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ASTM D8193 - Modern Oil-in-Water testing to replace EPA 1664

Measurement of oil-in-water (OIW) is a major analytical task in modern environmental testing reaching from upstream oil recovery monitoring and the measurement of reinjection and discharge water in the petroleum industry to monitoring of discharge water in food processing and general municipal waste treatment.

The most commonly used OIW test method is the gravimetric method (EPA 1664), where the water sample undergoes a liquid-liquid extraction with n-hexane followed by an evaporation of the solvent. After evaporation, the remaining residue is weighted. The mass of the residue represents non-polar material which was extracted by the solvent and is reported as oil in water, typically in mg/L.

While the gravimetric methods may seem intuitive and offer a straightforward implementation, they are hampered by inefficient procedure, limited analytical precision and accuracy and pose significant health and safety concern.

The modern oil in water method ASTM D8193 based on IR spectroscopy and a cyclohexane liquid-liquid extraction procedure offer a path to overcome the deficiencies of EPA 1664.

User Advantage	EPA 1664	ASTM D8193
Safer liquid-liquid extraction	Evaporates n-Hexane, a solvent listed on the EPA hazardous air pollutant (HAP) list. Evaporation creates fire hazards and exposes workers to chemical vapors.	Uses **Cyclohexane**, a chemical **NOT on the HAP list**. It does not employ solvent evaporation, keeping the exposure to workers to a minimum.
Less solvent/ waste	Uses 90 mL of solvent per test. A determination of silica gel treated (SGT) oil in water requires double the solvent (180 ml).	Uses **50 ml of solvent.** An SGT determination can be made on the same extract, requiring no additional solvent.
Higher efficiency	Standard measurement time is 25 minutes.	**Measurement time** under **15 minutes.**
Higher precision	Method Detection Limit (MDL) is 5 mg/L.	Significantly better Method Detection Limit (MDL) of **0.5 mg/L**.

The simple and quick measurement procedure of ASTM D8193 is illustrated in **era**lytics era**check** video: https://youtu.be/jDf8zErsON4?si=Vd7-dobKbUx429NO

Whereas the list of benefits to a method user is long, a comparability of the results between the two methods is not certain as all “Oil-in-Water” method are method defined parameters and the results may differ due to differences in solvent used for extraction, the detection method, the calibration material and the nature of the sample.

While these effects are expected to be minor for oils and greases, they may be significant for samples with volatile components, which boil off in EPA 1664 but are retained in ASTM D8193.

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To investigate the comparability of the methods, one light (API 35.8°) and one heavier (API 27.3°) crude oil were spiked into water at various concentrations and were measured according to EPA 1664 and ASTM D8193 by commercial laboratories.

API 27.3 [MG / L]	EPA 1664 [MG/L]	RECOVERY [%]	ASTM D8193 [MG/L]	RECOVERY [%]
20	16.0	80	19.3	97
20	20.0	100	17.5	88
50	45.0	90	49.8	100
50	45.1	90	49.9	100
100	89.8	90	100.5	101
100	100.0	100	99.8	100

API 35.8 [MG / L]	EPA 1664 [MG/L]	RECOVERY [%]	ASTM D8193 [MG/L]	RECOVERY [%]
20	12.4	62	15.9	80
20	14.5	73	17.9	90
50	26.8	54	44.1	88
50	21.6	43	45.3	91
100	69.1	69	89.5	90
100	67.7	68	90.7	91

For the heavy crude there is an excellent agreement between the two methods. The recovery of EPA 1664 is about 10% lower, which probably can be explained by the calibration material used.

For the lighter crude, the EPA 1664 values deviate significantly from the prepared concentrations. This reflects the volatile components of the lighter crude which evaporate during the EPA 1664 procedure. Here the recovery is significantly lower than for ASTM D8193.

ASTM D8193 produces excellent data with recoveries between 80 and 100% for both types of samples, and the repeatability of ASTM D8193 is factor 2 lower as compared to EPA 1664.

Conclusions

ASTM D8193 represents a more modern and safer alternative for oil in water testing. Its IR technology enables measurements with higher precision and accuracy, and its shorter measurement time increases lab efficiency. Lower solvent consumption and the absence of solvent evaporation reduce waste and eliminate workers' exposure to harmful air pollutants. For samples with low levels of volatiles, ASTM D8193 and EPA 1664 produce comparable results. For volatile samples EPA 1664 significantly under-reports the oil in water results due to boiling off the sample's light ends.