

M-4000 Mercury Analyzer

The innovative CETAC M-4000 is an absorption based mercury analyzer specifically designed for stable, sensitive, low cost measurement of mercury in aqueous samples. Inheriting attributes from the ground-breaking work of the M-6000A, the M-4000 is an economical solution for the determination of mercury. Key technology, including the patented gas/liquid separator that eliminates foaming with organic solutions, has been included. The analyzer is supplied with a pump/gas control module, allowing convenient bench-top control of gas and liquid flow.

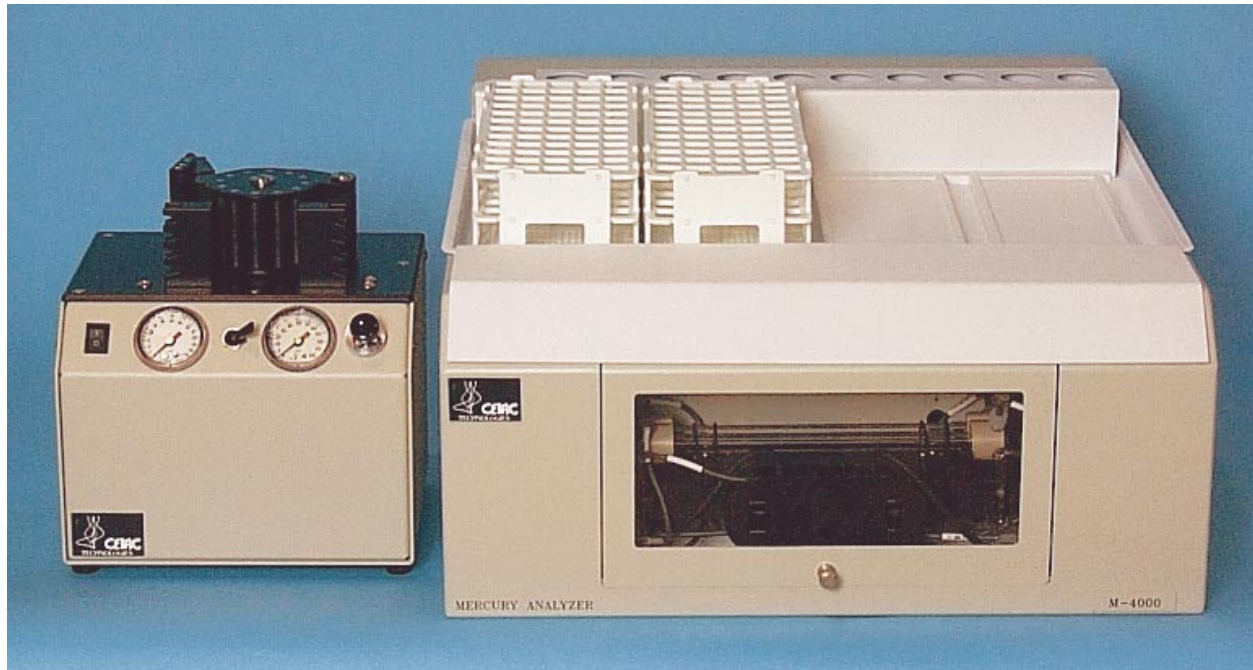


Figure 1 -- M-4000 Mercury Analyzer

- Modest cost
- Detection limit less than 5 ppt
- Patented, ultra-stable anti-foaming gas-liquid separator
- State-of-the-art, patent-pending CCD optical detector
- Thermostatically controlled mercury vapor lamp
- High performance Nafion[®] dryer cartridge
- Easy maintenance
- Stabilized double beam optics
- 12-roller fixed speed peristaltic pump
- Stabilized gas/liquid control module

Principal of Operation

An acidified aqueous sample ① containing trace level Hg^{2+} is introduced to the M-4000 by a peristaltic pump. Stannous chloride ②, a reducing agent, joins the sample stream at a mixing tee. Hg^{2+} is reduced to form Hg^0 by Sn^{2+} while the sample/reducing agent mixture is enroute to the CETAC patented gas-liquid separator. The resulting finely dispersed $\text{Hg}^0/\text{SnCl}_2$ solution is introduced into the top of the gas-liquid separator, forming a thin film on the entire exterior surface of the frosted glass center post. A dry carrier gas ③, either nitrogen or argon passes through the reference cell to facilitate measurement of incident radiant power at 253.7 nm.

