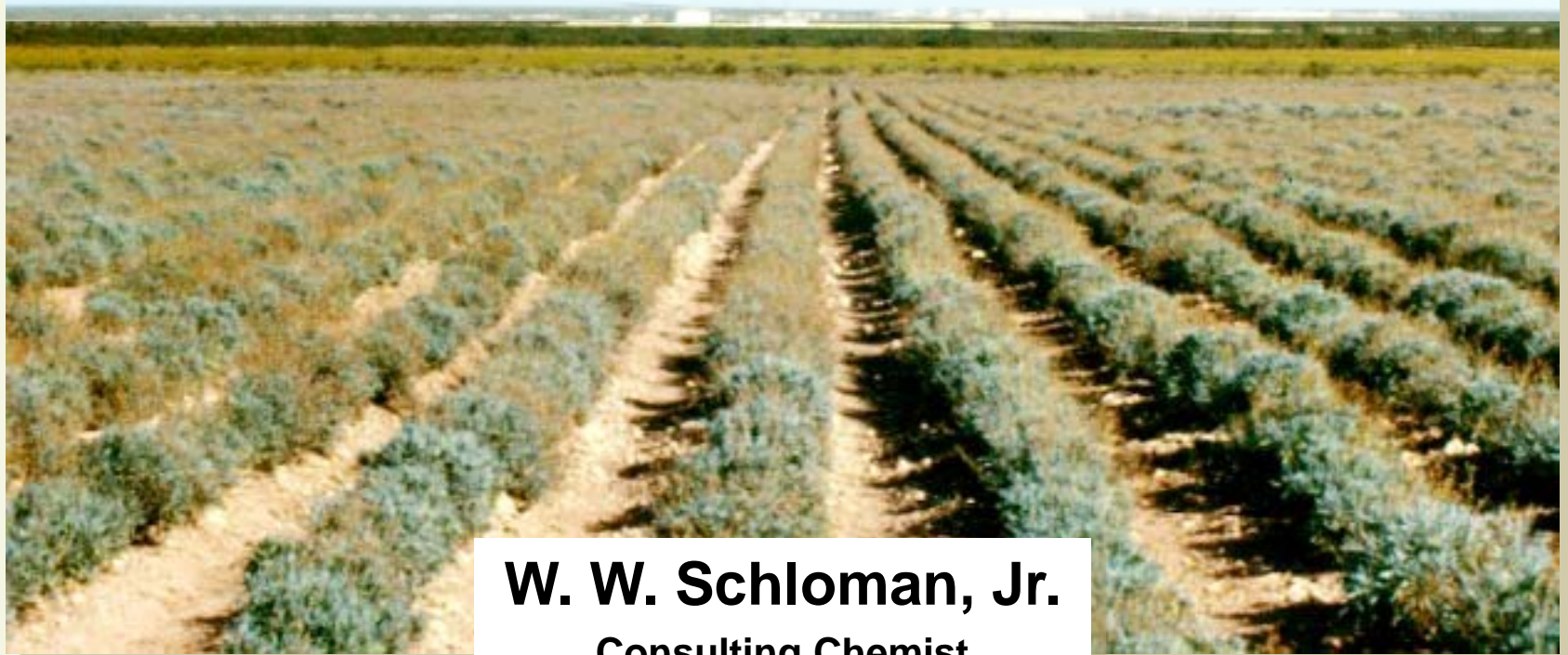


# Guayule Rubber Production at Sacaton, Arizona 1987-1990



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USA

# **THE FIRESTONE GUAYULE PROJECT 1983-1990**

- **1986: USDA contracted FTR to produce 54 t of GR meeting ASTM, modified FEMA specifications**
- **04/1987: Construction began at San Tan Industrial Park**
- **12/1987: Start-up**
- **12/1990: Operations ceased**

