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Weber et al.

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(54) **METHOD FOR REMEDIATING POLYFLUOROCARBON-CONTAMINATED SOIL**

(71) Applicants: **Queen's University at Kingston,**

(30) Foreign Application Priority Data

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B09C 1/08 (2006.01)

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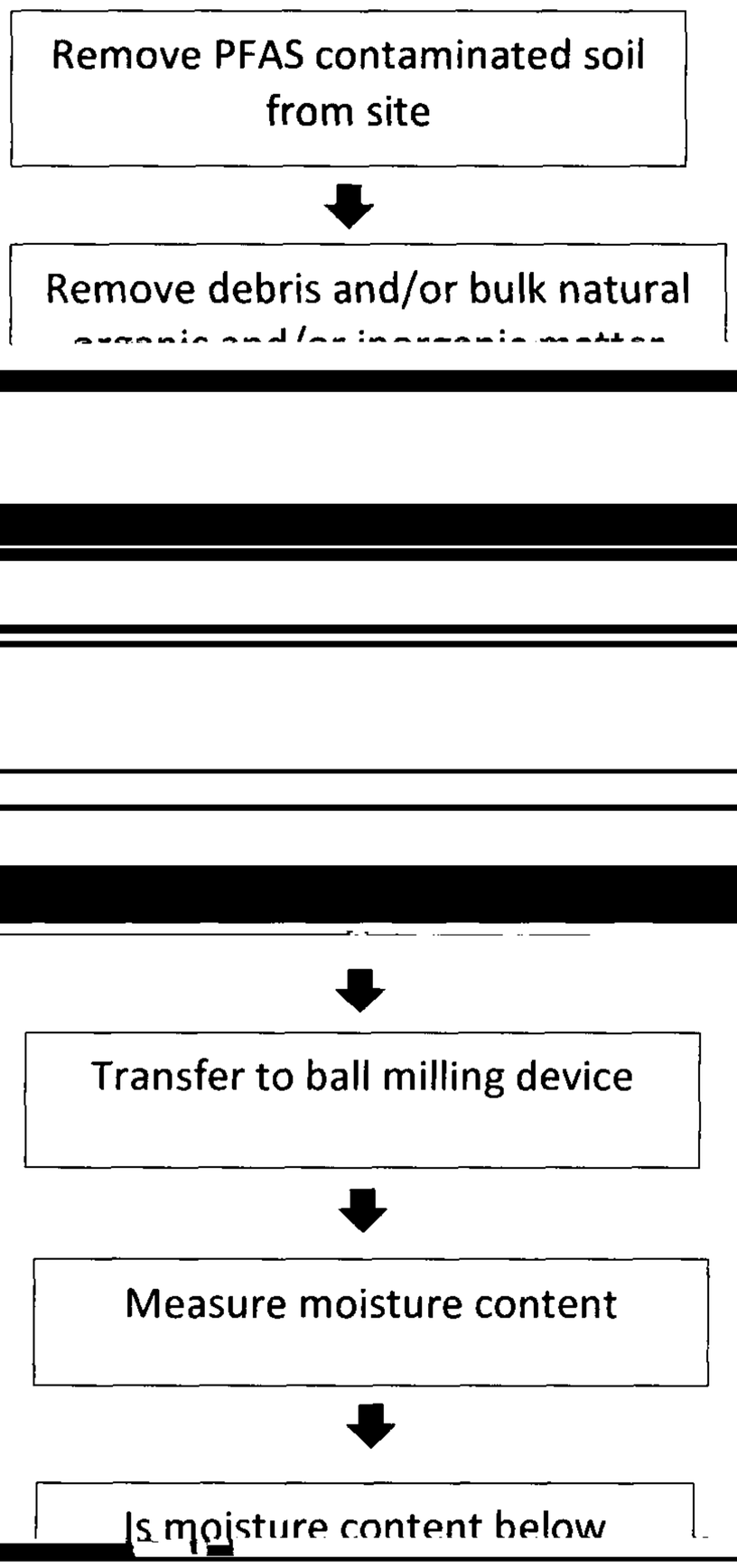
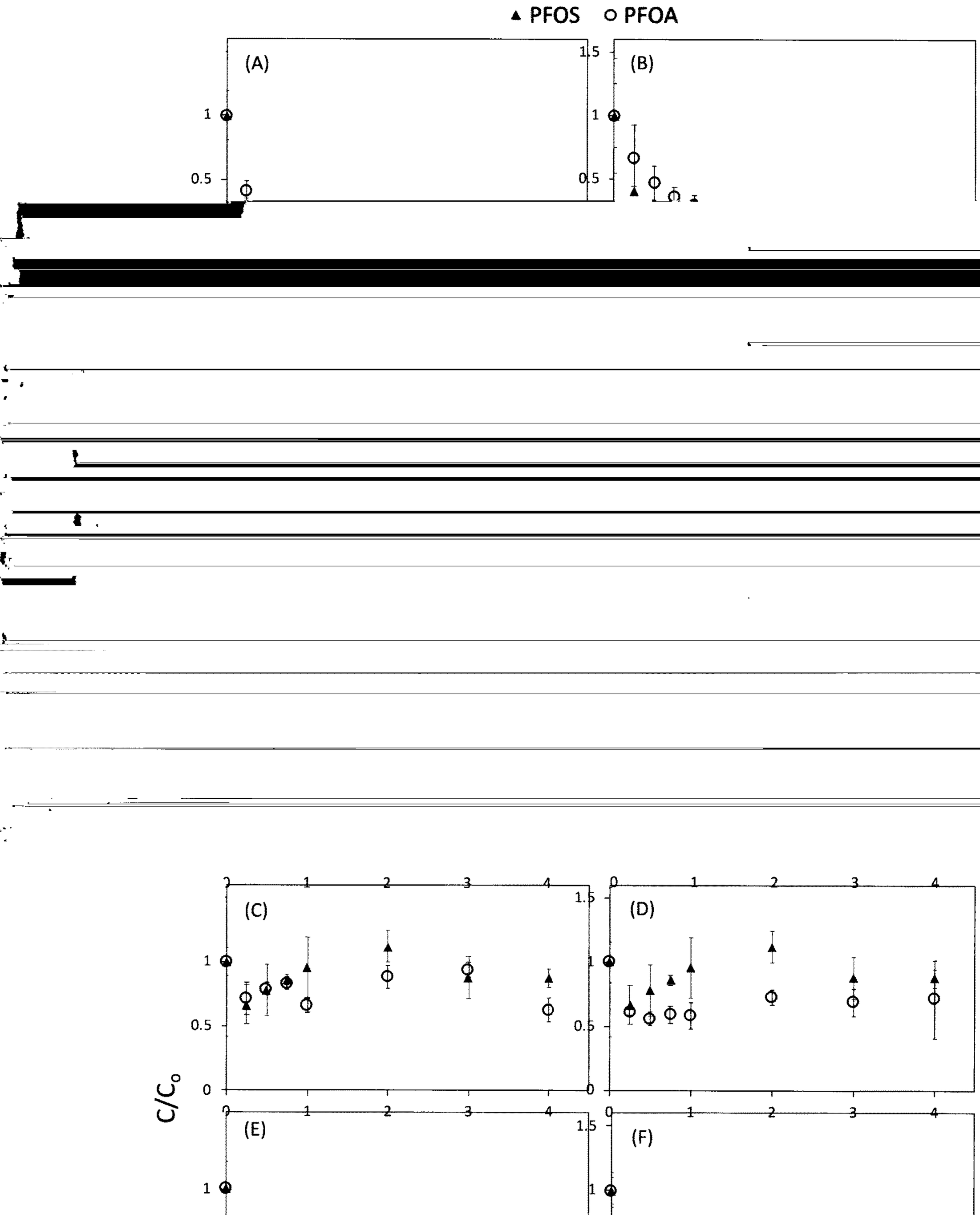
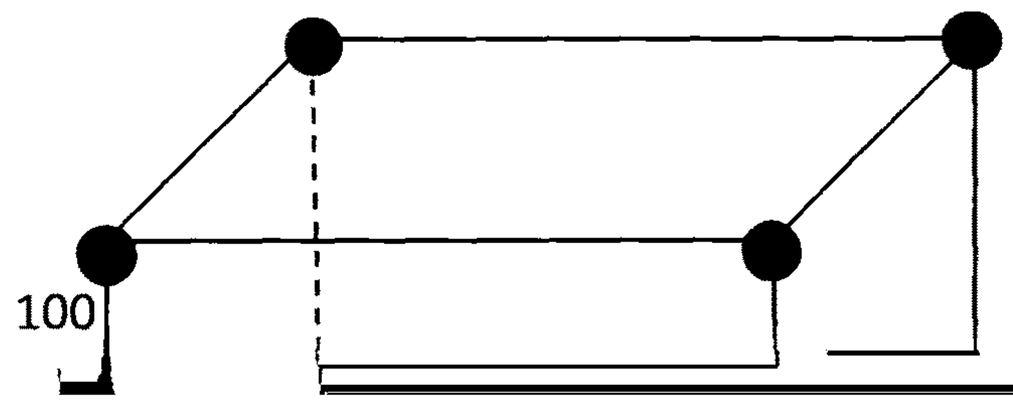

