Æ ł gpŤř ÆŽǫŰ ắ ĠǫĶŁǫdžə ůnjǿŢǫ p Oǫ Êʂ ĠǫŁǫ
ŽłƩł njǿŢǫ Oʼ ł yĦŁ ÆŽǫŰ ǰŽŁ
ħĥĥ ĸơ ħĤĤ ΘĸŢĹĐż ,ÂĦŤĤ žĶŁʂǫɛ ,ǫ3ĶĦš ŁžĶŽ ,Q Ł ľ Łžpʏ

ŁzYÑǩd t ʼ ĶƟ ɛł ǰ á Ʃ Ł Ķ Đ ə Ùz f Ɛʎ ắ ʒÑ ł p ắ z ǔ ǫ YłÑ ǫ Ɛǿ ƀ Ķơ Ǵ ʂ á K Ā ǫ

ĭ ÆǪǿəłƩʂł ÆǪŰ Ûʰ ắ YĶƋd ù Ł Ł ÆŽ ł Ķg ŁƩǿŽʂ Ûʰ Ķǿ t ʏ łƩƩê Æá K ljʒ Ŧ h ł pʒ ¡ʰ ʒÑř ÆŁHpʒ ĠǫÑdžüǫ
r-rezaei@tums.ac.ir njǿŢǫ Oʼ ł yĦŁ ŁpƩū ÛOʼ ł yĦŁ ŁyĞ ł ŁY Û(yÑĺ 5 á YƩř) ŽłƩĦơ ÆĞ ł ƶř ǫÑǪŰ ŁķŰ ł ŁY ÛyÑĺ ŽĶŁķǿƟ Û ǰ ǿŁŁtʒd Žłyǿǫ ÛŽłƩĦơ :ğÑlʂǫ ŁyŁʂá ÑŁ

Ǐğ/ġh/ĥĤ : p Ƹáƶřǐ Ǐğ/ġĤ/ĥh :OəĸéʒY

ŁyǿŨš

ắ ŁƩÑǫ p pʒ Ŧá ŽłÑŁŰ Ǵł Łʒ Æǫʂáɛ ţÊDžł yŁŁƩə OŰƩƧ t ʼ ĶƟ ʒY Ķg PAH Ǵł ĶgǪʂǿĶūʒłPƩÙǿǫ ù Łūlj ÆƧƩǫƧY OǿǪĶã :Ùyğ p Ǵǿǫɛ Ùz f Ɛł ắ ʒÑ ł p ắ z ǔ ǫ YłÑ ǫ Ɛǿ ĸ Gŭ Ķ ă ǫ ǰ áł ʒY .yƩłÑǫ yŁŁƩə ǰ áł Ɛł ắ Yyŭǫ ÆáĸǿŽǿ ł ÑŨźƶ ə Ķǫł Ñ Ű .YɛĶƧÆǫ YpyŢǫ t ʼ ĶƟ ɛł ÆūYÑĺd Ùz f .ył ÆƧʒƩł ŁYÑĺd t ʼ ĶƟ ɛł ǰ áƩǿŁə

ʒY ắ ʒÑ ł p ắ z ǔ ǫ YłÑ ǫ ğÑǪŢǫ 5 Śʂ ŁYÑŽ ŁYÑĺd ǰ áƩǿŁə Ǵł ÆŰÑŁdžǫ ʒÑĂ Ǵł Łʒ ÆǿpƩŨǿǫ p ÆáĸǿŽǿ ł ắ ĶgÆūYÑĺd ɛł ắ ʒĶŰ ÆŧĶƟ :ÆƧʒƩł p pʒ ɛł 5 ř t ʼ ĶƟ ʒY ŁyǿǫÆáĸ ǰ áƩǿŁə OǒǪŰ ǪǿĸĦł .YYƩū ŘDžĶ f ÆŽ ł f Æǿp ěĤġ Oʼ ł ʂ ł Ķơ ył Ǵ ə Ķ ǿ Ip ł ʒd Ǵł ÆǿpƩŨǿǫ NjÑǪUǫ Ķ ŁƩŽʒg OǒǪŰ pY ǰ ŁŁ .yƒył / ł ʂ MPN p pʒ Ķ ƶ ł Æǿp ƩŨǿǫ OǿűŽƩ .Oəƨū ʒłƩā / ł ʂ YʒÑǫ ắ ɛĶū ÆəłƩūÑơĶǫpƩŁ ŁĶŰǪʂY njʂÑơ Ŧ ǿÑʂłƩǪǿPł Ķ ƨłƩUǫʂł .ył ǫĶ ł ʂ ÆŢăʂ pY ŘǫĶŁ ŘáʒÑǪŁtĶə / ǽĶǫƸd ÆfłƩĂ 2 Ķʂł Ɛ Ǵ ű Ķ ă ǫ ǰ áƩǪ ł ǿ ł ắ z ǔ ǫ YłÑ ǫ YłY ʒĶ ł ł Ř ǫĶŁt ŘáʒÑǪŁtĶə / ǽĶǫƸd ÆfłƩĂ .Oʂł ŁYÑ Ɛǿ ƠĶơ ắ łʒłY ÆǪpƩŨǿǫ yłł ʒ yƒpʒ Ǵt YłY ʒĶ ł ł MPN ʒÑǫƸd ƨǽĶǪǪ :ĶgǴǪəĸá Ǵł ě ĪÎ/ĤĦ ƩĦƩł p ʒłyǿǫ ǰ áƩǪ ł ǿ ł Řáłyf ắ ʒÑ ł ø ƩŁtłyf ắ z ǔ ǫ YłÑ ǫ ğÑǪǿǪǪə Ùz f ʒĶǫyƒłʒ p ǴǪł ł ĦY ţ ÊDžł yŁŁƩə Ɛł Ɛǿ ĸ ǫ .yǫd Oʂ Y

