

PROCESS NMR ASSOCIATES

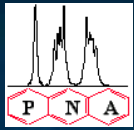
On-Line Analyses of Crude Feeds and Distillation Products: Utilization of On-Line NMR on a Refinery's Crude Distillation Unit

Paul J. Giammatteo* and John C. Edwards

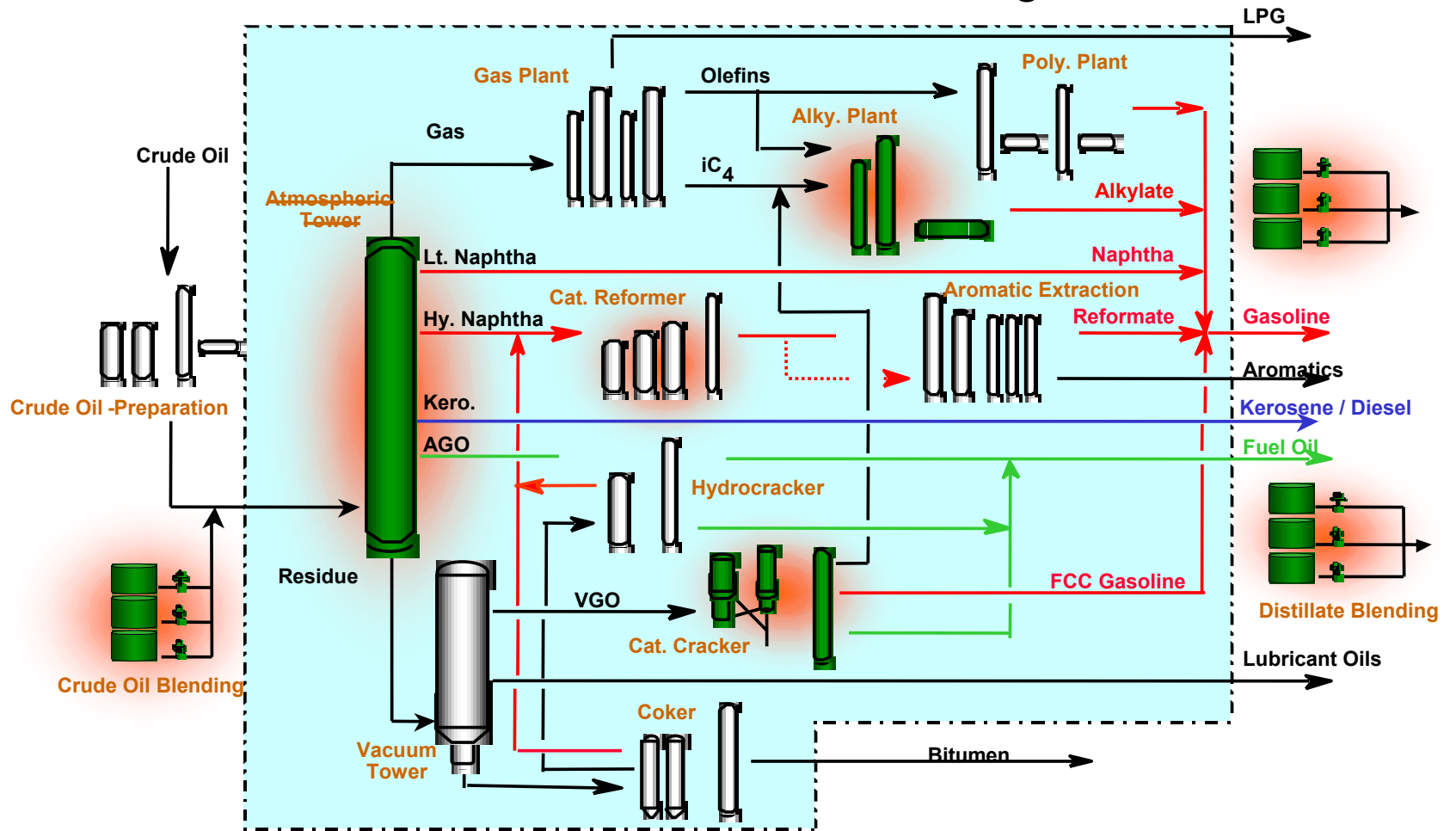
Process NMR Associates, LLC

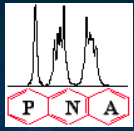
Danbury, Connecticut

www.process-nmr.com



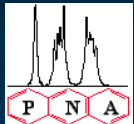
Process NMR Solutions in Refining



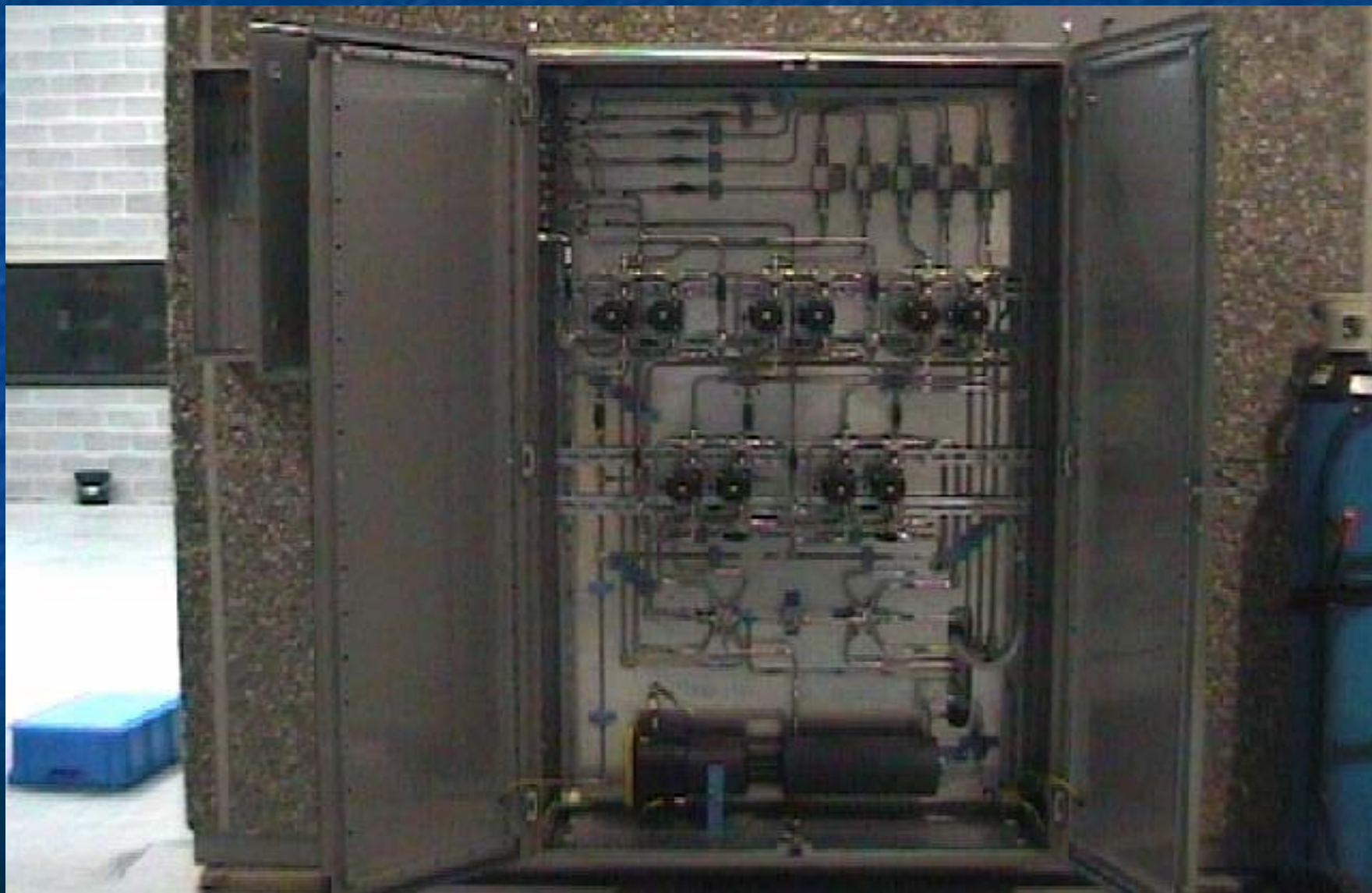


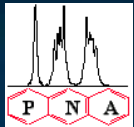
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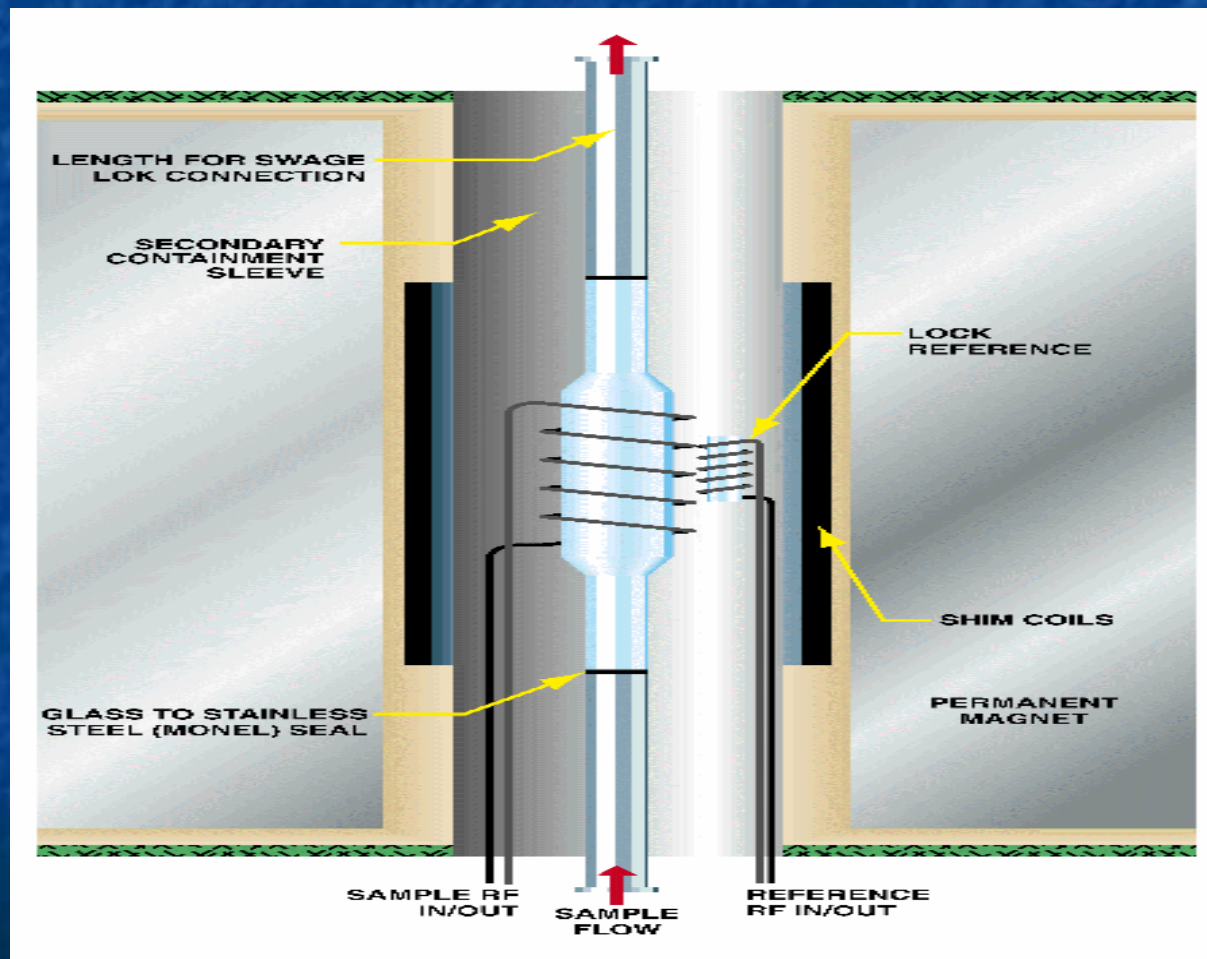


