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# Maze Analysis Delivers Consistent SARA Measurements Using Industry-First Microfluidic Technology

## Both repeatability and reproducibility are improved with method accepted by ASTM International Standard D7996 for asphaltene content measurement

### CHALLENGE

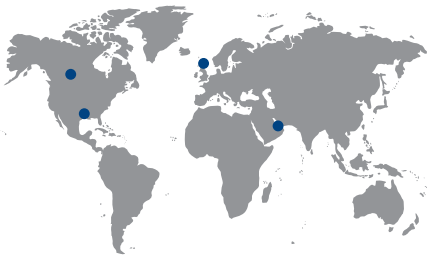
Improve the reproducibility, repeatability, and turnaround time when analyzing oil samples for saturates, aromatics, resins, and asphaltenes (SARA).

### SOLUTION

Employ new Maze* microfluidics SARA analysis built on novel microfluidics and spectroscopy technologies.

### RESULTS

- Achieved ASTM International Standard D7996 for asphaltene content measurement.
- Developed a fully automated process, removing operator dependency from the analysis.
- Reduced turnaround time from 3 to 5 days to only 4 hours and reduced required amount of solvent by 85%.



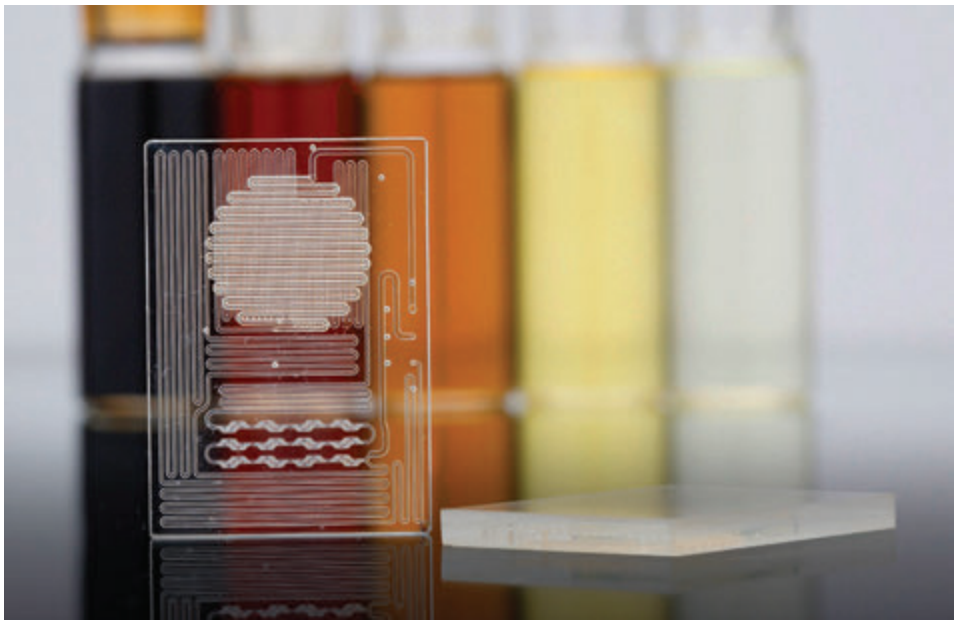
### New SARA analysis method needed

The industry's standard method for conducting SARA analysis of oil samples in the laboratory was causing problems for operators in terms of time and reliability. Available test methods were cumbersome and time consuming—taking 3–5 days on average to complete. In addition, slight procedural and equipment modifications, laboratory technician competency and efficiency, and chemical purity and availability were constant challenges in obtaining reproducible results.

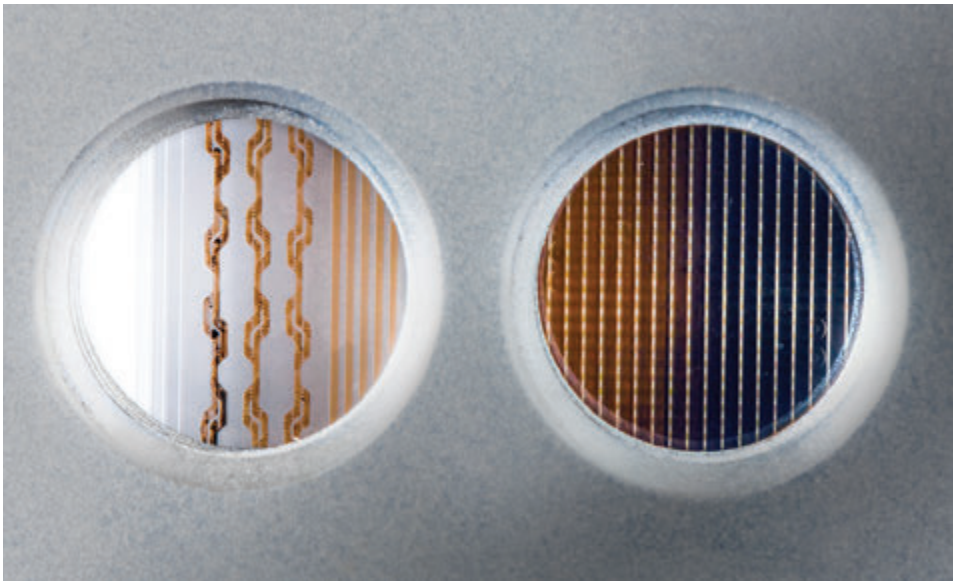
With SARA analysis being widely used across the industry—from validating oil samples prior to PVT analysis to supporting flow assurance and geochemical studies—it was important to develop a new method to improve the accuracy and efficiency of the measurements.

### Maze microfluidic SARA analysis developed

With the challenges of conventional SARA analysis fully understood, technical experts across Schlumberger's global network of research centers and reservoir laboratories developed Maze microfluidic SARA analysis as the next-generation, fully automated solution. Asphaltene content is first determined using proprietary microfluidics chip and spectroscopy technologies, followed by identification of saturate, aromatic, and resin fractions using a miniaturized chromatographic column coupled with refractive index and optical absorbance measurements.



*The microfluidic chip forms an integral part of the fully automated Maze analysis, designed for testing oil samples for saturates, aromatics, resins, and asphaltenes.*



*Oil is titrated with nonpolar solvent (n-heptane) to force asphaltene precipitation, which is filtered and separated through the microfluidics chip.*

**Maze Analysis Repeatability and Reproducibility†**

| | Repeatability, wt% | Reproducibility, wt% |
|---|---|---|
| Asphaltenes | ±0.3 | ±0.4 |
| Saturates | ±0.3 | ±0.9 |
| Aromatics | ±0.5 | ±0.6 |
| Resins | ±0.5 | ±0.7 |

† Measurements within ±2σ absolute deviation.

*Extensive SARA analyses on a wide-variety of oil samples—ranging from light to heavy oil—exhibited excellent repeatability and reproducibility on 95% of the sample set.*

## Accepted by ASTM industry standard

The automation provided by Maze microfluidic SARA analysis eliminates laboratory technician dependency for precise fluid measurements that are always repeatable and reproducible. Turnaround time for Maze analysis is only 4 hours compared with conventional technology at 3 to 5 days, and use of solvents is decreased by more than 85%. This new method improves accuracy and efficiency of SARA analysis enabling better-informed decision making—with upstream to downstream applications.

Maze microfluidic SARA analysis is the first commercial application of microfluidic technology to the oil and gas industry, and it has been accepted by ASTM International Standard D7996 for asphaltene content measurement.

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