Ùz f t ʼ ĶƟ ɛł ʒ ǰ áƩǿŁə ÆǪłÎ ŁyŁŁèd ɛł ắ ƐǪ ł ǿ ł ʒłyǿǫ yłʒYĸá ĶgǪʂǿĶūʒłPƩÙǿǫ ắ z ǔ ǫ YłÑ ǫ OǒǪŰ / Łtƶəł Ķ Ǵt YłY ʒĶ ł ł Ǵ ű Ķ ă ǫ ǰ áł :ắ Ɛǿū Ǵ ǪǪ Ùz f Ɛł Oəƨ ł ǿŕ Ķá p Æūyƒ ŁtOűǪĶŽǫ ƩĦ p ŁyłŁ ĶgǪʂǿĶūʒł pƩÙǿǫ yłł ʒ Y Ɛ ǿ Ķơ ł Σ Ñǫ ĸĦŁơ ǴǪəƶ ʒĶg Ǵł OǒǪŰ ŁYpyŢǫʒY ắ ʒÑ ł Ķǫł ÛyƒŁĶŽł .Oʂł Ǵǫ ł ł ył ǰ áƩǿŁə

ắ ʒÑ ł Ûắ z ǔ ǫ YłÑ ǫ Û t ʼ ĶƟ Æǫʂáɛ ţÊDžł Û / ǽĶǫƸd Æ fłƩĂ Ûắ ł ĆÆǪf yƒš Ŧ ǿĶǫpƩƶd ắ Ķg ǰ ƙƩgpƩyǿg :ắ yǿǫt ʒĶūţłP

Ɛh ł Ñł ÛŨ ł ƶř ǫÑǪŰ ŁķŰ ł ŁY ÛOʼ ł yĦŁ ŁyĞ ł ŁY ÛnjǿŢǫ Oʼ ł yĦŁ ył ƷŁ 2 Kh ł ƷĶt -Ĥ
ŽłƩĦơ ÛŨ ł ƶř ǫÑǪŰ ŁķŰ ł ŁY ÛOʼ ł yĦŁ ŁyŨ ł ŁY ƷĶó ł ŁY ÛOʂǽɛ njǿŢǫ ŽłƩƷŰ ŭłƩǫtY -ĥ
ŽłƩĦơ ÛŨ ł ƶř ǫÑǪŰ ŁķŰ ł ŁY ÛOʼ ł yĦŁ ŁyŨ ł ŁY ƸĶó ł ŁY ÛnjǿŢǫ Oʼ ł yĦŁ ŭłƩǫtY -Ħ
2 Ʒyǫ OǿƩơ ŁķŰ ł ŁY ÛŮƷǿ ł Ůʂyƒ Ħǫ ŁyŨ ł ŁY ƷĶźYĶǫʂł Ûŭţ ÑĺÑŁŰơÑǿĺ ŮƷǿ ł ŭłƩǫtY -ħ
ŽłƩĦơ ÛŨ ł ƶř ǫÑǪŰ ŁķŰ ł ŁY ÛOʼ ł yĦŁ ŁyŨ ł ŁY ƷĶźYĶǫʂł ÛĠǽƹ Ł ơ ŮƷǿ ł ắ łƩgY -Ĩ

[illegible]

[illegible] Polycyclic Aromatic Hydrocarbons (PAH) [illegible] PAHs [illegible] PAHs [illegible] PAHs [illegible] PAHs [illegible] PAH [illegible]

[illegible] (Bioremediation) [illegible]

[illegible] PAHs [illegible] PAHs [illegible] (P) [illegible] (N) [illegible] Alvarez [illegible] C:N:P= 120:10:1 [illegible] NH_4^+ [illegible] (NO_3^-) [illegible] (NO_3^-) [illegible] P [illegible] N [illegible] PAHs [illegible]

[illegible] Chen [illegible] C/N [illegible] Chaudhry [illegible]

[illegible] nm [illegible] (OD=1) [illegible] CECIL UV/VIS [illegible] 7100 [illegible] ProMAX [illegible] Heidolph [illegible] rpm [illegible] 2020 [illegible] (Most Probable Numer) MPN [illegible] K [illegible] (min) [illegible] (max) [illegible]

[illegible]

[illegible] HPLC grade [illegible] R_2A [illegible] ROMIL [illegible] BIOMARK [illegible] NaCl [illegible] Merck [illegible]

[illegible] cm [illegible] mm [illegible] g [illegible] Batch) [illegible] °C [illegible] (reactor [illegible] min [illegible] mg/Kg [illegible] pH [illegible] pH [illegible] HACH 40d [illegible] pH [illegible]

[illegible]

		مواد مغذی (mg/L)	محلول ماده مغذی (max)	محلول ماده مغذی (min)
Macro & Micro		K_2HPO_4	۸۰۰	۰/۱۳۲
		KH_2PO_4	۲۰۰	۰/۱۰۳
		KNO_3	۱۰۰۰	۱/۷
		$MgSo_4.7H_2O$	۲۰۰	۲۰۰
		$CaCl_2.2H_2O$	۱۰۰	۱۰۰
		NaCl	۱۰۰	۱۰۰
		$FeCl_3.6H_2O$	۱۰	۱۰
Trace		Trace elements	۱mL	۱mL

[illegible]