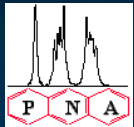
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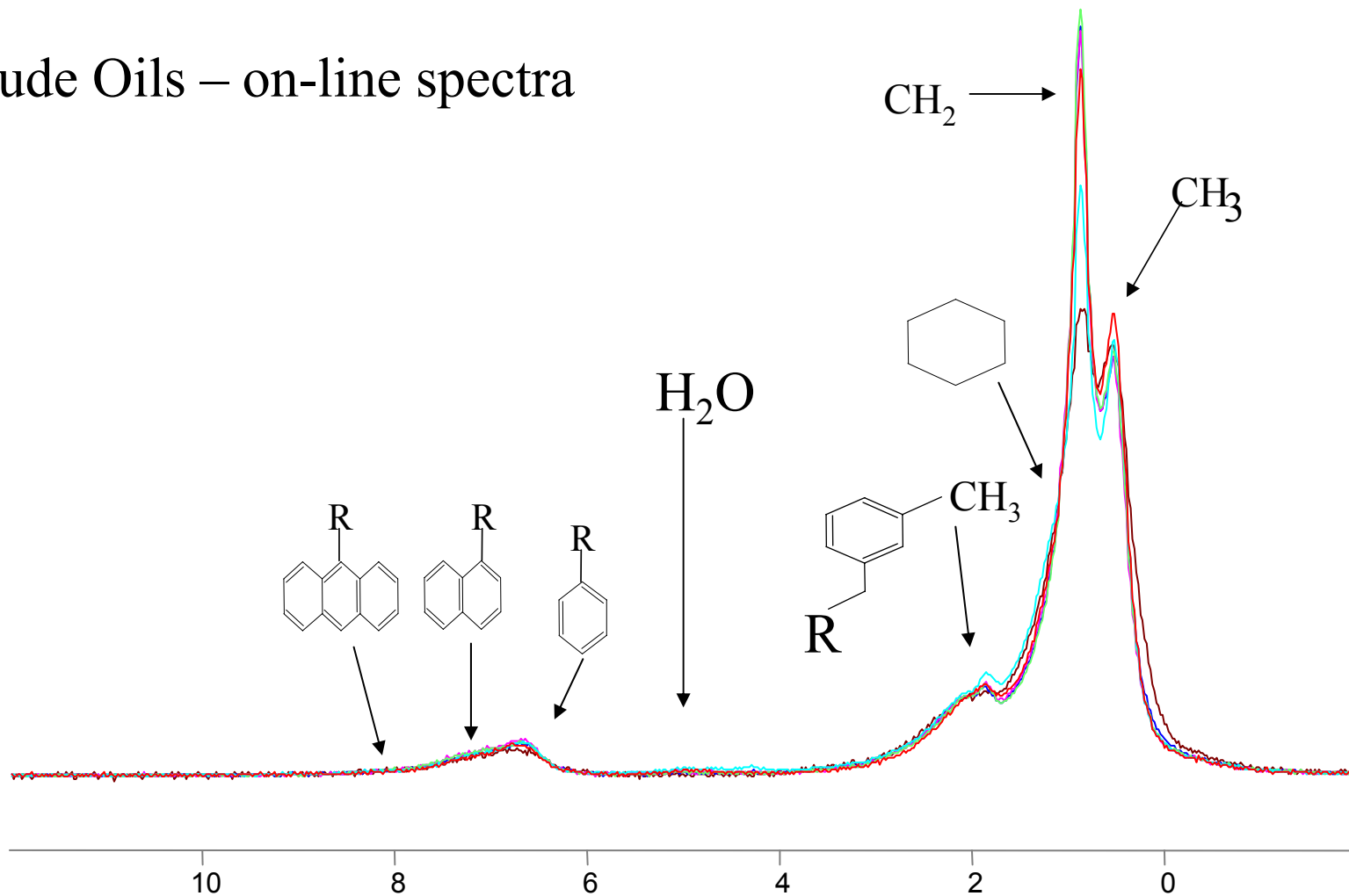


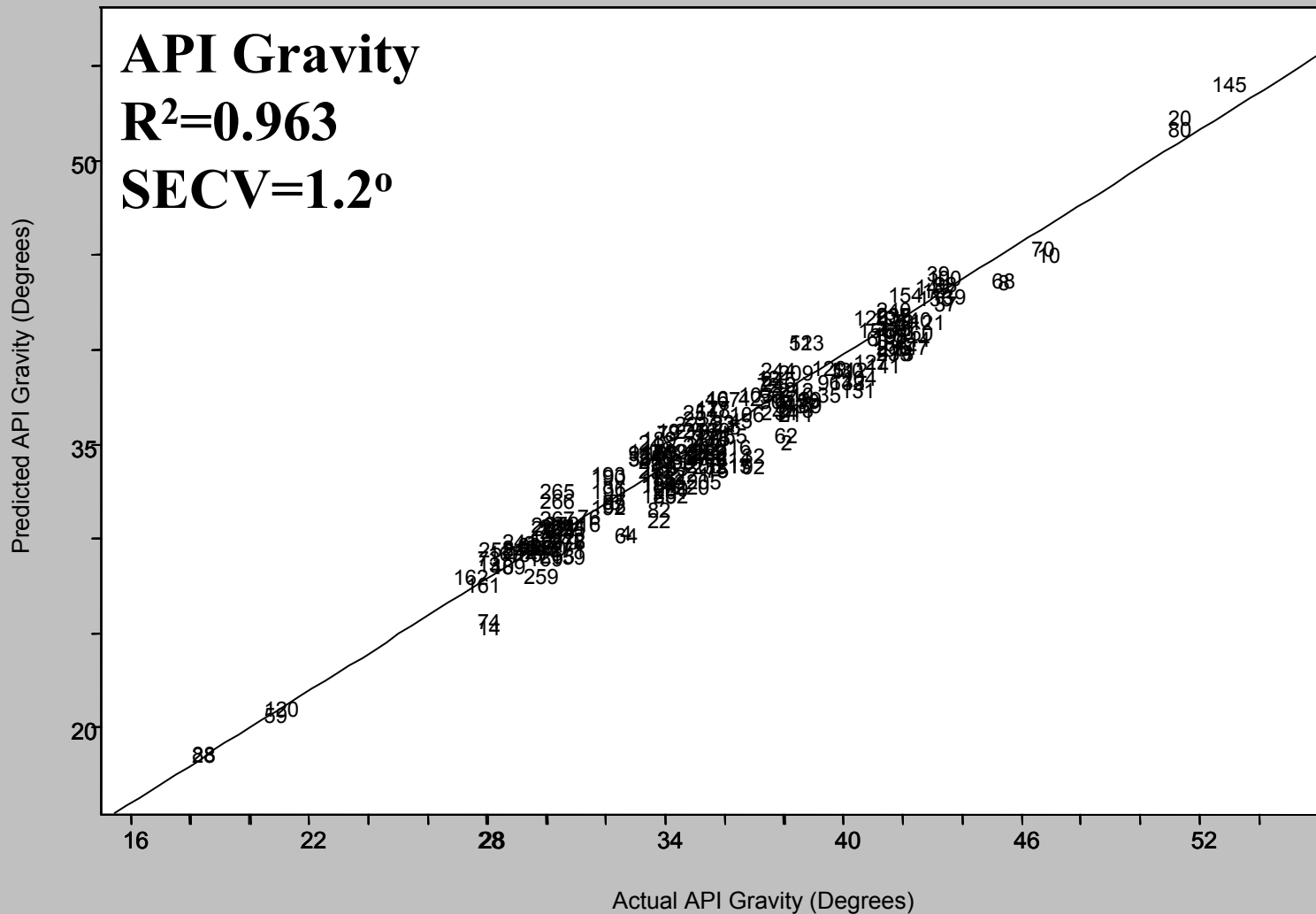
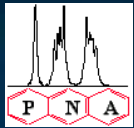
Basic Measurement Principle

