ŋzYÑ ľ ĸŌ ɛł ǰ á Ç ‖ĶDə Ùz f Ɛ ấ ȝÑ ‖ p ấ z ű ǫ YłÑ ǫ Ɛǿ ƀ Ơ Ġ ș á K Ä ǫ

ĭ ÄǪǿəłÇ ș ł ÄǪŰ Ûʰ ấ YĶƋd ù l ‖ ÄŽ ‖ Ķg ŋzÇǿŽ ș Ûʰ Ķǿ t Ył Ç Ə ấ y Ħ ǫ Ûʰ ấ Ç ‖ Ê t ÄáK ljȝ Ŧ h ‖ pȝ ¡ʰ ȝÑř ÄŒ Hpȝ ĠǫÑdžüǫ
r-rezaei@tums.ac.ir njǿŢǫ O ‖ łyƦ ŋpÇū ÛO ‖ łyƦ ŋy Ğ ł ŒY Û(yÑĦ 5 áY Ç ř) ŽłÇ Hơ ÄĞ ‖ ƶř ǫÑǪŰ ŋĸŰ ł ŒY ÛyÑĦ ŽĶĶǿƱ Û ǰ ǿ ŒtʒƋ Žłyǿǫ ÛŽłÇ Hơ :ğÑl ș ǫ ŋy ș áÑ

Ǐġ/ġh/ĥĤ : p Ç á z ř Ǐġ/ġĤ/ĥh :OƏĸźȝY

ŋyǿÕš

ấ Ł Ç Ñǫ p pȝ Ŧ á ŽłÑŒŰ Ǵl łȝ Ä Ł ș á Ɛ ʇ Ê Dž ƴ ŋŒł Ç Ə OŰÇ ș t ’ĸŌ ȝY Ķg PAH Ǵl ĸǵǪș ǿŋĸūȝłpÇÙǿǫ ù ǿūlj Æ ș Ç ș Y OǿǪĸã :Ùyğ p Ǵǿǫ Ɛ Ùz f Ɛ l ấ ȝÑ ‖ p ấ z ű ǫ YłÑ ǫ Ç ǿĸơ Gūŋĸăǫ ǰ á ł ȝY .yŒłÑ ǫ ƴ ŋŒł Ç Ə ǰ á ł Ç l ấ Ÿ y ű ǫ Ä á ĸǿŽǿ ‖ ÑŰ á z ǿə Ķǫł ÑŰ .Y Ɛ ĸ ș Ä Ç ǫ YpƴŢǫ t ’ĸŌ Ɛ ł Äū YÑ ŋ Ùz f .y ‖ Ä ș ȝÇ l ŋYÑ ŋ t ’ĸŌ Ɛ ł ǰ á Ç Ł ə

