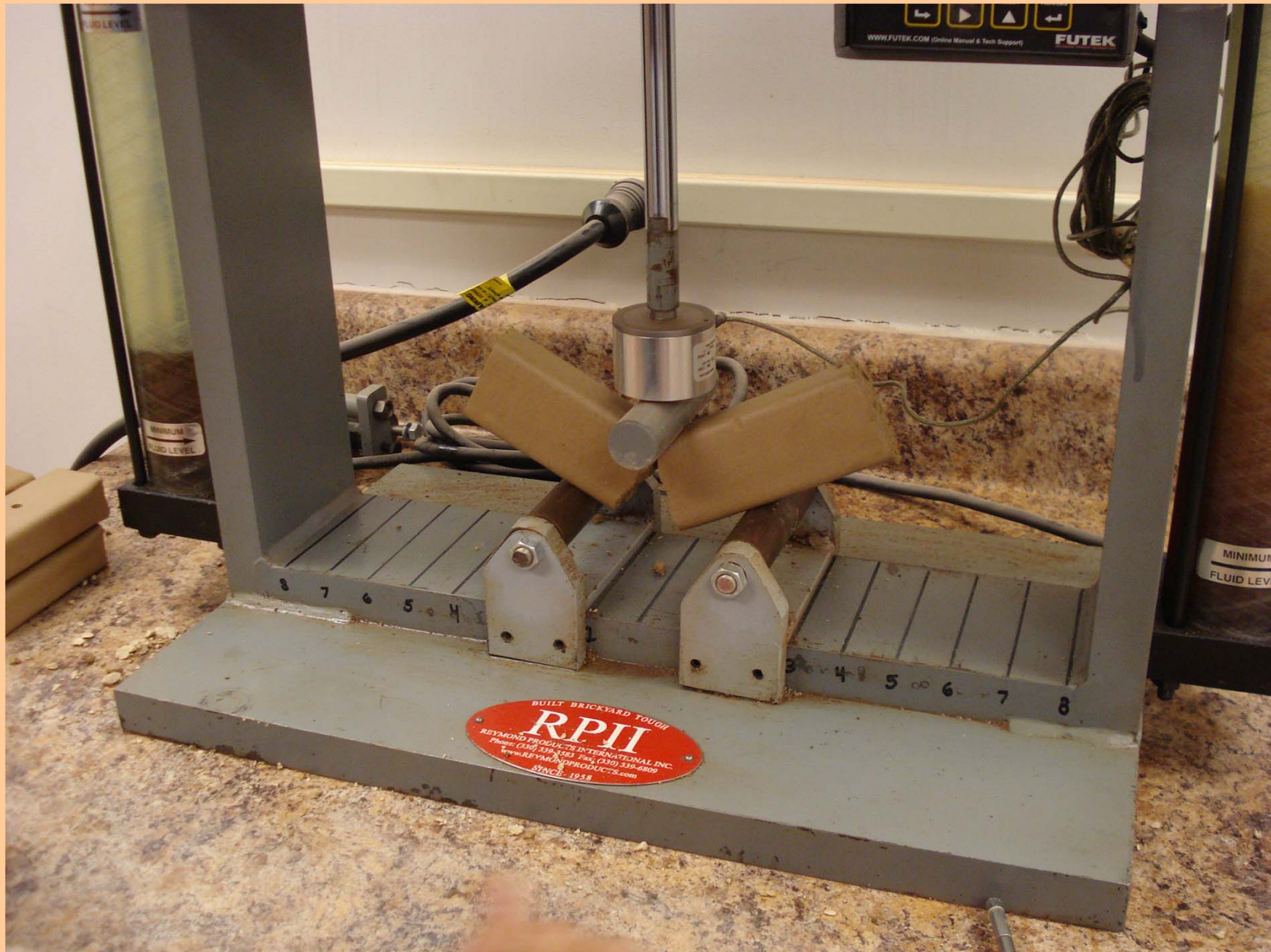


# Cut Sample Bars for Testing

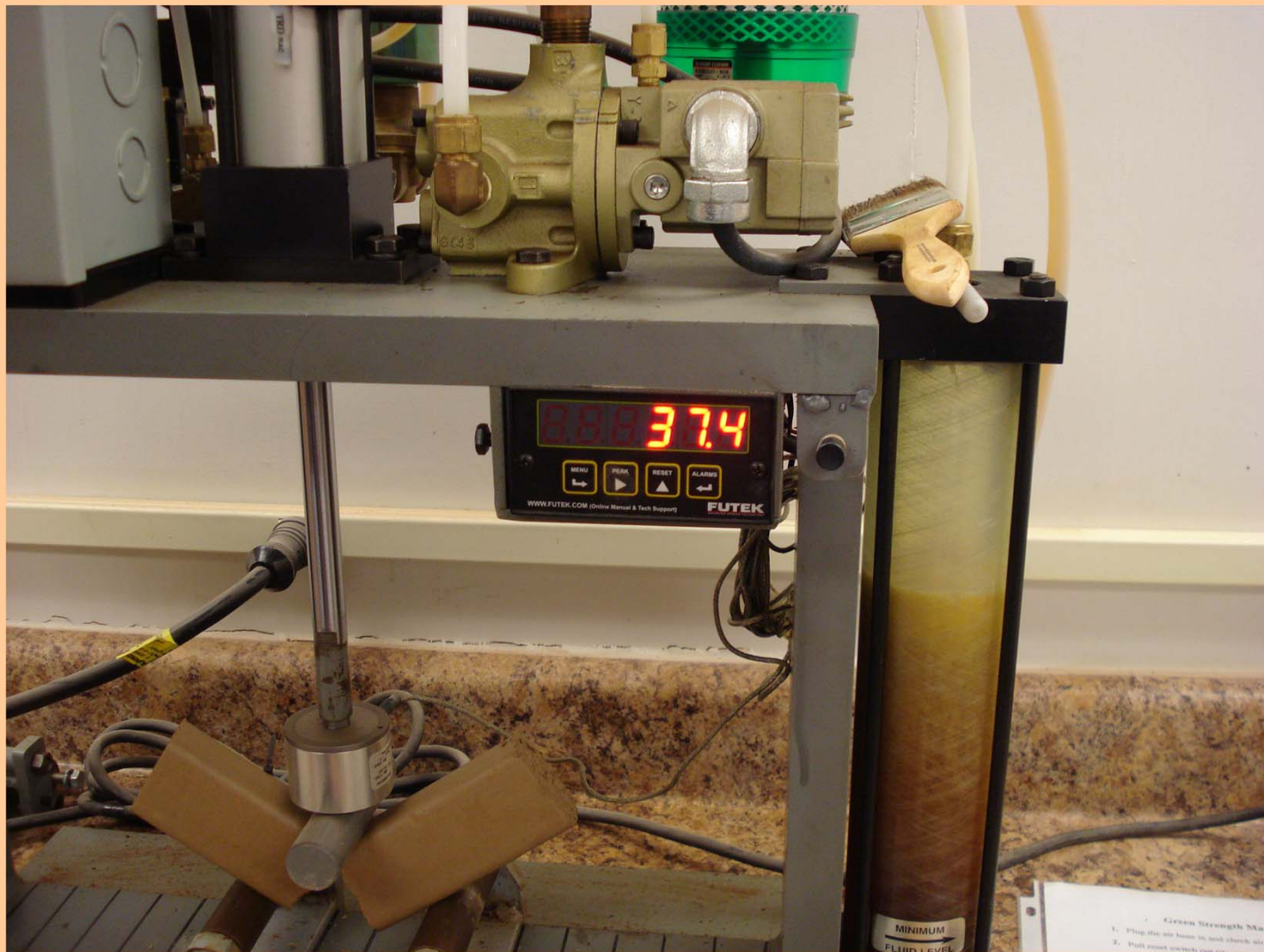


# Test Bars

- Green weight
- Dry weight
- Column hardness
- Green strength



Testing Green Strength

