YIELD CORRELATIONS BETWEEN TWO EVALUATION TECHNIQUES

Crude Oil Assay Distillation Versus HTSD

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To compare the laboratory techniques of Crude Assay Distillation to High-Temperature Simulated Distillation (HTSD), we analyzed approximately 85 crude oils using both techniques. The crudes had varying pitch, sulfur, nickel, vanadium, Conradson carbon, and asphaltene content. Our study demonstrated that HTSD offers tighter precision than conventional crude assay distillation.

The ability to evaluate the variability of crude distillation yield curves rapidly and accurately has increasingly important economic considerations in refining margins -- especially with heavier crude oil, which produces larger quantities of low-value heavy residue. As the average gravity of crudes continues to decrease, the need to characterize heavier crude oil increases. In the past, refiners have had to rely on Crude Assay Distillation methods ASTM D 2892 and D 5236 for the characterization, but advances in gas chromatography techniques now allow these methods to be replaced by HTSD.

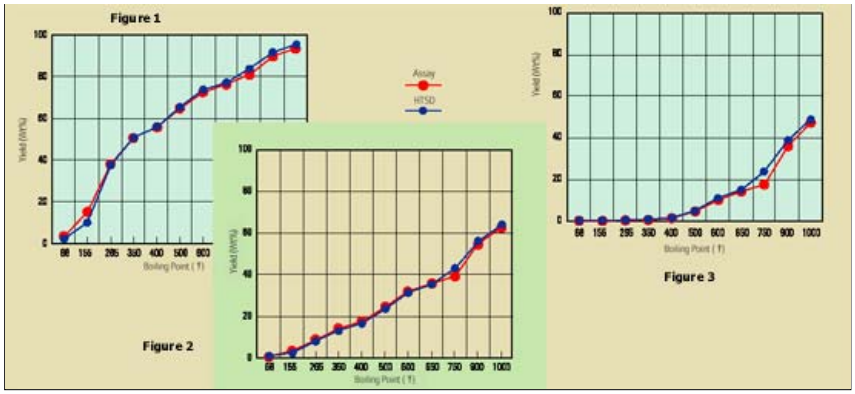

Figure 1. Assay and HTSD yields; light crude, API gravity 50.4
Figure 2. Assay and HTSD yields; intermediate crude, API gravity 24.2
Figure 3. Assay and HTSD yields; heavy crude, API gravity 9.7

Crude Assay Distillation
Crude Assay Distillation (ASTM D 2892) uses a 15-plate column operating under a reflux ratio of 5:1 to produce true boiling point (TBP) data. The method applies only to crude oil. Generally, the distillation starts at ambient pressure (760 mm Hg), and then switches to vacuum conditions to extend the method to 650°F atmospheric equivalent boiling point (AEBP). The remaining charge is transferred to a vacuum potstill method (ASTM D 5236) in which the distillation continues at 0.5 mm Hg to obtain an AEBP limit of 1000 to 1050°F.

High-Temperature Simulated Distillation
Basically, HTSD is an extension of ASTM Method D 2887, which produces the boiling range distribution of hydrocarbons by gas chromatography. The analysis is calibrated by correlating the C5 to C120 n-paraffins elution time to their AEBP. HTSD determines the true boiling point distribution of petroleum products up to a final boiling point (FBP) of 1382°F or 750°C. A key difference between HTSD and D 2887 is the ability of HTSD to analyze residue-containing samples, which makes it useful in monitoring and controlling the processes shown in Table 1.

To allow a meaningful comparison of the yield curves in our study, the crudes we analyzed were grouped into light, intermediate, and heavy categories, according to their API gravities (Table 2).

The yield curves, expressed in % weight, were compared at 10 distillation cutpoints. Figures 1, 2, and 3 show the yield curves obtained for three typical crudes. This comparison shows good overall agreement between the two methods.

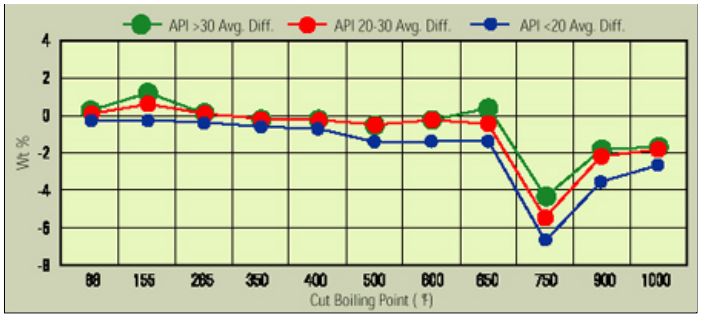

Figure 4. HTSD assay; weight % difference at each cut point

Figure 4 contains the average difference for all the crudes in each of the three API categories obtained by D 2892/D 5236 and HTSD. In general, the difference observed at each cutpoint is less than ±2 % weight. The estimated precision of the correlation between crude assay distillation and HTSD yield at each cutpoint results in standard deviations of < 2 % weight. The precision of HTSD cutpoints up to 1000°F is better than 0.5 % weight.

An exception occurs at the 750°F cutpoint for light and intermediate crudes and the region from 750 to 900°F for heavy crudes. The 750°F cutpoint is the first cutpoint following the crossover from ASTM D 2892 (TBP 15-plate) to D 5236 (vacuum potstill, 1-plate) conditions. This change in distillation conditions likely contributes most of the difference when compared to HTSD, which has no pressure-related crossover effects.

A Dedicated SIMDIS Analyzer

AC Analytical Controls' High Temp SIMDIS Analyzer determines the boiling-point distribution of petroleum streams with a final boiling point up to 1382°F (750°C). One use of the AC analyzer is in a crude assay to predict the quality and yield for the various petroleum fractions. Other applications determine the boiling-point ranges of vacuum gas oil, lube oil base stock, FCC feed, fuel, and gas oil.

Processes	Streams
Atmospheric distillation	Crude oil, atmospheric gas oil and residue
Vacuum distillation	Vacuum gas oil, lube oil base stocks and vacuum residue
Fluid Catalytic Cracking	FCC feed, gas oil, fuel
Thermal processes	Feed, gas oil, fuel

Table 1. HTSD analysis range

Crude Type	API Gravity	Number of Crudes	API Range
Light	>30	49	30.1 – 52.3
Intermediate	20 – 30	27	20.5 – 30.0
Heavy	<20	8	9.7 –19.5

Table 2. Grouping of crudes by API gravity

Based on the Hewlett-Packard HP 6890 Series gas chromatograph, this system offers a high level of automation that simplifies the analyses, decreases analysis time, and minimizes operator involvement. Ease of use is an integral feature of the AC High Temp SIMDIS Analyzer.

SIMDIS Replaces

Crude Assay Distillation Refiners need improved accuracy and precision of boiling-point data to optimize overall refining margins. From the results of our crude assay study, we concluded that HTSD offers tighter precision than conventional crude assay distillation (ASTM D 2892 and D 5236). It also provides faster turnaround and boiling-point data to a much higher final boiling point (1382°F). HTSD is a valuable business tool for evaluating new crudes and ensuring crude product integrity during transportation and delivery.

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