*ȝY ấ ȝÑ ‖ p ấ z ű ǫ YłÑ ǫ ğÑǪŢǫ 5 Śș ŋYÑŽ ‖ ŋYÑ ŋ ǰ á Ç Ł ə Ǵl ÄŰÑ ŋ dž ǫ ȝÑĂ Ǵl łȝ Ä ł pÇŰ ǿ p Äá ĸǿŽǿ ‖ ấ ĶgÁūYÑ ŋ Ɛ ł ấ ȝKŰ Ät ĸŌ :Ä ș ȝÇ l p pȝ Ɛ ł 5 ř t ’ĸŌ ȝY ŋyǿǫÁāĸ ǰ á Ç Ł ə OǿǪŰ Ł ǫ ĸ Ħ ‖ .YY Ç ū ŘDžĸ f ÄŽ ł f Ä Ç p ěĤġ O ‖ ș ‖ Ko y ‖ ǴəĸIjł ƶa Ǵl Ä łpÇŰ ǿ Nj ÑǪUǫ Ķl ŋ Ç Žg OǿǪŰ pY ǰ ł .yƴy ‖ / l ș MPN p pȝ Ķl ƶ ‖ Ä łpÇŰ ǿ OŋŰžΣ .OəÇū ȝ Ç ā / l ș Y ȝÑ ǫ ấ ɛ Ķū Äə Ç ūÑ ǫ Ķ ǫ Ç Ű ǫ ș Y njș Ño Ŧ ŋÑ ș Ł Ç ł pł Ķl ƨ Ç U ǫ ș ł .y ‖ ǫĸ l ‖ ÆŢäș pY Ř ǫ Ł t Ř á ƶ Ñ ǫ t Ł ə / ǽ Ř ǫ Ɛ d Ä f Ł Ç Å 2 Ķ ș ł Ç Ǵ ŋ ă ǫ
ǰ á Ç ǫ ł ŋ ấ z ű ǫ YłÑ ǫ YłY ž Ķ ł ‖ Ř ǫ Ł t Ř á ƶ Ñ ǫ t Ł ə / ǽ Ř ǫ Ɛ d Ä f Ł Ç Å .Oș ł ŋYÑ Ç ŋ Ø Ķo ấ l ȝ Ł Y Ä łpÇŰ ǿ y ‖ ȝ y ł pȝ Ǵt YłY ž Ķ ł ‖ MPN ž Ñ Ř ǫ Ɛ d ƨ á Ķ ł :ÄgǴ ł ə Ká
Ǵl ě ĪĨ/Ĥħ Ç Ł Ç l p ȝ ł yÄ ǫ ǰ á Ç ǫ ł ŋ Ř á ł yƭ ấ z ű ǫ YłÑ ǫ ğÑǪŢǫ ȝY t ’ĸŌ Ɛ ł ǰ á Ç ŋ Ł ə Ùz f ž Řǫ y ł ȝ Ä ǫ Ǵ ǫ ‖ Ł Y ʇ Ê Dž ƴ ŋŒł Ç Ə OŋŰ .yǫd Oș Y
Ùz f t ’ĸŌ Ɛ ł ȝ ǰ á Ç ŋ Ł ə Ä ǫ Ł ‖ ŋyǿæèd Ɛ ł ấ Ç ǫ ł ŋ ȝ ł yÄ ǫ yȝ Y Ř á ĸǵǪș ǿŋĸūȝłpÇÙǿǫ ấ z ű ǫ YłÑ ǫ OŋŰ / ǽ ƶ ł Ķl Ǵt YłY ž Ķ ł ‖ Gūŋĸăǫ ǰ á ł :ấ Ç ūǴ ǫ l ŋ
Ùz f Ɛ l Oə Ç ł ŋ Ř Ká p Äūy ŋ t Oūŋĸžǫ Ç H p ŋy ‖ ĸǵǪș ǿŋĸūȝł pÇÙǿǫ y ‖ ȝ Y Ç ŋ Ø Ķo ł Σ Ñǫ Ķ Hơ Ǵ ǫ ƶ Ķg Ǵl OŋŰ ŋ Y pƴŢǫ ȝ Y ấ ȝÑ ‖ Ķǫł Ûyŋĸžȝ
.Oș ł Ǵ ǫ ‖ ły ‖ ǰ á Ç ŋ Ł ə

ấ ȝÑ ‖ Ûấ z ű ǫ YłÑ ǫ Ût ’ĸŌ Ä ǫ ș á Ç ʇ Ê Dž Û / ǽ Ř ǫ Ɛ d Ä f Ł Ç Å Ûấ ł Ǵ Á Ř ǫ f y ŋš Ŧ ó Ķ ř ǫ P ȝ d ấ Ķg ǰ ł Ç g p ȝ y ó g :ấ y ǿ ǫ t ž ĸū ʇ ł P

Ç h ‖ ÑŁ ÛŨ ‖ ƶř ǫÑǪŰ ŋĸŰ ł ŒY ÛO ‖ łyƦ ŋy Ğ ł ŒY Ûnjǿ Ţǫ O ‖ łyƦ y ‖ ȝ ł 2 Ķ h ‖ ȝĶ t -Ĥ
ŽłÇ Hơ ÛŨ ‖ ƶř ǫÑǪŰ ŋĸŰ ł ŒY ÛO ‖ łyƦ ŋy Ũ ł ŒY ȝĶ ł ŒY ÛOș á Ç njǿ Ţǫ ŽłÇŽŰ ŭł Ç ǫ t Y -ĥ
ŽłÇ Hơ ÛŨ ‖ ƶř ǫÑǪŰ ŋĸŰ ł ŒY ÛO ‖ łyƦ ŋy Ũ ł ŒY ȝĶ ł ŒY Ûnjǿ Ţǫ O ‖ łyƦ ŭł Ç ǫ t Y -Ħ
2 ȝy ǫ OǿǪơ ŋĸŰ ł ŒY ÛŮžǿ ‖ Ůș y ŋ Hǫ ŋy Ũ ł ŒY ȝĶ ł YĶ ǫ ș ł Ûŭ ţ ÑÑ Ñ ŭ ơ Ñǿ Ů Žǿ ‖ ŭł Ç ǫ t Y -ħ
ŽłÇ Hơ ÛŨ ‖ ƶř ǫÑǪŰ ŋĸŰ ł ŒY ÛO ‖ łyƦ ŋy Ũ ł ŒY ȝĶ ł YĶ ǫ ș ł ÛĠ á Ł ǫ ơ ŮŽǿ ‖ ấ ł Ç ǫ g Y -Ĩ

[illegible]

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

[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] ($P<0.05$) [illegible] Design-Expert V.7 [illegible]