Trace Elements	mg/L
EDTA-Sodium Salt	۵۰۰
$ZnSO_4.7H_2O$	۱۰
$FeSO_3.7H_2O$	۲۰۰
$MnCl_2.4H_2O$	۳
H_3BO_3	۳۰
$CoCl_2.6H_2O$	۲۰
$CuSO_4.2H_2O$	۱۰
$NiCl_2.6H_2O$	۶
$Na_2MoO_4.2H_2O$	۳

[illegible] ($P<$[illegible]) [illegible] Design-Expert V.7 [illegible]

[illegible] Excel [illegible] (ANOVA) [illegible]

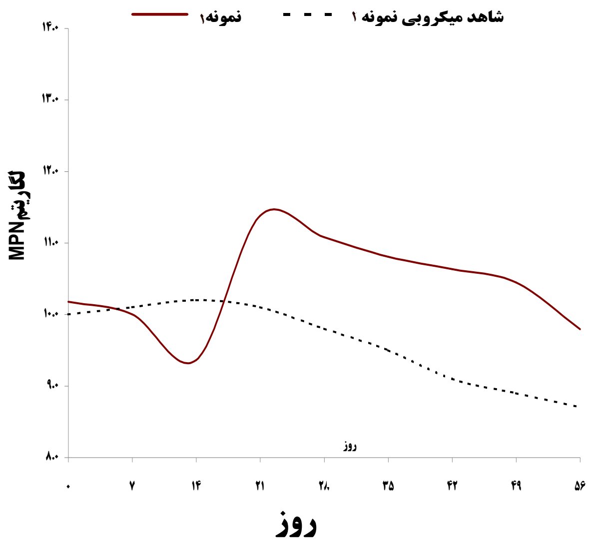
[illegible]

فنانترین	مخلوط میکروبی	شوری (Sal.)	مواد مغذی (Nu.)	آزمایش
+	+	۱+	۱+	نمونه ۱
+	+	۱−	۱+	نمونه ۲
+	+	۱+	۱−	نمونه ۳
+	+	۱−	۱−	نمونه۴
+	−	۱+	۱+	شاهد شیمیایی نمونه ۱
+	−	۱−	۱+	شاهد شیمیایی نمونه ۲
+	−	۱+	۱−	شاهد شیمیایی نمونه ۳
+	−	۱−	۱−	شاهد شیمیایی نمونه ۴
−	+	۱+	۱+	شاهد میکروبی نمونه ۱
−	+	۱−	۱+	شاهد میکروبی نمونه ۲
−	+	۱+	۱−	شاهد میکروبی نمونه ۳
−	+	۱−	۱−	شاهد میکروبی نمونه ۴

[illegible] (+۱) [illegible] (-۱) [illegible] (+) [illegible] (-) [illegible]

B 3550 p Ɗ3 ⵜƙƨł Ƹƛ BANDELIN SONOPLUS ƧłƸƲǷƨł ƘƷƲ (ĦĦ)(EPA) ƠƨȡƸ ǌƠƮǭ ƠǑƘǞƒ ƽƗƫƮ ğƴǭ ƙƛ ƫǸǞȡƸǷƘƨ ƙƘǗǷƨƳ Ǵƛ ƘǅǯƘƒ ğǸǭƮǭ p ƠǝƸǖ Ɵ3ǸǅǯƠƴǭ Ǵƛ ĩǵǵ rpm ƠǗƸƨ 3Ƴ p ƘǞǷǭ Hettich Universal GC ƙƘǗǷƨƳ ƙƛ ƚƴƙǭǞǠƙƛ ƚƴƀȡƩ ƠǑǭǗ .ƠǝƸǖ 3łƸǠ ĥĨ min .ƴǷ ǰǭǖǷ HP5 ǯǸǷƨ p CHROMPACK CP9001 ğƴǭ

ĥǵǵºC 3Ƴ Ĥ min ǴǭǷp ǯƙǭƸ :Ɵ3ǸǅǯǴƛ GC ƘȡƙǭƳ ǴǭƙǷƸƛ ǻƙǭƳ ƙƠ Ĥǵ ºC /min ƠǗƸƨ ƙƛ p ƙǭƳ Ⅰ ȡłƷǝł ƙƛ ƽƨp ǻƙǭƳ p ĥĨǵ ºC 3ǸǷƫǷƗ ǻƙǭƳ p ǯǸǷƨ ƘȡƙǷǷ ǻƙǭƳ ƘǷǹȡĥĨǵ ºC ƙƘǗ ǂ ȡƙǭƸƎ 3Ƴ Ⅰ ȡƙǭƸƎ Ƙ ƒłƸǭ ǴǭƫƏ .ƴȡƳƸǖ ǬǭǑǷǠĥĨǵ ºC3ǸǷƗǴƳ Ɵ3ǸǅǯǯłƸƗƠ ƘǗǁǯǷ ǪǸǷǗ ƙƘǗ ǂǁƳ ƠǁƮƴǷƛ ƙƴǗ ǂǁƳ ƟǸǭȡƙƨ .Ơƨł ǴǷǝƸȡȥ



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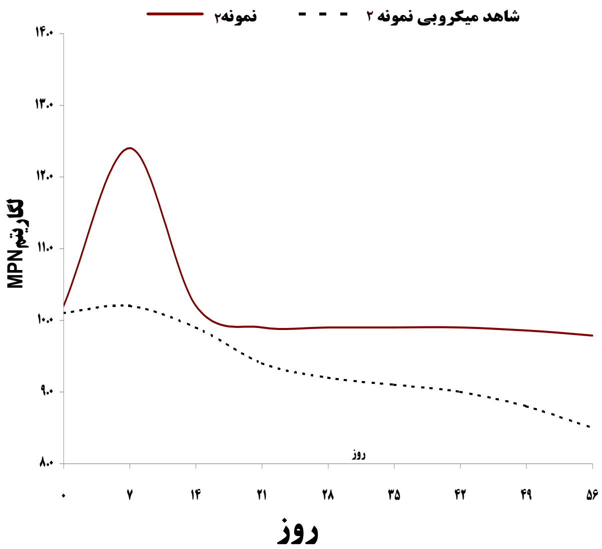