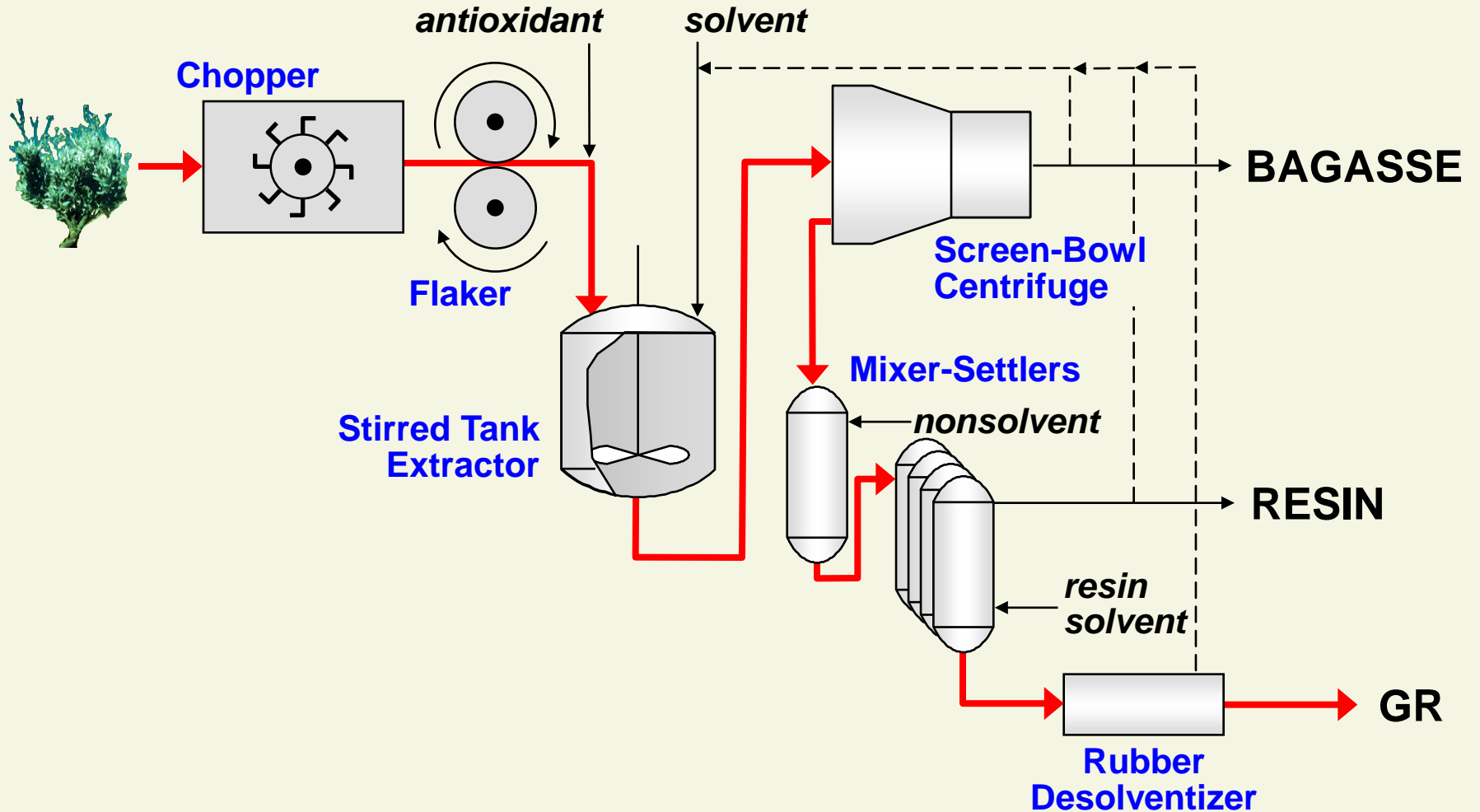
# MONOPHASE SOLVENT EXTRACTION

- **Continuous process**
- **Rubber, resin co-extracted from ground shrub: C<sub>5</sub>-acetone azeotrope (80:20)**
- **Rubber separated from resin and fractionated: coagulation with excess acetone**
- **Rubber desolventized and baled**

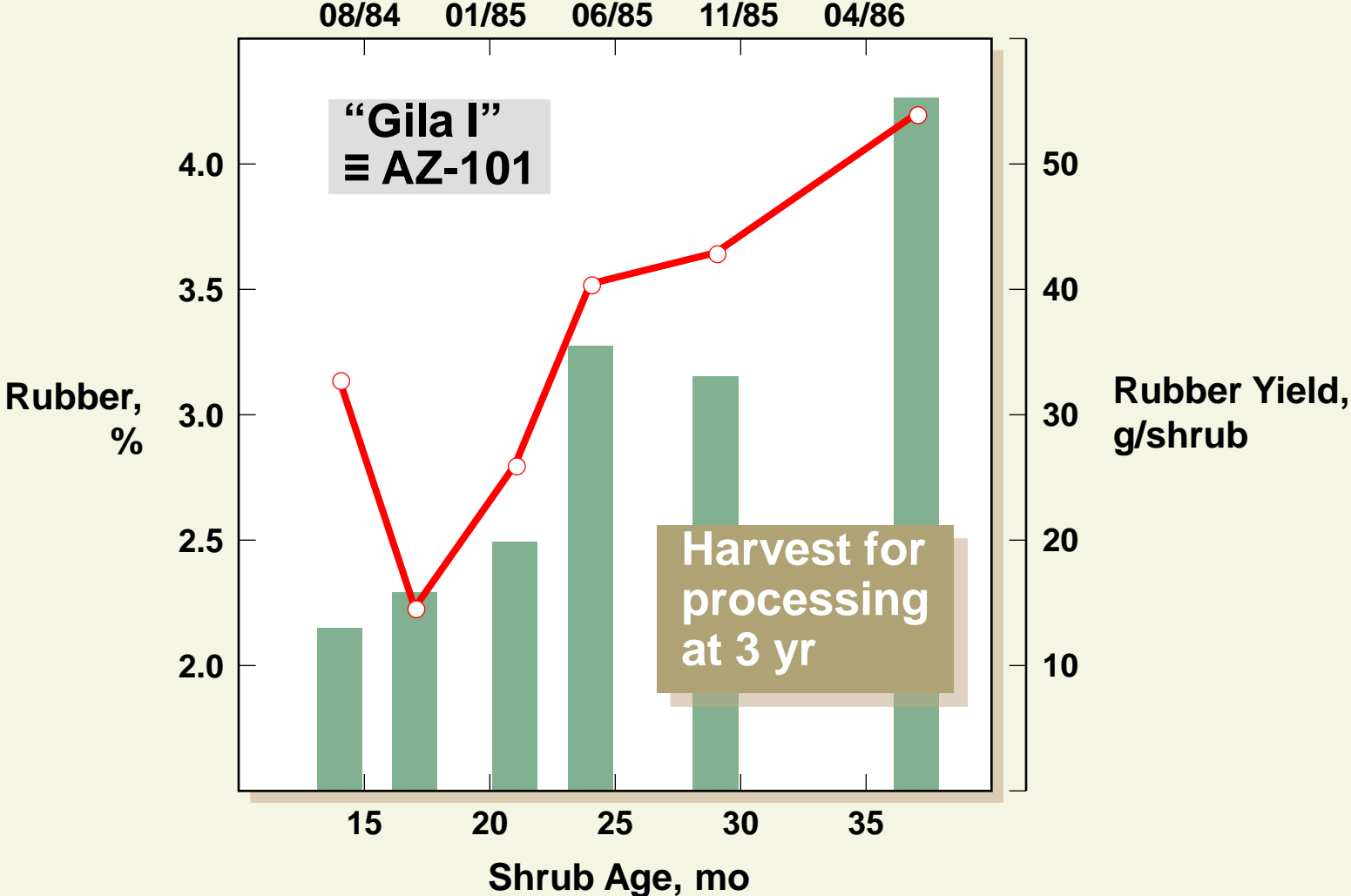


Prototype Processing Plant, Sacaton, Ariz.

