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SIMULTANEOUS SIMULATED DISTILLATION (CNS-SIMDIS) IN CRUDE OILS USING GAS CHROMATOGRAPHY

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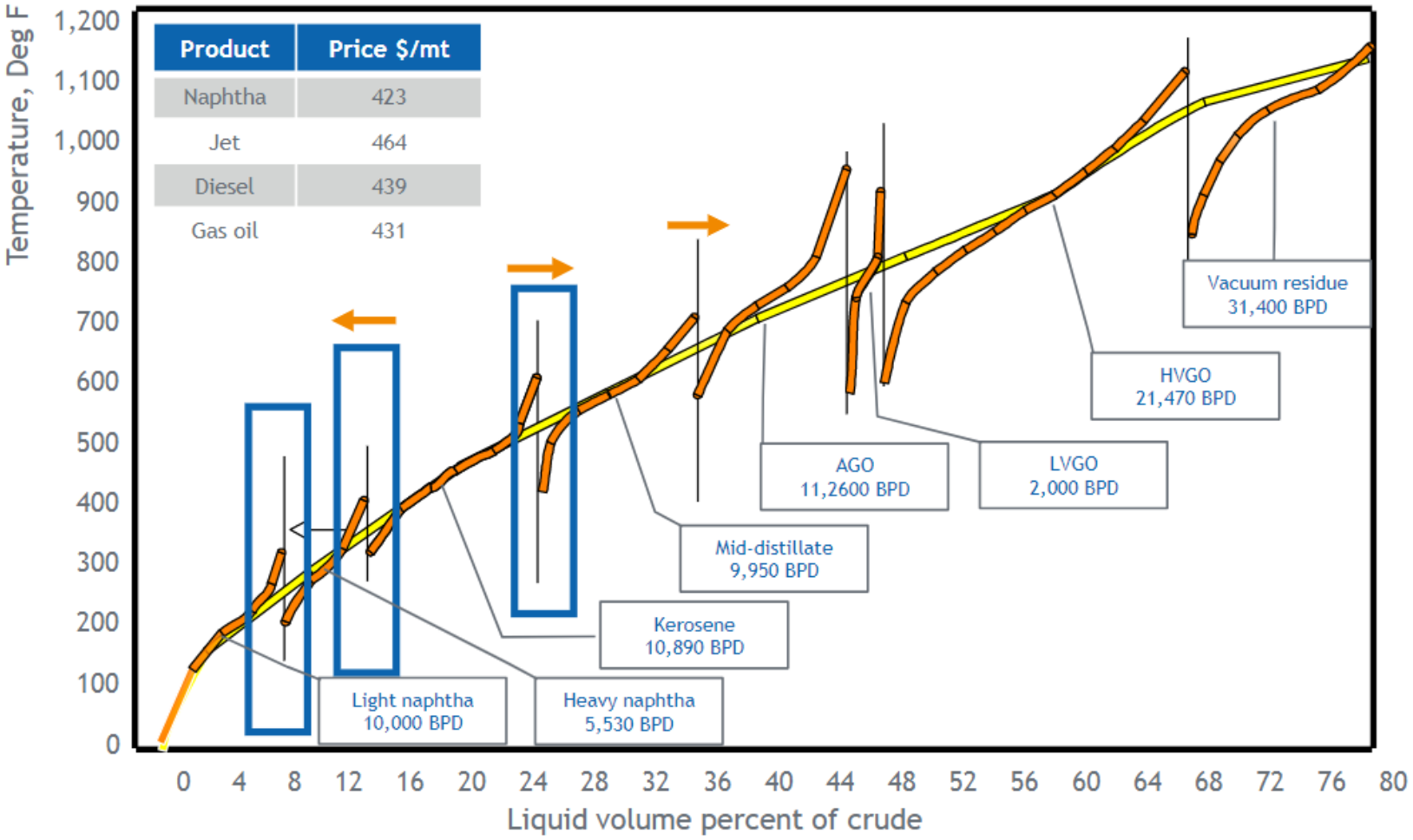
Outline

- Why CNS-SIMDIS?
- Overview
- Scope & Performance
- Technical Information
- Benefits
  - Laboratory Personnel
  - Refinery Personnel
- Examples
- Q&A

Why CNS-SIMDIS Analysis?

Crude distillation optimization, it is about the dollars.



Why CNS-SIMDIS Analysis?