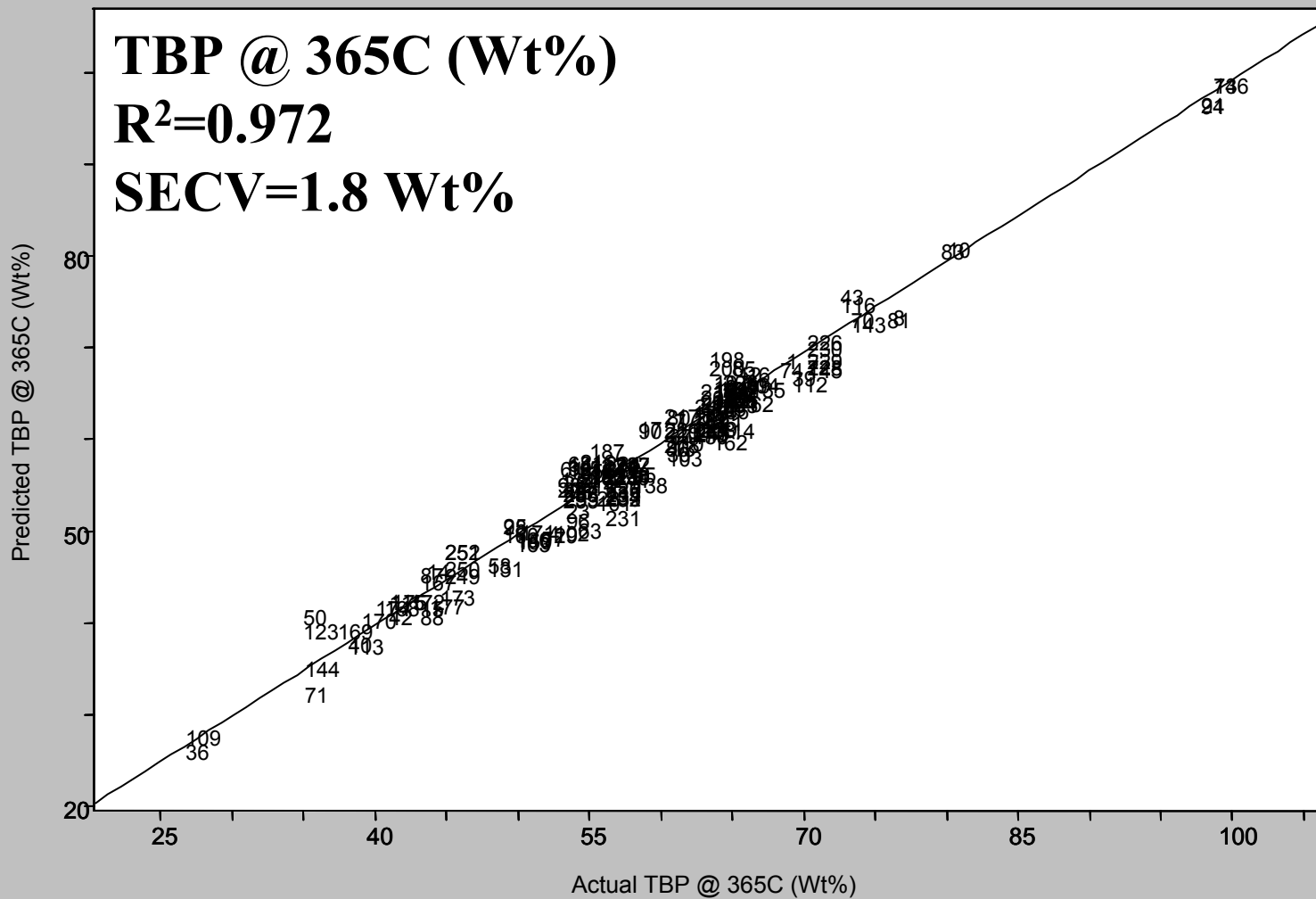
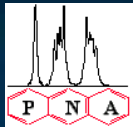