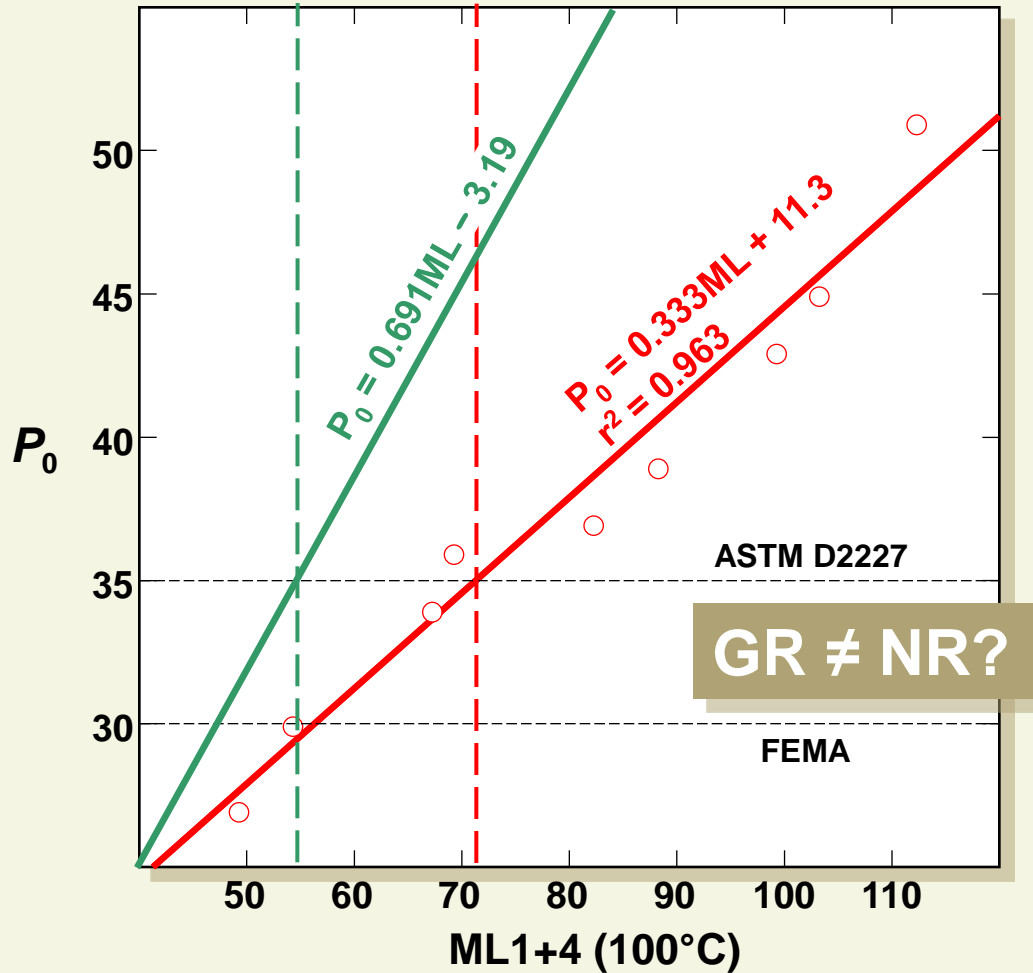
# Simultaneous *E*xtraction & *R*ubber *F*ractionation: PROCESS TO CONTROL PRODUCT QUALITY