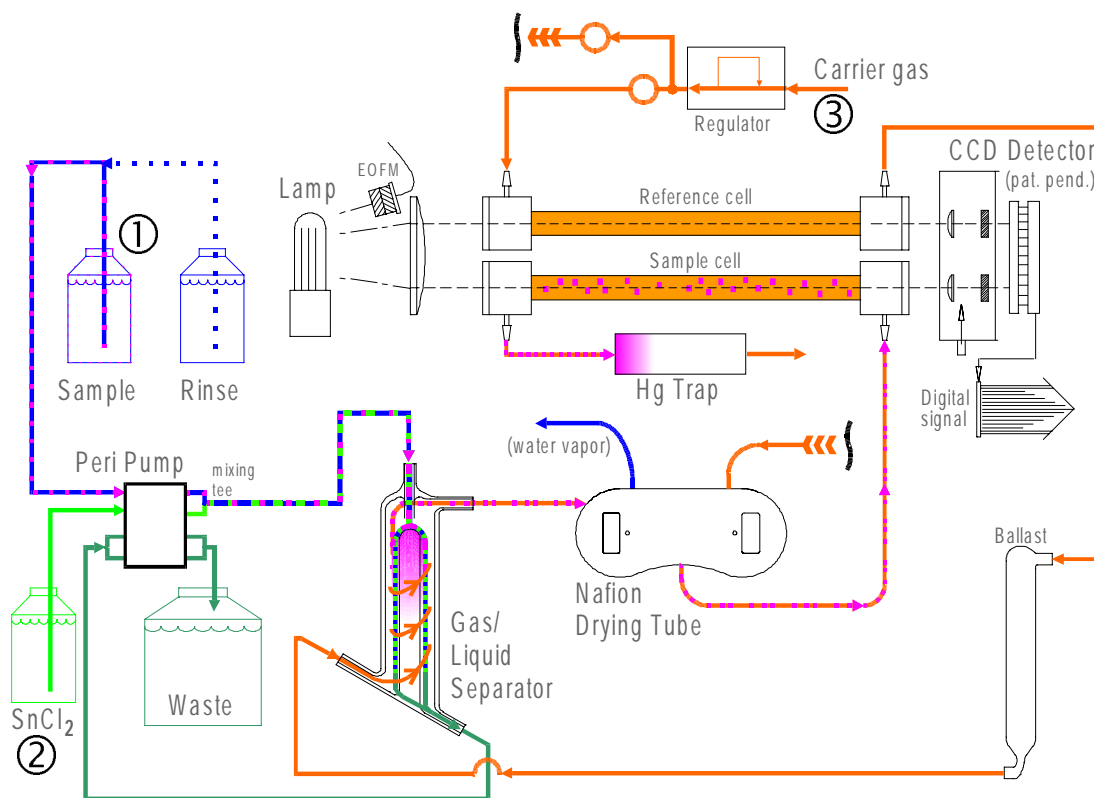


Figure 2 -- Principle of operation

After passing through the ballast, the carrier gas is introduced tangentially at the bottom of the Gas/Liquid Separator center post. The carrier gas swirls upward around the post, over the $\text{Hg}^0/\text{SnCl}_2$ film and toward the gas exhaust port. This highly efficient, patented technique evaporates Hg^0 from the solution into the carrier gas. The carrier gas, with Hg^0 vapor, passes through a Nafion[®] drying cartridge where water vapor is removed, and then into the sample cell for measurement of transmitted radiant power. The carrier/ Hg^0 gas stream is ultimately exhausted to a vapor trap where Hg^0 is absorbed and clean carrier gas passes to the atmosphere.

Performance Evaluation

The M-4000 Mercury Analyzer shares many of the same characteristics found in the M-6000A. Changes were made to produce a system of modest cost without sacrificing reliability. With an Instrument Detection Limit (IDL) of less than 5 ppt (compared to an M-6000A IDL of less than 1 ppt), the M-4000 still attains a remarkable degree of stability, as shown in Figure 3.

Time vs Concentration
(0.53 ppb mercury solution)

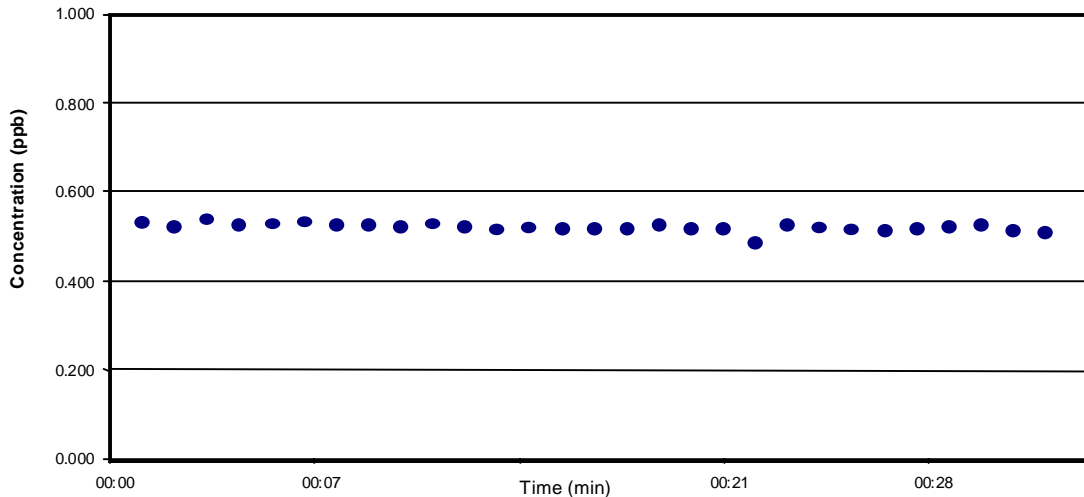


Figure 3 -- Repeated analyses of a 0.53 ppb mercury solution (1.7% RSD)

