Flow-Through Bioreactor for the In Situ Assessment of Remediation Strategies in Vadose and Saturated Zones

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Pollution of subsurface waters and soils are a common problem across the United States and the world. However, a growing body of evidence suggests that laboratory studies, particularly those involving bioremediation, do not accurately mimic what occurs in the field. Laboratory scale treatability studies are often performed to determine the efficacy of various in situ treatments for these sites and pollutants.

These studies usually involve removal of sediments and/or groundwater and subjecting these materials to treatments in the lab, followed by an assessment of the likelihood of these treatments to achieve cleanup objectives in the field. Obtaining samples for use in the lab often causes stress to the biota in these samples, which results in shifts in the microbial community. Subsequently, data generated from these altered communities may not be predictive for the field site. A device that performs laboratory scale experiments, in the field, is a way to overcome these laboratory shortcomings.

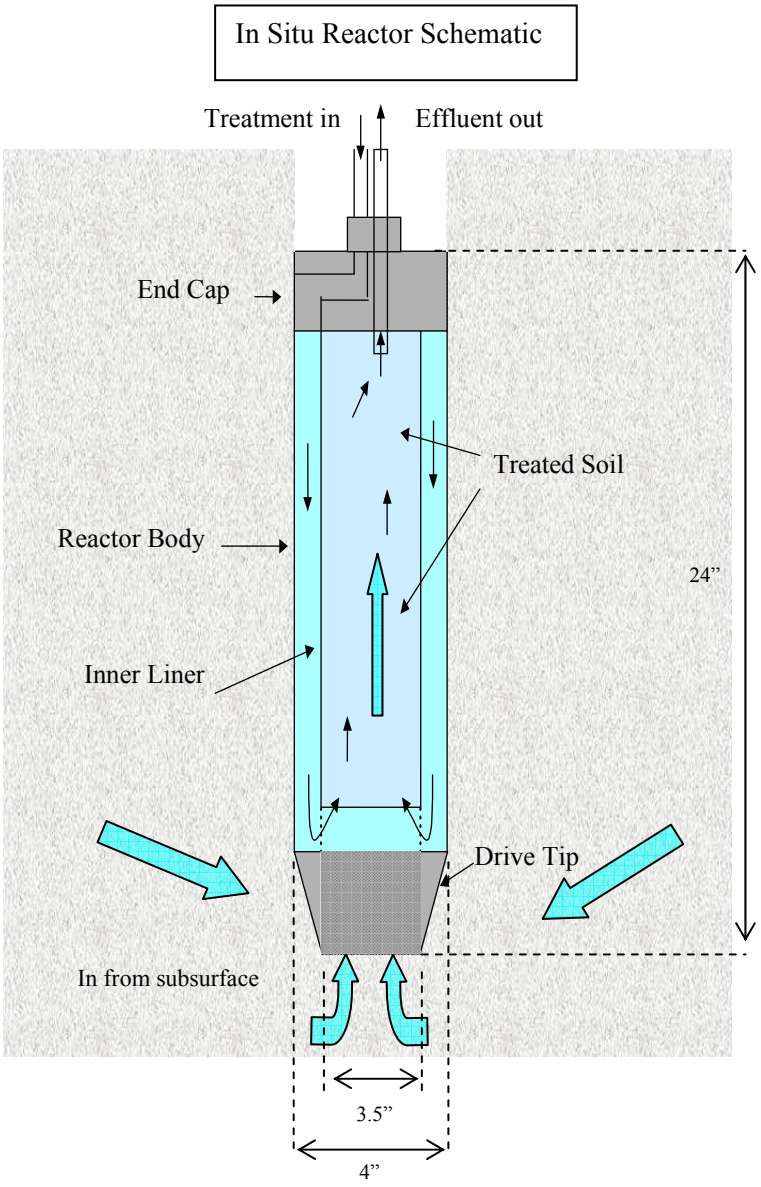


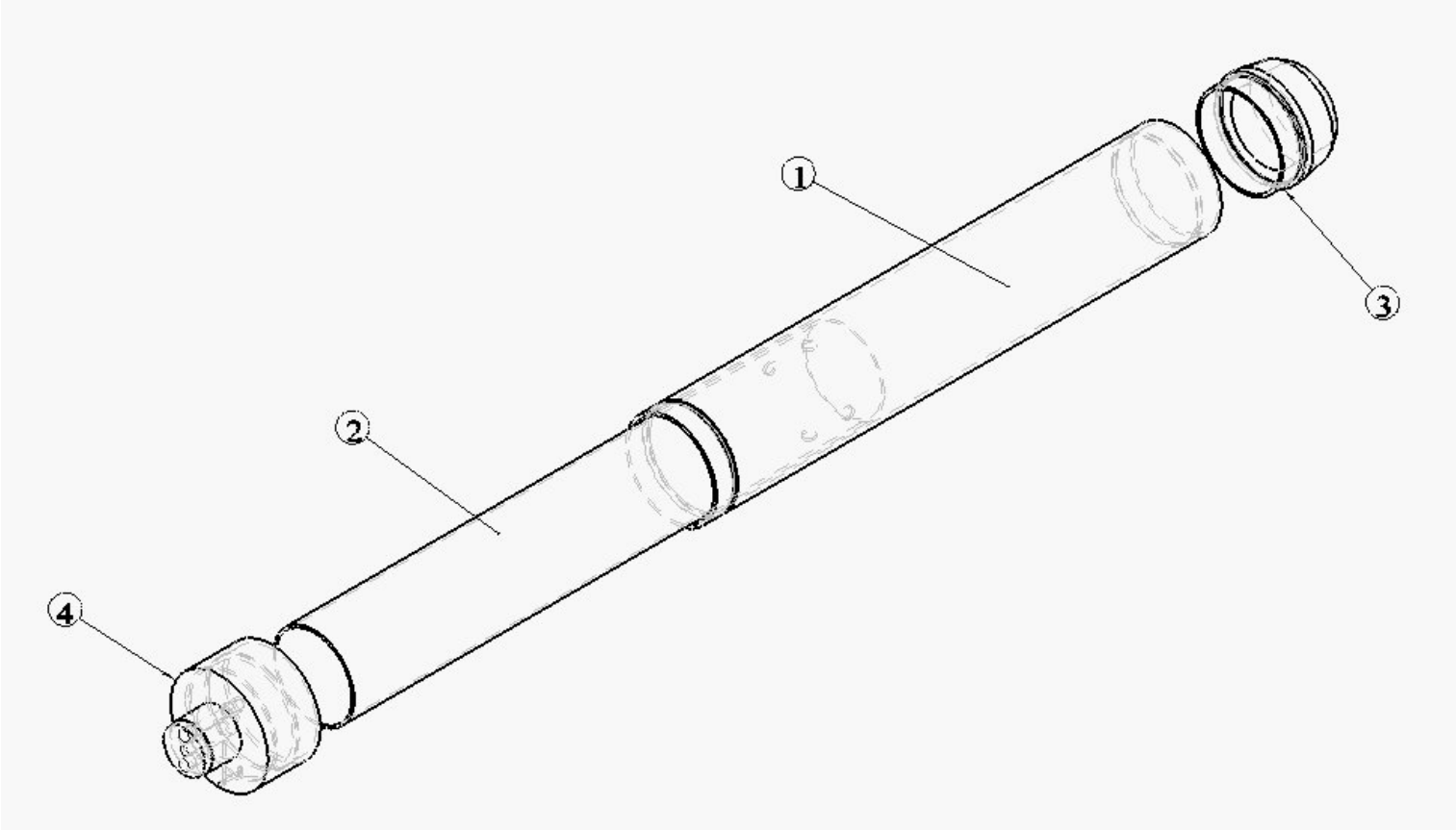
Figure 1. In situ treatments can be evaluated in the field using this flow-through bioreactor.

We have designed and begun development of a device that will operate as an in situ, flow through, bioreactor capable of being deployed using existing boring and sampling technology and suitable for use in the vadose and saturated zones. The device can be monitored and experimental conditions adjusted from the surface. The device can be removed with