

## **Fiber Rolls as a Tool for Re-Vegetation of Oil-Brine Contaminated Watersheds**

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**Title:** Fiber rolls as a tool for re-vegetation of oil-brine contaminated watersheds

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**Project Amount:** \$70,740

**Research Category:** Brine Scar Remediation

### **Description:**

Historic oil brine scars (sites that repeatedly received produced water) are extremely difficult to remediate because these sites possess degraded, highly saline soils, erosion damage, little or no plant cover and an altered microbial community. Ecosystem function is diminished as a result of these impacts.

We are evaluating the contribution of fiber rolls to restoration of a historic oil brine scar in south Arkansas. Four treatments (natural attenuation, standard soil reclamation techniques, fiber rolls, and soil reclamation with fiber rolls) have been applied to plots within the site. Fiber rolls are tubes formed with a geotextile material and filled with organic fiber, mycorrhizal fungal inoculum, bacterial inoculum (soil) and salt-tolerant plants. Consequently, fiber rolls may serve a variety of ecological functions including primary productivity, filtering of sediments and moisture and nutrient retention. Rolls also serve as a source vegetative growth, seeds, microbial spores, organic matter and nutrients.

### **Objective(s) of the Research Project:**

Our primary objective is to examine the utility of fiber rolls as an effective, inexpensive, and easy-to-use remediation tool at oil brine spill sites. Established fiber rolls and adjacent brine affected plots will be examined to determine the:

- 1) Structural integrity and ability of fiber rolls to withstand periodic flooding/water flow,
- 2) Amount of sediment accretion behind fiber rolls,
- 3) Survival, extent and type of vegetative growth in fiber rolls, and
- 4) Type and extent of vegetation expansion from fiber rolls onto adjacent soils.

Soil reclamation as a result of treatments will also be assessed through measurements of electrical conductivity, sodium adsorption ratio, and cation exchange capacity.

### **Progress Summary/Accomplishments:**

In August and September 2005, plant production, fungal inoculation of seedlings and fiber roll construction were completed in preparation of applying treatments on the brine scar. Preliminary analysis of soils indicated high salt (2096 ppm), sodium (6450 ppm), calcium (2055 ppm) and magnesium (420 ppm) concentrations. Treatments were applied during the first quarter of the project (November and December, 2005).

*Plant production:* Germination and seedling growth occurred under 24 hr fluorescent lighting in a laboratory. Seeds of *Distichlis spicata* (L.) Greene (Saltgrass), *Cynodon dactylon* (L.) Pers. (Bermudagrass), *Panicum virgatum* L. (Switchgrass), *Trifolium repens* L. (White clover) were sown into pots (LxWxHt: 5.2x5.2x7.7 cm) containing commercial potting mix (Promix BX; Premier Brands, Inc.). Percent germination of *Distichlis* was low. Consequently, *Distichlis* was not used in this study. Fungi were augmented by 'watering in' a total of ca. 5 cm<sup>3</sup> of inoculum (described below) when seedlings were ca 3 weeks old. Seedlings were fertilized once with full strength Miracle Gro (N-P-K: 15-30-15; Stern's Miracle Gro Products, Inc.). At the time of planting into the fiber rolls, seedlings were ca. 11 weeks old. In addition, inoculated *Myrica cerifera* L. (Wax myrtle, in nursery liners) and *Baccharis halimifolia* L. (Groundsel), obtained from the field and grown in 1 gal. containers) were also prepared for transplantation into the fiber rolls.

*Fungal inoculum:* Trap cultures were used to produce the fungal inoculum. *Sorghum vulgare* var. *sudanense* (Sudan grass) served as a host plant for the trap cultures because it associates with a wide range of mycorrhizal fungi, and exhibits rapid growth and an extensive root system. Trap cultures were initiated by mixing roots and associated soil from a field collection with autoclaved coarse sand. The field collection for this study was from an oil well site in Ranger, TX. The inoculum had shown some success in enhancing plant establishment on brine spill sites in Louisiana. By subdividing cultures and using the subdivisions to inoculate new cultures, a sufficient quantity of inoculum was accumulated. Fungal inoculum consisted of dried Sudan grass roots and any sand adhering to the roots.

*Fiber roll construction:* Rolls were constructed from two layers of jute mesh erosion control matting (water assumption capacity 450% of material weight). Seams were sown with polyester thread (70 kg resistance strength) using a bag closer. Roll size is 2 m length x 0.35 m diameter. Rolls were filled with compacted hay and sawdust with horse manure (bedding from horse stalls).

*Treatment application:* Twelve 36x4 m plots were delineated on the site. Each plot was divided into three 12x4 m subplots. Plots were aligned downslope. One of four treatments (natural attenuation, standard soil reclamation techniques, fiber rolls, and soil reclamation with fiber rolls) was assigned randomly to each plot (n=3). Plots with natural attenuation were not disturbed. Plots receiving standard soil reclamation techniques were disced using an all terrain vehicle (the soils could not support the weight of a tractor). Hay (equivalent to 278 bales/hectare) and chicken litter (to a depth of ca. 1 cm) were added to the plots and disced a second time. Chicken litter contained rice hulls. Litter analysis indicated N-P-K: 2.3%, 2.2% and 2.3%, respectively. On appropriate plots, fiber rolls were installed in pairs, two pairs per subplot on 17 November 2005 (4 roll/subplot x 3

subplots = 12 rolls/plot; Figs. 1-2). Rolls were aligned perpendicular to the slope to trap sediments. Two 2"x4"x3' wooden stakes were driven through each roll into the soil to anchor rolls in place. Seedlings and shrubs were transplanted into the fiber rolls after roll installation. Each roll received spaced relatively evenly: two Wax myrtle, one Groundsel, 2 White clover, 2 Switchgrass and 2 Bermudagrass plants. Fiber rolls were partially covered with chicken wire to reduce herbivory by deer. None of the species were expected to grow significantly through late fall and winter. Therefore, two weeks after planting, *Lolium multiflorum* (Rygrass; equivalent to 244 kg/ha) seeds were sown on the surface of the rolls.