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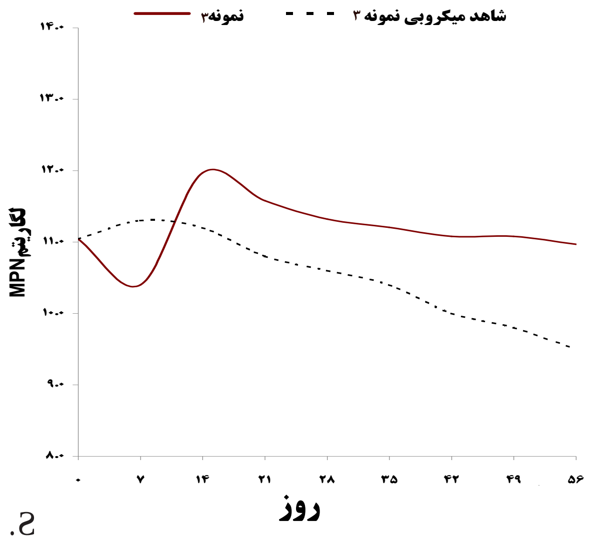

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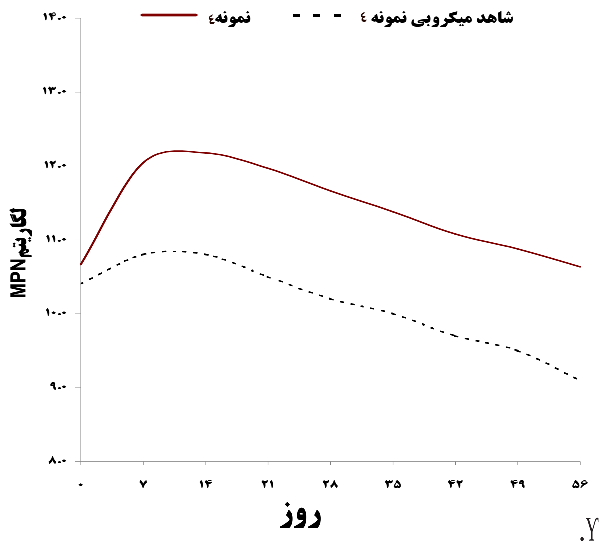

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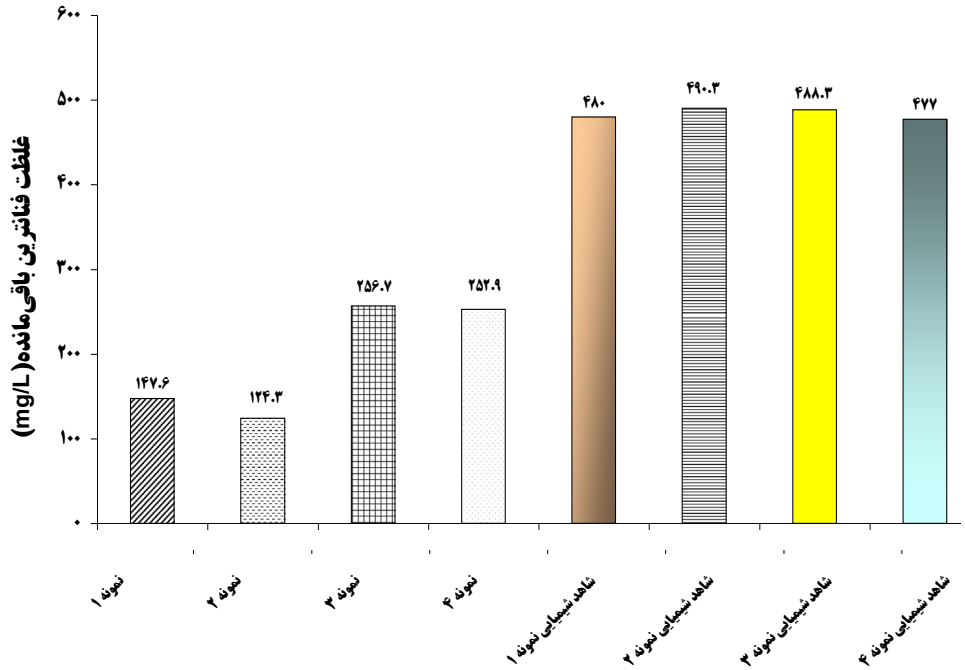
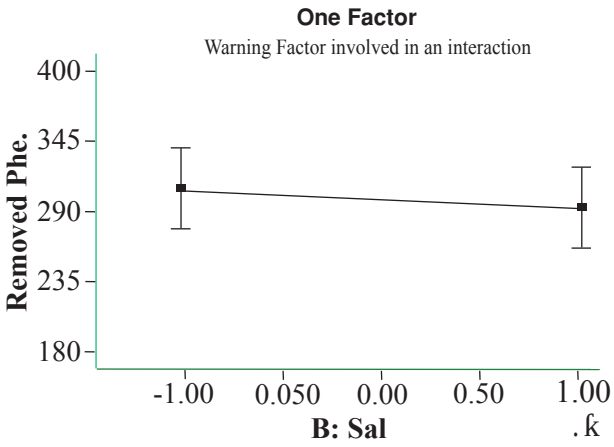
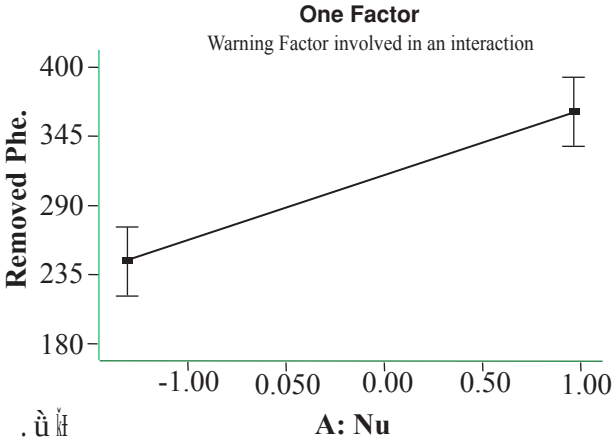
ƸƊ3 Ⅰ Ⅱ p ƙƘǖƾ ƙƷƊƳ ƘƗ 3Ƴ ħpĦpĥpĤ ƘǮƮƙ ǻƘǴǗǸǯ 3Ƴ ƘƊƸǑǷǭ ƴⅡ3 ƘǑǸǸǑ :Ĥ ƘǦⅡ

