MARATHON ASHLAND PIPE LINE
ULSD TESTING

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Distribution Concerns

- The distribution system has no experience in handling ultra low specification product in a batched system
  - Off-highway /heating oil <5000 ppm
  - Jet Fuel <3000 ppm
  - Low sulfur diesel <500 ppm
  - Kerosene <2000 ppm
  - Ultra low sulfur diesel ,15 ppm

Goals for MAPL ULSD Testing

- Determine whether sulfur from other refined products will “trail-back” in the pipeline
- Determine what batch sequences will work and the amount of interface generated

Goals for MAPL ULSD Testing (Con't)

- Determine sulfur degradation due to:
  - The originating tank and receipt manifold piping
  - The pipeline and its associated appurtenances
  - The delivery manifold, tank piping and transport loading equipment
- Determine an appropriate field test for sulfur

ULSD Testing

- Initial tests conducted with Premium Gasoline on 4 pipeline systems
  - Many lessons about contamination learned
- Precautions taken with ULSD tests
  - Automatic sumps were locked out
  - Booster pump units along the pipeline were not started
  - Simple tank to tank movements
  - Pipeline shutdowns minimized
  - Tank lines and tanks emptied prior to ULSD
  - Special sampling procedures implemented

ULSD Testing

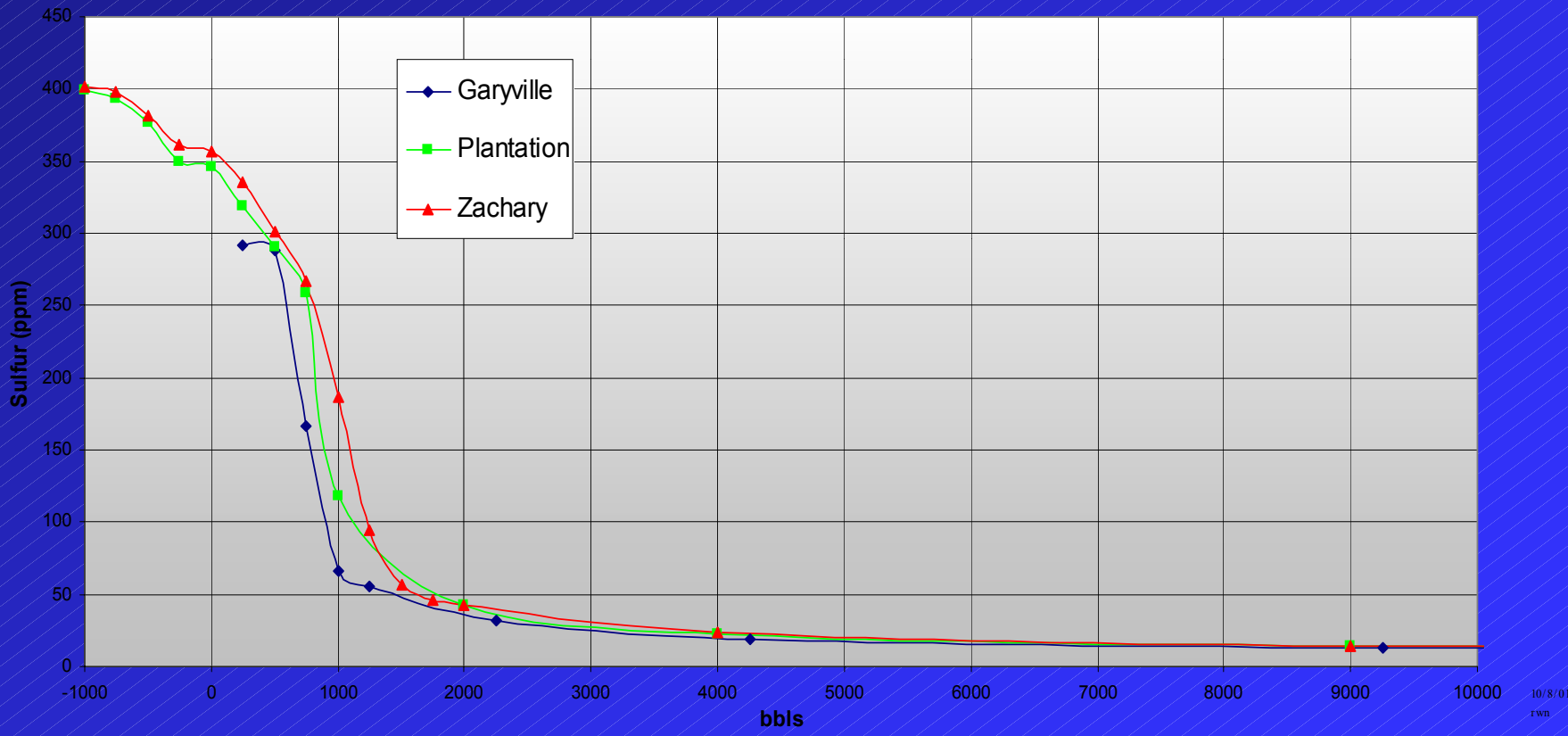
- ULSD tests were conducted on 4 pipeline systems
  - 10”, 12”, 16” and 20” diameter - 70 to 250 miles long
- Garyville to Zachary test was the most recent
  - Test is representative of all tests
  - Test covered movement from Garyville refinery tankage to MAP’s tankage at Zachary, La
    - 70 miles of 20” pipeline
  - Second test on this system in April, 2002

