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Mercury Measurement in Steel from Oil and Gas Operations without Damage or Harm

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Abstract

Prompt Gamma Neutron Activation Analysis (PGAA or PGNAA) is a non-destructive essential analysis system potentially applicable for the non-invasive dimension of wall- bound mercury (Hg) deposited at trace situations on the process bathe face of sword pipe and vessels in oil painting and gas product and processing. Total wall- bound mercury, on 17 mercury- impacted sword pasteboard samples was measured by two non-destructive styles PGAA and XRF (X-ray luminescence spectroscopy). Following then on-destructive dimension styles, the samples were digested and anatomized by an infinitesimal luminescence Spectroscopy system grounded on the principles of EPA 1631 system (Acid Digest- AFS), generally considered state of the art for accurate mercury in sword measures. PGAA and XRF results were compared to those from the modified EPA 1631 system. Relative analysis of the results indicated that the PGAA measures displayed a trend fairly like that of the acid condensation- AFS system measures. Dimension delicacy, as determined by comparison to a “standard system” (Modified EPA 1631) wasn’t yet acceptable for quantitative dimension [1]. Still, the thickness in the shadowing of the PGAA results with results from the “standard system” along with derivate of a tone- attenuation correction factor suggests the eventuality for bettered delicacy and correlation. Details of the inter-comparison are handed herein.

Keywords: Prompt Gamma Activation Analysis (PGAA); X-ray luminescence (XRF); Wall bound mercury; Mercury defiled sword

Introduction

Mercury attention can be measured using hand held X-ray luminescence Spectroscopy (XRF) instruments. Dimension of mercury attention in tickets can be determined using a modified EPA 1631E system. While this system is considered the most accurate for determining total mercury attention, it’s time- consuming, and requires complete destruction of the sample via acid digestion and must be performed in the laboratory. Prompt gamma activation analysis (PGAA) [2], also known as prompt gamma neutron activation analysis (PGNAA) is a non-destructive essential analysis system that has been shown to directly measure Hg attention in biological samples. PGAA requires a neutron source with which to irradiate the sample. Neutrons are largely piercing in numerous accoutrements. The neutrons are absorbed in the sample capitals and emit one or further gamma shafts. The energy of these gamma shafts is characteristic of the element from which they’re emitted. Therefore, the type of element and its mass can be determined by the gamma- shaft energy and intensity. It has been shown that the gamma-shaft counts from Hg vary linearly with attention and that emigration lines of 1693 and 5967 keV are applicable for the dimension of Hg attention and don’t lap with emigration lines of other heavy essence. XRF, acid digestion, and PGAA styles were used in this study to measure the Hg attention in 17 sword tickets. The results from XRF and PGAA are compared to the acid digestion results, and a discussion of the counteraccusations of these results is presented [3].

Experimental arrangement

Seventeen samples were under consideration to quantify the Hg content of each sample using PGAA. The samples handed comported of sword pipe sections with confines of roughly 2.5 cm wide, 1.3 cm thick, and 2.5 cm in length. The curve of the pipe was low enough that the samples were basically flat tickets. The samples were irradiated with the neutron ray at a 45- degree angle to the flat face of the pasteboard and the gamma- shaft sensor was located at a 90-degree angle from the direction of the neutron ray. Three tickets were anatomized at the University of Texas Nuclear Engineering Teaching Laboratory (UT-NETL) in October 2020 [4].

Neutron Source

The UT- NETL PGAA system neutron source is a collimated neutron ray, forming from a 1 MW exploration reactor, that’s delivered to the sample via a ray harborage and neutron surge companion. The system delivers a sub-thermal neutron flux with an average 2200m/s neutron fluence rate at full reactor power of 4.5×107 cm^{-2} s^{-1}. The neutron fluence rate scales linearly with power for all power situations of interest to PGAA measures (basically power situations lesser than 30 kW). The UT- NETL neutron ray harborage is configured similar that the focal aeroplane (where the neutron ray intersects the sample) consists of an area of 4.4 cm by1.5 cm. The HPGe sensor was energy and effectiveness calibrated using a Eu-152 standard for powers between 121 and 1457 keV. This effectiveness was also extended to 6018 keV by performing a PGAA dimension on an iron antipode standard and determining the relative effectiveness of individual prompt gamma lines from 122 to 6018 keV. This relative effectiveness is also regularized to the Eu-152 measured effectiveness using twelve iron PGAA lines between 122 to 1260 keV. This normalization was also applied to thirteen iron PGAA lines from 1612 to 6018 keV [5].

Spectral Evaluation Procedure

The UT- NETL PGAA system can measure a full spectroscopic

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range of gamma energy situations (gamma lines). Still, the analysis in this work used the following two lines for Hg and two lines for Fe [6].

