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( )

(p < 0.01)

pH

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(Virkyute *et al.*, 2002)

(Reddy and

(Giachetti and

.Cameselle, 2009)

.Sebastiani, 2006)

(DC)

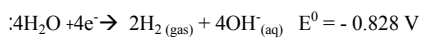
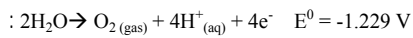
(Virkyute *et al.*, 2002)

(Giannis *et al.*,

.2007)

(Acar and Alshwabkeh, 1993)

(Reddy and Cameselle, 2009)



°C ) pH

(

.(Lear *et al.*, 2004)

(Lear *et*

*al.*, 2004; Lear *et al.*, 2007)

(Acar and Alshwabkeh, 1993; Reddy and

(2004) Luo *et al.*

(Wang *et al.*, 2009)

.Cameselle, 2009)

pH

.(Wick *et al.*, 2007)

.(Wang *et al.*, 2009)

.(Brookes, 1995)

pH

.(Brookes, 1995)

(Lear *et al.*, 2004)

(Lear *et al.*, (PCP)

pH

2007)

.(Reddy and Cameselle, 2009)

pH

pH

pH

(Sparks, 1996)

(Richards *et al.*, 1998)

( )

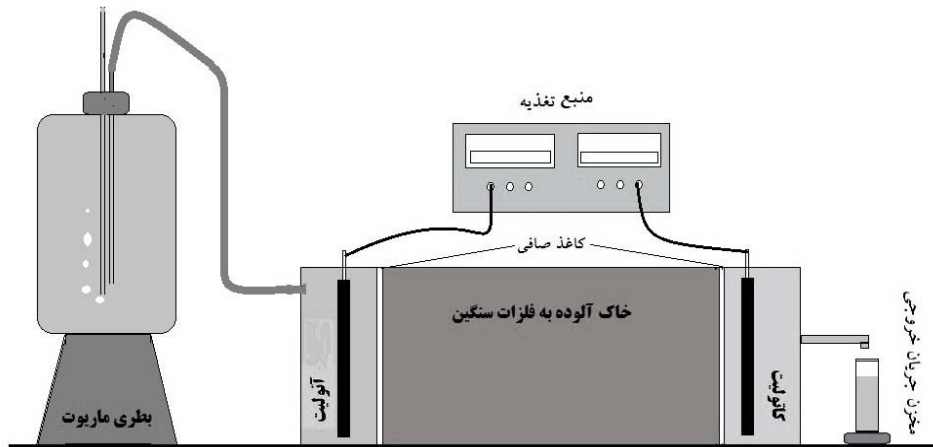
کادمیوم	نیکل	سرب	روی	رطوبت	pH عصاره	EC عصاره	کربنات	ماده آلی	شن	سیلت	رس
			غلظت فلزات سنگین قابل استخراج یا اسید	اشباع	اشباع	اشباع	کلسیم	(%)	(%)	(%)	(%)
			نیتریک چهار نرمال (mg kg <sup>-1</sup> )	(%)		(dS m <sup>-1</sup> )	معادل (%)				
۱۷/۴۶	۸۳/۰۶	۳۹۰۹/۰۷	۵۷۷۸/۰۰	۳۸/۸۸	۸/۲	۱/۴۳	۱۲/۷	۰/۸۶	۴۴	۲۸	۲۸

× ×

)

(

(Reddy and Chinthamreddy, 2003)



( )

Sigmaplot 11.0

)

× ×

( /

: pH

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pH

pH (p < 0.01)

pH

pH ( )

pH

H<sup>+</sup>

(Metrohm 744)

pH

pH

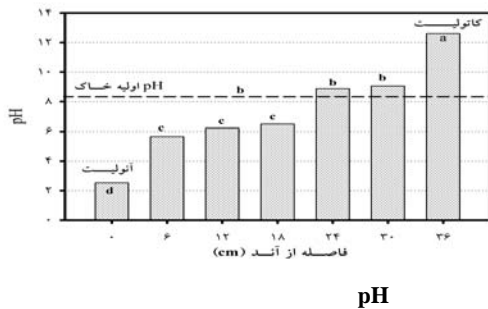
OH<sup>-</sup>

(Acar and Alshwabkeh, 1993; Reddy and

pH .Cameselle, 2009)

(Richards *et al.*, 1998)

(Shimudzu 670 )



(SMBC)

(Vance *et al.*,

Extraction-Fumigation (EF)

.1978)

( )

(66.7 mM K<sub>2</sub>Cr<sub>2</sub>O<sub>7</sub>)

Biomass C = 2.64 ± 0.060 (E<sub>c</sub>)