the core material intact for further assessment. Amendments can be added and sampling can be performed in either a continuous or batch configuration. This device will improve the accuracy of treatability studies and enable researchers to perform innovative experiments in the field.

Cost/Benefit

In situ reactors can be installed at a field site and multiple treatments can be tested for little more than the cost of obtaining soil and water samples. Moreover, in situ reactors cause little disruption to the soil matrix and little or no introduction of exogenous contaminants.

Operation: The ISB can be operated in one of three modes. Typically it is operated in the up flow mode. In this mode, the extraction will be roughly 10-times the treatment addition, approximating a 10-fold dilution in the field. The flow path may easily be reversed to create a downward flow for situations requiring a flow of pure amendment additions. In this down flow mode, the captured soil core comes into contact with 100% of the added treatment, with little or no influence from the groundwater and gases in the surrounding formation. Finally, we can operate in a pulsed mode, where the flows are added and held, subtracted and held, etc. This can be performed where extremely long contact times of the mobile phase with the captured soil core are necessary.



This figure is an illustration of the actual FTISR with the associated AMS part numbers.

Parts can be found in the AMS parts catalog unless otherwise noted.

1. Reactor Body # 428.28 (modified to 24”)
2. Inner Liner (used number 910.01 2.75” by 24” SST Liner
3. Drive Tip # 428.20 (modified)
4. End Cap # 428.15 modified

Custom Viton gaskets not depicted.