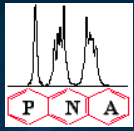


Crude Oils – on-line spectra

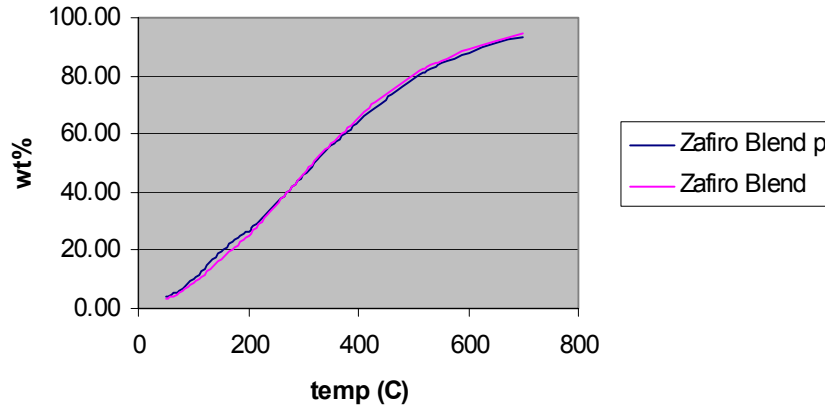




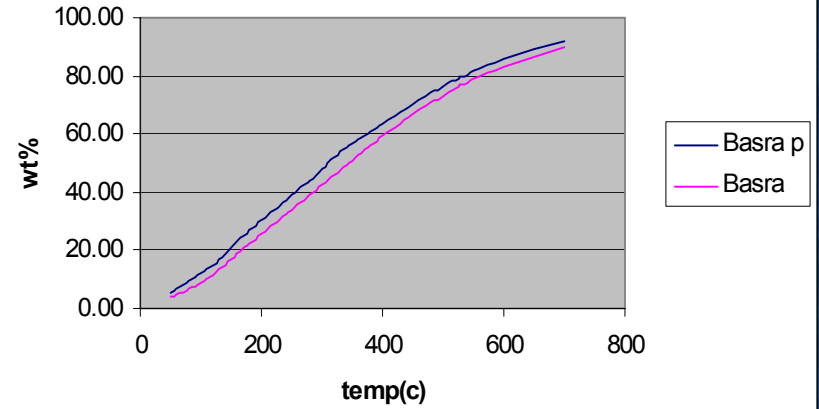




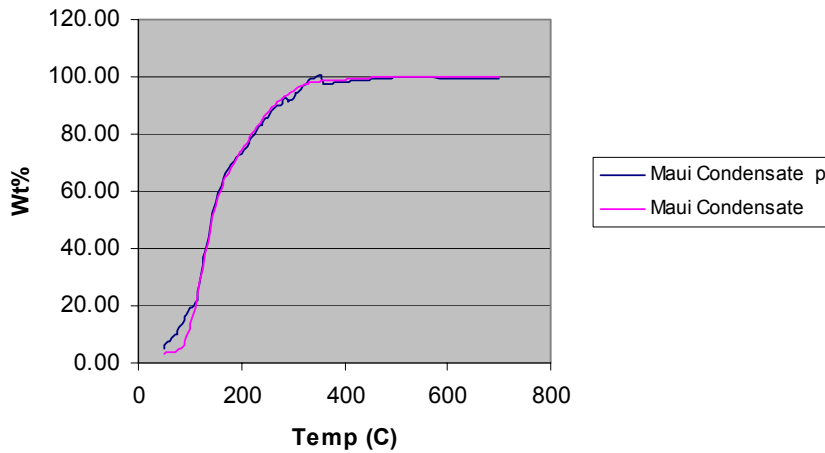
Zafiro Blend



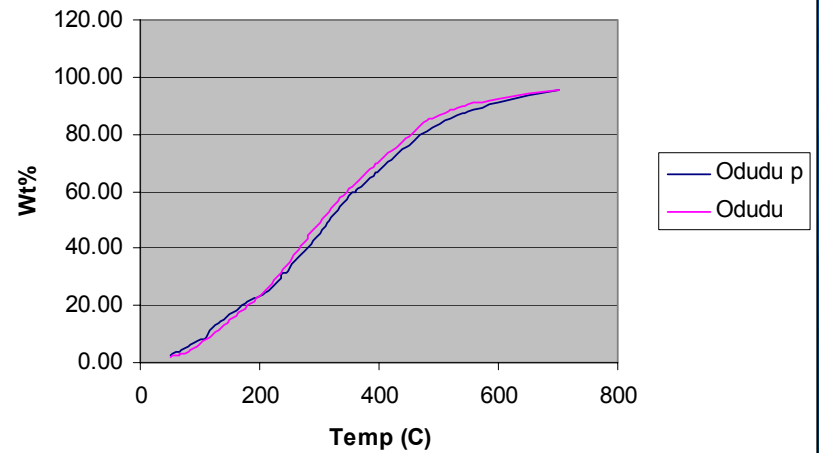
Basra

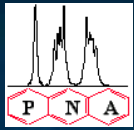


Maui Condensate

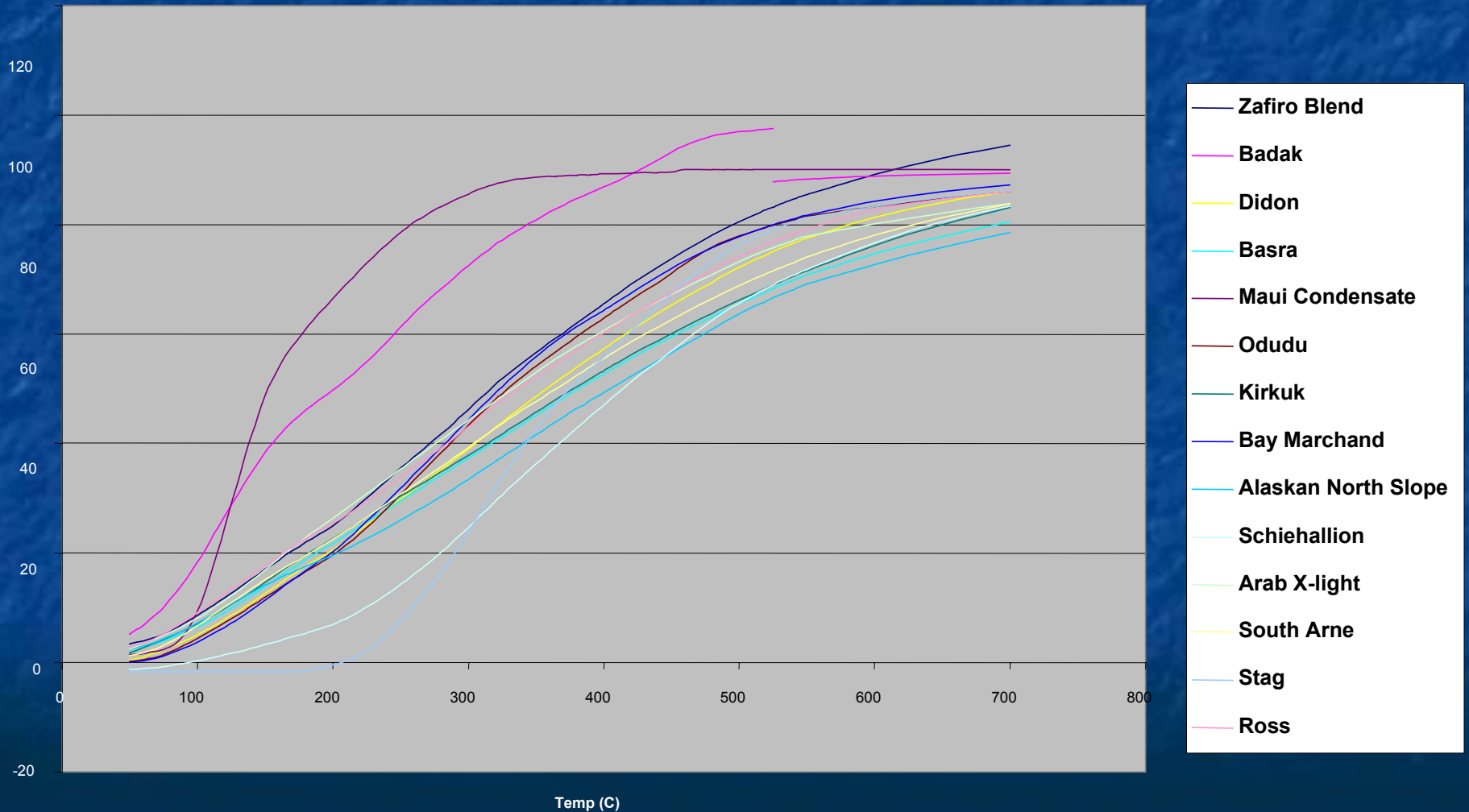


Odudu TBP

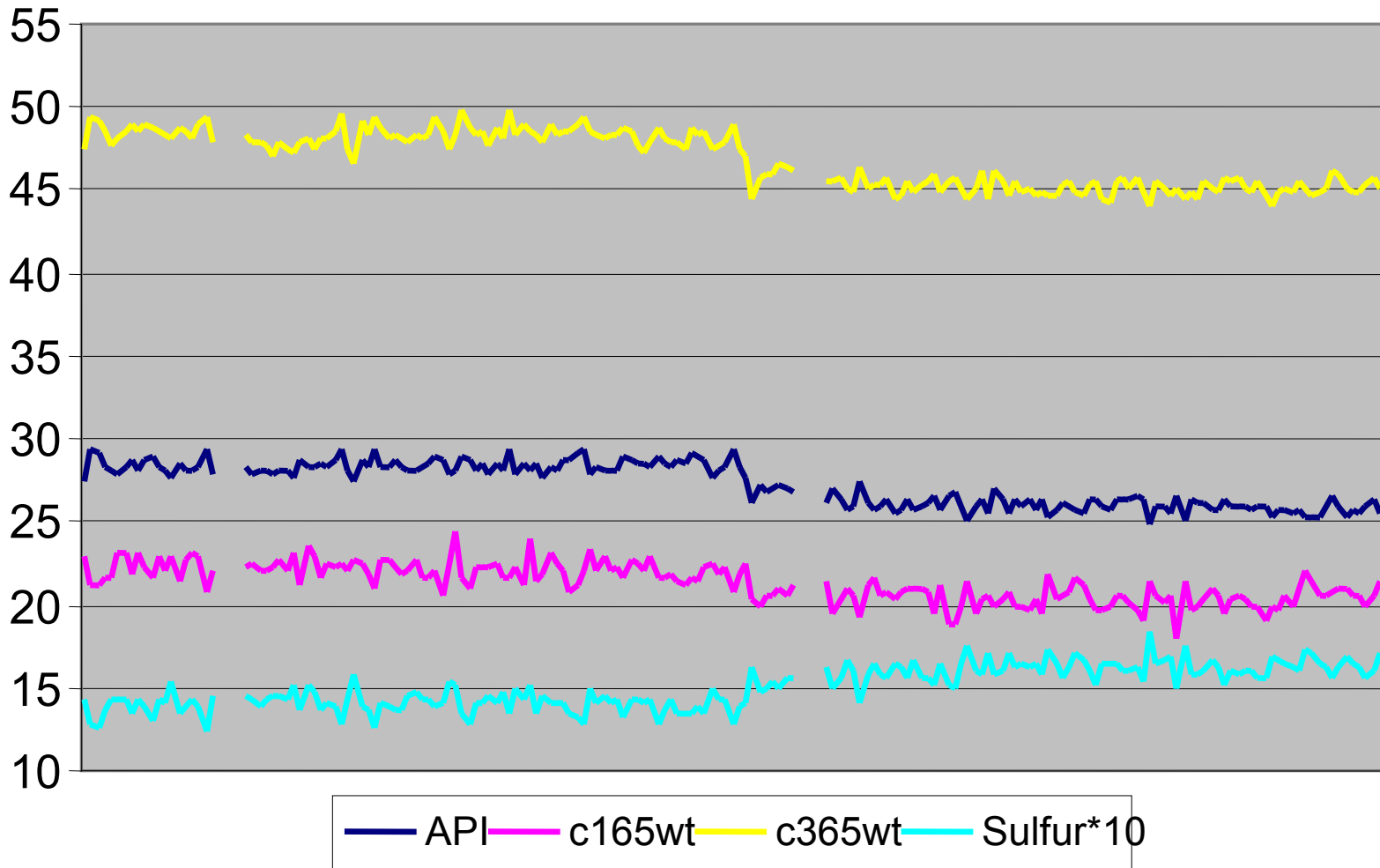




Actual NMR TBP Curves

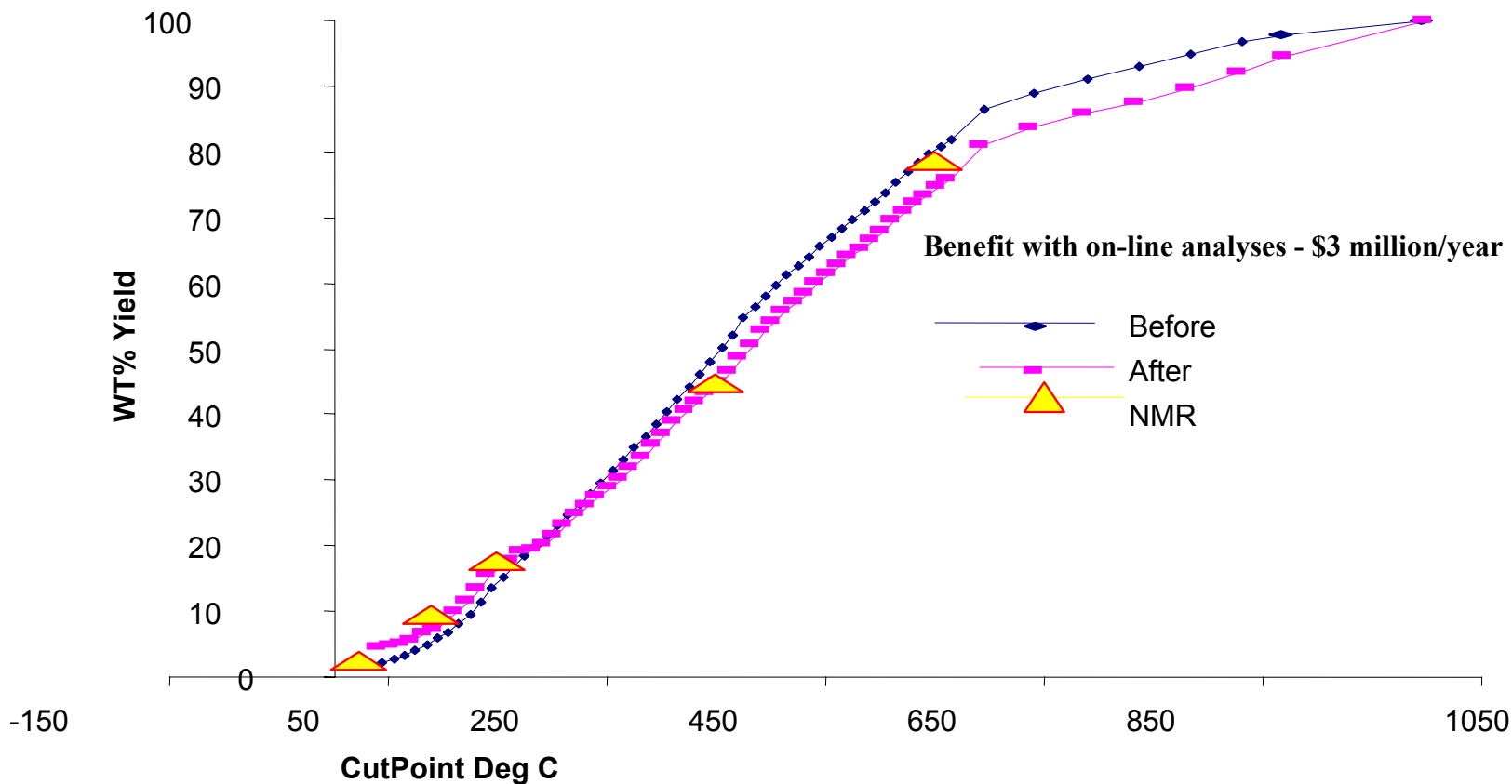


3 Day On-line Crude Feed Analyses showing real time results for API Gravity, two TBP cut points (wt%, deg C), and sulfur. Crude 1 and Crude 2 are actually crude blends of 3-4 individual crudes plus refinery slops (2-5% of blend).

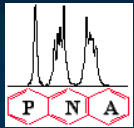


- Crude Assay Data may be old. Crude Composition has changed over time.
- Every Crude Tank has a heel of mixed Crudes received earlier. Crude in a Tank will settle.
- A Crude Switch (normally 7 to 8 hours) leaves you with an unknown Blend of the old and new Crude in the Pipeline

