QUARTERLY PROGRESS REPORT

January 1, 2001 - March 31, 2001

PROJECT TITLE: Environmental Impacts of Lead Pellets at Shooting Ranges & Arsenical Herbicides on Golf Courses in Florida

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COMPLETEION DATE: 3/31/2001 **PHONE: 352-392-1951**

WORK ACCOMPLISHED DURING THIS REPORTING PERIOD:

1. Based on the project milestones (Table 1) and to help the development of best management practices (BMPs), additional soil and plant/water samples were collected from a shooting range in south Florida.
2. Soil samples were characterized in laboratory. Leachability tests were conducted using EPA method 1311 (TCLP) and method 1312 (SPLP). Plant samples were also analyzed.
3. Chemical fractionations of Pb in soil samples with high Pb contamination from several shooting ranges were conducted using sequent extraction procedure.
4. Lead mineralogical properties in weathered materials of bullets were compared with those in soils using X-ray diffraction (XRD) and scanning electron microscopy (SEM-EDX) techniques.
5. Weathering processes of Pb pellets were simulated in laboratory tests.
6. Leaching characteristics of berm soils with high Pb contamination were identified using rainwater and water tests.
7. Preparation of Annual Report

SIGNIFICANT RESULTS ACHIEVED:

1. The extent of lead contamination in soils of shooting range was characterized in the order of pistol > rifle > shotgun ranges from the same site. Lead concentration was elevated in 75~150 m from the firing point for shotgun range, and berm soils for pistol and rifle range.
2. Lead and P concentrations in grasses growing on the range were positively correlated with soil Pb concentrations. Concentrations of nutrients, such as Fe, Ca, Mn, Zn, and K, were higher in grasses growing soils with low Pb than those with high Pb concentrations.
3. Lead was predominantly found in carbonate form in most of berm soils. Different Pb forms were observed in berm soils from rifle and pistol ranges even from the same site.
4. As expected, low pH, high temperature, high moisture, and strong ligand (EDTA) accelerated the weathering of Pb pellets.
5. Acid rain enhanced downward migration of weathered materials from pellet and increased Pb leaching from berm soils.

6. A sequential two-step weathering mechanism may account for the weathering process of pellets, i.e. oxidation of pellets followed by enhanced dissolution of lead second minerals.
7. XRD and SEM-EDX analyses showed lead minerals in bullet weathering materials were different from those in soils.

Table 1. Project Milestones

Tasks	**1st quarter**	**2nd quarter**	**3rd quarter**	**4th quarter**
Sample Collection	⊗	⊗		
Sample analysis	⊗	⊗	⊗	
Leachability test			⊗	⊗
Fractionation test			⊗	⊗
Quarterly report	⊗	⊗	⊗	⊗
Annual report				⊗

⊗: Task that has been accomplished according to the originally proposed timetable.

×: Task need to be accomplished in accordance with the proposal.

INFORMATION DISSEMINATION ACTIVITIES:

- A paper titled "Lead Contamination in Florida Soils: Determination and Interpretation" was submitted Chen et al., to the 93^{ed} annual meetings of American Society of Agronomy, Crop Science Society of America, and Soil Science Society of America at Charlatte, NC, October 21-25, 2001.
- A manuscript titled "Lead and As concentrations in a shooting range in Central Florida" was submitted by Chen et al., for publishing at the Soil and Crop Science Society of Florida Proc., Vol. 60, 2001"

TAG MEETINGS:

- The research team is contacting the technical advisory group members for this project and scheduling a half-day TAG meeting at the University of Florida, Gainesville, FL. based on the time availability of all TAG members.

WORKS TO BE ACCOMPLISHED DURING THE NEXT THREE MONTHS:

- Leachability and phytoavailability of lead in contaminated shooting range soils.
- Lab tests for the effectiveness of phosphate rock on Pb immobilization in shooting soils.
- XRD and SEM-EDX analyses need to be conducted for bullets and soil samples from shooting ranges in south Florida to confirm our hypothesis that more hydrocerussite tend to be formed in wet environments.