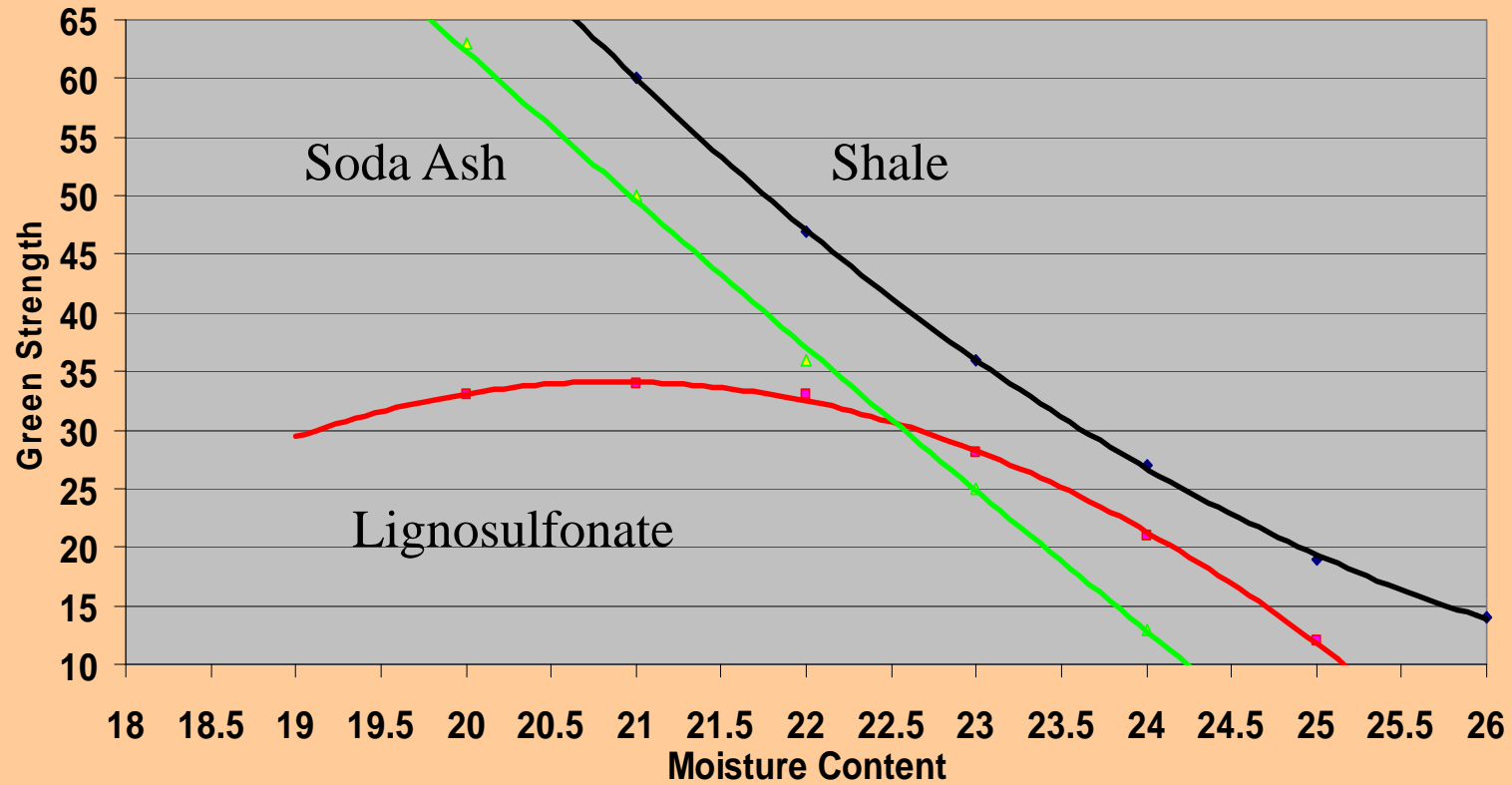


Record the Data



Recording the Sample Weight  
Determine Moisture Content

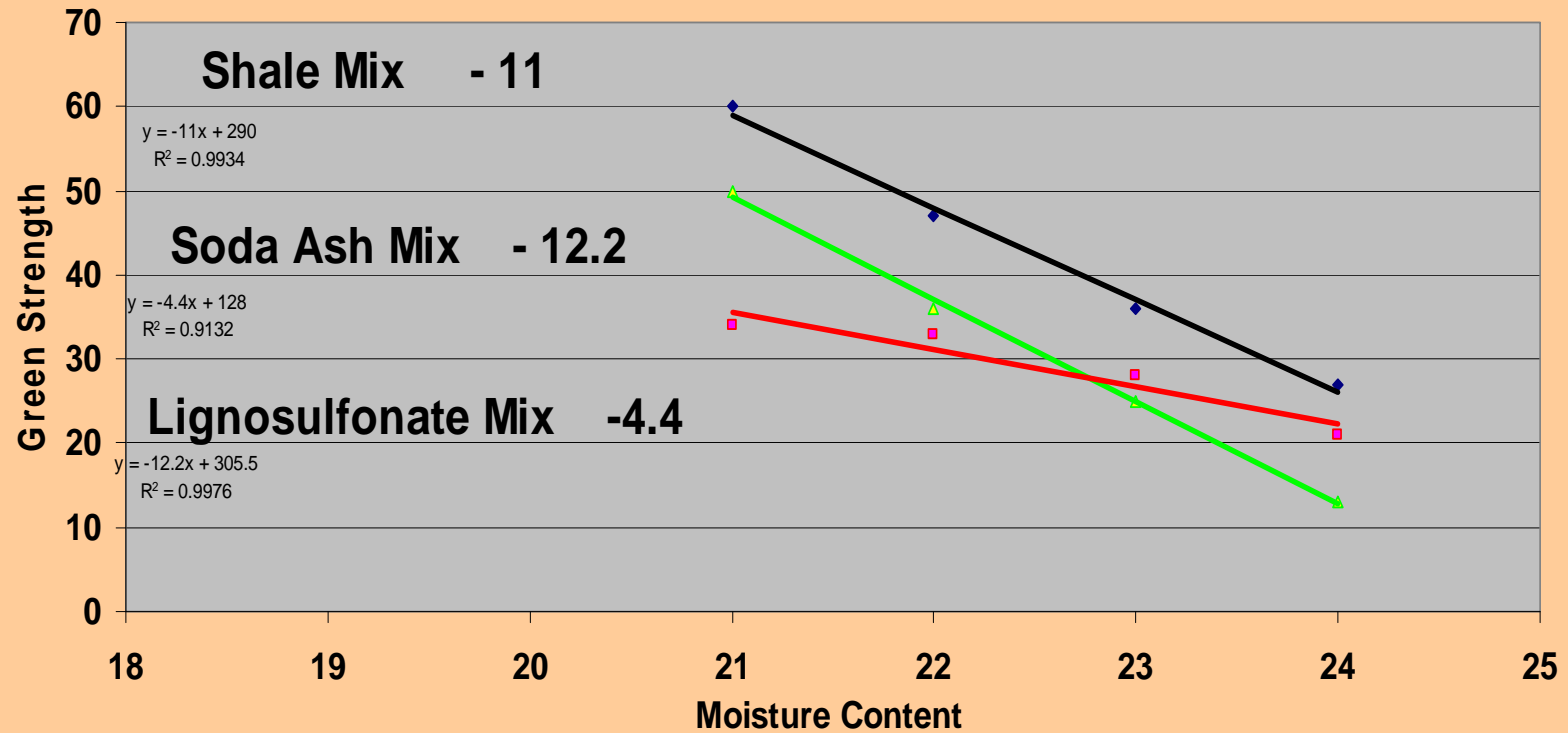
# Shale Body Green Strength Vs Extrusion Moisture