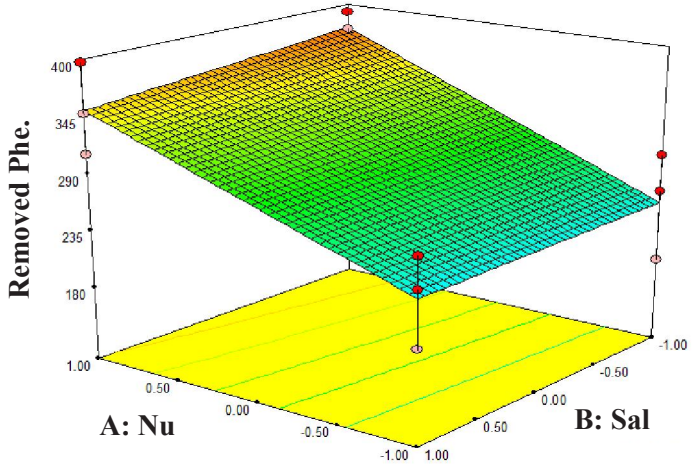
ANOVA ğþyΣ :hğþyΣ

Source	Effects	Sum of Square	df	Mean Square	F-Value	P_{Value} Prob > F	
Model		43228/1	3	14409/4	8/464	0/0073	significant
A-Nu	118/87	42387/9	1	42387/9	24/900	0/0011	
B-Sal	-13/57	552/2	1	552/2	0/324	0/5846	
AB	-9/80	288/1	1	288/1	0/169	0/6916	
Pure Error		13618/8	8	1702/3			
Cor Total		56846/9	11				









ǰ ǽƷǁǁǨǝ ǡyǪǩǭÆãǩ Ơǒǫǔ y ȝǸȚǫ p ǻȝǸǁ(ǩ) ǔǻzǔǫ ΥĦǸǫ(ù ǐĦ) Ʒǒǔǁǫ Ơǒǫǔ x ȝǸȚǫ .Ǩǫǩŧ ǨǽȝǸǫŧǩǝ ǻȝǪǫǝ ȝǒǩǨǝ 2 ǩsł ƩǩǩǷǒǔǁǫ ΘłƷƥ :Ħ ǨĞǁ Ʒǒǔǁǫ ƿΥ Ƹǵ ţ.Ǹăs ǻyǔǩ Ǵs ǀ ǽǨȝǩ(ƨ) ǔǫł Ĩĩ ɛƿȝ ȝǪǽǩǐ ȝΥ Ʒŧłyƒŧ p Ǩǎłyƒŧ Tăs ȝΥ ǪǵǴǁǸȝǁ ȝΥ ŧ ʼǪǒ ɛł ǡyǁ Ùzƒ

ƤȚǩ

ǔǁǁǫ ȝłǸǁŨ Ǵǩ PAHs ÙƐdžǫ ǻłƩǩ ǪǵkƿƩŨǒǫ ÆǽǪǁĦǸơ ÆăǒȚǫ njǽłƩǁ ğƩǁŧ Ǫǫŧ ǔƠsł ǡyǁ ΘǪǁĦ ǻţƩǁĦ Ǫǽ p Ælǁƒŧ ǪĦǫ ȝǪǒsǩ tʼǪǒ Ǵǩ kǪǒȝŧ ƩDžǨǁŨ Ǫǽ ǻzǔǫ ΥĦǸǫ ȝΥƿƹǽł p ȝΥ ÆǁƿƩŨǒǫ yǁȝ yǁƿȝ Ǵŧ ΥĦΥ ȝǩ+ǁ ĀǒǺȚơ ǰǽł ɛǽǪǁ .Ơsł Ơǁsǁ ǻƩǂǒ ǀ ǽłƹǝł (ĥ pĤ ǴǁǸȝǁ)ƩǷŧłyƒ ǻzǔǫ ΥĦǸǫ ǴǁǸȝǁ ȝŧȝǒǫ Ǵŧ ǻȝǸĂ Ǵǩ ǴǁǁĦΥ Ǩǻłyƒ ǻzǔǫ ΥĦǸǫ ǩ ǻǨgǴǁǸȝǁ Ǵǩ ǻǨgǴǁǸȝǁ ȝΥ ƩĀDž ɛƿȝ Ǵǩ Ơǁsǁ ÆǽǨǽƩǁŧǩ Ơǒũȝƨ ǀ ǽłƹǝł Ǵǩ ǴΣNơ ǩ Ǫǫł .Ơsł ǔΥNǩ ħ p Ħ ǻǨgǴǁǸȝǁ ɛł Ƨǁ+ǒǩ ĥ p Ĥ ȝΥ ÆǽǨǽƩǁŧǩ yǁȝ ȝΥ ƩǒƠǩơ Ħ p Ĥ ǴǁǸȝǁ ȝΥ ǻȝǸǁ ȝNNJƒ ǨĦǫ ÆǁƿƩŨǒǫ yǁȝ ȝĦΥNȝǁ ȝΥ ǪğgΥȝǨĦšǩ ơ ǪǁĀg ǻǨgɛƿȝ Æǁǁǫ (ĥǵǵī) Chaudhry Ʃǒǁ Ǵǩ ǴΣNơ ǩ ǔΥNǁÆǫ ǔyğǨ+ǫ ğǨȝǁƒł ǻȝǸǁ ǀ ǽłƹǝł ğǨǁǁΥ Ǵǩ ǰǽƩǁǁǨǝ ƠǒǩÊƒ ǀ ǵǨŧ Ƨǩ

