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Surface Quality Monitor Qualification

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Abstract

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Surface Quality Monitor Qualification
NASA/INSPIRE
NASA Center: Kennedy Space Center
Intern's Mentor: Jenny Ward
Internship Dates: June 7th – July 30th

During the eight weeks working at NASA, I was working in the Materials Science Division. The Materials Science Division (MSD) provides science-engineering services to NASA and contractors at Kennedy Space Center, including those working for the Space Shuttle, International Space Station, Launch Services and Constellation Programs.

Jennie Ward, one of the members of the Materials & Processing Branch, was my mentor for the eight-week program. Mrs. Ward is responsible for providing engineering support to both design/development and operations activities at Kennedy Space Center for the Shuttle, International Space Station, Launch Services, and Constellation Programs.

By working with the exceptional team of engineers, I learned how to successfully test metal for contamination by using a specialized system called the Surface Quality Monitor 200 (SQM200).

In order to properly understand the techniques and/or procedure, one must be familiar with the equipment, specifically the Surface Quality Monitor 200, manufactured by Photo Emission Tech, Inc. There are two specialized units; a control unit and a sensor stand with vertical height adjustment (Appendix A Figure 1). The sensor stand with vertical height adjustment allows the technician to measure the electrons emitted from the surface of metallic samples exposed to ultra-violet radiation, which is otherwise known as the OSEE (Optically Stimulated Electron Emission) as a current.

Due to the high contamination levels on surfaces, there is a need to create a high equality to simplify a fast and superb quality inspection to detect contaminates on metals. My job is to evaluate the presence or detect of organic and/or inorganic surface micro-contaminates. The technology for analyzing surface cleanliness or monitor absence or presence of organic or inorganic surface micro contamination is the use of the Surface Quality Monitor or SQM. This system is being tested to measure Optically Stimulated Electron Emission (OSEE), also known as photoelectric effect (Appendix A Figure 2). This is a phenomenon in which ultra-violet light radiation provides photon energy, which excites the electrons of a metal from their ground state energy levels to higher energy levels. Once these electrons have gained enough energy, they escape from the surface of the metal. The SQM200 measures the electrons emitted from the surface of metallic samples exposed to UV radiation (OSEE) as a current, and generates a number between one and one thousand which corresponds to the measured peak OSEE reading.

The readings generated by the SQM200 can thereby be used to determine the cleanliness of the surface of a sample. A peak OSEE reading closer to zero indicates greater surface contamination, while a peak OSEE reading closer to one thousand indicates greater surface cleanliness. This project seeks to define standards of cleanliness and determine acceptable and unacceptable levels of surface contamination, as well as

establish standard SQM200 settings (height of sensor stand from sample, rotary gain, and control unit gain) for more accurate quantification of sample contamination.

Clean metal discs are placed under the UV light and the SQM200 measures the OSEE, generating a number, which corresponds to the peak OSEE reading, and creating a standard for comparison. The OSEE of contaminated metal discs is measured and compared to the OSEE of clean metal discs (Appendix B Figure 3). Greater discrepancy between the peak reading of the clean disc and the peak reading of the contaminated disc indicates greater surface contamination. This concept can be used to provide an efficient method by which one can analyze the cleanliness of sample HFE-7100 3M (Appendix C Figure 4).

Wiltech Labs at NASA Kennedy Space Center use HFE in processing and cleaning components form the launch pad, shuttles, and satellites. The current method for analysis of HFE contamination levels are gravimetric analysis. This process takes approximately forty-five minutes and must be done several times a day to ensure the quality of the HFE. The SQM200 is qualified, can do the same analysis in approximately twenty minutes. Use of the SQM200 for measuring the quality of HFE will ultimately save Wiltech time and money in component refurbishment.

HFE -7100 3M is placed on a metal disc and then boiled off. The OSEE of this disc can then be measured using the SQM200. A low peak reading indicates more surface residue and therefore contaminated HFE-7100 3M.