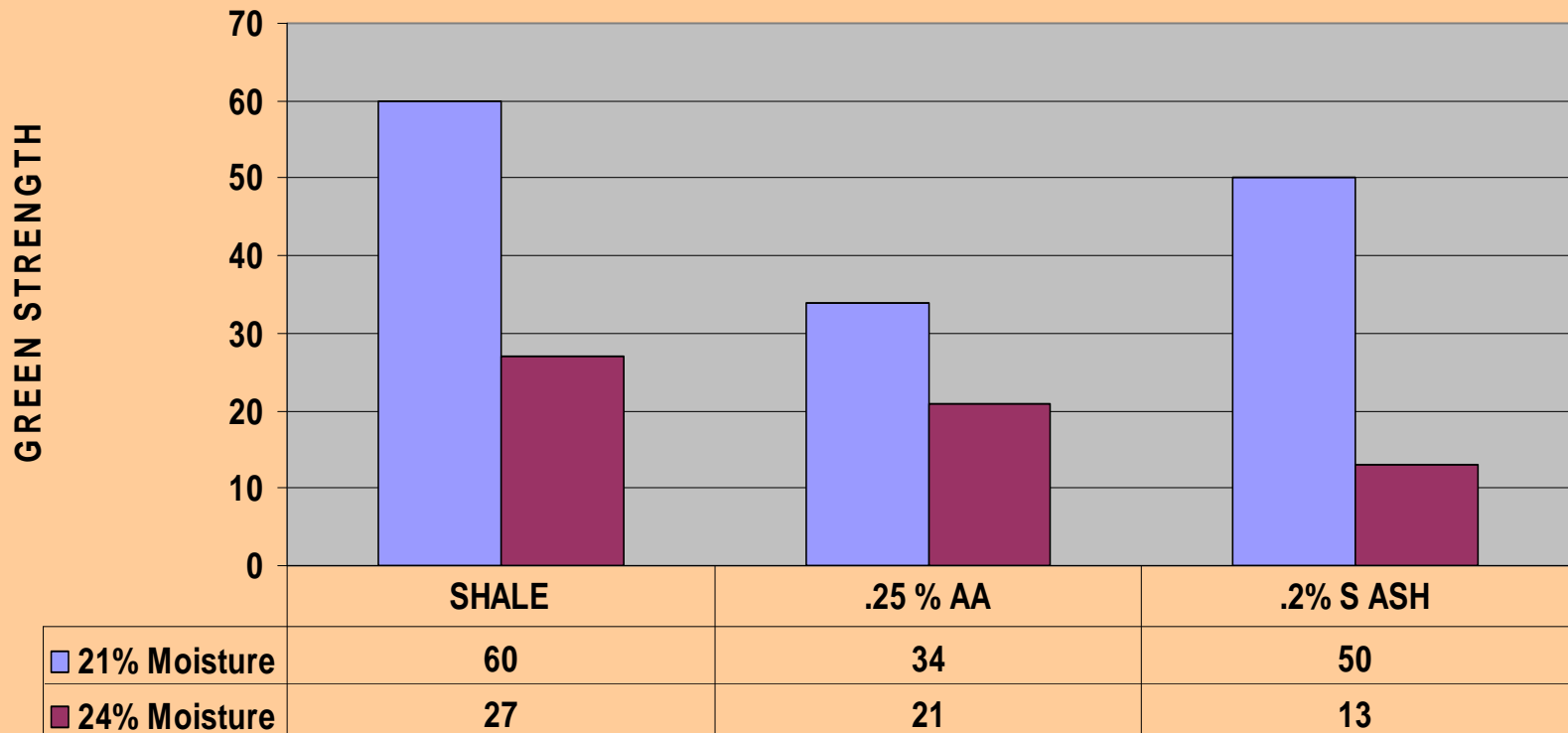
# Shale Mix Body Additions

## Green Strength Vs Extrusion Moisture Sensitivity

### 21 -24 % Linear Regression Lines



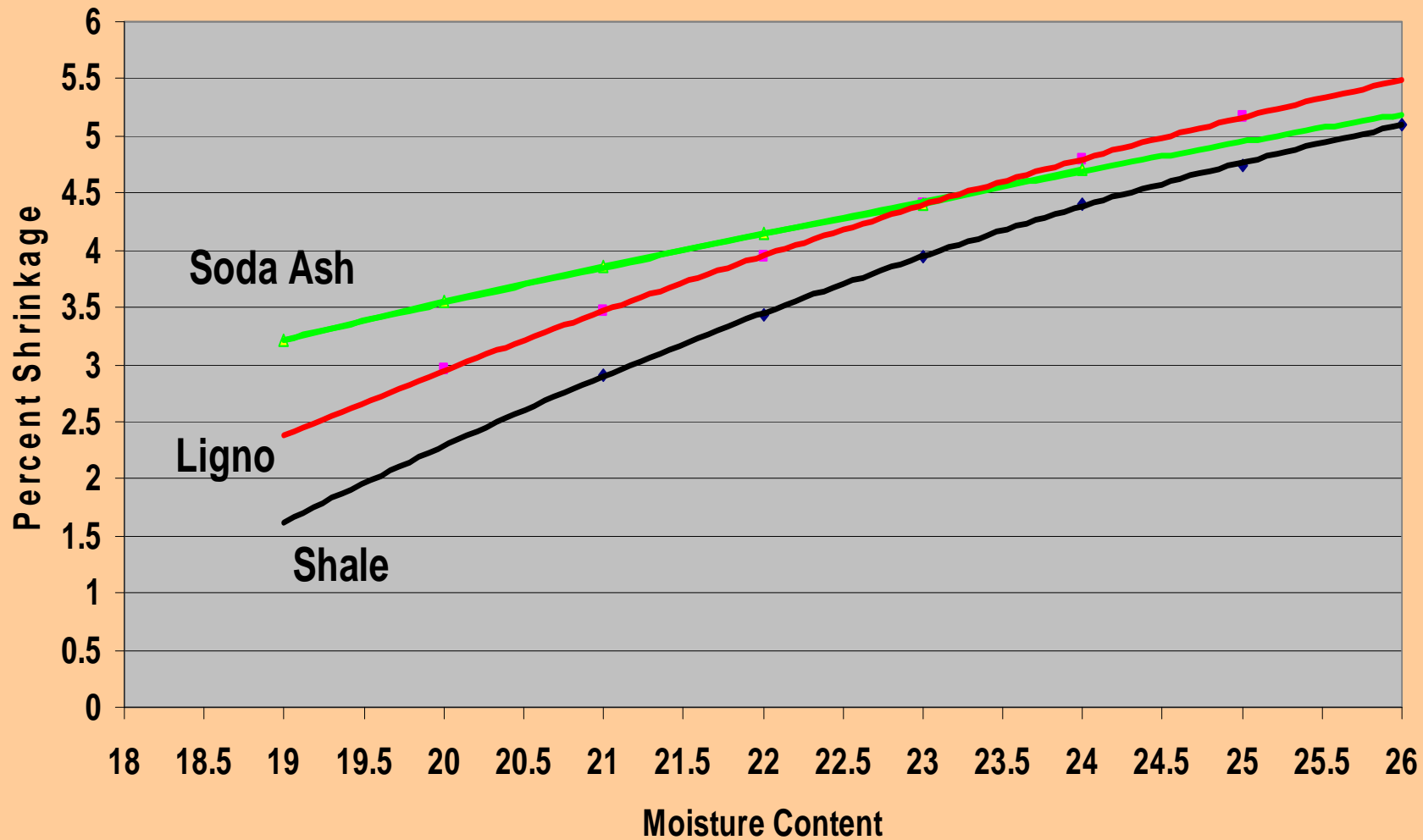
**SHALE MIX BODY ADDITIONS  
GREEN STRENGTH  
21 % AND 24 % EXTRUSION MOISTURE**