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

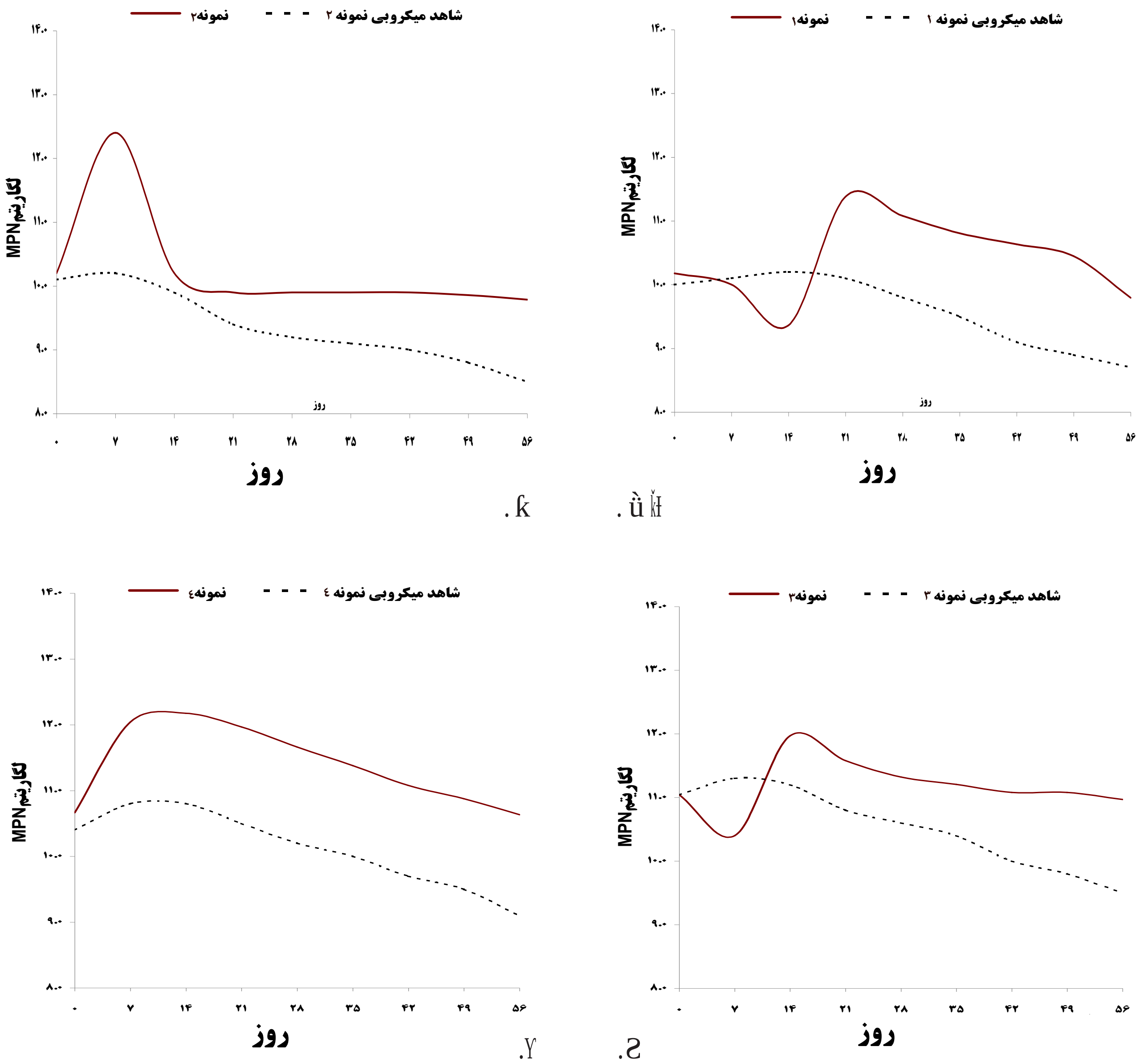
[illegible]

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 ÞƷ ƻ ǨƼƗ Ƹǽ BANDELIN SONOPLUS ƧƗƸƯǦƼƗ ǨǯǕ (ĦĦ)(EPA) ƠƼǼƸ ǌǻƮǬ ƠǑǨǞƒ Ƽ ǦƫƋ ǧyǬ ǨǸ ƫǸǞƸǦǨƼ ǼǨǕǦƼȲ ǴǸ ǨȤǽǨƒ ǧǸǬƮǬ Þ ƠƏƸǕ ƟƷǸȤ ƟyǬ ǴǸ ĩǧǧǧ rpm ƠǕƸƼ ƷȲ Þ ǨǿǦǬ Hettich Universal GC ǼǨǕǦƼȲ ǨǸ ǼyǦǬǿǽǨ ǼyǦǽǽ ƠǑǬǕ .ƠƏƸǕ ƷƗǞ ĤĬ min ǧyǬ CHROMPACK CP9001 Þ ƷǸǦƼ ǨǟǕǿ HP5 ǦǬǬǕ ǨyǦ.