- Hg Lines (in keV) 1693 and 5967
- Fe Lines (in keV) 1725 and 6018

In general, the tickets impacted the most were the bones with the thinnest walls. Hence, the largest difference from the supposition of an invariant wall was the largest for those samples. Wall consistence impacts dimension because of the tone- attenuation of the radiation through the wall. Inaccurate wall consistence estimates will lead to either over- or under-estimated Hg attention. While individual line powers devaluate else in different wall density, there should be constant product rates [7-8]. As a result, by observing the rate of those lines, it's possible to estimate the wall consistence and internally recalibrate (barring the demand for accurate knowledge of wall density of samples in the field). Such a conception would have to be demonstrated completely, but results to date suggest this would be doable. The relationship between the intensity of the 6019 keV line from iron per neutron delivered to the sample versus sample consistence. More advanced styles for determining sample consistence have been developed and proved. The query in the counts(y- axis error bars) is simply from the query in the net peak area for the 6019 keV peak(as reported by GENIE 2000) propagated with the query in the neutron counts. Still, the number of neutron counts is veritably high, so that query is negligible compared to the query in the net peak area. The query in the sample consistence (x-axis error bars) is from the dimension of the sample consistence using a set of calipers. The query in the calipers themselves is negligible but 4 locales were measured on each sample (1 from each external edge) and also equaled those with a standard divagation. What's reported is the standard divagation of the 4 measures not the query in the calipers themselves. The large query is attributed to small data set and sample face "roughness" (i.e., the sword pasteboard shells aren't smooth and invariant across the face). In all cases, these samples are pushing the limits of what the UT- NETL PGAA system is able of measuring for this large of an iron sample. A semi-quantitative analysis of mercury in sword was performed by three styles and yields similar results; still, there's still a long way to make the proposed non-destructive ways completely quantitative. The linearity of the ways is demonstrated, but presently can be used for analysis only after external estimation [9]. The use of PGAA for determining wall bound mercury attention is appealing as it offers the eventuality for anon-destructive non-invasive approach. The conception of exercising PGAA for this purpose has been demonstrated (to below 10 μg/g in under 2 h within 20 query in a laboratory terrain). Direct comparison of the three styles presented herein indicates significant differences between the data sets as attention increase, still, a qualitative review shows a clear direct relationship between the data sets(i.e., ordering pasteboard samples by mercury attention produces the same relative order anyhow of the approach). There's good relative agreement across the tickets studied, still, in general, both XRF and PGAA yield lower total mercury attention than the acid digestion approach. Similar results make sense when considering the face spot dimension operation of XRF and the eventuality for tone- attenuation during PGAA measures. The connection of the PGAA approach in the field has yet to be demonstrated. For PGAA to be suitable for field operation, a mobile result must be developed similar as consideration of a movable neutron creator [10-11].

Conclusion

Eventually, the thing is to maximize thermal neutron flux commerce with the sample (i.e., maximize the probability of neutron-mercury snippet relations and thereby maximizing gamma signal emitting from the sample). At the same time, it's critical to minimize gamma background signal from the rest of the setup, hence, the shielding demand. It's critical that fast neutron relations with all accoutrements girding the sample (away from the prolocutor which are specifically employed to thermalize fast neutrons) are minimized (i.e., background). In proposition, with similar minimization of background, trials performed with a movable neutron creator, results should at a minimal produce the same position of discovery (mercury) as demonstrated from the exploration reactor used in this study. The redundant iron in the sword greatly impacts limits of discovery. In proposition, this limit can be overcome with longer dimension times. While such an approach would drop statistical crimes associated with counts, dwindling returns would be anticipated for similar analysis since the Compton background due to gamma shafts from the iron matrix will grow at a rate equal to the growth of the signal from the Hg lines. The tone- attenuation correction factor can also be employed to overcome similar discovery limits; still, farther trials would be demanded over a wide range of sword pasteboard density to establish dependable correction factors [12-13].

References

1. Selin NE (2009) Global biogeochemical cycling of mercury: A review. Annu Rev Environ Resour 34: 43-63.
2. McCormack MA, Battaglia F, McFee WE, Dutton J (2020) Mercury concentrations in blubber and skin from stranded bottlenose dolphins (Tursiops truncatus) along the Florida and Louisiana coasts (Gulf of Mexico, USA) in relation to biological variables. Environ Res 180.
3. Wilhelm SM, Liang L, Cussen D, Kirchgessner DA (2007) Mercury in crude oil processed in the United States (2004). Environ Sci Technol 41: 4509-4514.
4. Osawa T, Hatsukawa Y, Appel PWU, Matsue H (2011) Mercury and gold concentrations of highly polluted environmental samples determined using prompt gamma-ray analysis and instrument neutron activation analysis. Nucl Instrum Methods Phys Res Sect B 269: 717-720.
5. Mauerhofer E, Havenith A, Kettler J (2016) Prompt gamma neutron activation analysis of a 200 L steel drum homogeneously filled with concrete. J Radioanal Nucl Chem 309: 273-278.
6. Da-Qian H, Wen-Bao J, Zhou J, Can C, Jia-Tong L, et al. (2016) Heavy metals detection in sediments using PGNAA method. Appl Radiat Isot 112: 50-54.
7. Lindstrom RM (1993) Prompt-Gamma activation analysis. J Res Natl Inst Stand Technol 98: 127-133.
8. Lobo P, Hagen DE, Whitefield PD (2011) Comparison of PM emissions from a commercial jet engine burning conventional, biomass, and Fischer-Tropsch fuels. Environ Sci Technol 45: 10744-10749.
9. Moore RH, Thornhill KL, Weinzierl B, Sauer D, Kim J, et al. (2017) Biofuel blending reduces particle emissions from aircraft engines at cruise conditions. Nature 543: 411-415.
10. Moore RH, Shook MA, Ziemba LD, DiGangi JP, Winstead EL, et al. (2017) Take-off engine particle emission indices for in-service aircraft at Los Angeles International Airport. Sci Data 4:
11. Schripp T, Anderson B, Crosbie EC, Moore RH, Herrmann F, et al. (2018) Impact of alternative jet fuels on engine exhaust composition during the 2015 ECLIF ground-based measurements campaign. Environ Sci Technol 52: 4969-4978.
12. Mancini AA, Ackerman JF, Richard LK, Stowell WR (2004) Method and Coating System for Reducing Carbonaceous Deposits on Surfaces Exposed to Hydrocarbon Fuels at Elevated Temperatures 8: 67-70.
13. Kosir ST, Behnke L, Heyne JS, Stachler RD, Flora G, et al. (2019) Improvement in jet aircraft operation with the use of high-performance drop-in fuels. AIAA Scitech Forum 6: 56-59.