

Chlorine (Cl) and Silicon (Si) in Gasoline

Method ID: N/A

Category: Petrochemical

Technique: ICP-OES

Summary

This technical note demonstrates the ability of the Teledyne Leeman Labs Prodigy Plus ICP-OES system to determine various elements in gasoline. The presence of certain elements in gasoline can have an adverse impact on internal combustion engines. Ionic and organic forms of chlorine (Cl) are corrosive for many metals. Silicon (Si) contamination can cause O₂ sensors to give false rich signals, resulting in the engine running lean. The concentration limit for Cl and Si in gasoline is 1 mg/L per the National Technical Committee for Standardization of Petroleum Products and Lubricants GB/T 33647-2017.

Instrumentation

Teledyne Leeman Labs Prodigy Plus High Dispersion ICP, in Dual-View Configuration, equipped with Halogen Option. ESI PC³-LT Cooled Spray Chamber (Elemental Scientific).

Method Parameters

Prodigy Plus Method Parameters	
Parameter	Value
RF Power	1.30 kW
Coolant Flow	16 L/min
Auxiliary Flow	2.0 L/min
Nebulizer Pressure	15 psi
Uptake Rate	15 rpm
Nebulizer Type	ESI PFA-100
Spray Chamber	ESI PC ³ -LT
Temperature	-20 °C
Torch	Quartz Demountable
Injector	1.1 mm bore
Halogen Integ Time	30 s
Axial Integ Time	10 s

Calibration

Calibration Standards of 0, 1, 5 and 10 mg/kg for both Cl and Si were used. LGC V-23 (900 ppm Si) and Conostan (5000 ppm Cl) were used as stock solutions. The standards were all made by weight in gasoline that had nondetectable concentrations of Cl and Si.

Sample Preparation

Three different brands of gasoline were analyzed (Regular Grade: 87 Octane, E10) without any pre-treatment or dilution.

Results

Detection Limits were calculated by measuring the blank 20 times and multiplying the standard deviation by 3.

Detection Limit, mg/kg	
Cl 134.724	0.180
Si 251.611	0.003

Analysis of the three brands of gasoline indicated they all easily met the 1 mg/mL limit for Cl and Si.

Sample	Element	Conc, mg/kg
Brand 1	Cl 134.724 x	< 0.130
	Si 251.611	< 0.003
Brand 2	Cl 134.724 x	< 0.130
	Si 251.611	< 0.003
Brand 3	Cl 134.724 x	< 0.130
	Si 251.611	< 0.003

To determine recoveries, the Brand 2 sample was spiked with 0.983 mg/kg of Cl and 0.984 mg/kg of Si.

	Cl	Si
Conc, mg/kg	0.957	0.953
% Recovery	105%	100%

Conclusion

The Prodigy Plus demonstrated its ability to determine Cl and Si in gasoline. The data indicates the elements can be easily determined at the 1 mg/kg level. The use of the ESI PC³-LT Cooled Spray Chamber, operated at -20 °C, permits gasoline to be analyzed without any sample preparation or dilution.