Don Kahn of Wiltech at the Kennedy Space Center (KSC) has provided the SQM200, HFE-7100 3M, and metal samples. Jennie Ward, Chad Carl, and Angela Balles, of the NE-L directorate at KSC, are overseeing the project. All lab work will be done in the NE-L lab in the Operations and Checkout (O&C) building at KSC under the supervision of Dionne Jackson.

Appendix A

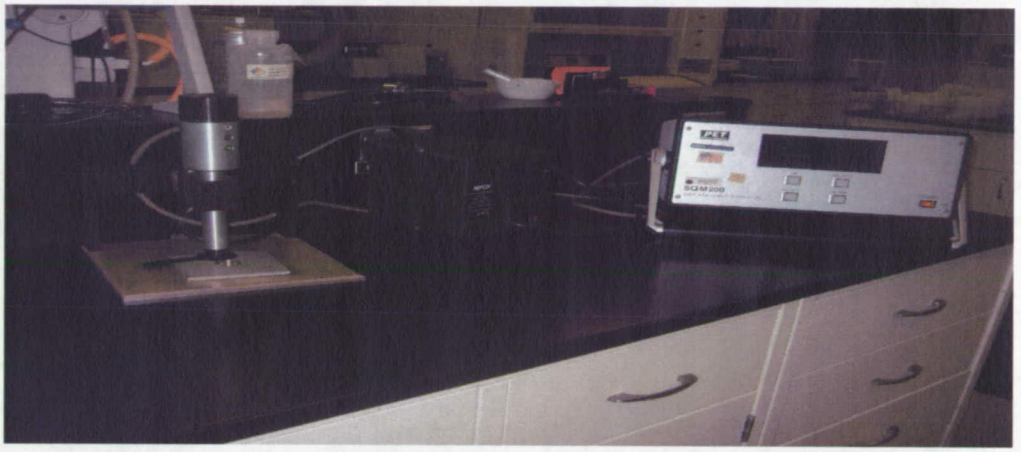

Figure 1: This is a visual of the two specialized units; a control unit (right) and a sensor stand with vertical height adjustment (left).

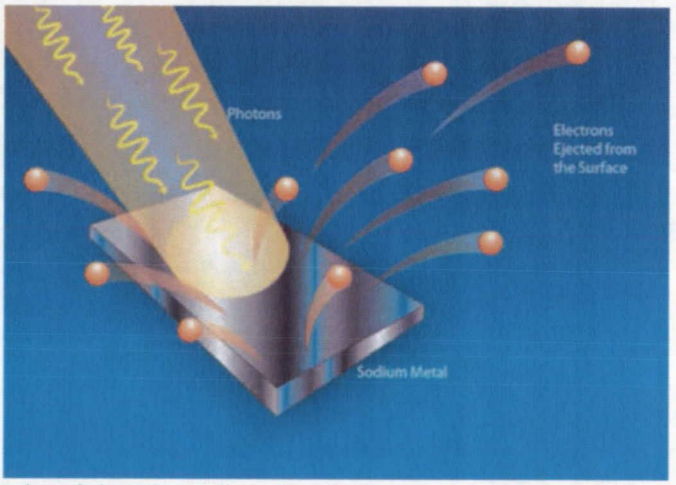

Figure 2: Example of the photoelectric effect on a clean, metallic sample.

Appendix B

Table 1

Clean				
Coin Number	T1	T2	T3	Average
1	944	701	OR	882
2	434	591	252	426
3	696	OR	OR	899
4	OR	853	892	915
5	OR	783	OR	928
6	OR	OR	OR	1,000
7	512	641	906	686
8	OR	OR	945	982
9	OR	OR	OR	1,000
10	904	973	949	942
Average Clean:				866

Table 2

Contaminated				
Coin Number	T1	T2	T3	Average
1	135	542	392	356
2	312	432	378	374
3	467	715	774	652
4	101	652	139	297
5	687	560	527	591
6	515	747	167	476
7	291	468	297	352
8	631	135	497	421
9	495	671	572	579
10	145	595	204	315
Average Clean:				441