Remove PFAS contaminated soil from site
Remove debris and/or bulk natural
Transfer to ball milling device
Measure moisture content
Is moisture content below
Use drying techniques


▲ PFOS ○ PFOA
(A)
(B)
(C)
(D)
(E)
(F)
C/C0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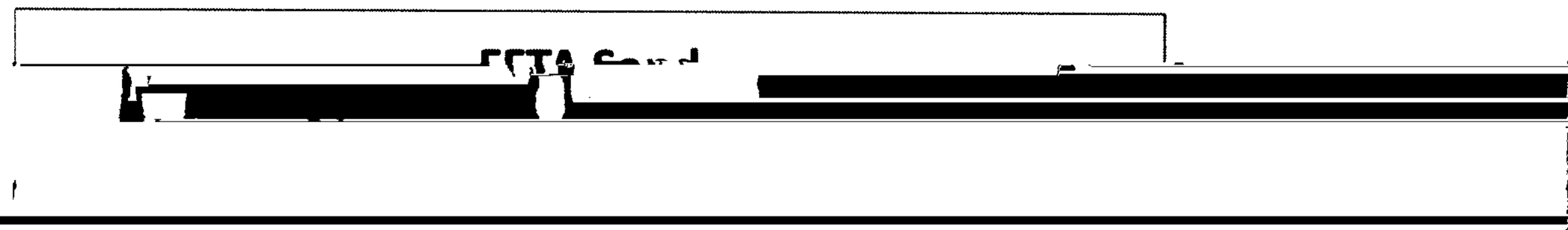

METHOD FOR REMEDIATING POLYFLUOROCARBON-CONTAMINATED SOIL

RELATED APPLICATION

This application claims the benefit of the filing date of

2019, the contents of which are incorporated herein by

the liver and kidneys. Since these compounds are lipophobic, they do not enter fatty-tissues the way many other organic contaminants may.

PEAS impacted soil is a continuous source of contamination to groundwater, which threatens supplies of drinking water as well as ecosystems. Unfortunately, options for treating or remediating PFAS-contaminated sites are limited.

able for PFAS-contaminated soil include encapsulation,

that the level of PFAS contamination in the soil is less than

per sulphate, phosphorus pentoxide, potassium hydroxide,

EMBODIMENTS

Methods for remediating soil that is contaminated with

nation thereof. In one embodiment, soil is allowed to air dry.

If the hydration level is above a threshold level, the PFAS-contaminated soil is first dried in, or outside of, the ball milling device. Drying can be done by milling the

removed from the ball mill and, if drying agent was used, optionally the drying agent is separated from the treated soil.

Although not wishing to be bound by theory, the inventors

factorial experimental design, presenting the mass of sand (g), mass of KOH (g) and hydration level (%) on the x, y and z axes, respectively.

suggest that ball milling breaks up PFAS compounds and forms compounds, atoms, and/or ions that are less hazardous. HPLC-MS/MS (e.g., triple quadrupole MS) may be used to confirm the absence of PFAS compounds in

Referring to FIG. **4**, a graph is shown to compare results of the absence and presence of KOH as a co-milling reagent in remediating PFAS spiked sand. It was evaluated without KOH pellets and a high level (10 g) of KOH pellets. KOH

used by (Van De Ven and Mumford 2018; Yee, Fein, and Daughney 2000) to remove impurities and fines. The resulting clean sand was dried at 60° C. for 48 hours. Sand was

PFAS-contaminated soil samples as described above were remediated using the long roll jar mill. FIGS. **6** and **7**A, **7**B show the results.

solutions made from reagent grade PFOS (97%, CAS #1763-23-1) and PFOA (98%, CAS #335-67-1) purchased

Example 5. Analytical Methods

Solid Sample Extraction

PFOA concentrations were reduced by 98% and 99%

Initial sand and sediment samples were extracted in basic

until 11 minutes and the system was given 4 minutes adjustment buffer (TISAB)(available from Fisher Scientific)

post-run to re-equilibrate the mobile phase and pressure was added. A calibrated fluoride ion specific electrode (ISE)

TABLE 3-continued

Destruction percentages for FFTA sands and clays after 6 hours of milling

Media	PFOS	PFOSA	PFHxA	PFPeA	PFBA	PFHxS
S3	69% ± 12%	x	x	x	x	x
C1	84% ± 5%	x	<QL by 1 hr	x	x	NO DESTRUCTION
C2	96% ± 1%	x	<QL by 4 hr	<QL by 1 hr	<QL by 1 hr	<QL by 6 hr
C3	69% ± 1%	x	x	<QL by 1 hr	X	x

x - Not detected in sample

PFOS destruction percentages and fluoride recovery

(PFUnA), fluorotelomer and fluorotelomer sulfonate (FTS).

11. The method of claim **1**, wherein the PFAS-contami-

nated soil comprises bulk natural inorganic matter, bulk crete, asphalt, or granular activated carbon materials.

24. A method for remediating per- and polyfluoroalkyl substances (PFAS)-contaminated soil, comprising:

disposing PFAS-contaminated soil into a ball mill;

disposing a plurality of milling balls in the ball mill; and

operating the ball mill until a specified PFAS contamination target level is achieved, wherein the remediation is conducted in the absence of a hydroxide base.

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