RA-915M

Zeeman mercury analyzer

Direct mercury determination in naphtha

INTRODUCTION

The presence of mercury in refinery hydrocarbon streams results in detrimental effects, including catalyst poisoning, corrosion, failures in cryogenic equipment, and health and safety issues. The **mercury concentration in naphtha** and light petroleum products (condensate, gasoline, and diesel fuel) should be determined as the commercial price of product depends on this. The mercury content varies in a wide range of less than 0.1 ppb to dozens ppm. Direct mercury determination in crude oil and petroleum products according to **ASTM D7622** method can be carried out at the range above 5 ppb. Mercury determination at a level below 5 ppb is a vital problem for the oil refining and petrochemical industry. The complex organic matrix impedes conventional quantitative analysis for mercury. Lumex Instruments proposes the solution for mercury determination at the lower level of concentration.

MEASUREMENT METHOD

The ASTM D7622 method implementation for naphtha analysis using Lumex Instruments mercury analyzers can be carried out for direct analysis of the condensate, naphtha and other products of oil distillation, including gasoline and diesel fuel.
For the low mercury content (<5 ppb) preconcentration by the solid-phase extraction on the aluminium oxide should be implemented. The special vacuum manifold is used in this case.

PRINCIPLE OF OPERATION

The principle of the method is based on the reduction of Hg (II) to the atomic state due to the thermal decomposition of mercury compounds and the follow-up transporting of mercury atoms into the analytical cell of the analyzer by air flow. Then the mercury concentration is determined from the absorption of the 254-nm resonance radiation by mercury atoms measured by **RA-915M mercury analyzer** combined with **PYRO-915+ thermal decomposition attachment** using differential atomic absorption spectroscopy with Zeeman correction for background absorption.

ANALYTICAL CHARACTERISTICS

Non-measurable component	Direct analysis	Analysis with preconcentration
Sample volume	20–200 µl	1–5 ml
Detection limit	5 ppb	0.1 ppb
Upper limit of the measurement range	1000 ppb	20 ppb
Measurement time	1–2 min	5–6 min

ANALYSIS FEATURES

- Direct rapid analysis (1–5 min)
- Direct mercury determination without preliminary accumulation on a gold trap, in contrast to the method prescribed in UOP938
- No need for sample pretreatment in the case of mercury concentration above 5 ppb; preconcentration from 1–5 ml sample required for mercury determination at a sub-ppb level
- Wide dynamic measurement range, no «memory effect»
- Calibration and QA/QC with the certified SRM of any composition
- Control of the non-selective absorption during the measurement excludes analysis errors
- No need for cylinders with compressed oxygen or other carrier gases
- Low running cost

EQUIPMENT AND REAGENTS

The following equipment and materials are used for analysis:

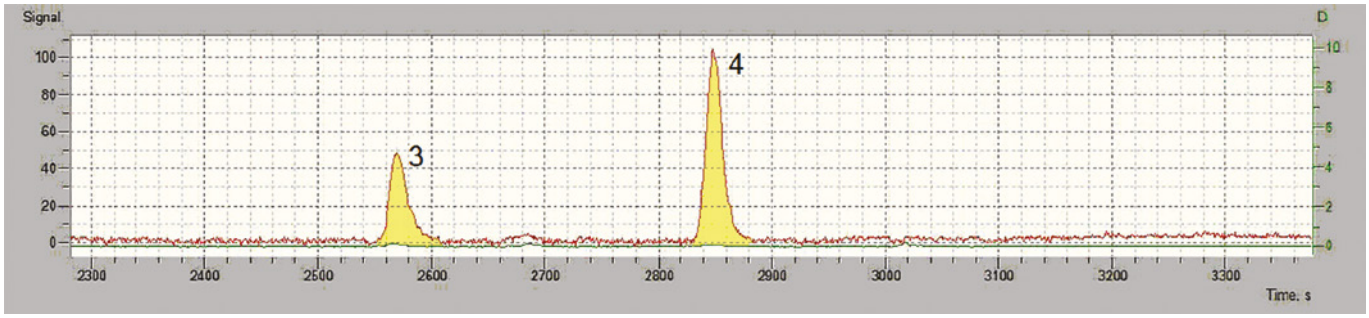
- mercury analyzer RA-915M combined with PYRO-915+ attachment;
- PC with Windows® and RAPID software;
- any solid or liquid certified SRM of mercury;
- Lumex Instruments kit, order **No 0300002285 (with vacuum manifold)** or Lumex Instruments kit, order **No 0300002328 (without vacuum manifold)**.

EXAMPLES OF ANALYSIS

Measurement of mercury concentration in naphtha using the preconcentration step

No	Sample weight, mg	C, ppb	No	Sample weight, mg	C, ppb
1	2537	0.70	6	1855	0.79
2	2679	0.77	7	2137	0.78
3	1447	0.72	8	3106	0.72
4	3034	0.70	9	1743	0.68
5	3906	0.74	10	3717	0.70

Cav, ppb	0.730
SD	0.037
RSD, %	5.1



3 – sample weight 1.45 g; (measured value is 0.72 ppb)
4 – sample weight 3.03 g; (measured value is 0.70 ppb)

Analysis of the spiked naphtha using Lumex Instruments vs. UOP938

Spike, ppb	Found, ppb		Δ (UOP – Lumex Instruments), %	Recovery of the spike (UOP), ppb (%)	Recovery of the spike (Lumex Instruments), ppb (%)
	UOP	Lumex Instruments			
0.0	0.497	0.450	+9.4	–	–
0.1	0.561	0.530	+5.5	0.064 (64)	0.080 (80)
0.3	0.705	0.705	0.0	0.208 (69)	0.255 (85)
0.5	0.964	0.925	+4.0	0.467 (93)	0.475 (95)
1.0	1.53	1.46	+4.6	1.03 (103)	1.01 (101)