( )

$$E_c = C_F - C_{nF}$$

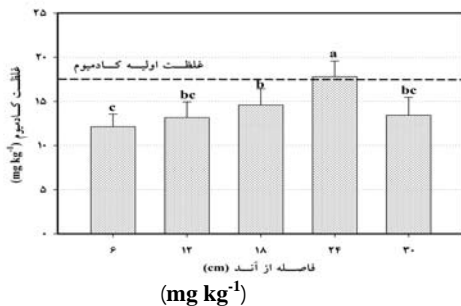
E<sub>c</sub>

C<sub>F</sub>

C<sub>nF</sub>

(Vance *et al.*, 1978)

(Cang *et al.*, 2009)

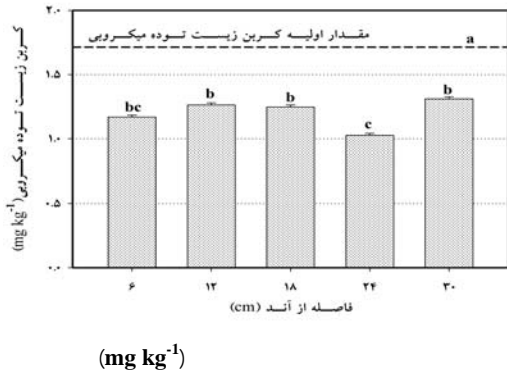


(C<sub>mic</sub>/C<sub>org</sub>)

(Shukurova *et al.*, 2006)

SPSS 16.0

( )



(mg kg<sup>-1</sup>)

(Oliveira and Pampulha, 2006)

(Shukurova *et al.*, 2006; Vance *et al.*, 1978; Vásquez-Murrieta *et al.*, 2006)

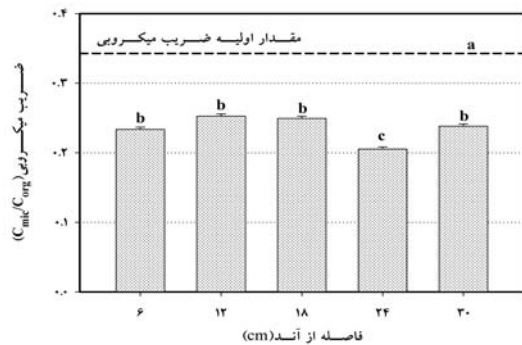
:

( )

(SOC)

(Cang (Chen *et al.*, 2006)

*et al.*, 2009)



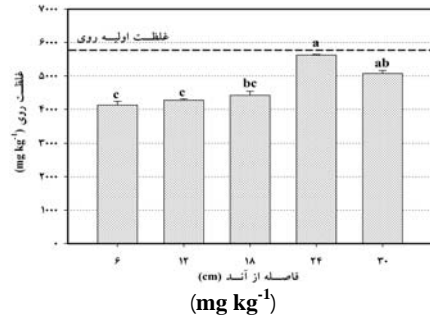
(C<sub>micro</sub>/C<sub>soil</sub>)

(Acar and Alshwabkeh, 1993)

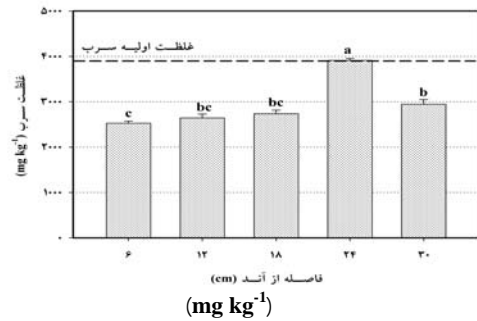
pH

( )

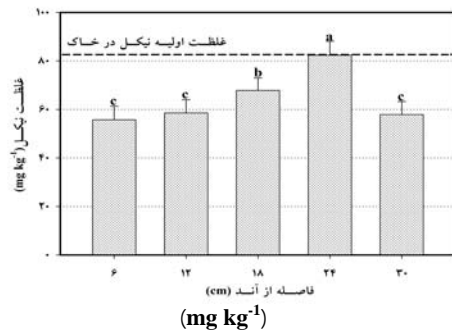
( )



(mg kg<sup>-1</sup>)



(mg kg<sup>-1</sup>)



(mg kg<sup>-1</sup>)

( )

$(C_{mic}/C_{org})$

pH

pH (Lear *et al.*, 2007)

pH (Mikanova, 2006; Shukurova *et al.*, 2006; Vásquez-Murrieta *et al.*, 2006)

pH ( $C_{mic}$ )

pH ( $C_{org}$ )

(Mikanova, 2006)

$CO_2$

(Khan and Scullion, 2007)

pH

pH (Cang *et al.*, 2009; Lear *et al.*, 2004; Lear *et al.*, 2007; Wang *et al.*, 2009)

pH (Mikanova, 2006; Shukurova *et al.*, 2006; Lear *et al.*, 2007)

(Brookes, 1995)

pH (Lear *et al.*, 2004; Lear *et al.*, 2007)