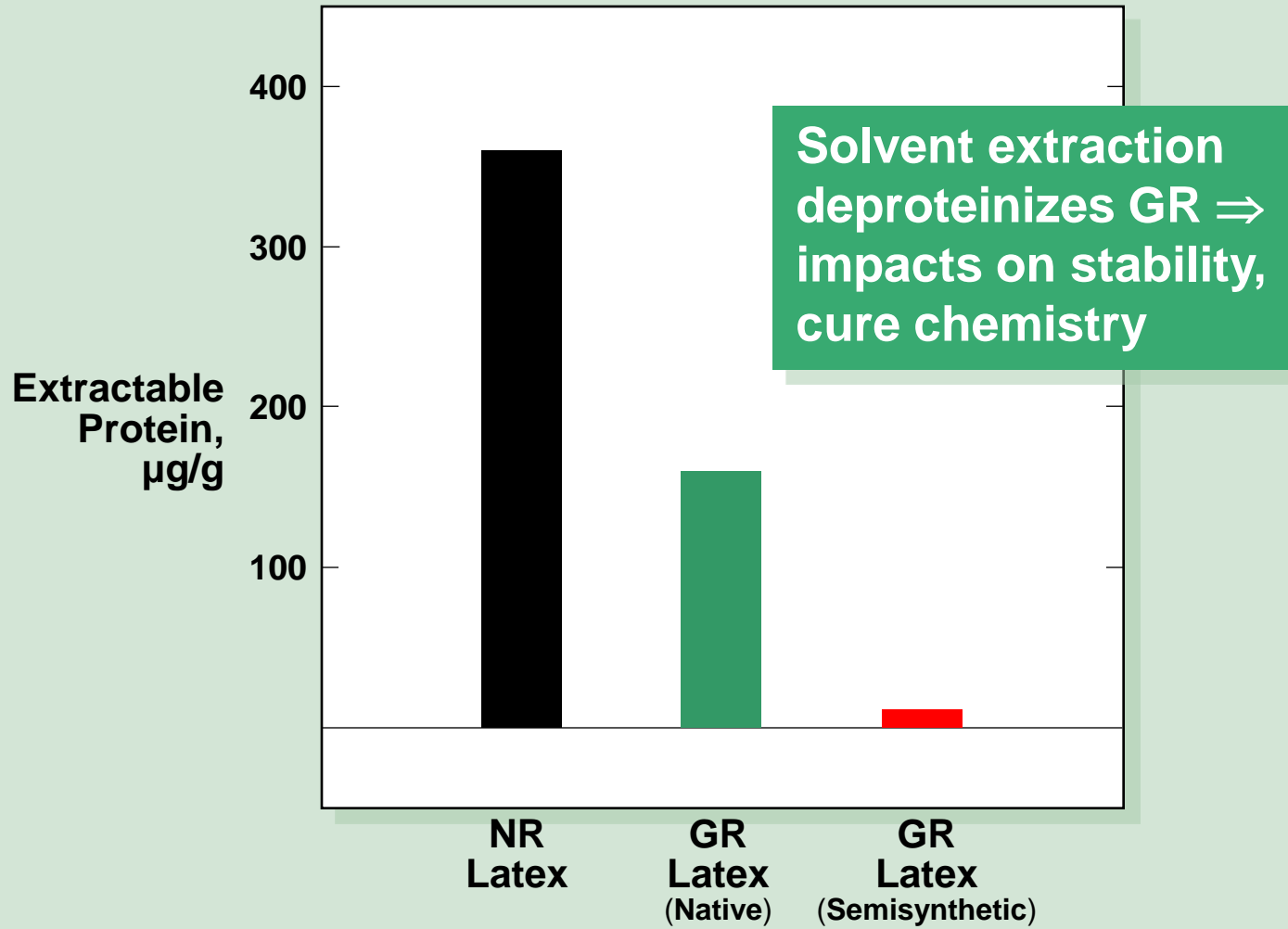
# GR CONTENT INCREASES WITH SHRUB AGE



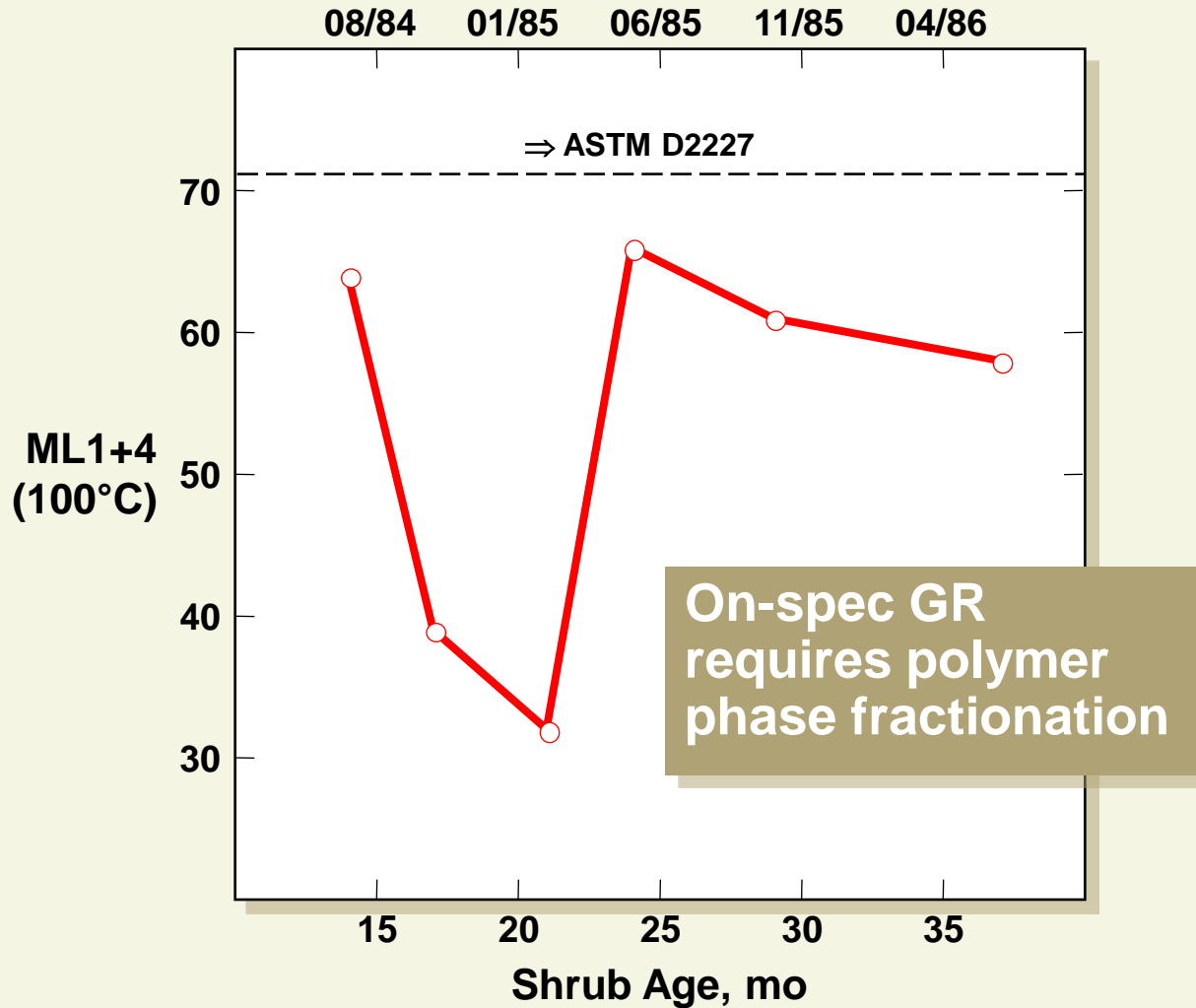
# BULK VISCOSITY RELATIONSHIPS:



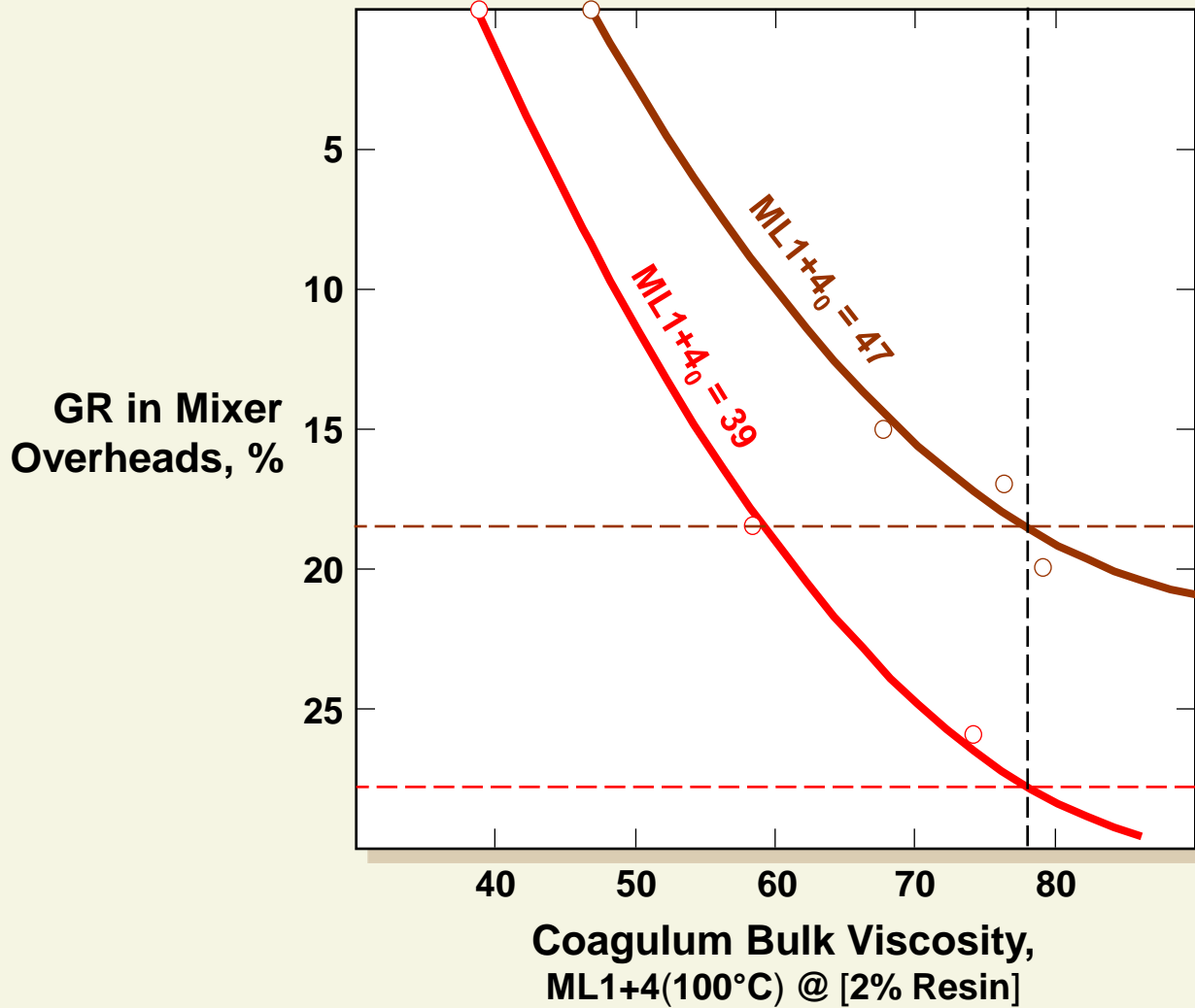
# CAST FILMS:



