

July 22, 2010

The Non-Toxic Solar Alliance e.V. (NTSA)
Karlplatz 7
10117 Berlin

Dear Mr. Hemme:

The State of California has established a procedure with set limits for hazardous waste characterization.

T.T.L.C. and S.T.L.C. are used when determining the hazardous waste characterization under California state regulations as outlined in Title 22 of the California Code of Regulations. (CCR). The T.C.L.P. is a characterization based on federal guidelines, but the California regulation overrules the T.C.L.P. within California.

The intent of the leachate procedure (S.T.L.C.) is to simulate the conditions that may be present in a landfill where water may pass through the land-filled waste and travel on into the groundwater carrying the soluble material with it.

The total threshold unit concentration (T.T.L.C.) analysis determines the total concentration of each target analyte in the sample. When the waste exceeds the TTLC limits, it is classified as hazardous and the waste code is determined by the compound that failed.

The results of the T.T.L.C. can determine if the Soluble Threshold Limit Concentration (S.T.L.C.) is necessary by comparing 10 times the S.T.L.C. limit to the T.T.L.C. results. A factor of ten (10) is necessary to compensate for a 1:10 dilution factor that is present in the S.T.L.C. If the T.T.L.C. results do not exceed 10 times the S.T.L.C. limit then normally no further analyses is required. For example, the cadmium results for the T.T.L.C. performed on the CdTe Solar PV-Modules was 720 mg/kg which exceeds the T.T.L.C. limit of 100 mg/kg; thus the S.T.L.C. is not needed as the material is hazardous, and with the 1:10 dilution for the S.T.L.C., the projected concentration would exceed the S.T.L.C. limit of 1.0 mg/kg. On the other hand, lets say the T.T.L.C. results where 10 mg/kg or greater, a S.T.L.C. would have to be performed since the S.T.L.C. limit for cadmium is 1.0 mg/kg and the T.T.L.C. results exceeded that by 10x.

The following is a narrative of the procedure performed.

Sierra Analytical Labs, Inc. performed two separate forms of Cadmium analysis on the "Thin-film Cadmium-Telluride (CdTe) solar PV-modules" received in April of this year. The analysis was performed in order to identify if the sample would be characterized as California Hazardous Waste. The two forms of testing are identified as the Total Threshold Limit

Concentration (T.T.L.C.) and the Soluble Threshold Limit Concentration (S.T.L.C.). The procedure and regulatory limits for these tests are documented in Title 22 of the California Code of Regulations. The analysis was performed according to E.P.A. method guidelines, by Sierra Analytical Labs, Inc. (a California Certified Environmental Laboratory).

Specifically, the sample was first put through a particle size reduction step (crushing with a standard hammer) and the material passed through a 2.00 millimeter No. 10 U.S.A. standard testing sieve. Once the particle size had been reduced and the sample mixed for homogenization, separate aliquots for each test to be performed were measured in triplicate.

The T.T.L.C. analysis is performed by putting the sample(s) through a rigorous acid digestion procedure (E.P.A. Method 3050b), to get the analyte(s) of interest in solution. The digestate is then analyzed using an Inductively Coupled Plasma – Atomic Emission Spectroscopy (ICP-AES) technique (E.P.A. 6010b). The T.T.L.C. result of the CdTe solar PV-modules was 720mg/kg, with duplicate values of 735mg/kg, and 725mg/kg. This result indicates the sample level exceeds the T.T.L.C. regulatory limit of 100mg/kg and is considered hazardous.

The S.T.L.C. analysis, which was performed on the CdTe solar PV-modules includes an extraction procedure outlined in Title 22 of the California Code of Regulations known as the Waste Extraction Test (WET). This procedure starts with a portion of the homogenized sample being placed in a pre-cleaned glass container. A Sodium Citrate buffer solution at a pH of 5.0 ± 0.10 , is then added to the sample, the sample is purged with Nitrogen gas, capped tightly, and placed on a shaker table to be agitated for a period of 48 hours. At this point the sample is filtered, and the filtrate is considered to be the WET extract. The extract is then prepared for analysis, by undergoing an acid digestion procedure (E.P.A. 3010a). The digestates from this procedure are then analyzed by ICP-AES using the protocol established in method E.P.A. 6010b (same as the T.T.L.C.). The results obtained from this analysis are the S.T.L.C. values. The S.T.L.C. result of the CdTe solar PV-modules was 2.81mg/L, with duplicate values of 2.95mg/L, and 2.90mg/L. This result indicates the sample level to above the regulatory limit of 1.0mg/L.

