UNIVERSITY OF CALIFORNIA, BERKELEY RICHMOND FIELD STATION
BEST MANAGEMENT PRACTICES FOR
DISTURBANCE OF SOILS CONTAINING PYRITE CINDER FILL

Introduction

These Best Management Practices (BMPs) for managing pyrite cinder fill at the University of California, Berkeley (UC Berkeley) Richmond Field Station (RFS) have been developed to provide University staff and Contractors with information on existing conditions that could be encountered during excavation and other soil disturbance activities and to define controls Contractors and University staff must use to minimize generation of dust. It is the responsibility of Contractors and Subcontractors to develop a Health and Safety Plan (HASP) and to provide training to its employees on management of pyrite cinders. Specific recommendations for worker protection shall be provided by the Contractor's Health and Safety Officer. For University staff, a Job Safety Analysis (JSA) and training on the JSA is to be completed by the responsible department as required by the Injury and Illness Prevention Program.

Pyrite Cinders Appearance and Chemical Composition

Pyrite cinders are readily identified due to their purplish color. Pyrite cinders are usually found as a finely divided sandy, sometimes gravelly, soil. Pyrite and associated mixed sulfide minerals contain metals including iron, copper, zinc, lead, mercury and arsenic. Figure 1 shows the locations where pyrite cinders have been observed.

Pyrite Cinder Health Concerns

Workers digging in cinders may be exposed to these metals by inhaling dusts when digging in dry cinders or by ingesting cinders not washed from hands or clothes. The primary health risk posed by pyrite cinders is associated with arsenic, which is a regulated human carcinogen (cancer-causing chemical). The National Institute of Occupational Safety and Health (NIOSH) recommends that occupational exposure to carcinogens be limited to the lowest feasible concentration. Table 1 provides the analytical results of samples of pyrite cinders at RFS. Although the estimated worker exposure to arsenic during many of the maintenance activities at RFS appears to be limited, the implementation of the following two basic elements of worker protection during field work performed in the vicinity of pyrite cinder-affected soil are prudent practices that will minimize exposure:

1. Engineering Controls and Best Management Practices

a) Workers shall practice good hygiene techniques including:

- Hand-washing prior to eating drinking or smoking,

- Use of personal protective equipment (PPE) such as disposable coveralls and other equipment as outlined in the JSA or HASP and/or

- Changing clothing that has been in contact with soil where pyrite cinders are present immediately at the end of the work activity to avoid carrying cinders into personal or work vehicles and homes.

b) Dust suppression techniques shall be used during any excavation activities. All soils being excavated shall be adequately wetted by spraying water. All excavated soils shall be covered with a weighted tarp at the completion of daily activities.

c) If pyrite cinder fill or other potentially contaminated material is found, workers shall inform UC Berkeley Office of Environment, Health and Safety (EH&S) prior to performing intrusive activities. For University staff, EH&S will evaluate the potential for worker exposure to chemicals and the need to implement additional engineering controls prior to resuming work. The University reserves the right to monitor the effectiveness of BMPs and stop work when these measures are not properly followed or adequate.

d) Excavation spoils may be returned to the trench or moved to an approved stockpile location. This determination will be made by EH&S. The location(s) of pyrite cinders encountered during excavation activities at RFS should be marked on a copy of the project site plan. As-built drawings indicating pyrite cinder locations shall be supplied to EH&S. In addition, pyrite cinder backfill should be placed in the uppermost portions of backfill so that disturbance to the utilities will not occur and trench shoring will not be required if UC Berkeley should ever be required to remove pyrite cinders from the site.

2. Worker Training

Workers should receive training regarding the potential hazards associated with exposure to pyrite cinders for each work task they may need to perform. The California Occupational Safety and Health Administration's (Cal/OSHA) Hazard Communication Standard (8 CCR 5194) requires that employers inform employees about potential hazards to which they may be exposed and appropriate control measures for reducing their exposure. The standard is very specific about training for employees who may be exposed to regulated carcinogens, such as arsenic. For UC Berkeley employees, all staff performing work that results in soil disturbance should receive training on the Job Safety Analysis for the work activity. This training for existing and new employees can be provided by EH&S or another trained staff member. Training of Contractor staff is the

responsibility of the Contractor's Health and Safety Officer. The training should be of sufficient length to cover the following topics at a minimum:

- Hazards the employee may be exposed to during each work task, including, but not limited to arsenic and other chemical hazards.
- Identification of pyrite cinders.
- The estimated quantity and known locations of pyrite cinders found at RFS and the specific nature of operations which could result in exposure to chemical hazards.
- Potential health risks associated with each chemical present in pyrite cinders.
- Work and hygienic practices to be followed to reduce exposure to chemical hazards of pyrite cinders, such as engineering controls or other best management practices and use of PPE.
- Limitations of PPE.

The above training elements are also required under the Cal/OSHA standard for inorganic arsenic (8 CCR 5214).

Table 1. Analytical Results for RFS Upland Area Pyrite Cinders Soil Sampling (all results mg/kg).

Analyte	Sample ID 05060C180	Sample ID 05060C164	Sample ID 05060C112	Sample ID W. PERI-METER COMP 3	Sample ID RFSPC001	Sample ID RFSPC002	Sample ID RFSPC003	Ave.	95% UCL	TTLC	H-SSTL[(a)]
Arsenic	23	38	110	44	71	66	70	60	86	500	120
Copper	540	420	820	490	580	760	910	646	811	2,500	98,900
Lead	53	220	260	150	290	74	69	159	247	1,000	750
Mercury	3.9	0.94	0.7	2.1	1.1	0.99	0.88	1.52	2.54	20	494
Zinc	130	230	420	150	350	240	260	254	346	5,000	1E+5

Sample ID locations:

05060C180 - One discrete soil sample collected on June 6, 2005 from a small excavation of a tree stump, parking lot east of Bldg. 180.
05060C164 - One discrete soil sample collected on June 6, 2005 from a hand shovel excavation for a water line north side of Bldg. 164.
05060C112 - One discrete soil sample collected on June 6, 2005 from area near former transformer pad north of Bldg. 112 (by RFSPC001).
W. PERI-METER COMP 3 – Composite sample collected November 18, 2005 along the northwest perimeter of Building 155 where cinders were found in near-surface soils next to the foundation. The composited sample consisted of three discrete subsamples collected at various depths between 0 and 12 inches deep from 17 sample locations. This sample probably also contained a small percentage of non-cinder soil, but was predominantly pyrite cinders.
RFSPC001 - One discrete soil sample collected on July 11, 2006 from area near former transformer pad north of B112.
RFSPC002 - One discrete soil sample collected on July 11, 2006 from northeast corner of Crow and Owl intersection dig.
RFSPC003 - One discrete soil sample collected on July 11, 2006 from northeast corner of North field (north of B167).

Notes:

H-SSTL- Human health site-specific target level
TTLC - Total threshold limit concentration
UCL - Upper confidence level

(a) Construction Worker Receptor Human Site Specific Target Level (Human Health Site-Specific Target Level) as reported in Human Health and Ecological Tiered Risk Evaluation University of California, Berkeley, Richmond Field Station/Stege Marsh Richmond, California, URS, November 2001 Table 3-13.