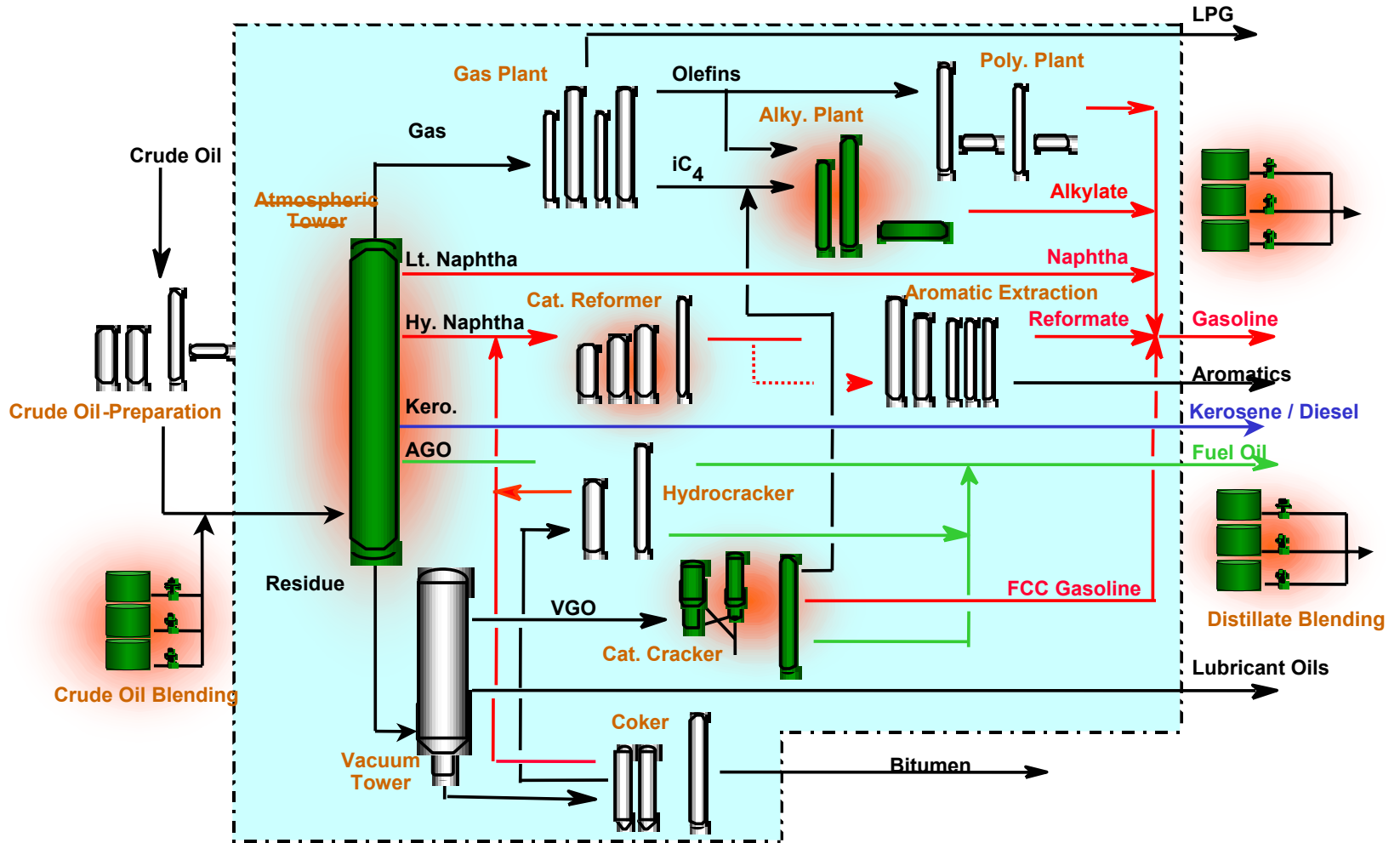
Crude Adjustment

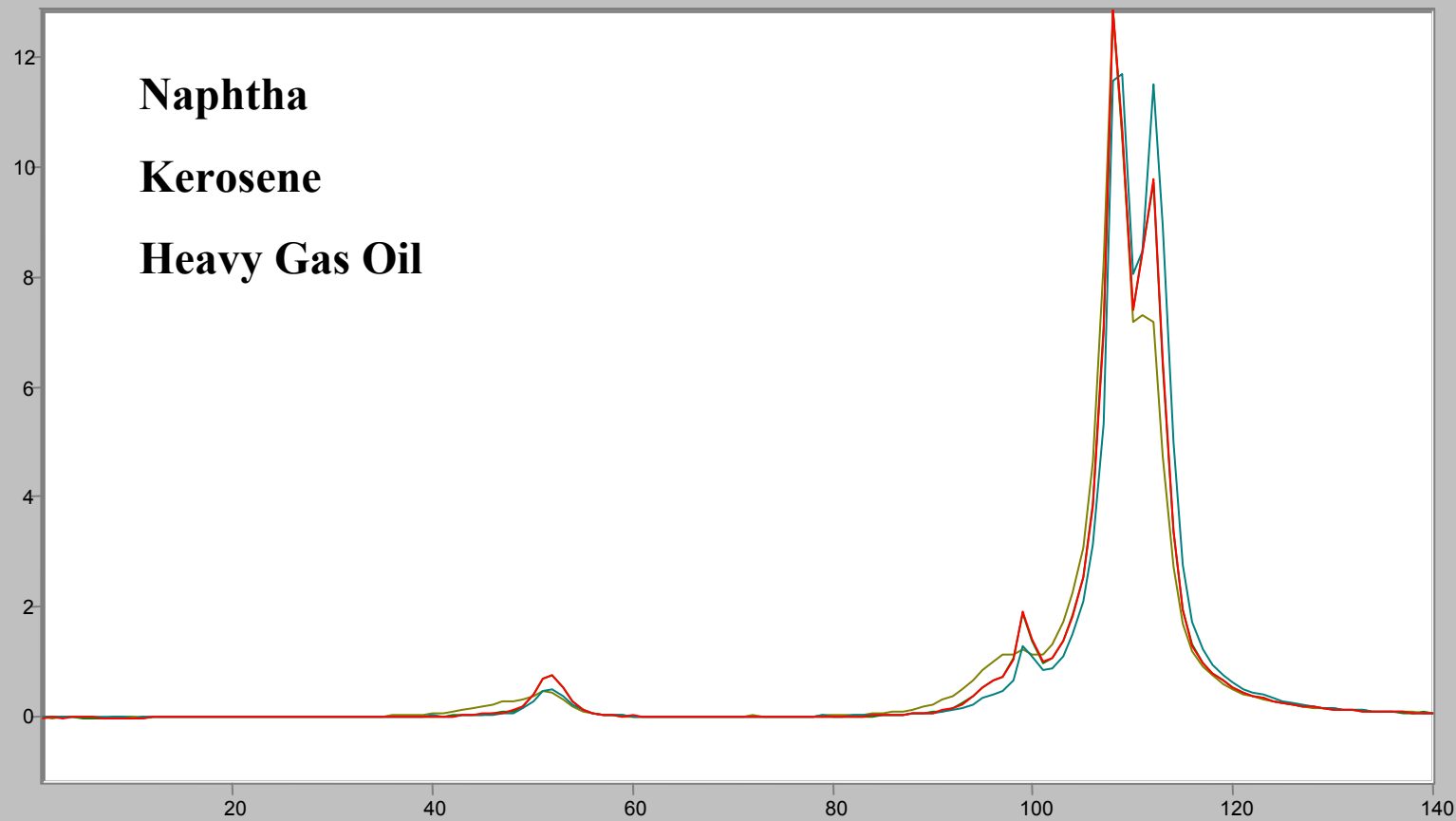
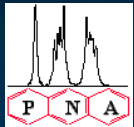


Crude Reconciliation



Process NMR Solutions in Refining

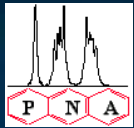




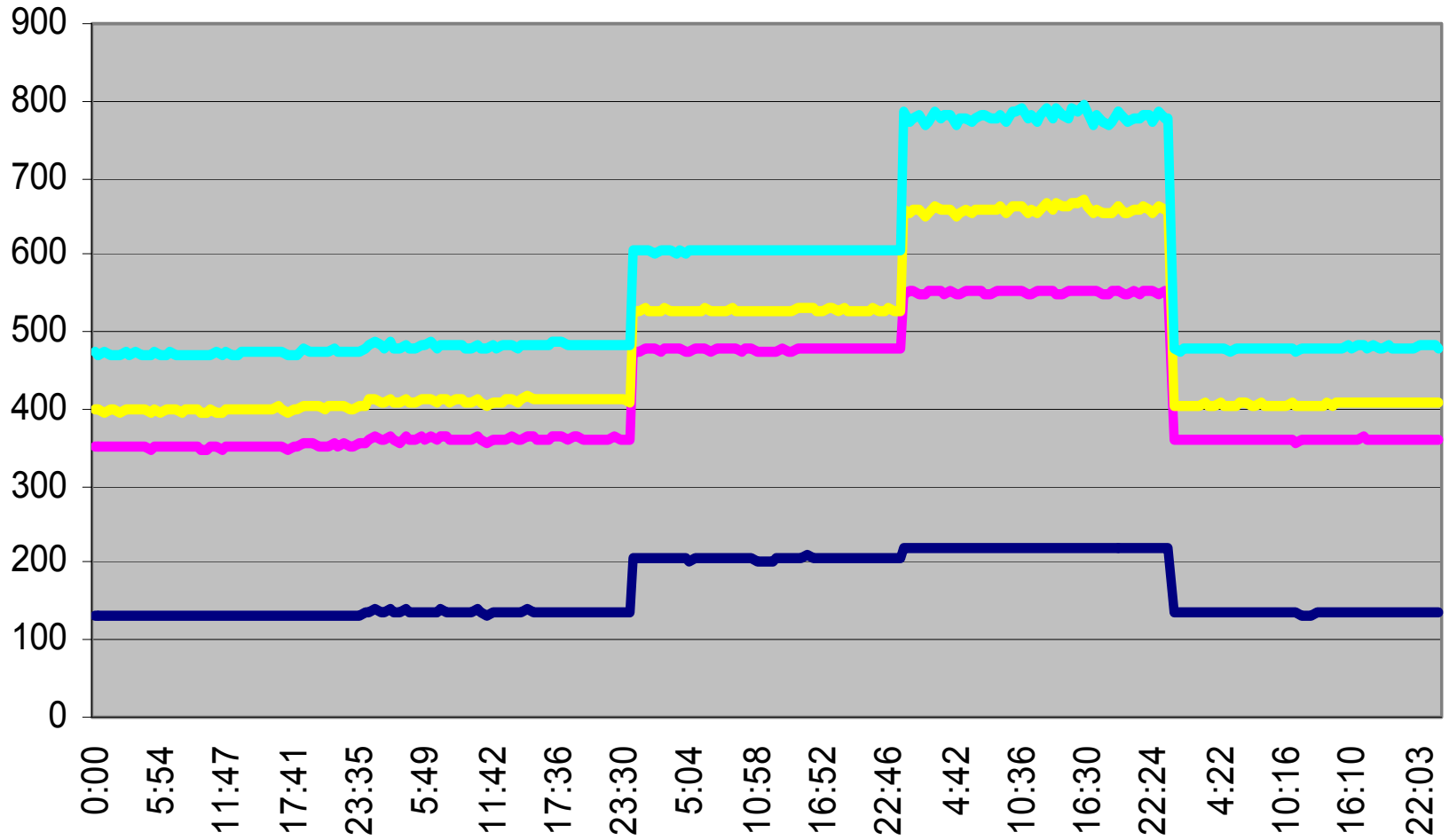
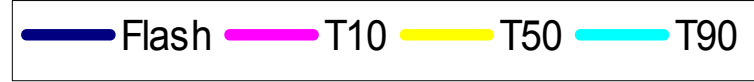
Arbitrary Y / Arbitrary X

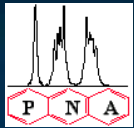
File # 1 = LGO000~1

Foxboro NMR SPC File.