Differentiator	Δ	Price effect*
API	+1°	0.007 US$/$ Brent
Sulphur	+1%	-0.056 US$/$ Brent
TAN	+1 unit	-0.051 US$/$ Brent
Example: 1 barrel Crude Brent price level = 50US$/barrel	 +1% Sulphur (All other parameters identical)	 Expected price difference -2.80 US$ → 47.2 US$

* *Crude Oil Price Differentials and Differences in Oil Qualities: A Statistical Analysis.* ESMAP Technical paper October 2005

Quality (API & Sulfur) and production location define the price of a crude

Why CNS-SIMDIS Analysis?

- Regulations (Sulfur)
- Catalyst poisoning (Sulfur)
- FCC unit catalyst deactivation (Nitrogen)
- Salt formation (Nitrogen) - heat exchanger fouling or filter blockage

Negative impact on:

- Up-time
- Profit
- Process control
- Product value

Why CNS-SIMDIS Analysis?

- CNS provides key data
  - → Fast quantified information on sulfur and nitrogen versus boiling point
  - → Better understanding on input crude quality
  - → Allows improved modelling and blending

- Improve production rates (lowering down-times)
- Decrease Cost of Labor
- Improve Refinery Profit
- Optimize value within specification (product giveaway)

Overview

- Gas Chromatography solution based on Simulated Distillation / Chemiluminescence Technology (SCD & NCD)
- Compares to ASTM D2887, D6352, D7500 and D7169
- Provides detailed Sulfur, Nitrogen and Carbon speciation boiling point information comparable to traditional Crude Assay information
  - Can provide a distribution of the components in various boiling point ranges, that total sulfur or nitrogen analyzers cannot do
- Analysis time <30 minutes for crude and crude final products
- Optional DHA FE Merge for <C9 information (151°C)

Scope & Performance

Analysis Scope	LOW TEMP CNS SIMDIS			HIGH TEMP CNS SIMDIS		
Comparable to	ASTM D2887, D3710, D7096, D7807, ISO3924, IP406			ASTM D6352, D7500, D6417, D7213, D7398 and D7169, EN15199-3, IP545 (DHA FE)		
Sample Type / Range	Jet Fuel, Diesel			Distillates, Base Oils, Lube base Stocks		
Carbon Number Range	C5-C44			C9-C90*		
Boiling Point Range	FBP < 538°C (1000°F)			IBP > 151°C (304°F) FBP <700°C (1292°F)		
Sample Injection	Neat			1-2% dilution		
Analysis Performance	LOW TEMP CNS SIMDIS			HIGH TEMP CNS SIMDIS		
	S	N	C	S	N	C
Application Range**	50-10000 (ppmS wt)	100-10000 (ppmS wt)	n.a.	200-50000 (ppmS wt)	500-50000 (ppms wt)	n.a.
Repeatability	<10% RSD			<10% RSD		
Equimolarity	<10%	<10%	n.a.	<10%	<10%	n.a.
Selectivity	S/C: 5E7			S/C: 5E7		
	N/C: 2E7			N/C: 2E7		

* With DHA FE addition (option)
** Depended on distribution / recovery of a sample

Technical Information

- Simulated Distillation
  - Cool on Column (COC) injection
  - A nonpolar (DB-1) gas chromatographic capillary column with 100% polydimethylsiloxane
  - Flame Ionization Detector (FID)
  - Sample preparation - 1-2% dilution solvent
  - DHA Front End Option for <C9 Merge (Separate GC)
  - Specialized reference standards and reference oils
- Sulfur & Nitrogen Chemiluminescence Detector (NCD & SCD)
  - Microfluidic splitter with constant split ratio to detectors
  - Post column vent