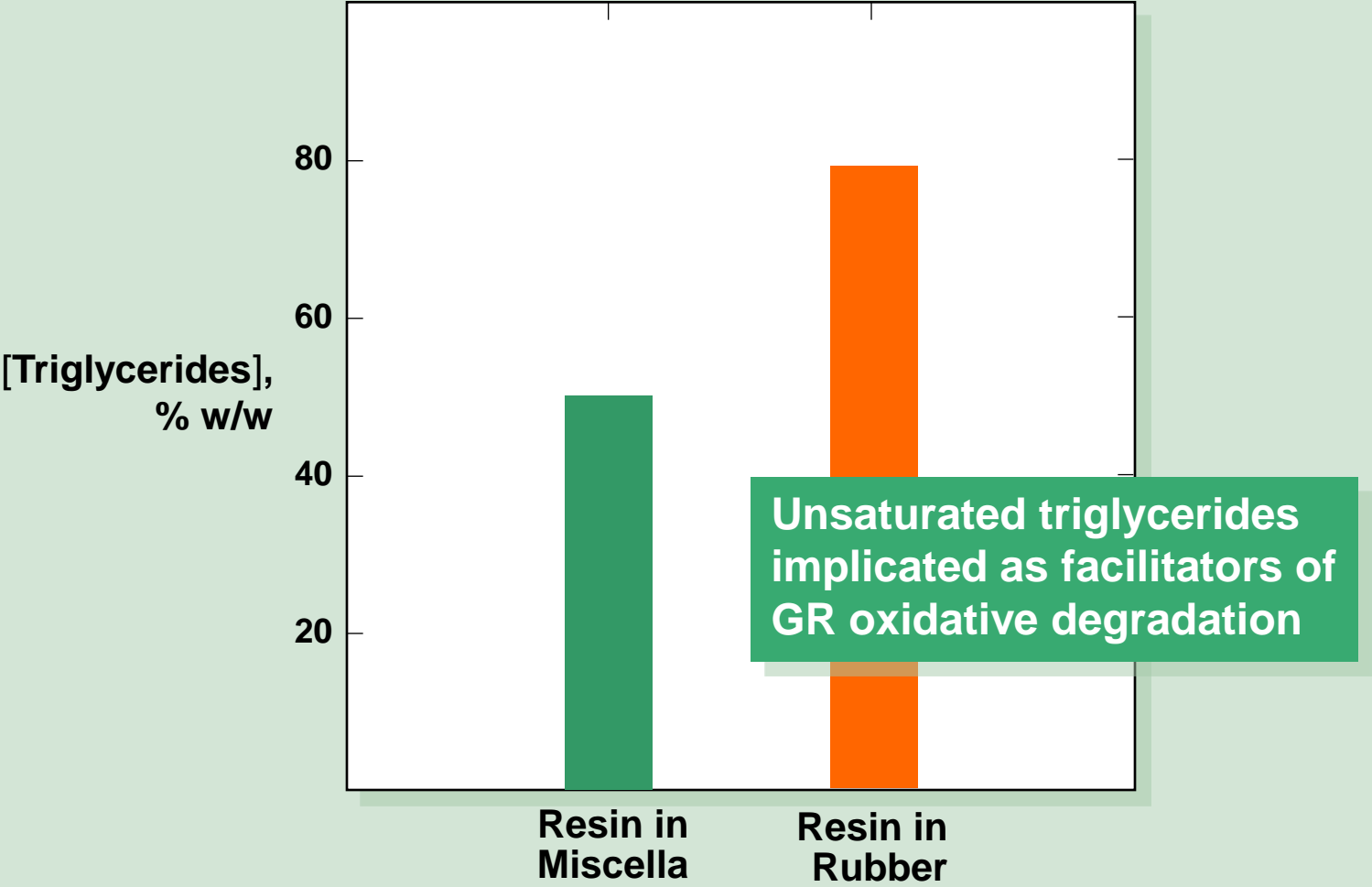
# BULK VISCOSITY VARIES WITH SHRUB AGE



# PARTITION REDUCES GR RECOVERY



# PARTITION ENRICHES [TRIGLYCERIDES]



# Overview: 1986

- **What we knew:**
  - AZ-101 differs significantly from USDA lines: higher biomass, lower GR content
  - Extent of GR fractionation will vary with age, cultivar, source location
  - GR and NR have different chemical and physical properties
  - Resin:  $\leq 4\%$   $\Rightarrow$  hindered-amine AO
- **What would have been nice to have known at the time:**
  - AZ-101 is an interspecific hybrid
  - Low protein content of GR product affects its behavior
  - Resin in GR is enriched in (polyunsat'd) triglycerides
  - Supply of AZ-101 feedstock would be inadequate to meet production quota(s)

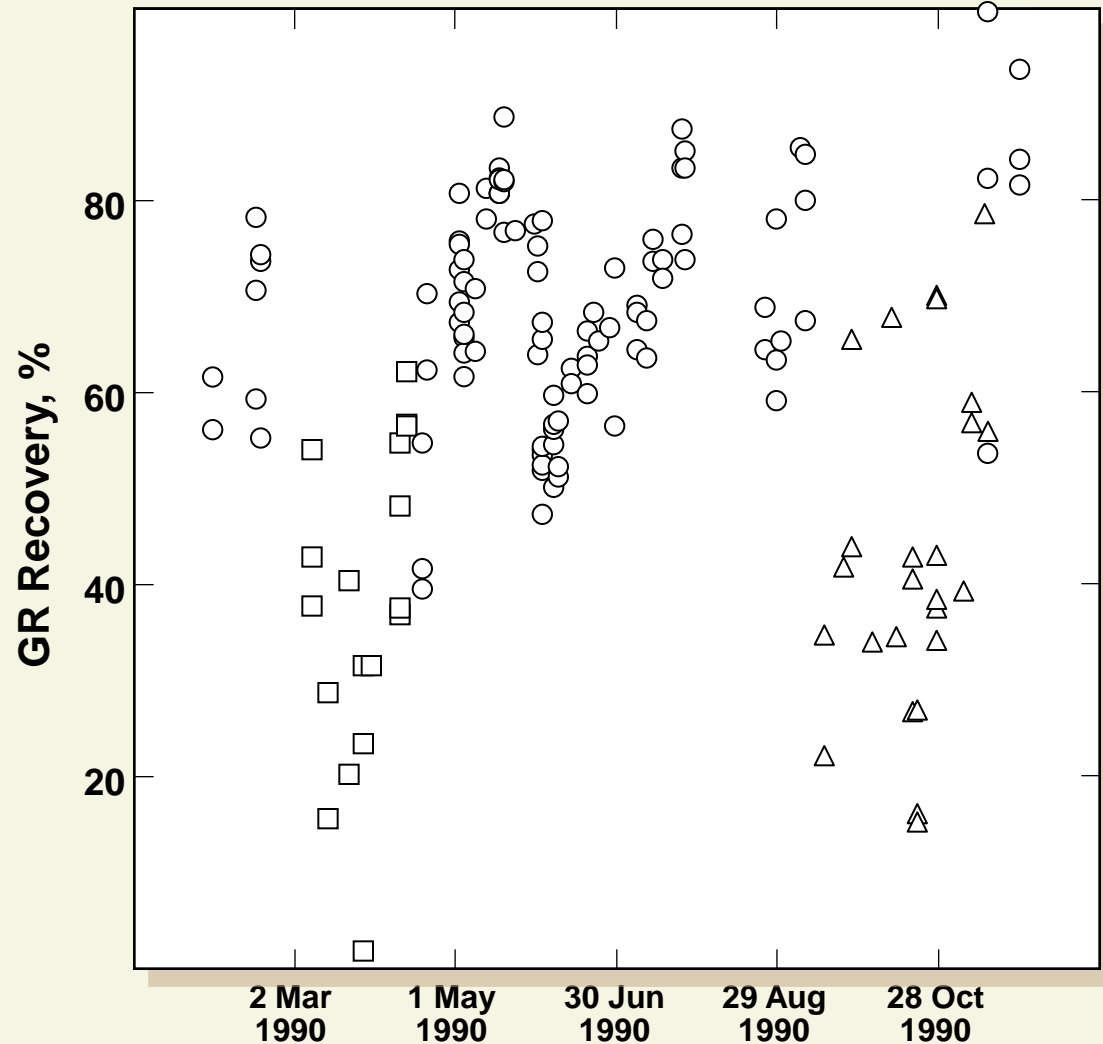
# FEEDSTOCK OVERVIEW ( $t_0$ )