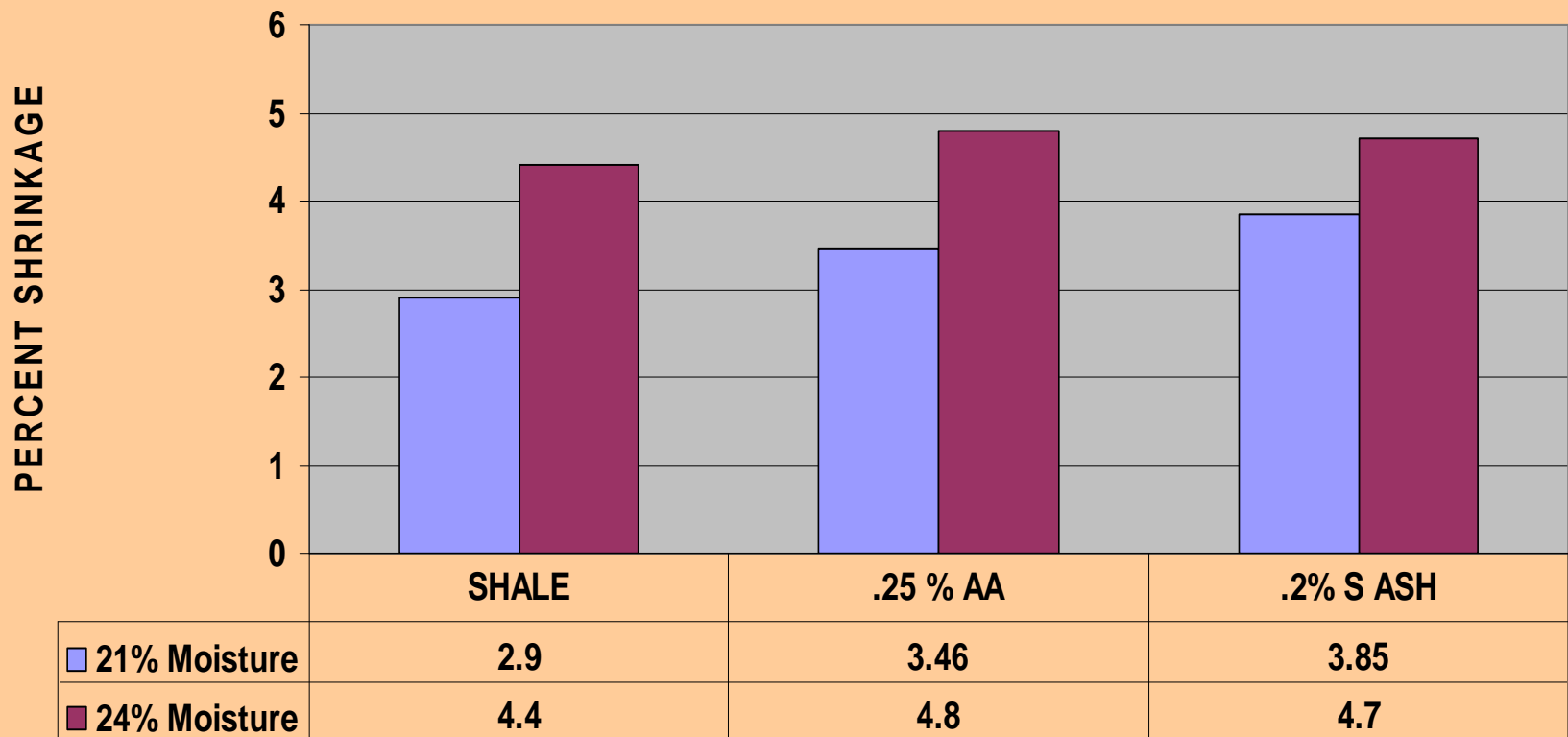


# Shale Body

## Dry Shrinkage Vs Moisture Content

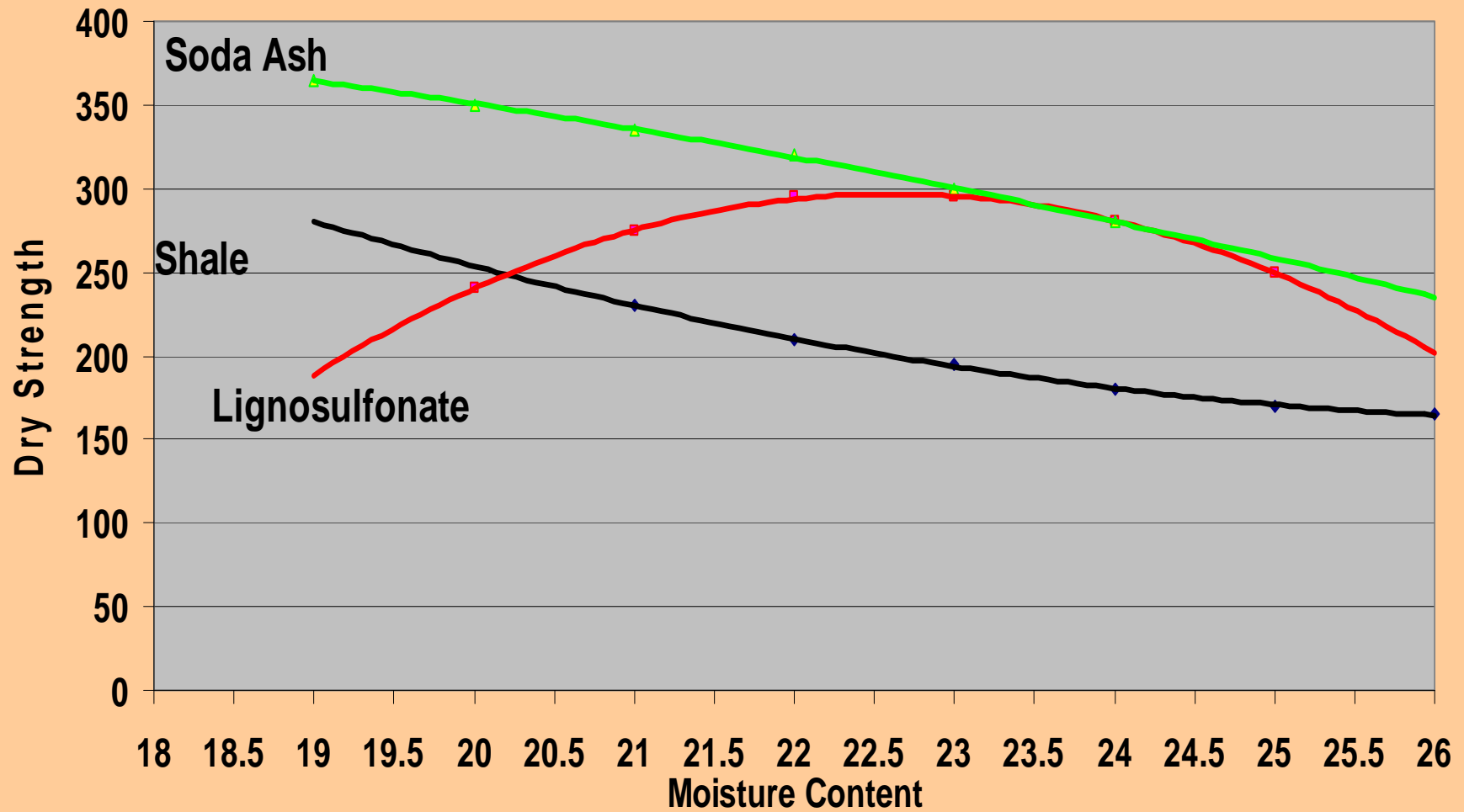


# SHALE MIX BODY ADDITIONS PERCENT DRY SHRINKAGE 21% AND 24 % EXTRUSION MOISTURE



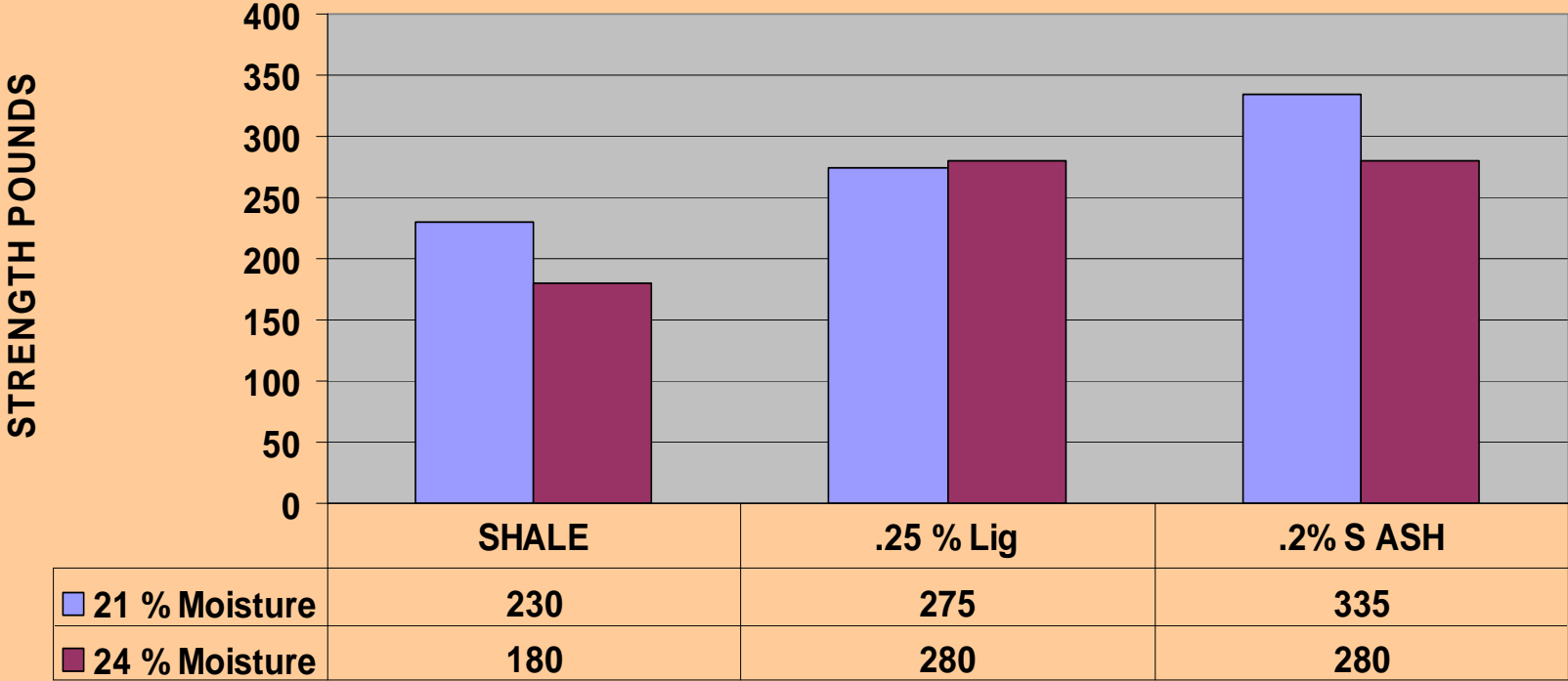
# Shale Body

## Dry Strength Vs Extrusion Moisture



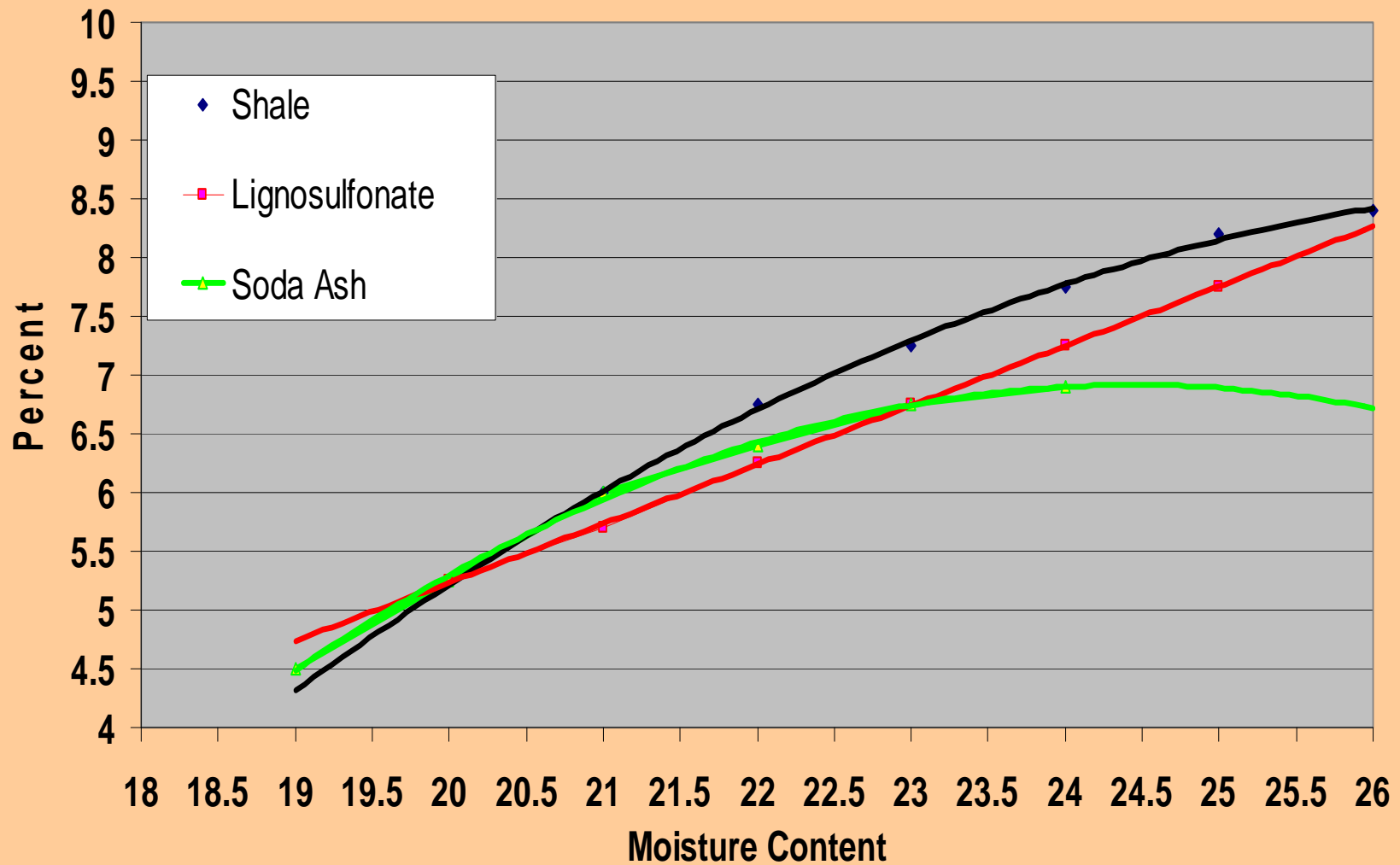