Ğǁǰǒȝǵ ȝΥ ǰǽƩǁǁǨǝ tʼyǁĦ ȝǨǒsǩ Ùzƒ ȝłyÆǫ ǩ ȝǒǁ ǴǁǸȝǁ ȝǒǩǨǝ ǻȝǪǫǝ ȝǸǫƩd ɛł ǨDžǩƒ ɜǽǨǁǁ 2 ǩsłƩǩ .Ơsł ǔyǁ ǪǒsƩơ ǰǽł ǻłƩǩ ÆǁǨUǁĦ (Linear)ÆăƱ ğyǫ ÛANOVA ø 5 ǁǨǽȝłp (Significant) ğǸǁǻ ǨǁǨǻ P<ǵ/ǵĨ p ȝłƩŨơ ȝǨǩ Ǵs ǩ ǀ ǽǨǫƩd ɜǽǨǁǁ .ΥǸȝǁ ΘpǨNJǻ ǨgǴǫǽǩ Ƨǩ Æǁţsȝ Ǵǩ ȝǸǸơÆǫ ǰǽłƩǁǨǸǁ ǔΥNǩ ǰǽƩǒǪHǫ ĥħ/Ĭ ¡F-Value Ǩǩłȝǻzǔǫ ΥĦǸǫ ȝǸǁŧǩǝ ÛȝǸǫƩd ǰǽł ǻzǔǫ ΥĦǸǫ p ǻȝǸǁ ǻǨgƩǒǔǁǫ ΘłƷƥ Ħ ǨĞǁ .ΥĦΥ ȝǩ+ǁ Ʃǒǔǁǫ ɛł ǨDžǩƒ ǻǩǎƱ .yğΥÆǫ ȝǩ+ǁ łȝ ƩŨǽyŨǽ ǩ ǨHǁd ǨƱłyơ p .yǽΥƩū ǴǁsǨȚǫ ǨHǁd ȝłƩŨơ ǩ Θǩ+ǽǩǫƩd

