APPLICATION NOTE #1081

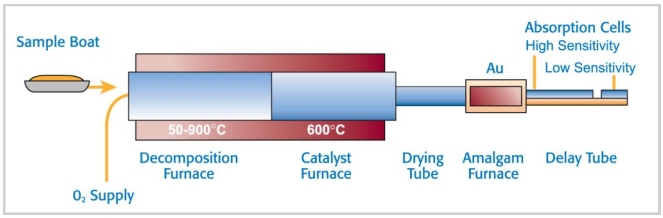
The Determination of Mercury in Food Grade Plastics by Thermal Decomposition, Amalgamation and Cold Vapor Atomic Absorption

INTRODUCTION

The accurate determination of mercury in food grade plastics is of interest because it's is a toxic element that can be leached into foodstuffs that come in direct contact with those materials. Using the ***Hydra II_C*** Direct Mercury Analyzer provides simple and convenient analyses of these materials in about 7 minutes without sample digestion or production of hazardous chemical waste.

The ***Hydra II_C*** heats samples in an oxygen stream to decompose any mercury compounds which are then collected on an 'amalgamator'. Once all of the sample's mercury has been collected, the amalgamator is quickly heated and the mercury is released for determination by cold vapor atomic absorption (Figure 1).

Figure 1



SAMPLE AND STANDARD PREPARATION

Samples of the plastic materials were cut into small pieces and approximately 0.05 gm was placed into tared sample "boats". Aqueous standards were prepared in 1% HNO_3 for system calibration.

INSTRUMENTAL

The ***Hydra II_C*** employs two optical paths of differing lengths for extended dynamic range. Its software automatically selects the best analytical signal for each measurement. The calibration curves are displayed in Figures 2 and 3 as micro absorbance vs. total mercury injected.

These calibration curves were generated using weighed deposits of aqueous standards in concentrations of 0.1, 1.0 and 10.0 ppm (w/w) mercury. Tared nickel boats were used for analysis.

Table 1 shows the instrument parameters employed for the calibration and sample analysis.

Table 1: Operating Conditions

Parameter	Setting
Dry	300°C for 30 sec.
Decomposition	550°C for 250 sec.
Catalyst	600°C
Catalyst Wait Period	60 sec.
Gold Trap	600°C for 30 sec.
Measurement	100 sec.
Oxygen Flow	350 ml/min

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Figure 2. Hydra II_C low concentration range (0-2ng)

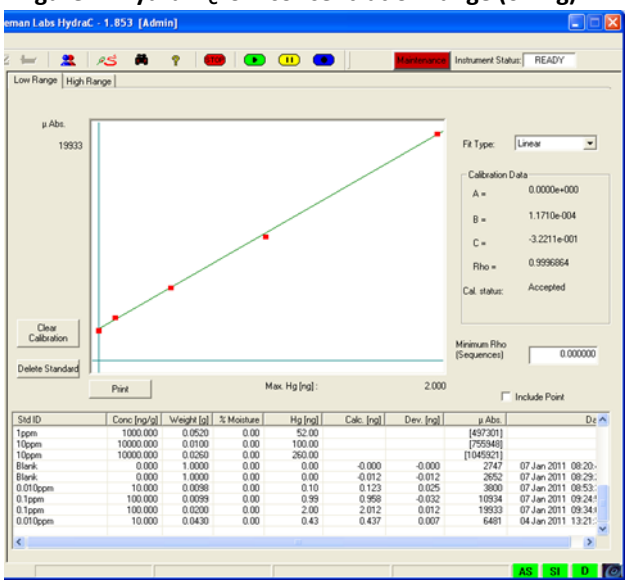
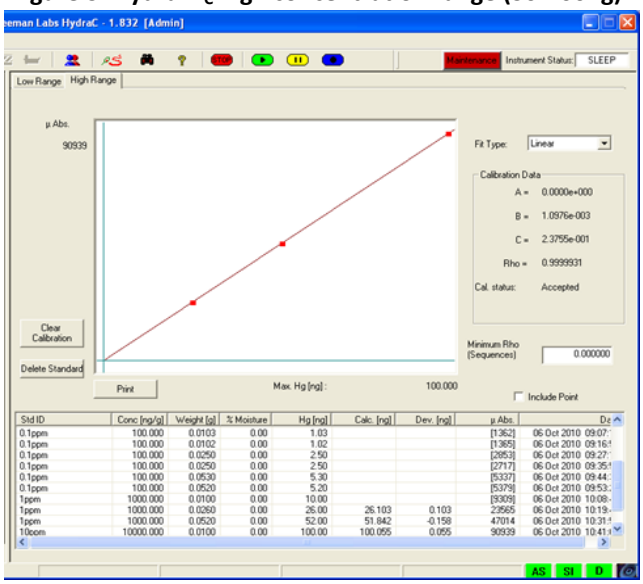


Figure 3. Hydra II_C high concentration range (30-100ng)



Due to the low mercury concentration of all the samples tested the instrument was only calibrated to 2 ng on the 'low' curve for maximum accuracy while the 'high' curve was calibrated to 100ng for the analysis of the higher concentrations found in the CRM's.

RESULTS

Samples of polyethylene terephthalate (PET), high-density polyethylene (HDPE), low-density polyethylene (LDPE), polypropylene (PP), and polystyrene (PS) were obtained for analysis. Each sample was analyzed in triplicate. The sample results, including the average sample weight, mean and standard deviation of the three replicates are presented in Table 2. Reference materials ERM-EC680k and ERM-EC681k (LDPE spiked with mercury) were also analyzed to check for method bias. The results of that analysis are presented in Table 3.

Table 2: Sample Results

Sample	Average sample weight (grams)	Measured Concentration (PPM)	Standard Deviation (PPM)
PET	0.035	0.00068	0.00019
HDPE	0.045	0.02244	0.00261
LDPE	0.044	0.02487	0.00443
PP	0.042	0.03212	0.00093
PS	0.042	0.02326	0.00365

Table 3: CRM sample results

Sample	Average sample results (PPM)	Certified mercury concentration (PPM)	Recovery (%)
ERM-EC680k	4.60	4.64	99.2
ERM-EC681K	24.1	23.7	101.8

CONCLUSIONS

The ***Hydra II_C*** successfully analyzed the plastics without pretreatment in about 7 minutes per sample. Analysis results were in excellent agreement with certified reference values. No hazardous chemicals were employed and there was no toxic waste produced.

MORE ABOUT THE HYDRA II_C

The ***Hydra II_C*** provides a 70-position autosampler and has 'on-the-fly' loading capability for virtually unlimited capacity. Additionally, a conversion kit is available which employs chemical reduction to satisfy the monitoring of drinking water in accordance with USEPA Method 245.1 and the European Standards EN1483 & EN13806.