Cultivation Site	Resin, %	Rubber, %	ML1+4 (100°C)
<b>Sacaton, AZ</b>			
AZ-101 (05/84)	8.8	4.7	28.5
AZ-101 (11/84)	8.8	4.5	26.5
AZ-101 (05/85)	8.4	5.6	47.5
AZ-101 (07/85)	8.4	4.0	44.5
Mexican Bulk	6.2	6.1	49.5
<b>Las Cruces, NM</b>	8.1	6.8	65.5
<b>Marana, AZ</b>	6.5	5.8	51.0
<b>Pecos, TX</b>	6.2	6.9	39.0
<b>Salinas, CA</b>	8.9	8.2	62.5
<b>Weslaco, TX</b>	9.7	8.6	34.5

**AZ-101:  
inferior feedstock**

# PROCESS EFFICIENCY: FEEDSTOCK DEPENDENT

- **Rubber recovery greater for**
  - **Shrub with lower rubber content**
  - **Shrub producing lower-viscosity miscella**
- **Outcome of using AZ-101 in process design phase**



# Operation History

- **Issue:**

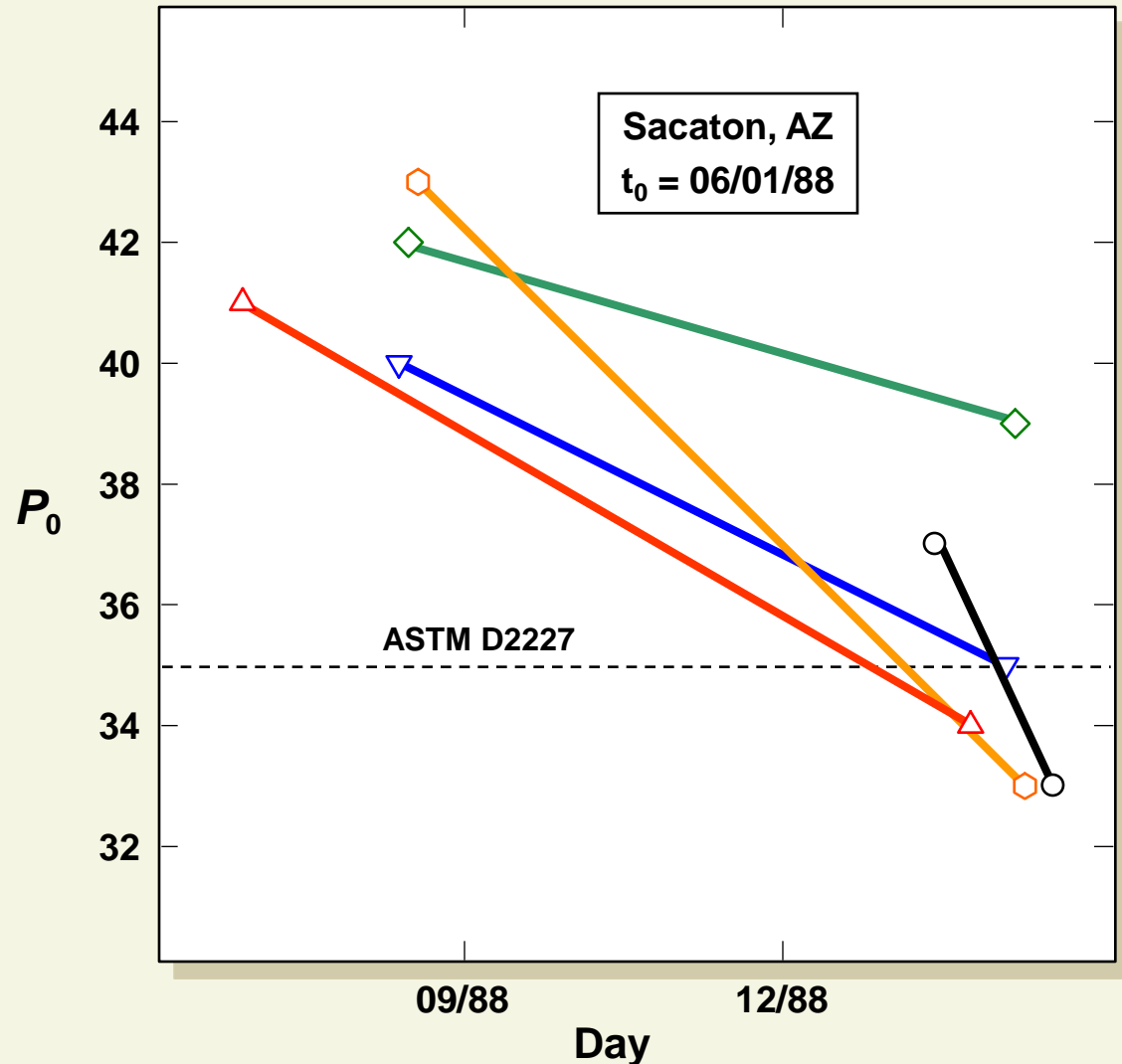
- Solvent loss
- Low recovery efficiency
- High ash content