Based upon both the T.T.L.C. and S.T.L.C. results obtained by Sierra Analytical Labs, Inc. the CdTe solar PV-modules would be considered California Hazardous for disposal purposes.

Sincerely,

Richard K. Forsyth
Laboratory Director

STLC and TTLC Regulatory Limits¹

Inorganic Substances	STLC ² Regulatory Level, mg/L	TTLC ³ Regulatory Level, mg/kg, Wet Weight	Recommended EPA Test Method
Antimony and/or Antimony compounds	15	500	6010B/7000A
Arsenic and/or Arsenic compounds	5.0	500	6010B/7000A
Asbestos		1%	PCM/PLM
Barium and/or Barium compounds	100	⁴ 10000	6010B/7000A
Beryllium and/or Beryllium compounds	0.75	75	6010B/7000A
Cadmium and/or Cadmium compounds	1	100	6010B/7000A
Chromium (VI) compounds	5	500	6010B/7000A
Chromium and/or Chromium (III) compounds	5 ⁵	2,500	6010B/7000A
Cobalt and/or Cobalt compounds	80	8,000	6010B/7000A
Copper and/or Copper compounds	25	2,500	6010B/7000A
Fluoride salts	180	18,000	300/340.2
Lead and/or Lead compounds	5.0	1,000	6010B/7000A
Mercury and/or Mercury compounds	0.2	20	6010B/7471A
Molybdenum and/or Molybdenum compounds	350	3,500	6010B/7000A
Nickel and/or Nickel compounds	20	2,000	6010B/7000A
Selenium and/or Selenium compounds	1.0	100	6010B/7000A
Silver and/or Silver compounds	5	500	6010B/7000A
Thallium and/or Thallium compounds	7.0	700	6010B/7000A
Vanadium and/or Vanadium compounds	24	2,400	6010B/7000A
Zinc and/or Zinc compounds	250	5,000	6010B/7000A

Organic Substances	STLC Regulatory Level, mg/L	TTLIC Regulatory Level, mg/kg, Wet Weight	Recommended EPA Test Method
Aldrin	0.14	1.4	8081A
Chlordane	0.25	2.5	8081A
DDT, DDE, DDD	0.1	1.0	8081A
2,4-Dichlorophenoxyacetic acid	10	100	8151
Dieldrin	0.8	8.0	8081A
Dioxin (2,3,7,8-TCDD)	0.001	0.01	8280
Endrin	0.02	0.2	8081A
Heptachlor	0.47	4.7	8081A
Ketone	2.1	21	
Lead compounds, organic		13	DHS
Lindane	0.4	4.0	8081A
Methoxychlor	10	100	8081A
Mirex	2.1	21	8081A
Pentachlorophenol	1.7	17	8270C
Polychlorinated Biphenyls (PCBs)	5.0	50	8082
Toxaphene	0.5	5	8081A
Trichloroethylene	204	2040	8260B
2,4,5-Trichlorophenoxypropionic acid	1.0	10	8151

¹Used for California regulated hazardous waste. Source is California Code of Regulations, Title 22, Chapter 11, Article 3.

²If a substance is ten times the STLC value found in the TTLIC, the Waste Extraction Test (WET) is indicated. If any substance in the waste extract is equal to or greater than the STLC value, it is considered a hazardous toxic waste.

³If a substance in a waste is equal to or greater than the TTLIC level, it is considered a hazardous toxic waste.

⁴Excludes barium sulfate.

⁵If the soluble chromium as determined by the TCLP is less than 5 mg/L, and the soluble chromium as determined by the STLC test equals or exceeds 560 mg/L, and the waste is not otherwise identified as a RCRA hazardous waste, then the waste is a non-RCRA hazardous waste.