# SHALE MIX BODY ADDITIONS DRY STRENGTH

## 21 % AND 24 % EXTRUSION MOISTURE

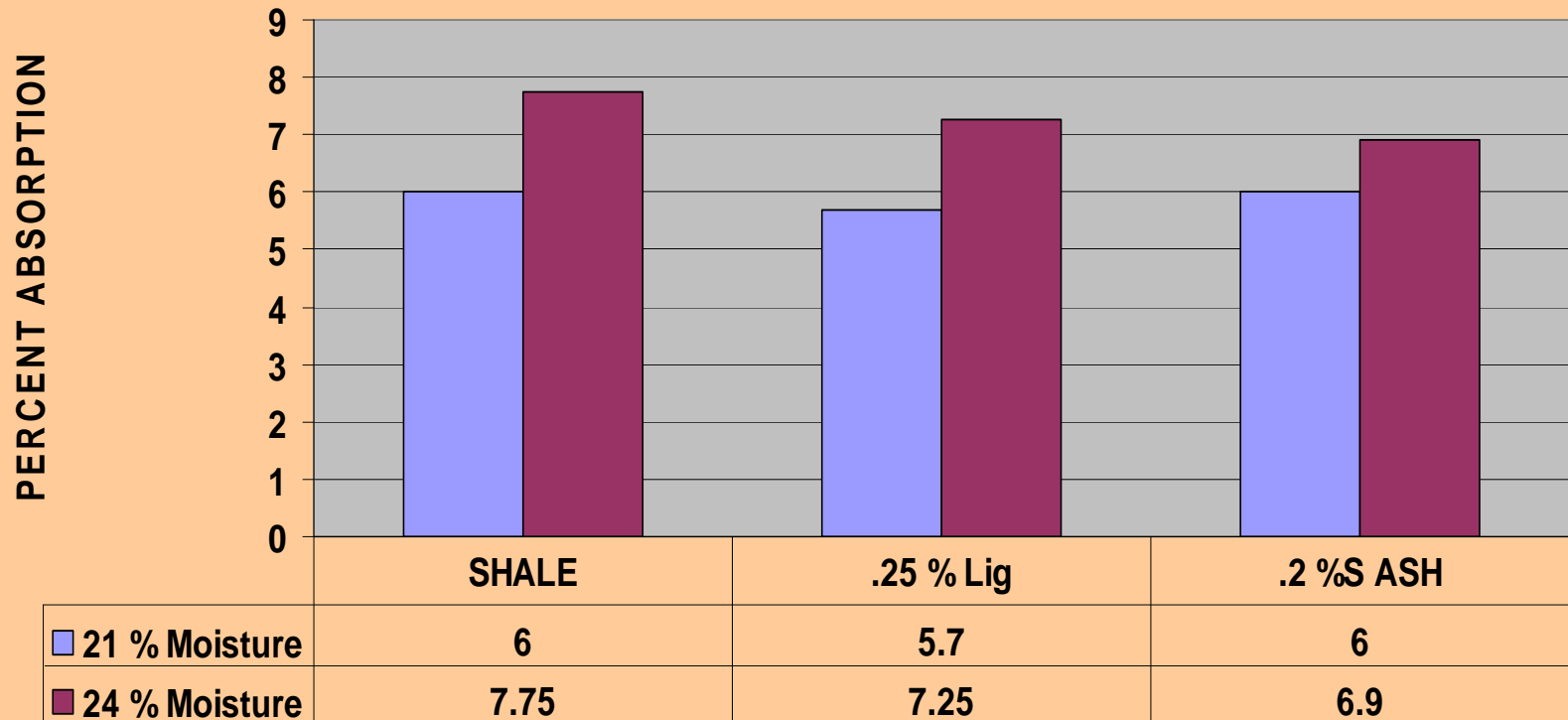


# Shale Body

## Cold Water Absorption Vs Extrusion Moisture

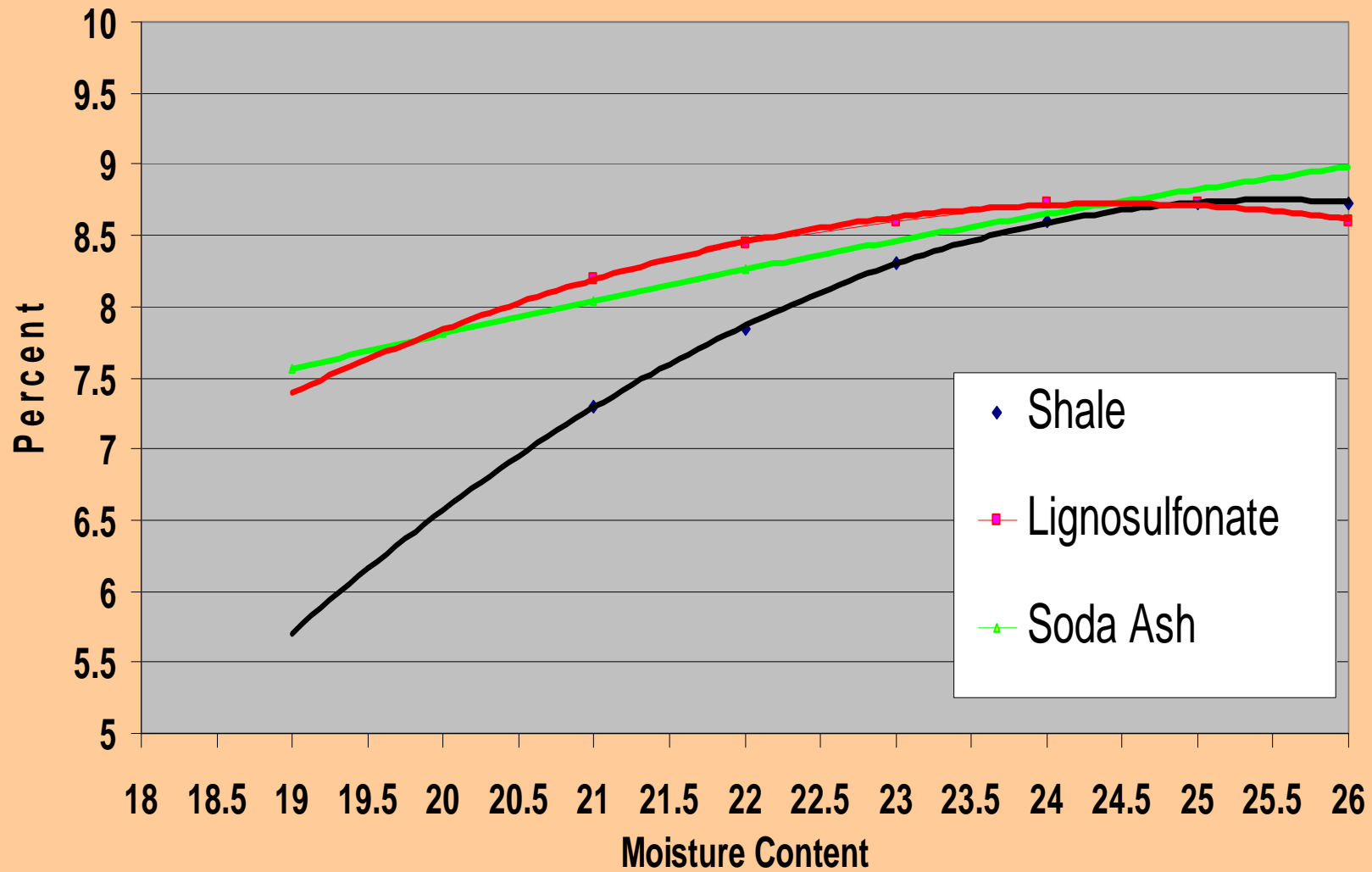


**SHALE MIX BODY ADDITIONS  
24 HR COLD WATER ABSORPTION  
21 % AND 24 % EXTRUSION MOISTURE**



# Shale Body

## Total Shrinkage Vs Extrusion Moisture



# PLANT STUDY

Old Plant

