



The Determination of Mercury in Whole Blood by Thermal Decomposition and Atomic Absorption

Introduction

Mercury is a toxic element that can enter the body through the lungs, skin or by ingestion. Repeated exposure to mercury has adverse health effects whose symptoms are well documented. Individuals at high risk of exposure or who are suspected of mercury intoxication are typically monitored through analysis of blood and urine samples. The mercury blood test will detect all types of mercury but because mercury remains in the bloodstream for only a few days the test should be performed soon after exposure. The urine mercury test only measures inorganic and elemental mercury as organic forms are not excreted.

This application note describes the direct analysis of blood samples using the *Hydra-C mercury analyzer*. The *Hydra-C* employs the thermal decomposition approach to mercury analysis and is ideally suited for the determination of mercury ranging from <10 ug/L up to the elevated levels sometimes found as a result of occupational exposure.

Instrumentation

The Hydra-C (shown to the right) is fully automated for unattended operation, comes complete with a 70-position autosampler and has on-the-fly loading capability for virtually unlimited sampler capacity. Hydra-C operates from a single 110/220V, 50/60 Hz power supply and oxygen supplied at 15-20 psig. All instrument operating parameters (e.g. furnace temperatures, gas flows, autosampler control) and process stages are computer controlled for ease-of-use.



Hydra-C Mercury Analyzer

Principle of Operation

Hydra-C operates on the principle of thermal decomposition to liberate elemental mercury from solid or liquid samples. Figure 1 shows a schematic diagram of Hydra-C's Principle of Operation. First, a weighed sample is deposited into a sample boat and introduced into the decomposition furnace. After the furnace is closed, an oxidant (typically oxygen or compressed air) begins to flow over the sample and the furnace temperature is ramped in two stages; first to dry the sample, then to decompose it.

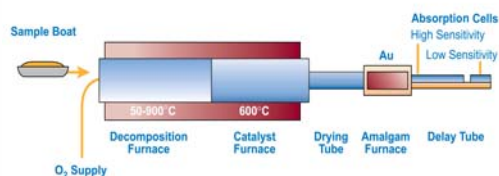


Figure 1. Schematic of Hydra-C's Principle of Operation

The analytical process typically involves combusting (thermal decomposition) the sample at high temperatures with oxygen; although, for some applications gentle heating of the sample in air is adequate to release the mercury. During the combustion step the evolved gases are carried through a heated catalyst to produce free mercury while removing halogens, nitrogen oxides, and sulfur oxides. The remaining combustion products including elemental mercury (Hg) are swept first through a dryer and then through a gold amalgamation trap where all elemental mercury is captured. Following the decomposition step, the amalgamation trap is heated and the free mercury is carried into an atomic absorption spectrometer. The mercury level is reported using a wide dynamic range detection system that operates from 0.005 ng (its detection limit) to its upper limit of 1000 ng. For applications requiring significantly higher detection capability an optional high range detection system is available which can be used to analyze samples containing up to 20,000 ng of Hg.

Experimental

Table I shows the instrument parameters employed for whole blood. For this analysis nickel boats were used for all samples and standards.

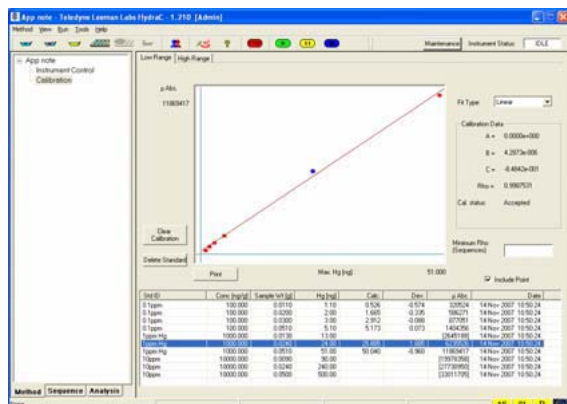
Table I: System Parameters

Parameter	Setting
Dry	300°C for 45 sec.
Decomposition	800°C for 150 sec.
Catalyst	600°C
Catalyst Wait Period	60 sec.
Gold Trap	700°C for 30 sec.
Measurement	90 sec.
Oxygen Flow	300 ml/min

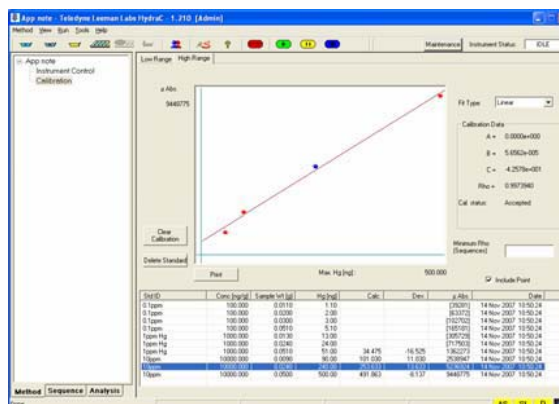
Calibration

Calibration was completed using aqueous standards prepared in 1.0% HNO₃. Working standards were blank, 0.1, and 1.0 ppm. The calibration curves are displayed as microabsorbance vs. total mercury injected.

Low Concentration Range (0-50ng)



High Concentration Range (50-500ng)



Results

Three certified reference materials were analyzed for mercury and the results appear below in Table II.

Table II: Correlation of Certified Reference Materials

Name	Certificate (ppb)	Acceptance Range (ppb)	Measured (ppb)	Recovery (%)
Lypho 1	9.6	7.7-11.6	9.08	94.8
Lypho 2	39	31-47	35.5	90.9
Lypho 3	73	58-87	66.7	91.4

Conclusions

The *Hydra-C* provides a simple, fast and accurate means for determining mercury concentrations in blood. Since it requires no sample digestion samples can be processed in about 5 minutes, allowing rapid response for clinical diagnoses. Results for the whole blood controls showed excellent agreement with established values.