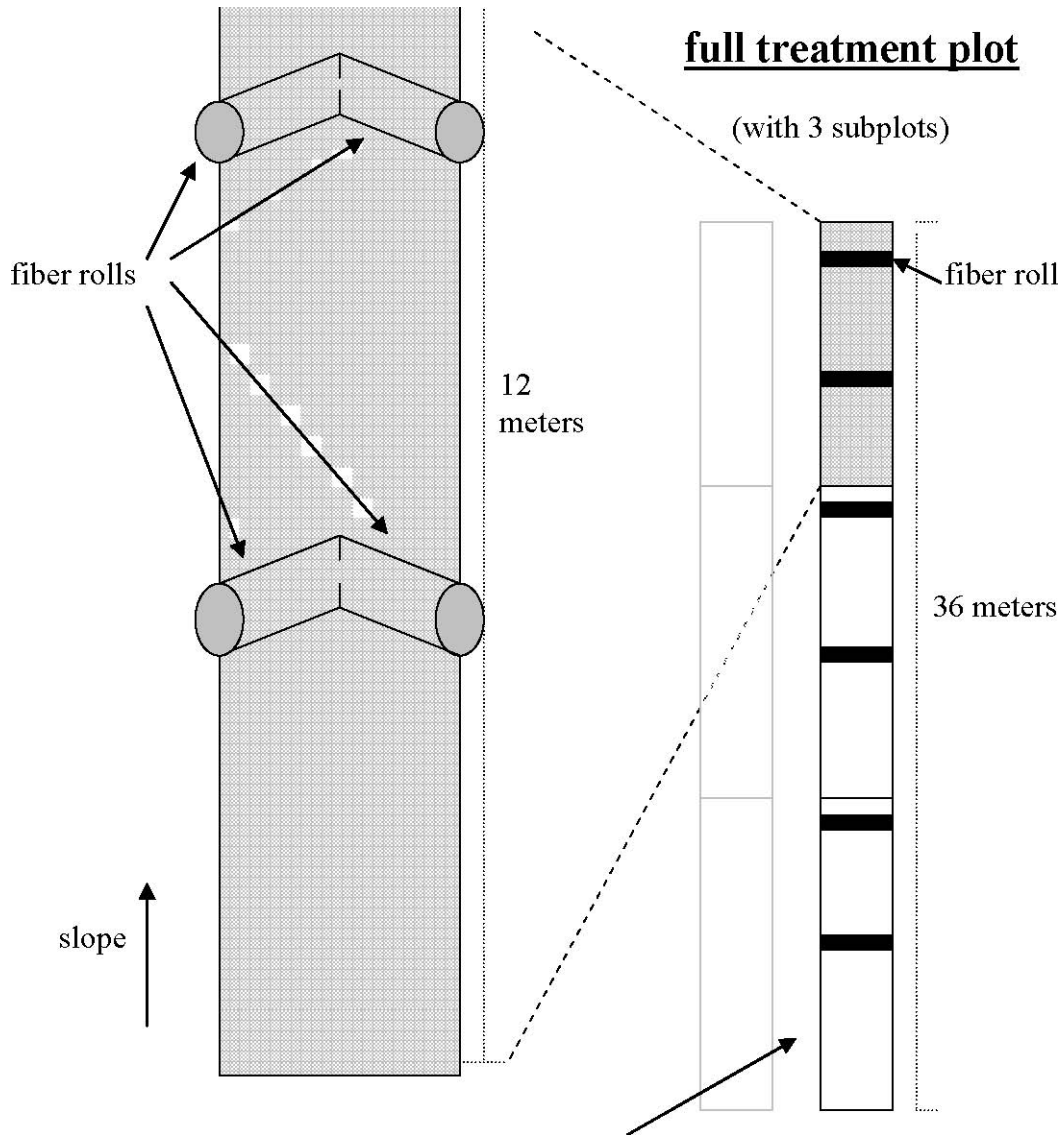


Figure 1. Layout of fiber rolls installed on an historic brine scar in south Arkansas to assess the feasibility of rolls to initiate remediation.



Figure2. Fiber rolls installed and partially planted on an historic brine scar in south Arkansas.

### **Publications/Presentations**

Abstract for an oral presentation submitted to the 3rd National Conference and EXPO on Coastal and Estuarine Habitat Restoration, New Orleans, LA, December 9-13, 2006.

### **Future Activities**

Future activities will involve assessing contribution of fiber rolls to remediation. Assessment will include roll integrity, plant survival, cover and spread to soils adjacent to the rolls, plant cover on plots between rolls, sediment accretion on the upslope side of the rolls, and changes in soil chemistry and composition.

**Supplemental Keywords:** Brine restoration; Historic Brine Scar; Fiber Roll; Bioremediation