OR (Over Range)
OSEE peak reading: 1,000

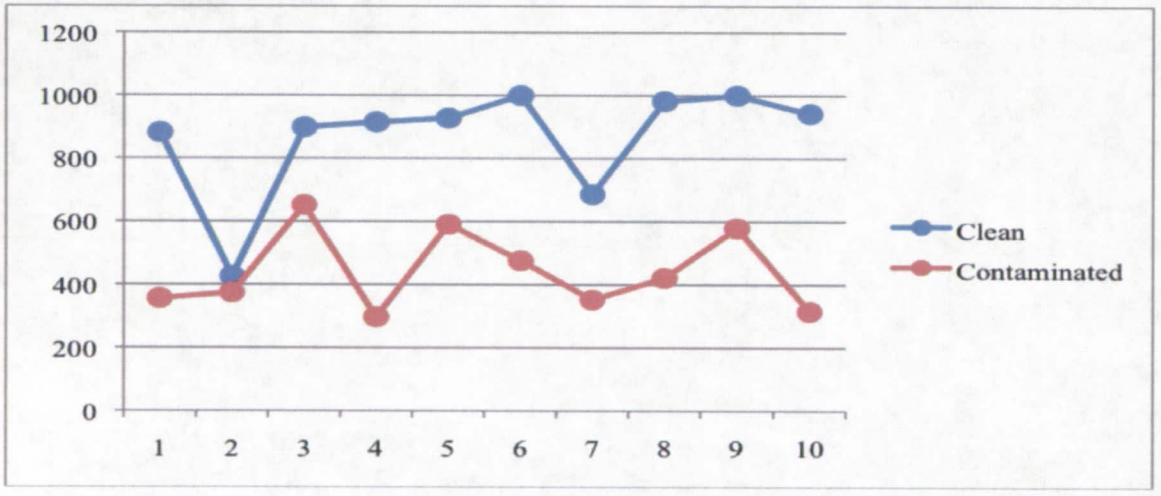

Figure 3: As shown, table 1 represents OSEE readings of clean metals, as table 2 represents OSEE readings of contaminated metals.

Appendix C

Table 1

Clean				
Coin Number	T1	T2	T3	Average
1	995 (OH)	OR	914	970
2	786	784	730	767
3	881	OR	981	954
4	826	674	747	749
5	661	822	629	704
Average Clean:				829

Table 2

HFE Boil Off (5.1 mg/ 500ml)				
Coin Number	T1	T2	T3	Average
1	408	595	705	569
2	203	304	193	233
3	397	566	611	525
4	633	323	383	446
5	336	569	649	518
Average HFE Boil Off:				458

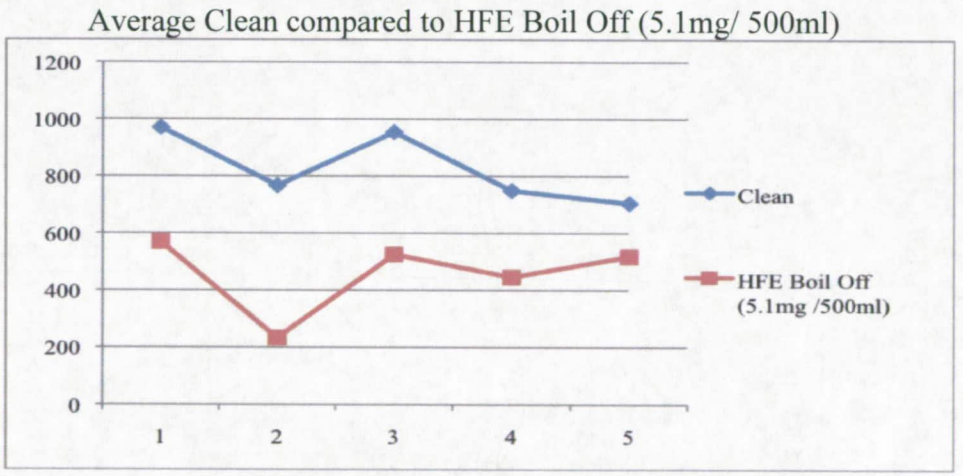

Figure 4: As shown, table 1 represents OSEE readings of clean metals, as table 2 represents OSEE readings of contaminated metals, contaminated by HFE.