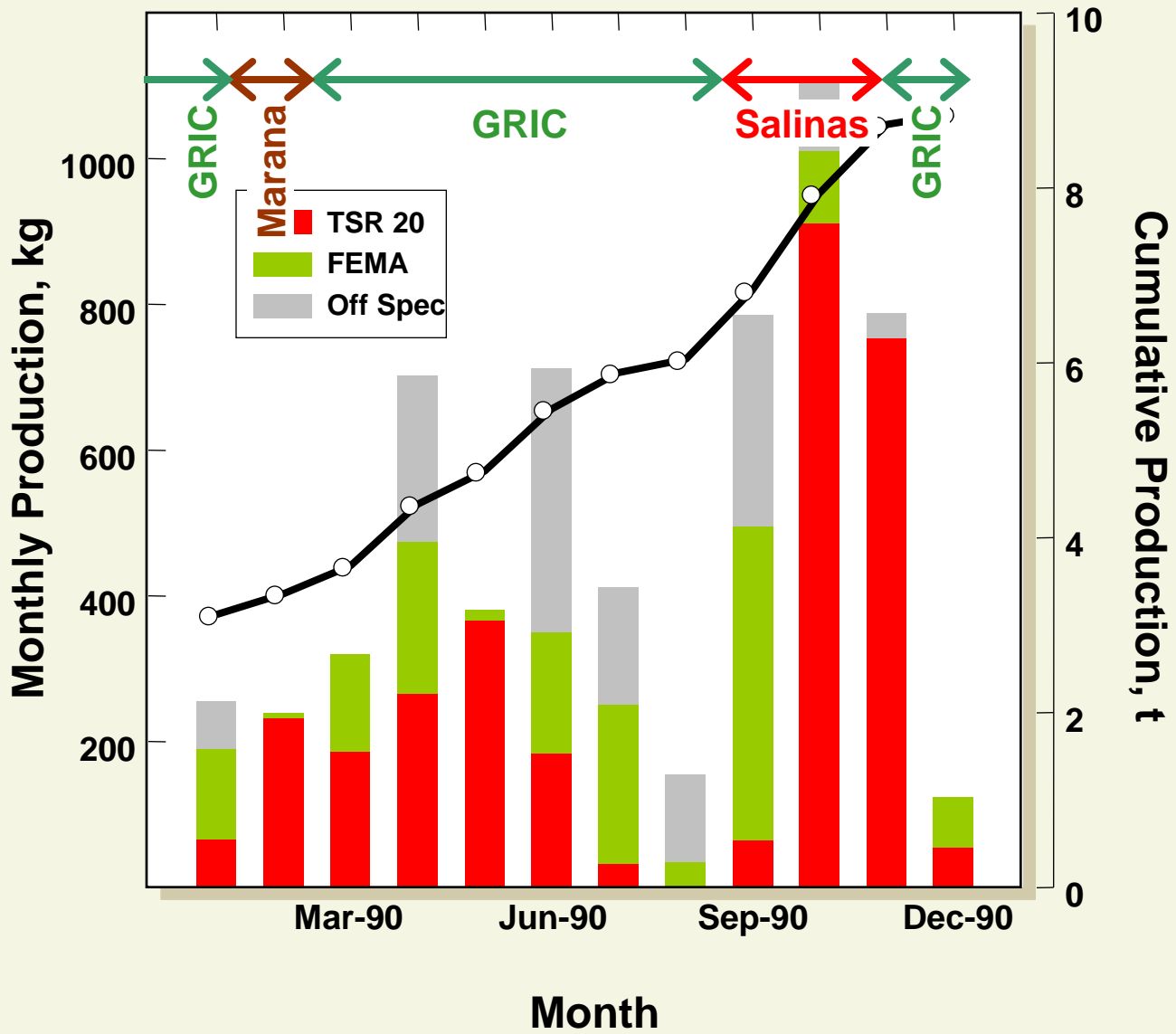
- **Solution/Response:**

- Change dryer seals
- $C_5 \rightarrow C_6$
- Improve separation of bagasse and miscella
  - Reduce miscella feed rate to centrifuge
  - Reduce GR content of miscella
- Reduce miscella fines
  - 5% w/w H<sub>2</sub>O in miscella
  - Solid-bowl centrifuge + settling tank upstream of fractionation

# POST-PRODUCTION DEGRADATION OF GR

- Thermal process in low-protein polymer
- Rate significant at  $T \geq 60^\circ\text{C}$
- Necessitates added stabilization, controlled storage
- Zn dibutyldithiocarbamate added (0.5 phr) as “secondary” antidegradant





# Postmortem

## What we learned/confirmed:

- **Centrifuge performance (bagasse-miscella separation) had the greatest impact on recovery and product quality**
- **Processing should accommodate a range of feedstocks and extraction solvents**
- **Post-production control of product quality must be assured**
- **Primary non-mechanical problem: AZ-101**

# ACKNOWLEDGMENTS

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- **J.D. Bultman (NRL)**
- **J.P. Wagner (Texas A&M)**
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