## REFERENCES

- Acar, Y.B. and Alshwabkeh, A. (1993). Principles of electrokinetic remediation. *Environmental Science and Technology*, 27(13), 2638-2647.
- Brookes, P.C. (1995). The use of microbial parameters in monitoring soil pollution by heavy metals. *Biology and Fertility of Soils*, 19, 269-279.
- Cang, L., Zhou, D.M., Wang, Q.Y. and Wu, D.Y. (2009). Effects of electrokinetic treatment of a heavy metal contaminated soil on soil enzyme activities. *Journal of hazardous Materials*, 172, 1602-1607.
- Chen, X.J., Shen, Z.M., Lei, Y.M., Zheng, S.S., Ju, B.X. and Wang, W.H. (2006). Effect of electrokinetic on bioavailability of soil nutrients. *Soil Science*, 171(8), 638-647.
- Giachetti, G. and Sebastiani, L. (2006). Metal accumulation in poplar plant grown with industrial wastes. *Chemosphere*, 64, 446-454.
- Giannis, A., Gidarakos, E. and Skouta, A. (2007). Application of sodium dodecyl sulfate and humic acid as surfactants on electrokinetic remediation of cadmium-contaminated soil. *Desalination*, 211, 249-260.
- Khan, M. and Scullion, J. (2007). Effect of soil on

- microbial responses to metal contamination. *Environmental Pollution*, 110, 115-125.
- Lear, G., Harbottle, M.J., Sills, G., Knowles, C.J., Semple, K.T. and Thompson, I.P. (2007). Impact of electrokinetic remediation on microbial communities within PCP contaminated soil. *Environmental Pollution*, 146, 139-146.
- Lear, G., Harbottle, M.J., Gast, C.J., Jackman, S.A., Knowles, C.J., Sills, G.C. and Thompson, I.P. (2004). The effect of electrokinetics on soil microbial communities. *Soil Biology and Biochemistry*, 36, 1751-1760.
- Luo, Q.S., Zhang, X.H., Wang, H., and Qian, Y. (2004). The migration and its mechanism of phenolic contaminants in soil by electrokinetics. *China Environmental Science*, 24(2), 134-138.
- Mikanova, O. (2006). Effects of heavy metals on some soil biological parameters. *Journal of Geochemical Exploration*, 88, 220-223.
- Oliveira, A., and Pampulha, M.E. (2006). Effects of long-term heavy metal contamination on soil microbial characteristics. *Journal of Bioscience and Bioengineering*, 102(3), 157-161.
- Reddy, K.R., and Cameselle, C. (2009). *Electrochemical remediation technologies for polluted soils, sediments and groundwater*. New York, John Wiley and Sons.
- Reddy, K.R., and Chinthamreddy, S. (2003). Sequentially enhanced electrokinetic remediation of heavy metals in low buffering clayey soils. *Journal of Geotechnical and Geoenvironmental Engineering*, 129 (3), 263-277.
- Richards, B.K., Steenhuis, T.S., Peverly, J.H., and McBride, M.B. (1998). Metal mobility at an old, heavily loaded sludge application site. *Environmental Pollution*, 99, 365-377.
- Shukurova, N., Pen-Mouratova, S., and Steinberger, Y. (2006). The influence of soil pollution on soil microbial biomass and nematode community structure in Navoiy Industrial Park, Uzbekistan. *Environment International*, 32, 1-11.
- Sparks, D.L. (1996). *Methods of soil analysis: Part 3. Chemical methods and processes*. Soil Sci. Soc. Am., Book Series 5, SSSA, Madison, WI.
- Vance, E.D., Brookes, P.C., and Jenkinson, D.S. (1978). An extraction method for measuring soil microbial biomass-C. *Soil Biology and Biochemistry*, 19, 703-707.
- Vasquez-Murrieta, M.S., Migueles-Garduno, I., Franco-Hernandez, O., Govaerts, B., and Dendooven, L. (2006). C and N mineralization and microbial biomass in heavy metal contaminated soil. *European Journal of Soil Biology*, 42, 89-98.
- Virkutyte, J., Sillanpaa, M., and Latostenmaa, P. (2002). Electrokinetic soil remediation-Critical overview. *Science of the Total Environment*, 289, 97-121.
- Wang, Q.Y., Zhou, D.M., Cang, L., Li, L.Z., and Wang, P. (2009). Solid/solution Cu fractionations /speciation of a Cu contaminated soil after pilot-scale electrokinetic remediation and their relationships with soil microbial and enzyme activities. *Environmental Pollution*, 157, 2203-2208.
- Wick, L.Y., Shi, L., and Harms, H. (2007). Electro-bioremediation of hydrophobic organic soil contaminants: A review of fundamental interactions. *Electrochimica Acta*, 5, 3441-3448.