ULSD Testing – Garyville to Zachary

- Garyville made 90,000 bbls of ULSD in mid-September, 2001
  - ULSD in tank had 10 ppm sulfur and API gravity of 38.7 degrees
  - ULSD from unit had 7 ppm sulfur
- 76,500 bbls lifted to Zachary
  - LSD at head end
  - Regular gasoline at tail end

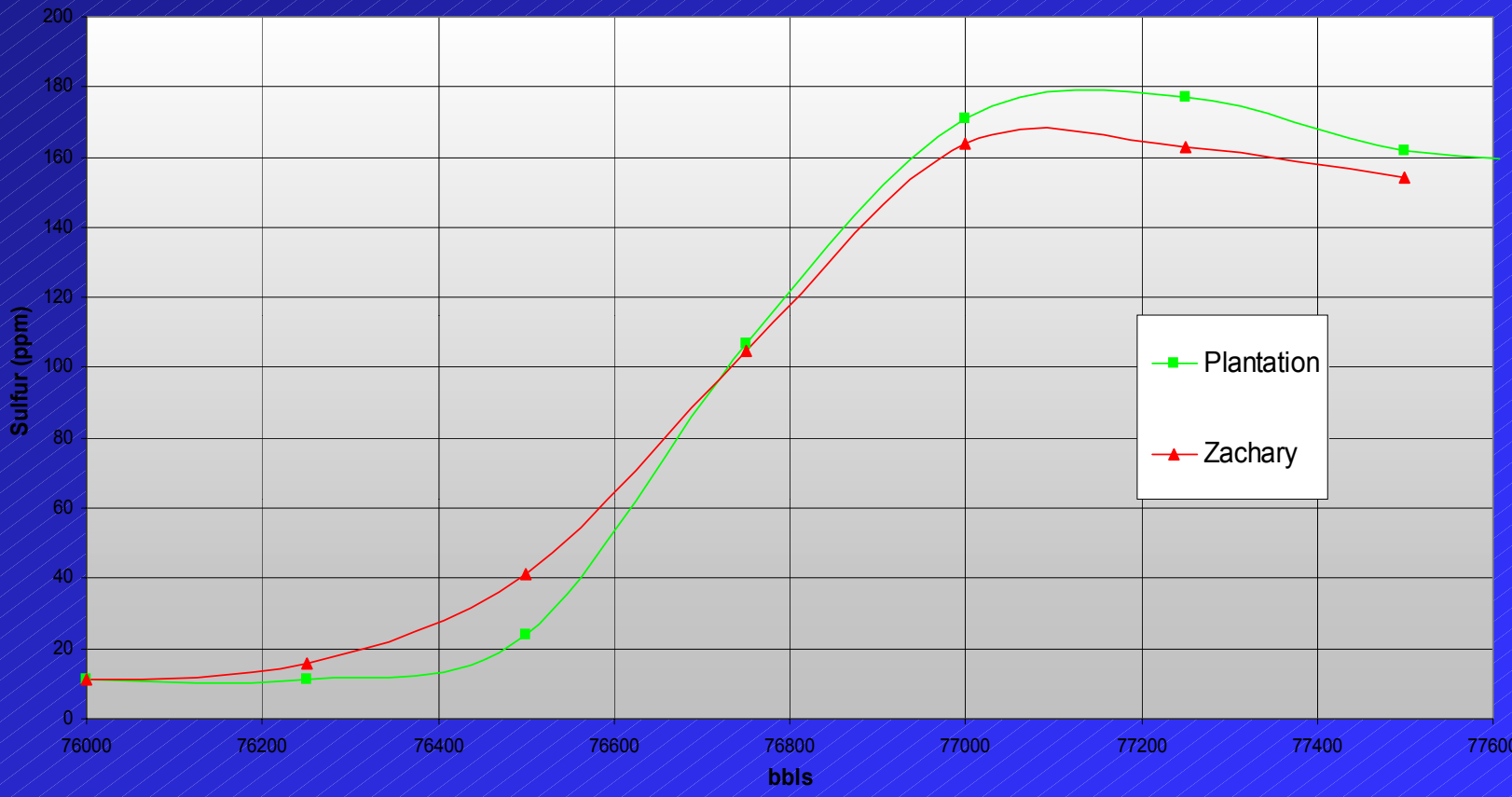
ULSD Testing – Garyville to Zachary Results (Con't)