$$R{-}S + O \rightarrow SO + \text{other products}$$

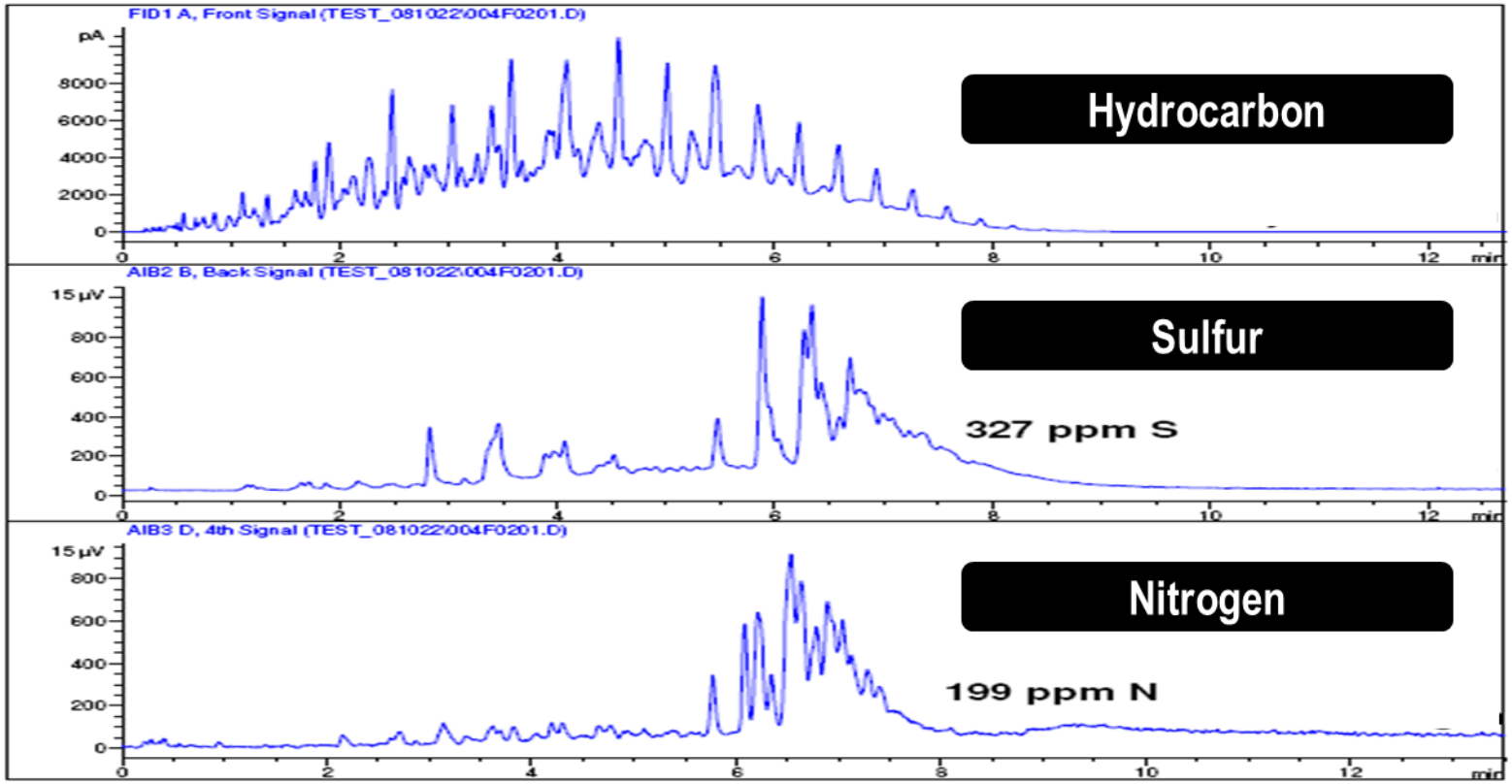
$$SO + O_3 \rightarrow SO_2^* \rightarrow SO_2 + O_2 + h\nu \text{ (around 350 nm)}$$

$$R{-}N + O_2 \rightarrow NO + CO_2 + H_2O$$

$$NO + O_3 \rightarrow NO_2^* \rightarrow NO_2 + O_2 + h\nu$$

Technical Information

3 Channels Run Simultaneous from 1 injection



Benefits – Refinery Personnel

- Unique, accurate and precise method to <10% RSD
  - Blending and process accuracy
- Less sample required
- Real time decision making <30 minutes analysis
- Accurate sulfur and nitrogen data for each carbon number or range
- Easy to read report with export functions for use with models and calculations

Benefits – Laboratory Personnel

- Minimal technician/chemist training
  - Sample preparation 1-2% dilution only with solvent
  - Prepared standards for purchase
  - Software does the rest
  - Software used for regular SIMDIS is used
- <30 minutes analysis time. Time saver!
- Easy to calibrate all-in-one
- Smaller laboratory footprint
- Less expensive
- Safety!
  - Smaller sample amount required
  - Dilution of sample is cyclohexane, isooctane or toluene, not CS_2

EXAMPLES

Q&A