Hand Hack

Tumbled Line

16 Wide Kiln

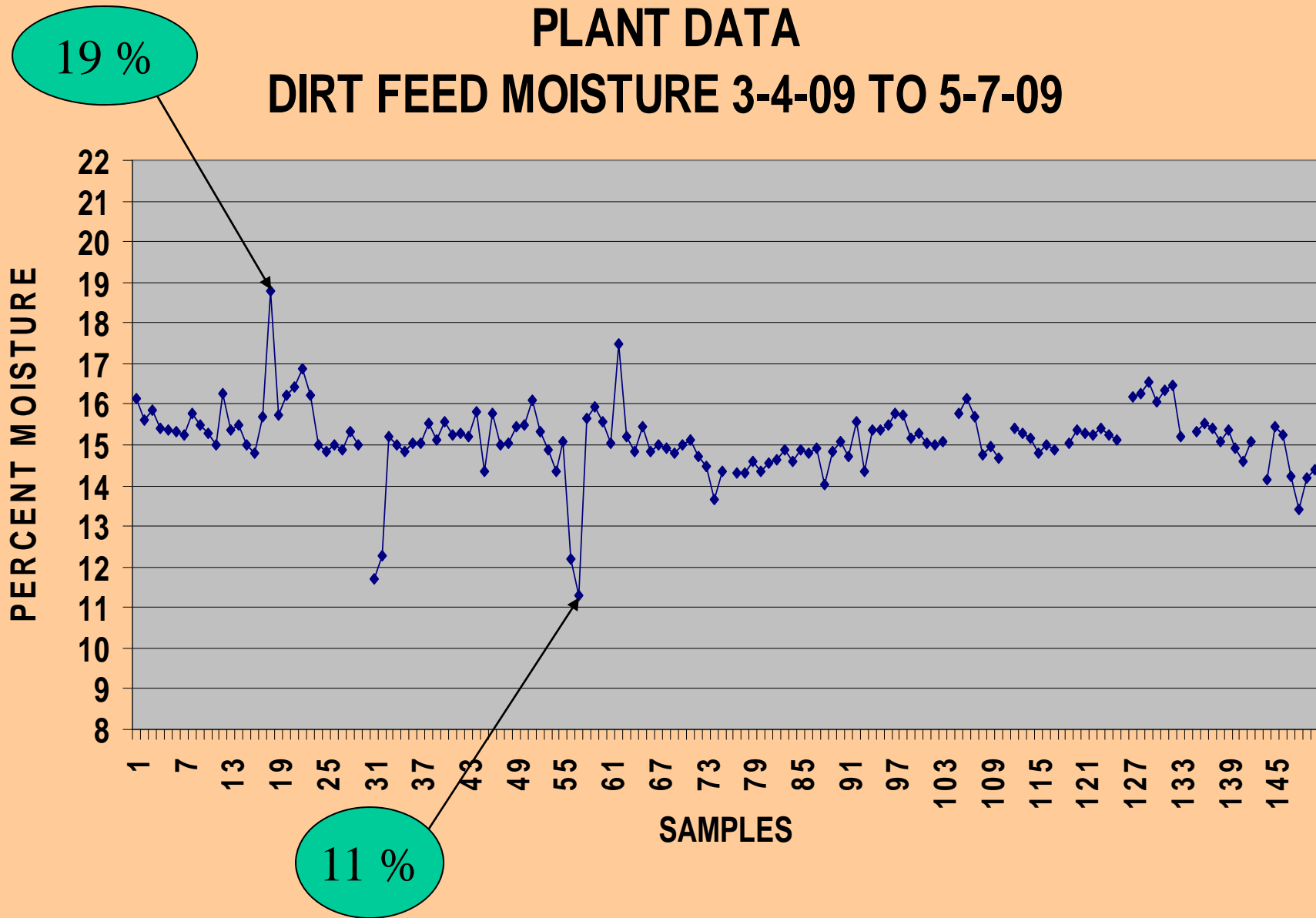


# Monitor Plant Conditions

- Moisture of Ground Dirt
- Moisture of Dirt Fed to Pug Mill
- Manual Water Addition Rate-Die Oil Pressure
- Production Rate
- Vacuum Level
- Green Brick Moisture
- Green Strength-Penetrometer
- Additive Feed Rate