Software Overview

The M-4000 is controlled using a Windows™ based software package offering a graphical interface (figure 4) which is both friendly to beginning users and powerful enough for experienced analysts and scientists. Calibration, sample analysis, quality control and report

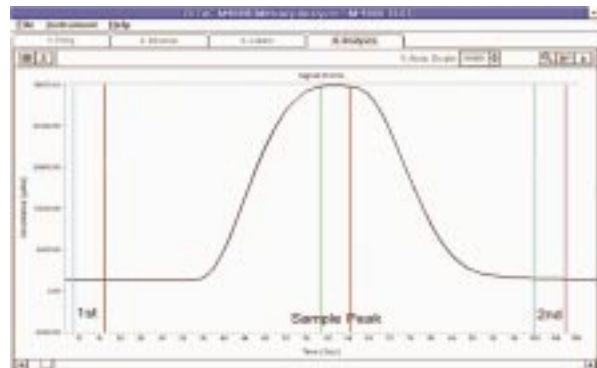


Figure 4

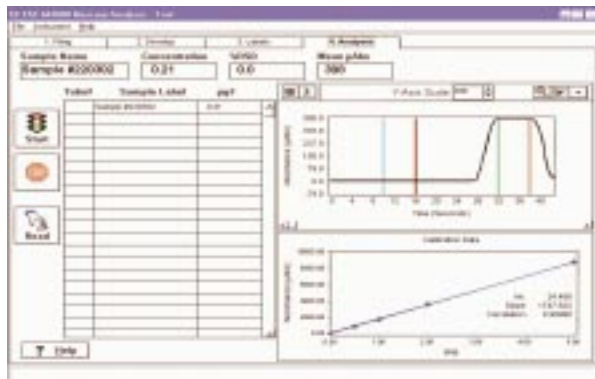


Figure 5

generation templates are built into the software (figure 5). Real time data can be displayed in a chart recorder window, aiding in instrument optimization. Once optimum parameters are identified, they can be stored and password protected as a template. Methods for routine analysis may be created from the templates.

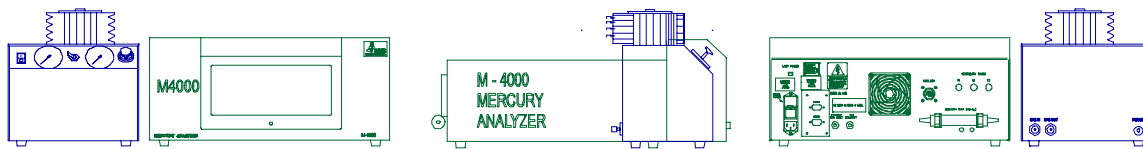


Figure 6 -- Front, side and rear view of M-4000

Specifications

M-4000 Mercury Analyzer:

Analysis temperature:		ambient
Power requirements:	100 - 130 VAC	50-60 Hz, 1.0 A, 200 W
	205 - 240 VAC	50-60 Hz, 1.0 A, 200 W
Minimum computer requirements:		IBM compatible Pentium™ 200 MHz 32 MB RAM Windows 95, 98 (NOT NT or 2000) One available ISA slot
Weight (shipping):		40 lbs 11.5 kg
Height x Width x Depth	20.2 x 46 x 53.3 cm	8 x 18¼ x 21 in
Lower detectable limit:		< 5 ppt (wt/v)
30 minute reproducibility (0.5 ppb):		1.7 % RSD
10 sample reproducibility (0.5 ppb):		0.9 % RSD
Linear detection range:		0.005 - 300 ppb (wt/v)
Recovery time from 1 ppm sample:		< 3 minutes

Pump/gas control module

Gas

Maximum input pressure	250 p.s.i.
Output pressure	0 - 60 p.s.i.
Carrier gas (N ₂ or Ar) consumption:	0.5 - 1.5 L / min
Carrier gas (N ₂ or Ar) flow:	30 - 250 mL / min

Liquid

Sample uptake rate:	4.0 mL / min
Power requirements:	100 - 240 VAC 50-60 Hz, 1.0 A, 200 W

Measurement #	Concentration (ppb)
1	0.532
2	0.524
3	0.539
4	0.527
5	0.530
6	0.534
7	0.528
8	0.527
9	0.524
10	0.530

Table 1 -- 10 sample reproducibility (0.9% RSD)

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