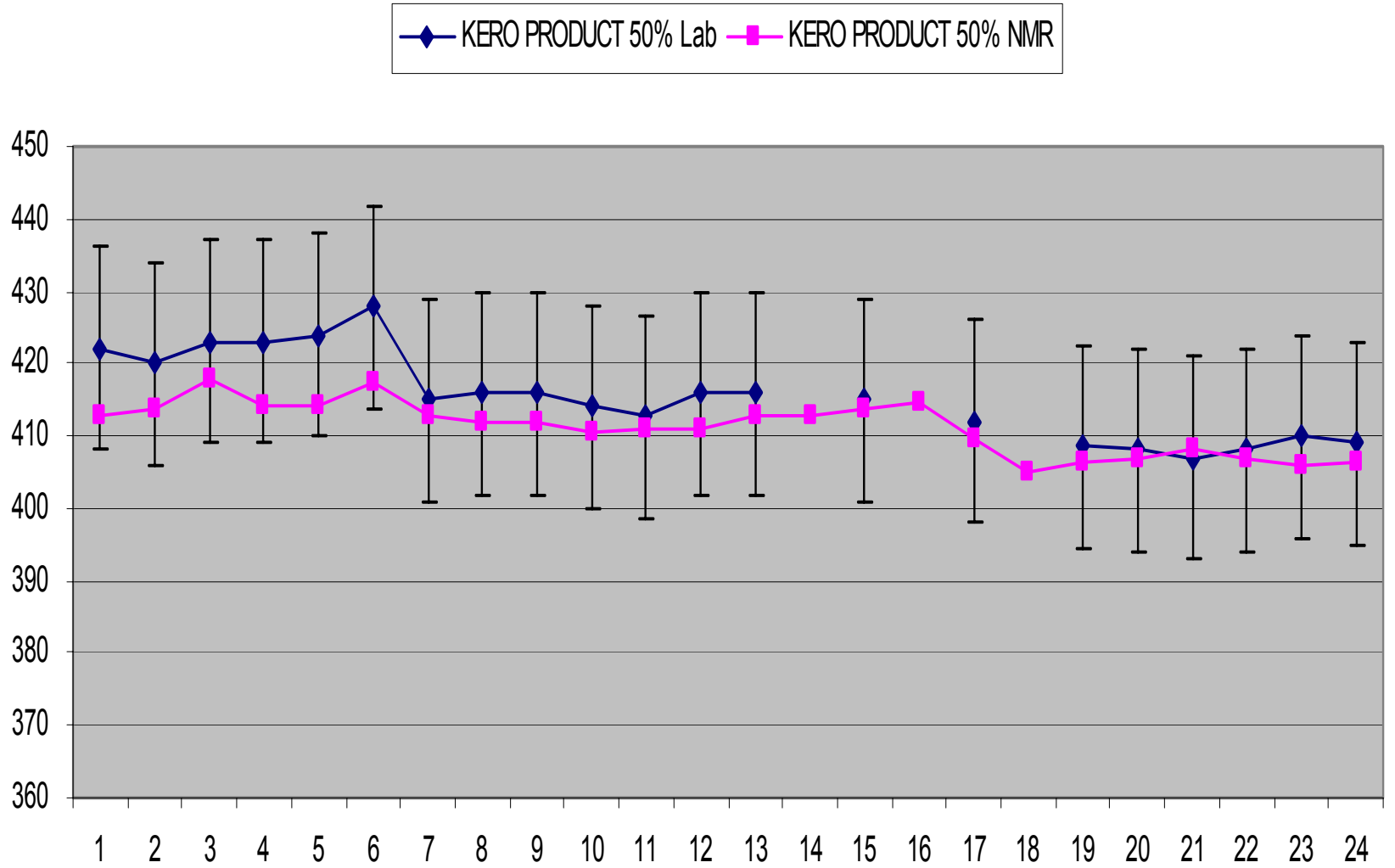


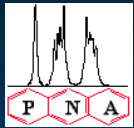
Distillation Parameters on CDU



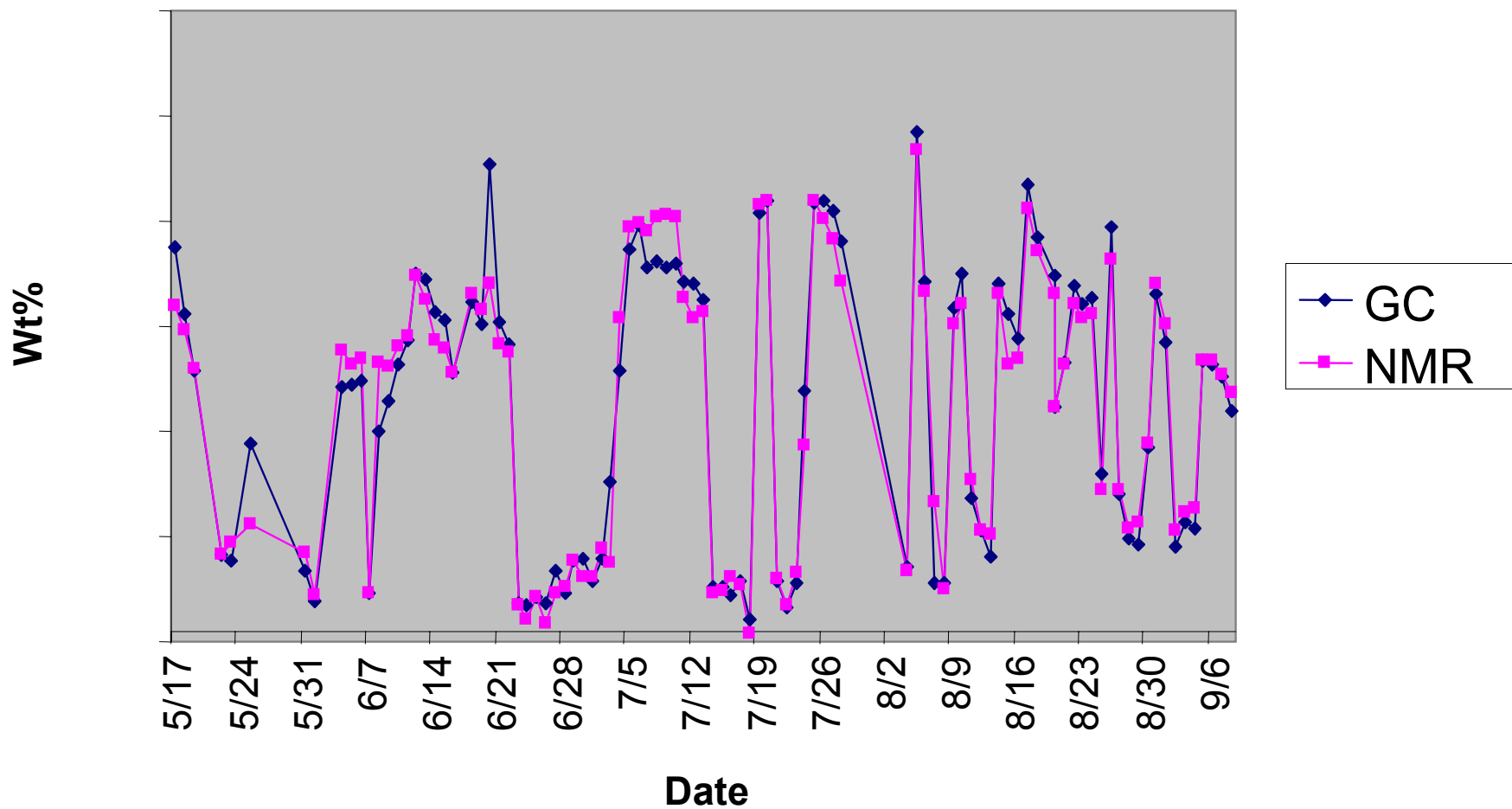


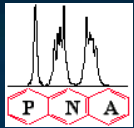
PROCESS NMR ASSOCIATES



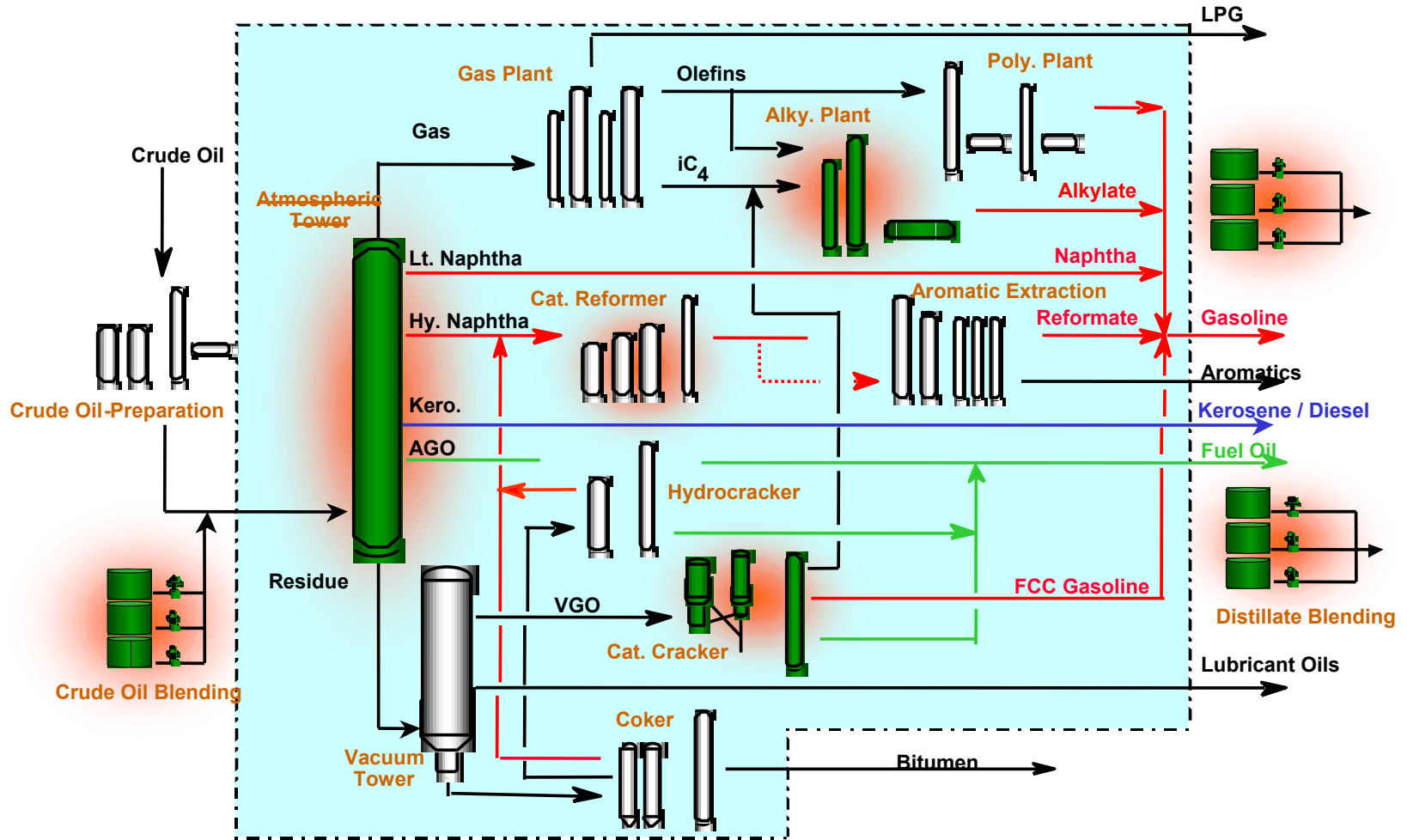


Naphthenes

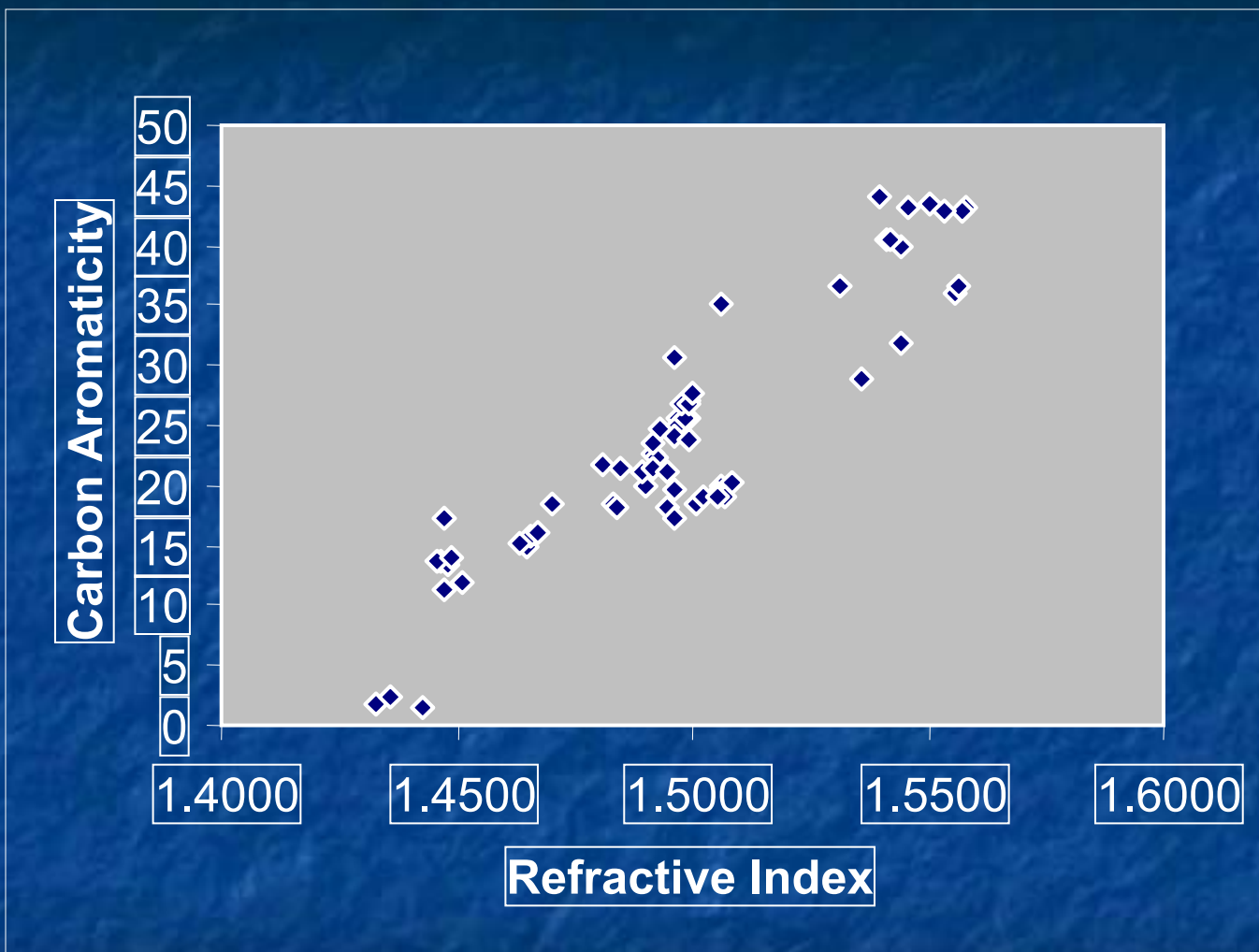