| غکت کا njllσΣǒ ƨ́ll ĠüǏĸăǒ ǰ ź́ł ȝY ÉΛpΣŨǒǒ yllȝ | غکت YȝłY Ǩt yğKǁ ȝłYNȞȝ ğKf ȞKȞğ ȝY .(ĩ)yllKΛ ǰźΣǁKDə OǑKÊf ĠǁǁłY YNσ ÉǪDż ĠlNȞȝ Ġʌ Oǁsǁ ǎΣǁȞt yllȝ ƨ́ll KğĠlNȞȝ OσǒǪŬ Ġʌ KğǪsǑKūȝłpΣŨǒǒ ÆsΣǁsY ǫyŰ ȝd ǨǑkY Ġt Oσł ŭlllǒ ȞiNlŰ Ġʌ) ǰźΣǁKDə ȝNNJf ǫyŰ OłΣ Ġʌ ǰʌȼt ɛł ÉlllsKlǒ Kʌ ĠsźKĖǒ ȝY yğKǁ ĠlNȞȝ ȝY (ğNǪTǒ ȝY YNΣNǒ ĠlźΣt ÉlŰ ysȝÆǒ Ɛǒǁ Ġʌ ÉΛpΣŨǒǒ yllȝ | ğKt Ġlǒǁȝ Y p ÆǪDż ĠlNȞȝ YłNǒ ȝNǪtKə pY ɛł ΣǑKǪǒ ǰźΣǁKDə Ùzf ŮĠǫłYł ȝY .(łĬpłĩ) .YYΣūÆǒ ÉsȝΣʌ p ƤTʌ KHlld Ǩσłyσ p ǎȝNǁ p ǎzüǒ ɛł yğYÆǒ ȞKǁĩ ěĬĨ ȞKlǒȞǺł yDžȝY Kʌ 5 lKźȝłp ƨǑKlld ƨźKQǁ ǎłȝłY ǎzüǒ YłNǒ njŁə ŮKHlld Ǩσłyσ p ǨǎǪsǒ ǎKgƐǒŭǪǒ ȞKǒǒ ǎȝNǁ Gt ÆǏf ȝY ƭYNʌ ġ/ġgĤĤ ΣłΣʌ (P<ġ/ġĨ) ǪHǒ ΘłΣǑł yǁYNlll ÆŽHǒ ΣǑł ǎłȝłY ΣŰźyŮź Kʌ ȝNǪtKə pY Σg Ǩσłyσ p Ȟłƨǒǒ Σʌ OlllRǒ ΣǑł ǎzüǒ YłNǒ ȝNǪtKə ł ǒσΣσ ǰźł Ġʌ .(P>·/ġĨ) ǰźł ÆǏp YȝłY ÆĂlǒ ΣǑł ǎȝNǁ ȝNǪtKə KǪł ĠǪǁłY ǰźΣǪlKDə Ùzf Ġʌ ĠΣNσ Kʌ p ƭYNʌ Ŧ šNt ȝKǒsʌ OlƨΣσNl ΣǑł Kʌ ĠsźKĖǒ ȝY ΣǑł Ǫt ȝKǒsʌ ł ǒǁ ǎłȝłY (ÆĖał ȝNŢǫ) ǎȝNǁ ΣǑł ƙ ø Ħ ǨĞǁ ǰźł ÆǏp ƭYNʌ ΣRtłyf Tăs OŽs Ġʌ Ăăłyƒ ÆǪǒǪŬ Tăs ɛł ǎΣǪ+ǒʌ ĠΣȝY ǎłȝłY (ùlł -Ħ)ǎzüǒ YłNǒ ΣǑł ȝłYNŽl ȝY ł ǒǁ ΣσèKʌ OσǒǪŬ Kʌ ǎzüǒ YłNǒ p ΣǪŽt ǎȝNǁ Gt Ælūǒ ǰźł Ġʌ .Oσł ƨźKQǁ Ġʌ ĠΣNσ Kʌ .yłȝłY ǰźΣǪlKDə Ùzf ȞKǒyłHȝ Σʌ ǎΣǪ+ǒʌ ΣǑł Ùzf ȝKǒyłHȝ ɛł ǨDžǨf .Oσł Ăăłyƒ ǎȝNǁ p ΣRtłyf OlƨΣσNl ĠăÆl ȝY ǰźΣǪlKDə ȝY ǎzüǒ YłNǒ ĠlKǂǒ ǎKgOσǒǪŬ Kʌ ǎKgĠlNȞȝ GsźκĖǒ ǰłlšǪg ĠlKǂǒ ǎKgOσǒǪŬ Kʌ ǎKgĠlNȞȝ p (ĥ Kʌ Ĥ GlNȞȝ) ΣRtłyf Tăs Gt yğYÆǒ ȞKǂǁ (ħ Kʌ Ħ GlNȞȝ) Ăăłyƒ Tăs ȝY ǎzüǒ YłNǒ ΘpĸĂσ ǎzüǒ YłNǒ Σσǁǁɛł ĠlKǂǒ GlNȞȝ pY ǰłʌ Ùzf yDžȝY ȝY ΣσσKσ ł ΣNǒ KHlσσ ěĥ OσǒǪŬ ȝY ǎȝNǁ p ĠǪǁłyl ÆlłyllšĠźǪσp ȝyl ÆlyłūǒȞłƨǒǒ ȝY ǎΣσKσ p ƭyźYΣū ÆlpΣŨǒǒ yllȝ (ĥğgĩ)Betancur-Galvis .Oσł ĠǪǁłyl ǰźΣǪlKDə ǰʌȼtpȝyłg ȞłȝKĞȝg p Ǩǒǒ ĀσĖȚσ ȝY Ġg yłYΣg ǫÊŰł YNσ ĠłKĖǒ ȝY (W/V) OσǒǪŬ ȝY łȝ ǎȝNǁ ÆūyłtOŭlKȞǒ ΣǑł ƨ́ll (ĥğgĩ) yf ɛł | ǒʌ ǎȝNǁ ǰσlšǪg .(Hī)yłtÆǒ ȞKσʌ NaCl ɛł ěĥ/ħ yllȝ yƭźΣə ȝY (Lag phase)ǎΣσσKσ ɛKə | ź́ł ȝY ł ΣNǒ ĠlσσHʌ yllȝ Ȟłƨǒǒ | ǵKt Ġʌ ǨłKȞσ ǪsσKūȝłpΣŨǒǒ p ƭyllł ÆlpΣŨǒǒ