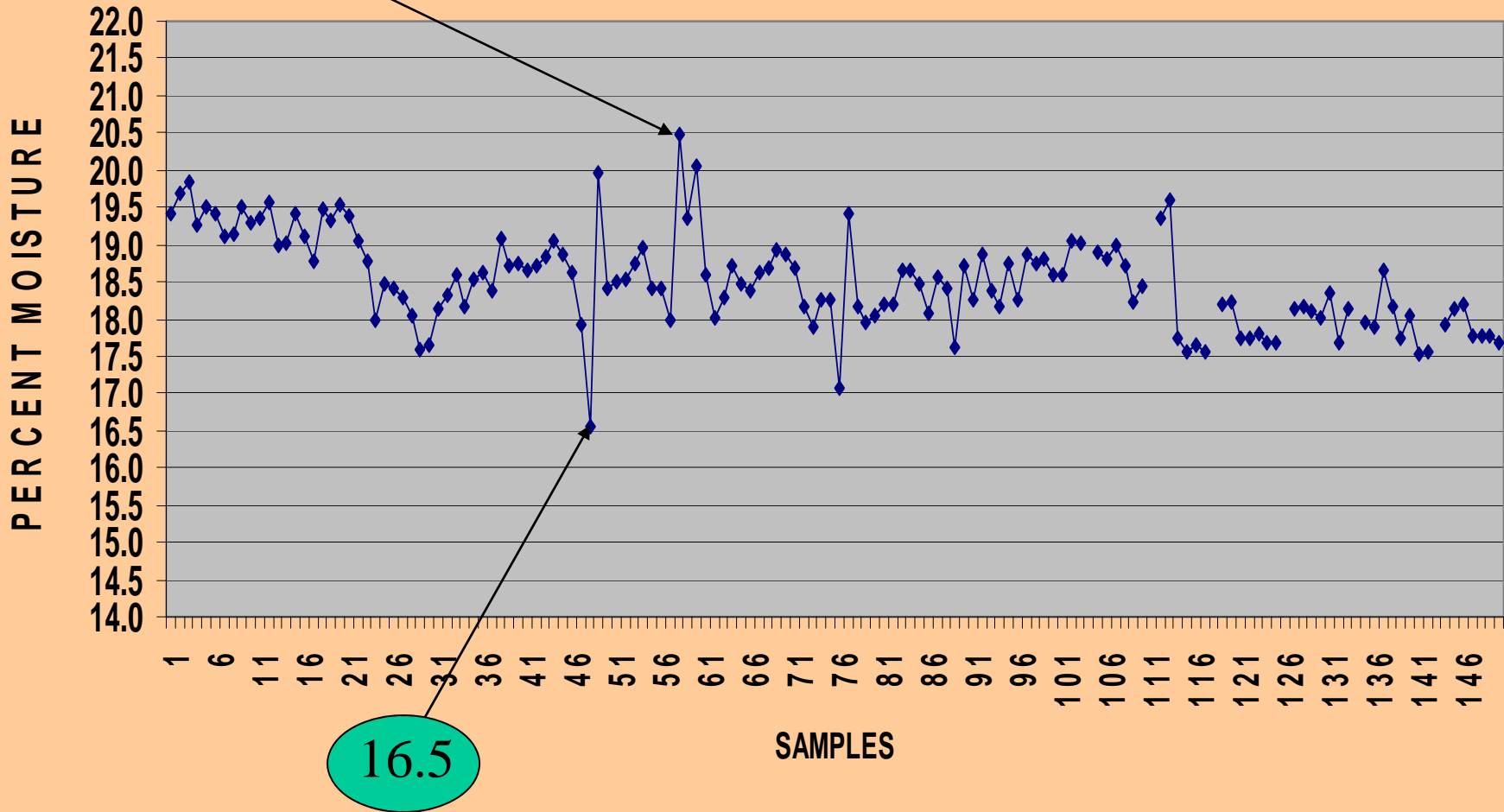
# PLANT DATA

## DIRT FEED MOISTURE 3-4-09 TO 5-7-09

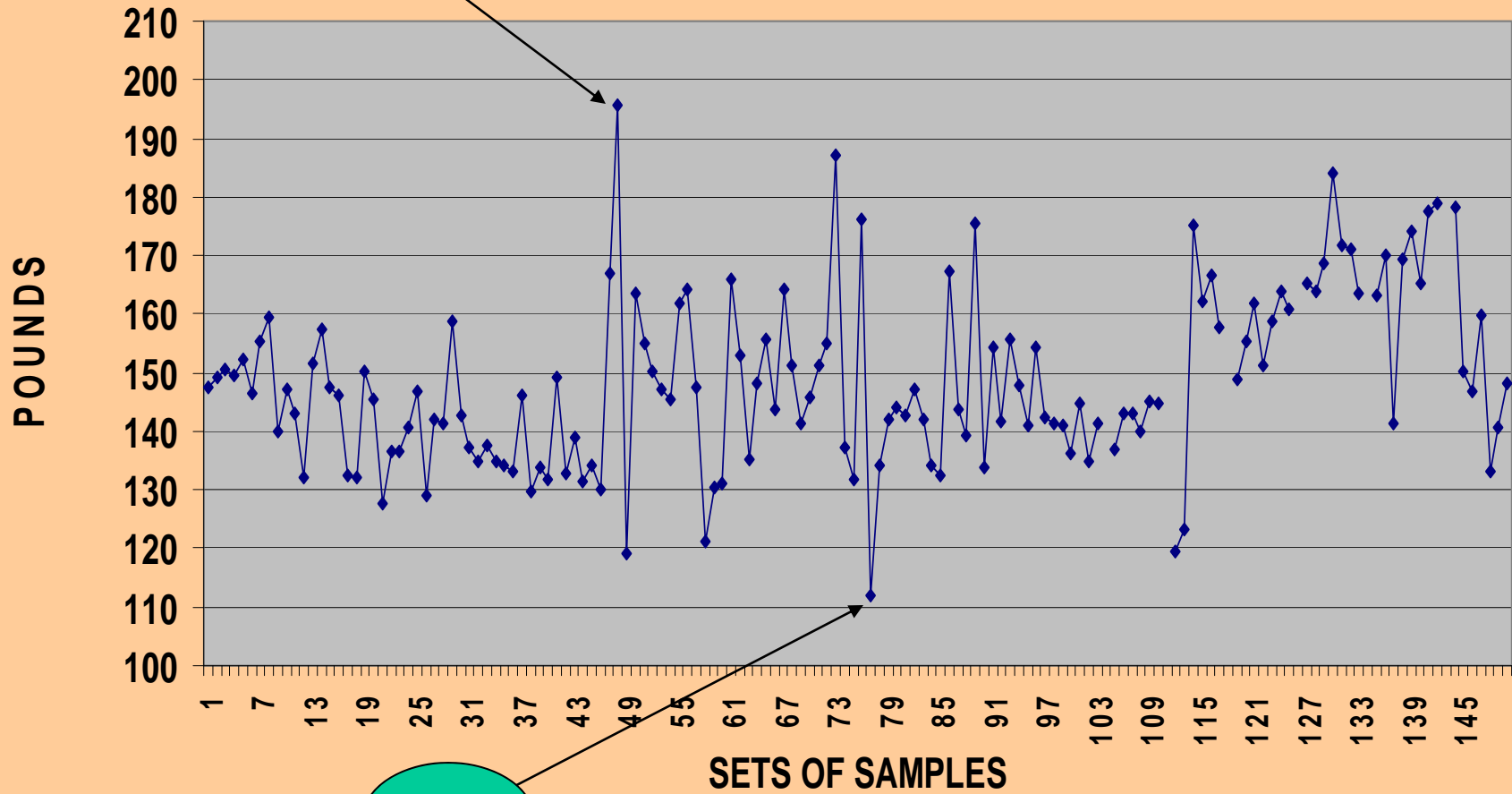




# PLANT DATA EXTRUDED BRICK MOISTURE 3-4-09 TO 5-7-09



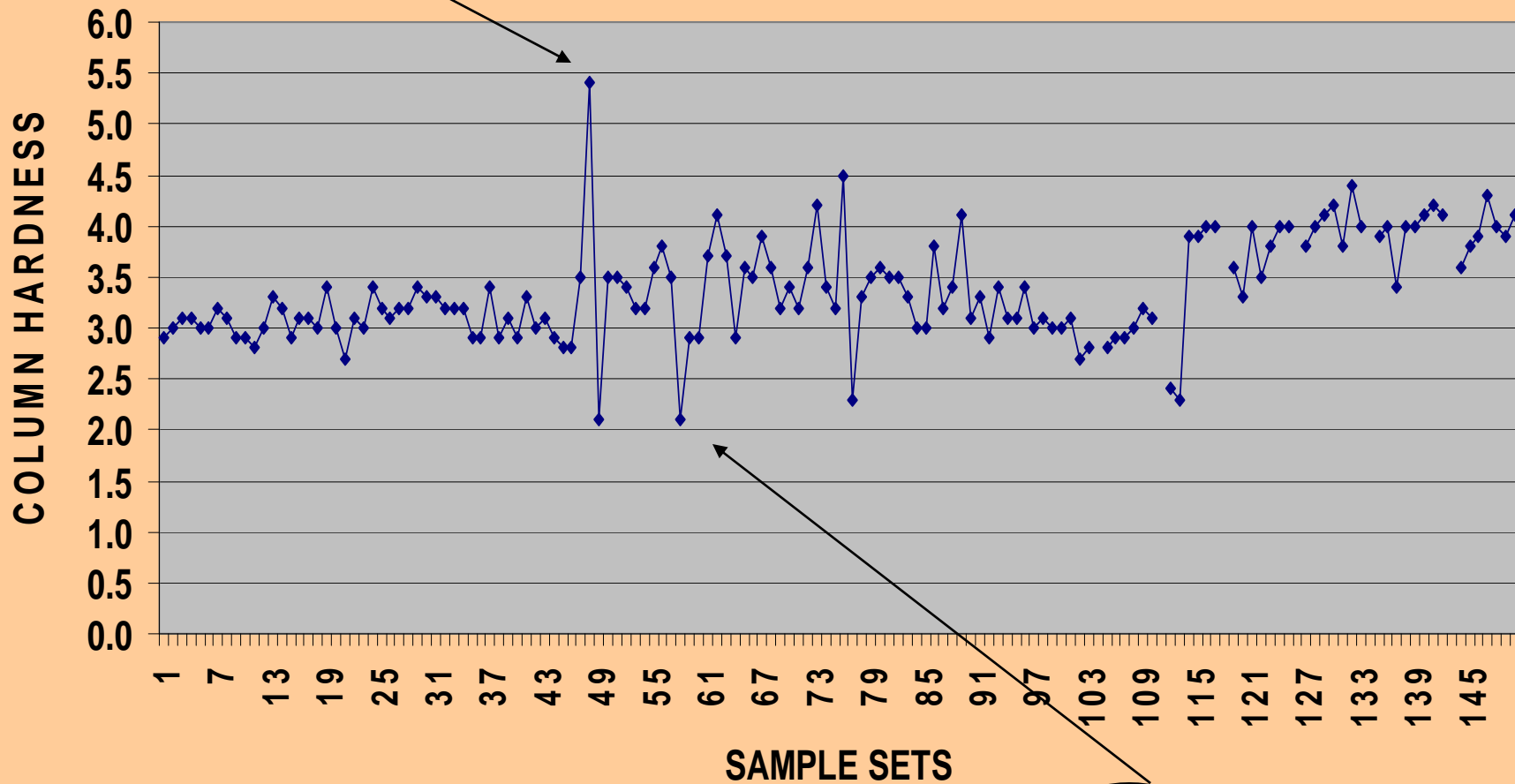
# PLANT DATA BRICK GREEN STRENGTH 3-4-09 TO 5-7-09