Garyville to Zachary Head End Expanded Sulfur Profile
(9/15/01 - 9/16/01) Chart 2



ULSD Testing – Garyville to Zachary Results (Con't)

Garyville to Zachary Expanded Tail End Sulfur Profile
(9/16/01) Chart 3



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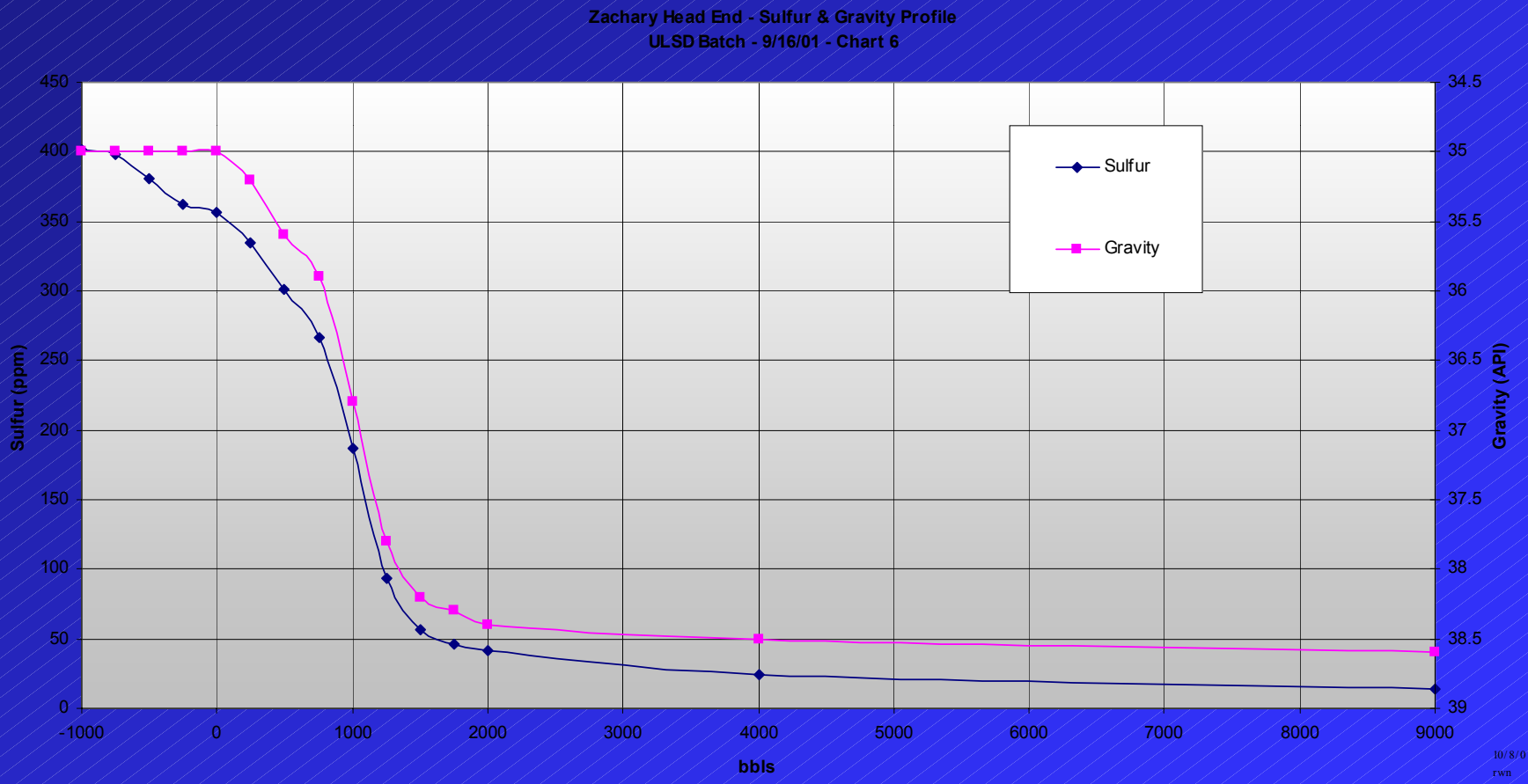
ULSD Testing – Garyville to Zachary Results (Con't)



ULSD Testing – Garyville to Zachary Results (Con't)

- Zachary via 20" system wrapped with LSD and gasoline
  - 73,034 bbls out of 76,588 bbls delivered to a clean tank at Zachary
  - 1-2 ppm sulfur degradation tank to tank
  - 4.6% loss to interface
  - Refinery tank line at Garyville contaminated head end 4000 bbls
  - No migration of sulfur at head end or tail end beyond the normal gravity interface zone
  - No degradation due to the pipeline and associated appurtenances
  - No sulfur degradation from delivery piping

Testing Summary

- MAPL results indicate:
  - Pipelines can transport ULSD and maintain the sulfur specification
  - Gravity changes correspond closely to sulfur changes; protective gravity cuts may be acceptable
  - The loss to interface should be the same as with current critical cuts

Testing Summary (Con't)

- MAPL results indicate:
  - Contamination occurs from front end systems such as refinery piping and origin station piping
  - Little sulfur contamination occurs in the pipeline
  - Tankage and delivery system piping does not add significant sulfur contamination

Testing Conclusions

- Must have in-line testing equipment
  - Control contamination that happens during transit
  - Define cut points
  - Suitable test equipment is not available
- Test equipment must be robust
- May need an indirect method for interface detection

Testing Conclusions (Con't)

- Each pipeline system will have its own "personality"
  - Anything which creates a product quality problem today will be exacerbated when handling ULSD
    - Slow actuating valves – leaking valves
    - Non-dedicated tank lines
    - Long dead-legs in stations – long suction/discharge piping at pump stations
    - Sumps that inject automatically – prover loops that are not flushed
    - Systems with frequent shutdowns or large elevation differences
  - May need to redesign facilities to minimize contaminaiton

Testing Conclusions (Con't)

- Pipeline ULSD sulfur specifications could vary by system or routing
  - Simple tank to tank movements could add only 1 ppm sulfur with a moderate interface loss
  - More complex network routings could add several ppm sulfur and have a large loss to interface

DISCUSSION