Børresen njsNσ Ġt ǎłĠüĺĸăǒ .(Ĥh)YȝłY 5 ǫNσʌ OσσKs p ǎèKl ǎKgOσǒǪŬ YłY ȞK+ll yll ǫKlłH (ĥġgĪ)ȞłȝKŮȞğg p ĥġġ NH_4-N/ p ĪĤ mmol Na^+/Kg soil) Oƭź£NlI ø ŦȞl p NH_4^+ ȞYpƨəł Kʌ t'KσǒǪŬ ȝY ǎȝNǁ | ź́ł ȝəł ĀźΣĂ ɛł (Kg soil ΣǑł KǪł ƭYłY | ź́ł ȝəł łȝ KgĠsǑKūȝłpΣŨǒǒ ǎȝKūΣKs ȞKǒΣ Na^+ ĠʌȞyσsȝ Kσ ǨǪKt Ġźȝlσ) ȞyllÆlyűǒ ǎpȝ ÆūyłtOŭlKȞǒ)Oσł ĠǪǁłyl Kg | ź́KǒΣd ȞKźKĭ ȝY ȞKtYłƨŮg Ǩt (ƙd p CO_2 .Oσł Güĺĸăǒ ǰź́ł Ġlǒǁȝ ΣʌǑł ȝY ǎyǑźKσ Gt (ĦĬ OĀl ÆŮźţNĺNǑʌ Ġźȝlσ Ælłyǒǒ p ÆgKŮ+źKǒΣd ΘKüĺĸăǒ OŰΣs | ź́ł ȝəł ł ΣNǒ ÆaKljł ǎzüǒ YłNǒ Gt yłlƭYłY ȞK+ll ǎzüǒ YłNǒ ğΣlltt ȞpyΛ njźΣǁ ĠʌOσsl ÆŮźţNĺNǑʌ Ġźȝlσ ΣǑǪKσ Σʌ Gt ÆĖǒĖTσ ȝY (ĥġgĪ)ȞłȝKŮȞğg p Lee .(ĥġ)yłlƭyll ÆŮǒlǪǒtpΣlŮĖ | ź́ł ȝəł Σʌ ΘłΣǪǒl p (TEP) ΘKĀsə Ǩǒσł ǎΣσ ǎΣźzř zNĀl OσǒlKā Kʌ ǎKgťKσ ȝY ğźźY ÆŮźţNĺNǑʌ Ġźȝlσ ǫKlłH Tăs ħ ȝY łȝ ÆǪsźΣ ţÊDżł yƭźłΣə ȝY Gt yltÆǒ ǨŽŰ ΣǪlhʌ ÆlKǒΣ ΣĀsə YłY ȞK+ll .(ħĤ)yllKʌ NO_3^- ǨĦǒ ƭyłΣǑūȝłpΣŨĖł Ŧź ȝNNJf ȝY ŮÆǪsźΣ ǫKlłH (Ĥġgĩ) Alvarez p Betancur njsNσ Gt ǎłĠüĺĸăǒ ȝY ʌ ƭYNʌd t'KσǒǪŬ ǎKgǪsǑKūȝłpΣŨǒǒ ÆlpΣŨǒǒ ŦźΣŢσ ΣǑǪKσ yll biosoil ǎKgƭyƭtȝpȝKʌ njsNσ ȞΣǑKdpźȝl p ǰ słΣǁd Ůǰź́ΣǪlKDə ʌ p NH_4^+ p NO_3^- ΘȝNDż ʌ N ǎpKf ÆlyűǒƭyƭtȝpȝKʌ p ÆsȝΣl ĤĤĥ d Θyǒ ȝY p yllyl ĠəKljł t'KσǒǪŬ ʌ PO_4^{-3}ΘȝNDż p ÆlyűǒǒǎKg ƭyƭtȝpȝKʌ YΣlȝKt YłY ȞK+ll ȞKld ź́KǒǒǪŬ Gt yll ʌ ƭyl Ġüĺĸăǒ ȝY ǫNσʌ PAHs Ġźȝlσ | ź́ł ȝəł ł ΣNǒ biosoil Kʌ ƭyl ţÊDżł t'KσǒǪŬ ɛł ƭyll Ùzf ǰźΣǪlKDə OσǒǪŬ Gt ǎȝNĂ Oǁsǁ ǰź́ł .(Ħī)Oσł ĠǪǁłY | ź́ł ȝəł ΣlΣʌ Ĥ/Ī ȞłȝǑǒ ʌ P، N ɛł ÆlŮ ğNǪTǒ ȝY ΣljKf Ġüĺĸăǒ ȝY ǰźΣǪlKDə Ġźȝlσ | ź́ł ȝəł ȝY ğNǪTǒ ΣlΣʌ Ĥ/Ī ɛł | ǒʌ (ÆlyűǒǒǎKgƭyƭtȝpȝKʌ) ǎzüǒ YłNǒ Ġüĺĸăǒ ȞKǒΣ Θyǒ Ĥ/ĥ) Ĩĩ d Θyǒ ȝY ǎzüǒ YłNǒ ΣǑǁ ɛł ΣǑǒźə ÆlNlŰǎ ŘlKā ʌ Ǫlǒǁȝ Gt YNʌ ((ĥġgĩ) Alvarez p Betancur ÆsȝΣl ǎłΣl ƨ́ll (ĥġgĦ) Loh p KwokĠt ǎłĠüĺĸăǒȝY .Oσł ĩ ǎpȝ Σʌ łyǒσNĩr 2 KlNǒpYNs njsNσ ǰźΣǪlKDə ÆǪsźΣ Ġźȝlσ yll DŽU+ǒ yƭYłY ǫKlłH ȝNĩKŮlss ù ǪǪUǒ ĀĂKlǒ t'KσǒǪŬ ɛł ŮNlll ȝY .Oσł ÆǪsźΣ ǎKg | łtłP ȝY ƭyƭtłYpyȚǒ ŘǫKŰ Ŧź ΣĀsə

[illegible]

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Comparison of Nutrients and Salinity on Phenanthrene Removal from Polluted Soil

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Received; 13 April 2011 Accepted; 12 July 2011

ABSTRACT

Background and Objectives: The poor accessibility of microorganisms to PAHs in soil has limited success in the process of bioremediation as an effective method for removing pollutants from soils. Different physicochemical factors are effective on the rate of biodegradation. The main objective of this study is to assess effects of nutrient and salinity on phenanthrene removal from polluted soils.

Materials and Methods: The soil having no organic and microbial pollution was first artificially polluted with phenanthrene then nutrients and salinity solution in two concentrations were added to it in order to have the proportion of 10% w:v (soil: water). After that a microbial mixture enable to degrade phenanthrene was added to the slurry and was aerated. Finally, the residual concentration of Phenanthrene in the soil was extracted by ultrasonic and was analyzed using GC. We measured the microbial populationusing MPN test. This study was conducted based on the two level full factorial design of experiment.

Results: MPN test showed that the trend of microbial growth has experienced a lag growth. The full factorial design indicated that nutrient had the maximum effect on bioremediation; the rate of phenanthrene removal in the maximum nutrients – minimum salinity solution was 75.14%.

Conclusion: This study revealed that the more nutrient concentration increases, the more degradation will be happened by microorganisms in the soils. However, salinity in the concentration used had no effect on inhabitation or promoting on the Phenanthrene removal.

Keywords: PAHs, Experimental Design, Soil Bioremediation, Nutrient, Salinity

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