195

110

# PLANT DATA PENETROMETER READINGS 3-4-09 TO 5-7-09

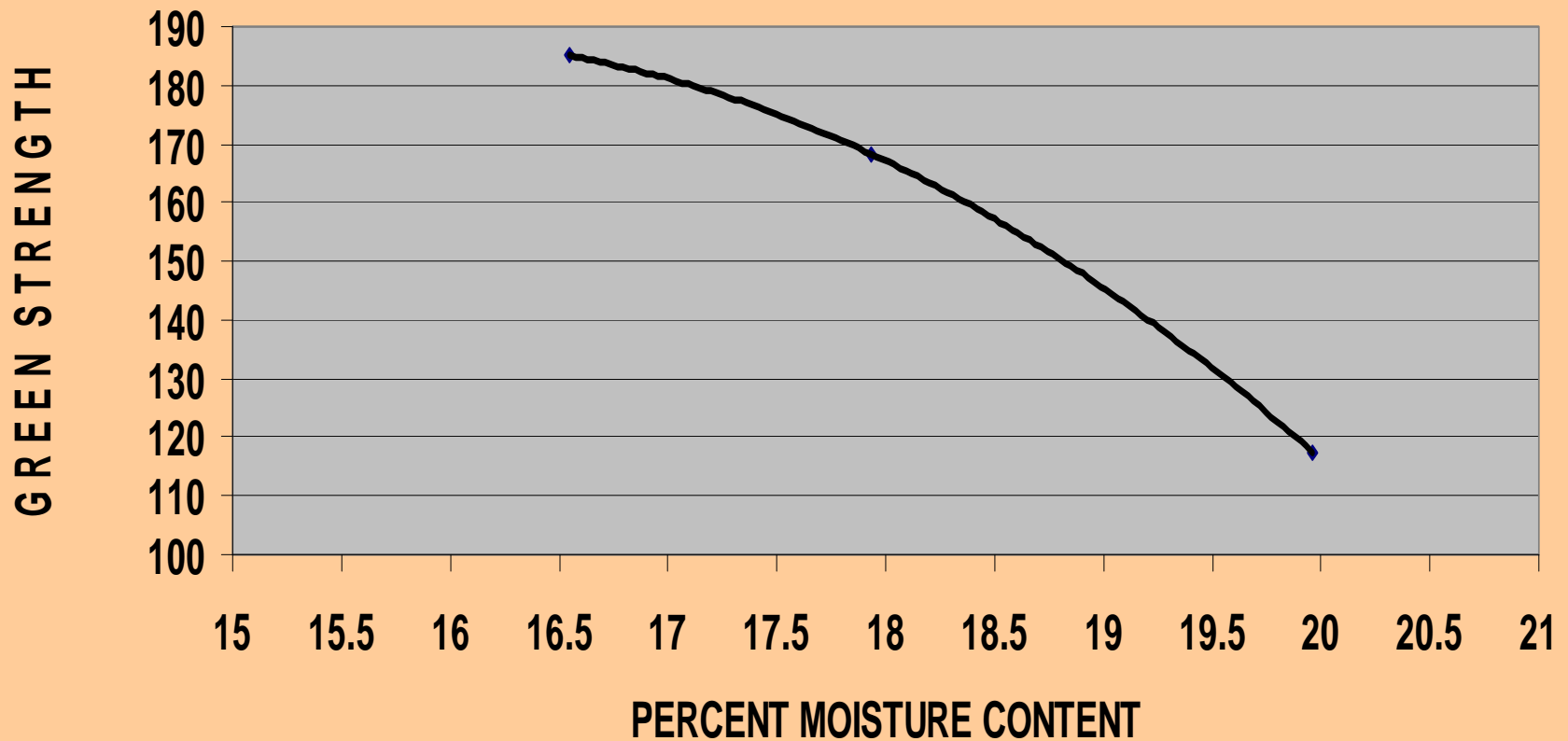


5.5

2.0

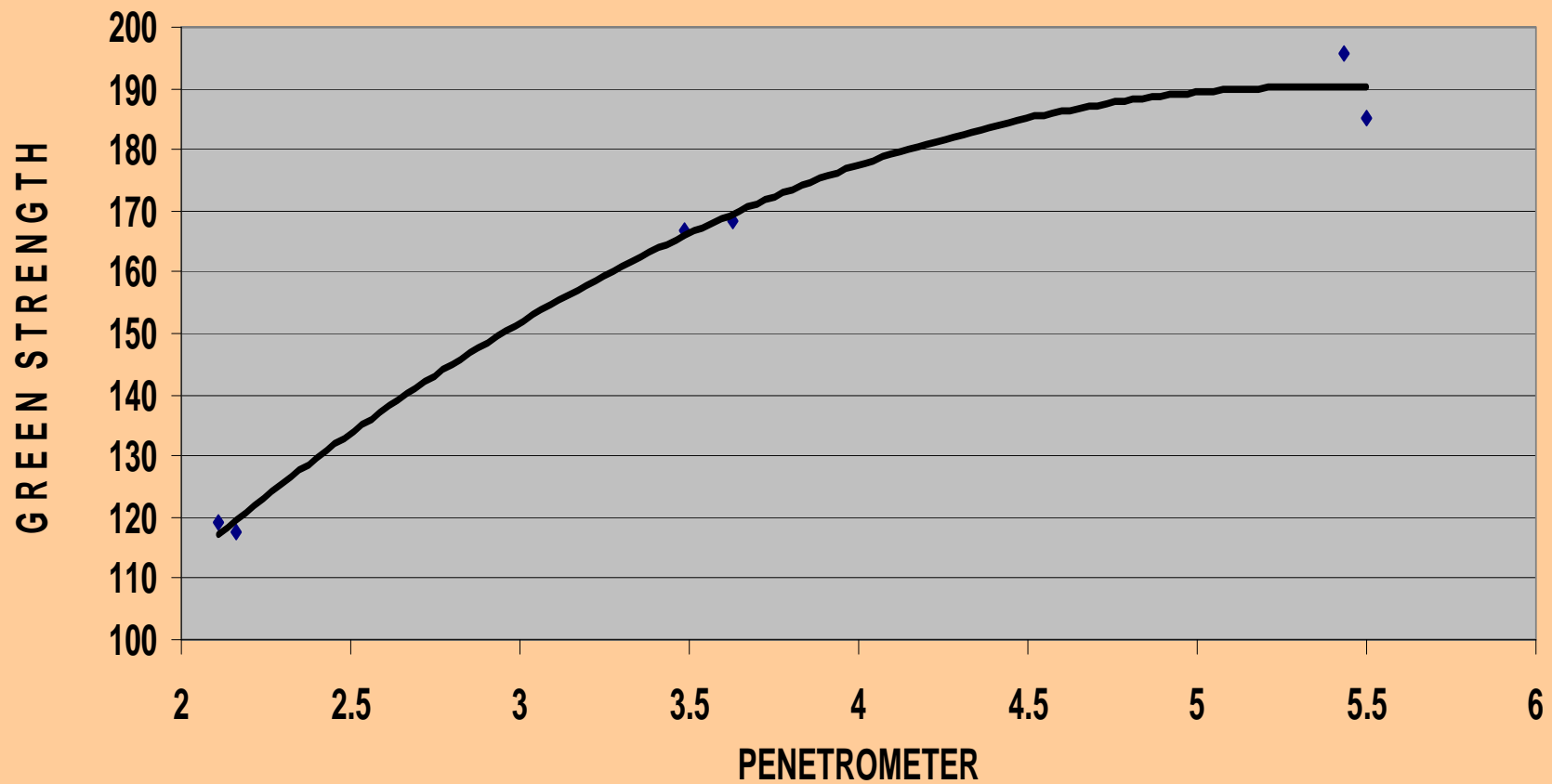
**THINGS OUT OF CONTROL**

**PLANT TEST**  
**CONTROLLED MOISTURE CONTENT TEST**  
**GREEN STRENGTH VS MOISTURE CONTENT**





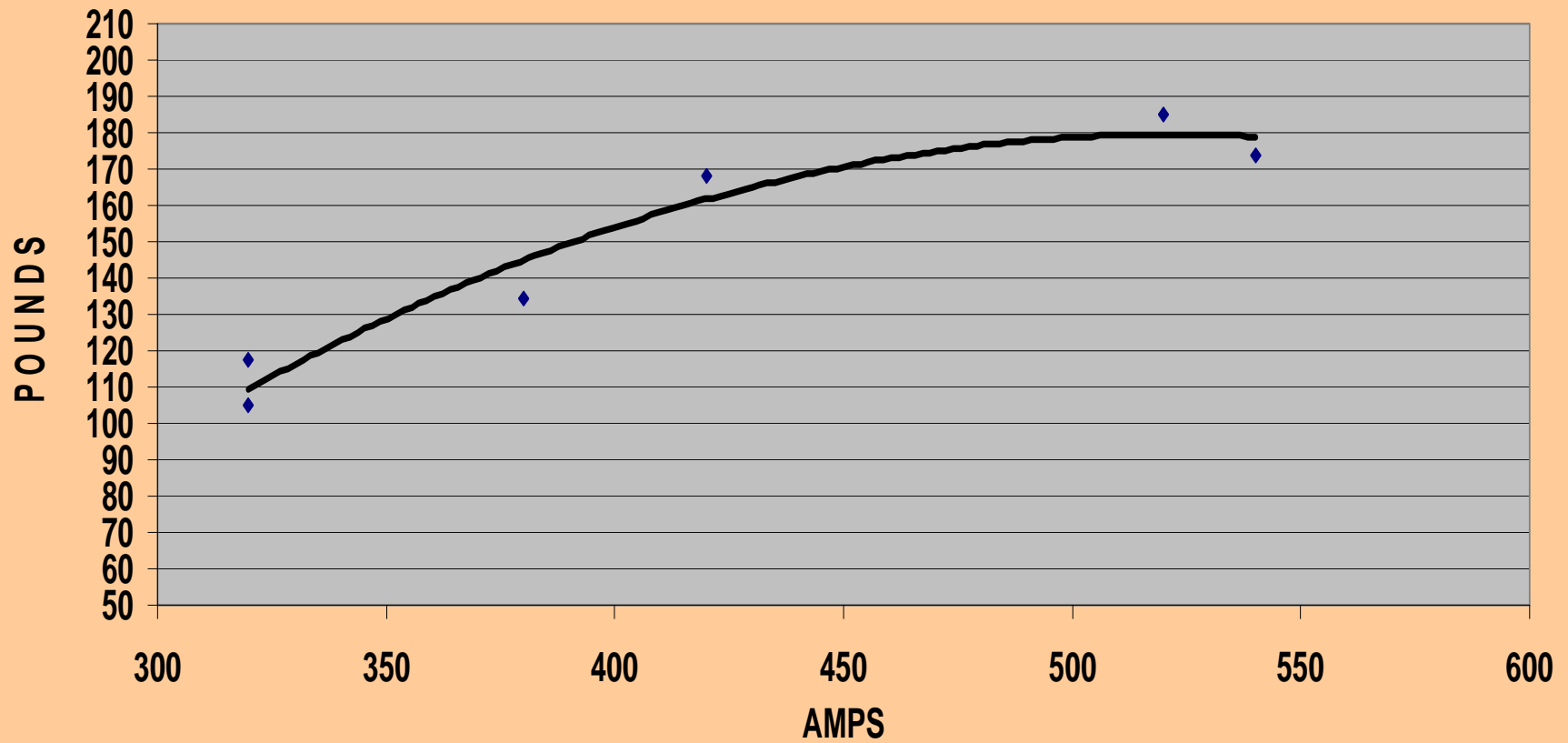
**PLANT DATA**  
**VARIED MOISTURE CONTENT**  
**GREEN STRENGTH VS PENETROMETER**



# PLANT TESTS

## CONTROLLED EXTRUSION MOISTURE

### GREEN STRENGTH VS EXTRUDER AMPS



# Action Taken

- Installed a Moisture Control System-In House
- Monitor Incoming Dirt Feed Rate and Moisture Content
- Control Water Addition and Additive Feed Rate Based on Incoming Dirt Feed Rate
- Eliminated Manual Water Feed Adjustments
- **Control Moisture Feed Rate Based on Automatic Continuous Penetrometer Readings**

# RESULTS

- Got Control of Extrusion Process  
Moisture Addition Rate  
Additive Feed Rate  
Production Rate
- Set Target Penetrometer Reading at 3.9
- Improved Green Brick Quality
- Improved Brick Hack Quality
- Allowed Control of Drying Process
- **Increased Recovery Rate by 5-7 %**

# Potential Value

## 6 % Increase in Recovery

- 40 Million Brick Production
  - 2.4 Million Extra Brick to Sell
  - Market Value \$225 / M
  - Increased Revenue \$540,000
- 75 Million Brick Production
  - 4.5 Million Extra Brick to Sell
  - Market Value \$225 / M
  - Increased Revenue \$1,012,500

# Message to Sales

“We Got Extra Brick”

“You Need to Sell Them”