Process NMR Solutions in Refining

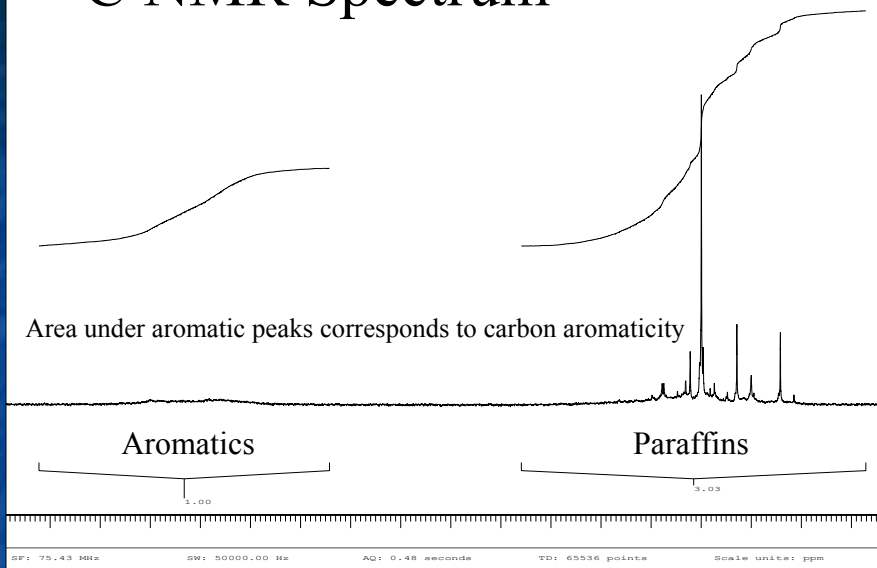


Correlation Between Carbon Aromaticity and Refractive Index

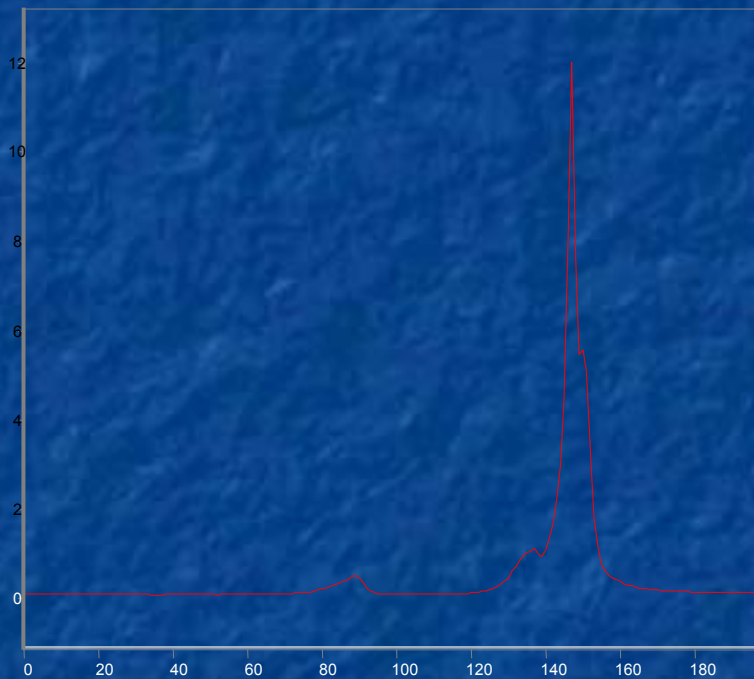
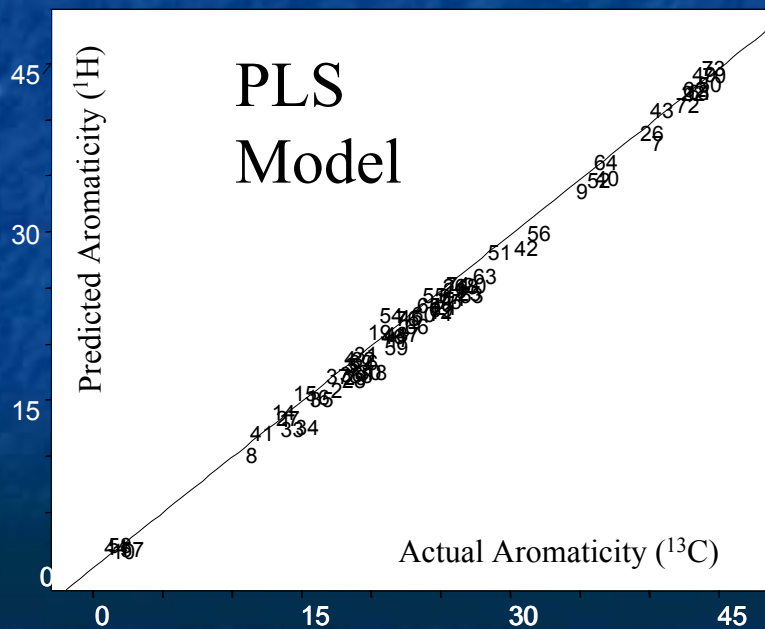


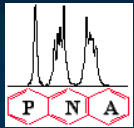
Why Measure Refractive Index When NMR Allows the Carbon Aromaticity to be Obtained Directly?

^{13}C NMR Spectrum



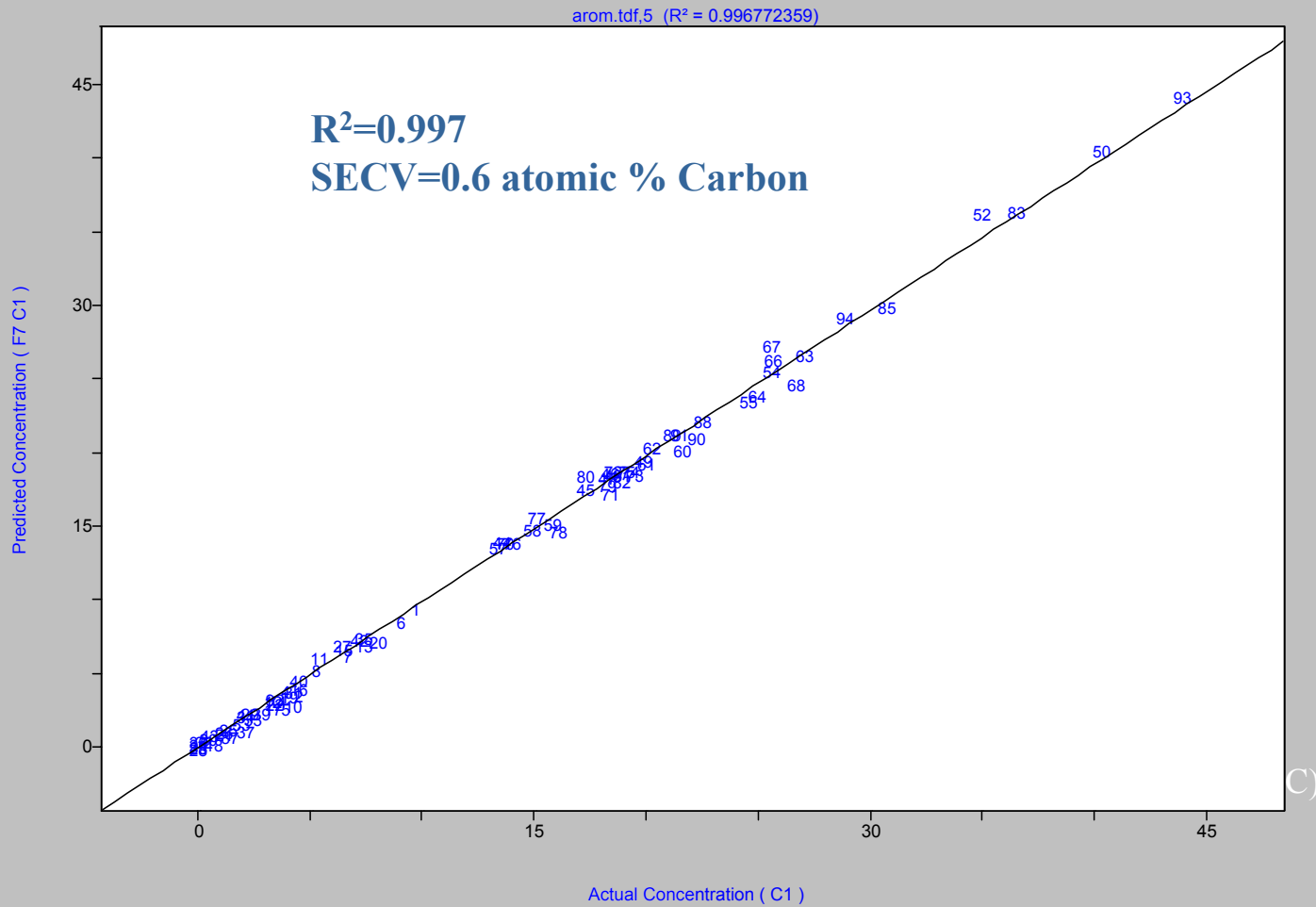
Correlate to 60 MHz
Foxboro NMR Using PLS

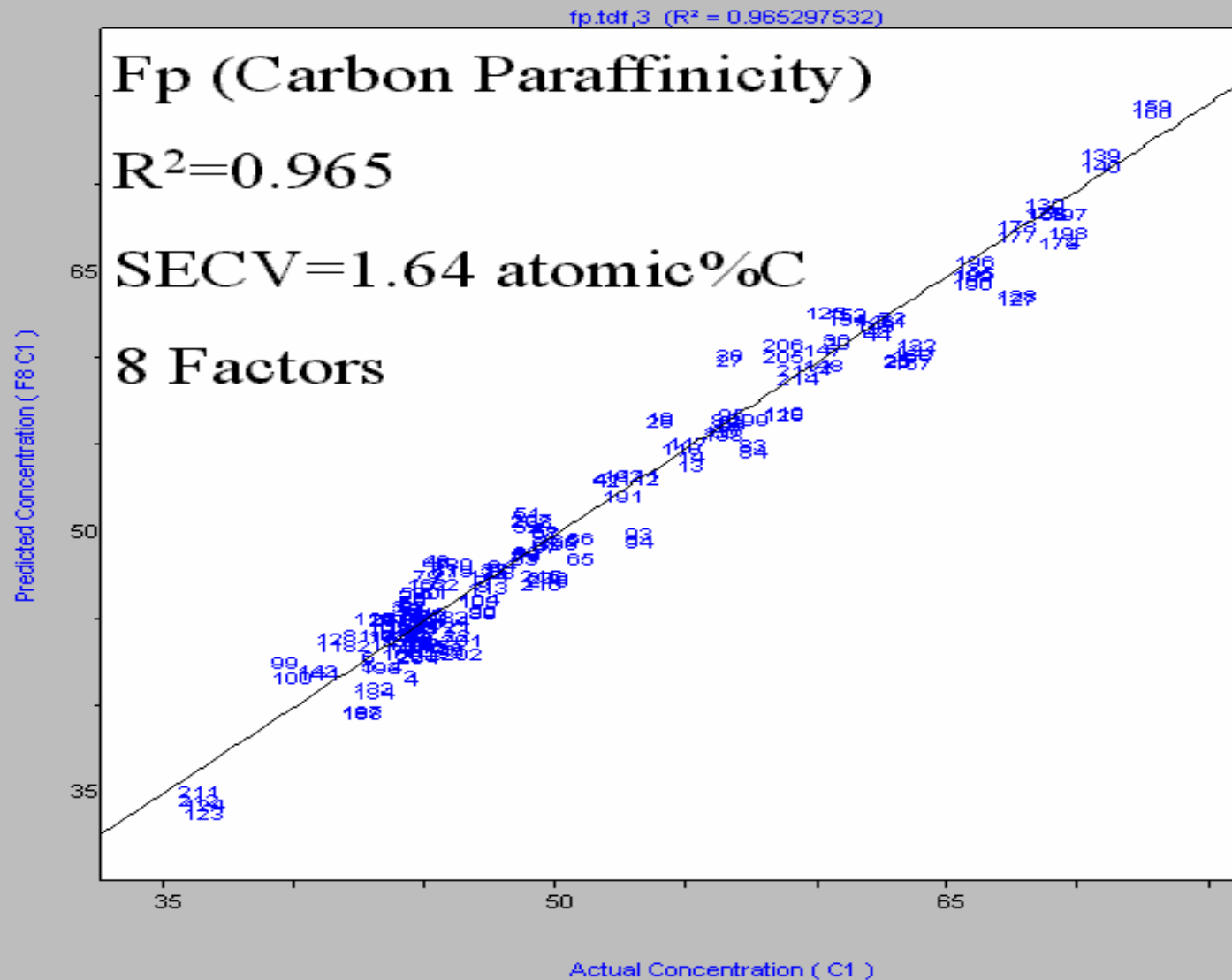
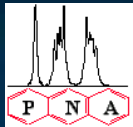


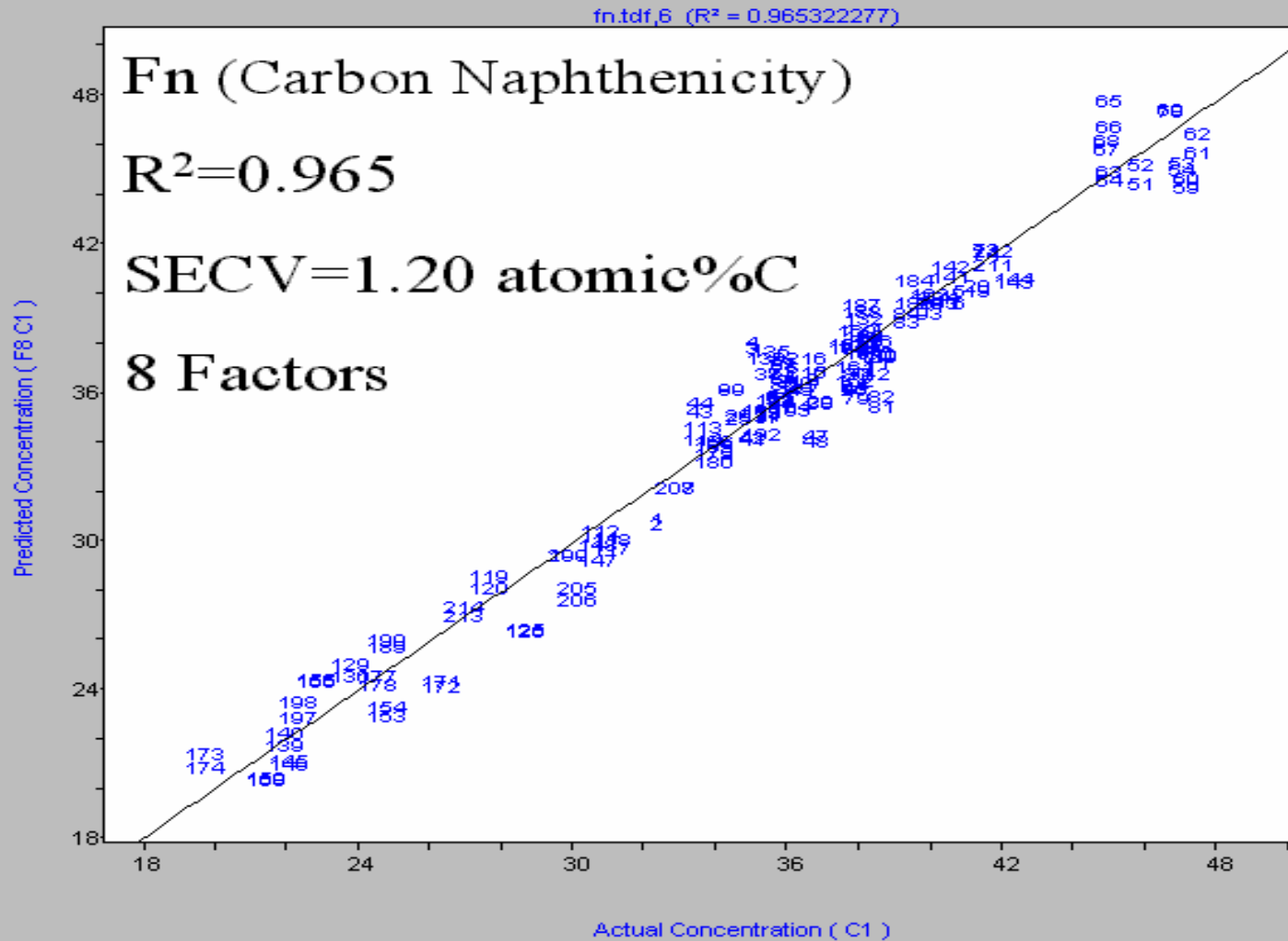
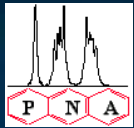


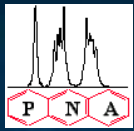
Base Oil and VGO Carbon Aromaticity by ¹H NMR and PLS in One Model

¹H NMR Predicted Result (At% C)



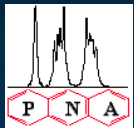






Summary

- High Resolution NMR is now possible in a wide variety of on-line, process environments.
- Simultaneous, multi-parameter analyses can be performed using either direct measurements or chemometric based correlations.
- The hardware has been proven stable, robust, and available.
- Economic paybacks, especially when linked to advanced process control applications are substantial.

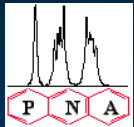


Acknowledgements

J. Cijntje and S. Ranganathan, Isla Refinery, Curacao

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Invensys



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