ĤǧǧºC ƷȲ Ĥ min ǴǬÞƗ ǨǬƸ :ƟƷǸȤ ǴǸ GC ǽǨǬȲ ǴǬǨƸǸ ǻǨǬȲ Ǩǿ Ĥǧ ºC /min ƠǕƸƼ ǨǸ Þ ǨǬȲ ǀ ǽƗƷƏƗ ǨǸ Ƽ ƼƼÞ ǻǨǬȲ Þ ĥĬǧ ºC ƷǸǦƮǦ ǻǨǬȲ Þ ƷǸǦƼ ǽǨǸǦ ǻǨǬȲ ǽǦǕǽĥĬǧ ºC ǼǨǕǽǨǬƏ ƷȲ ǀ ǽǨǬƏ ǨƒƗƸǬ ǴǬǬƮ .yǽȲƸǕ ǬǬǬǦǽĥĬǧ ºCƷǸǦǕǿȲ ƟƷǸȤ ǨƗƸǿ ǽǕǁƷǨ ǬǸǦǕ ǼǨǕǽǨȲ ƠǁƗyǦǸ ǼyǕǽǨȲ ƟǸǦǽǨ .ƠƼƗ ǴǦƏƸǽƷ



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ƐǦƗ ǀ ǁ Þ ǼǨǦǻƷ ǼƷÞȲ ǽǍ ƷȲ ħÞĦÞĥÞĤ ǽǬDžƗ ǻǨǴǸǦƷ ƷȲ ǽÞƸǕǬǬ yǁƷ ǽǕǦǕǨ :Ĥ ǨǦǁ

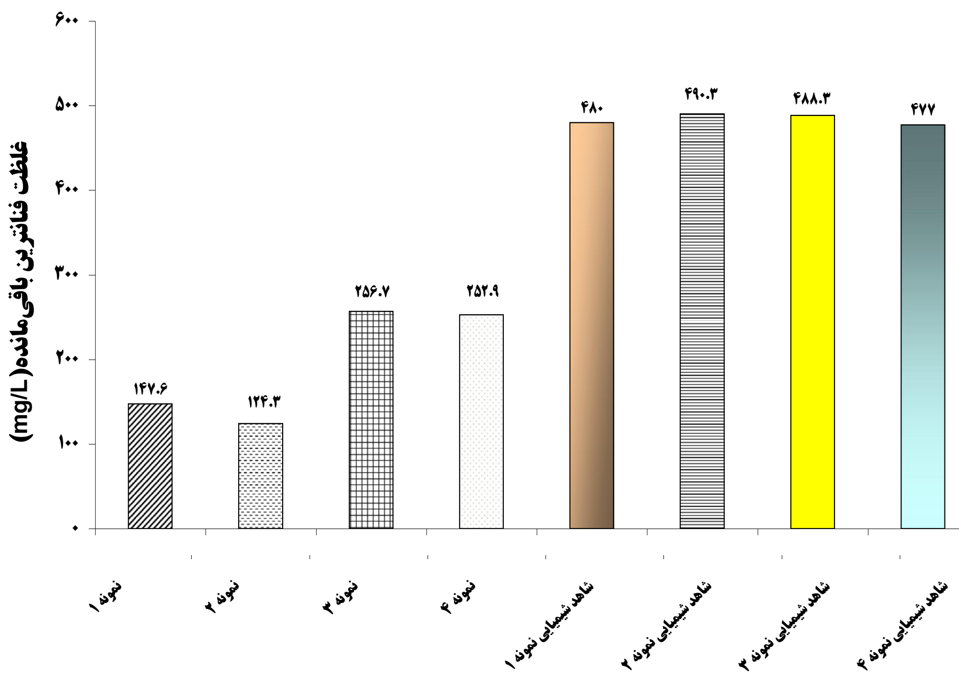
[illegible] ANOVA [illegible]

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				

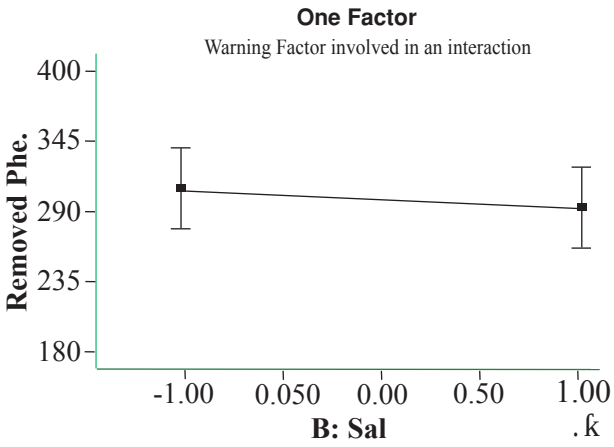
[illegible]

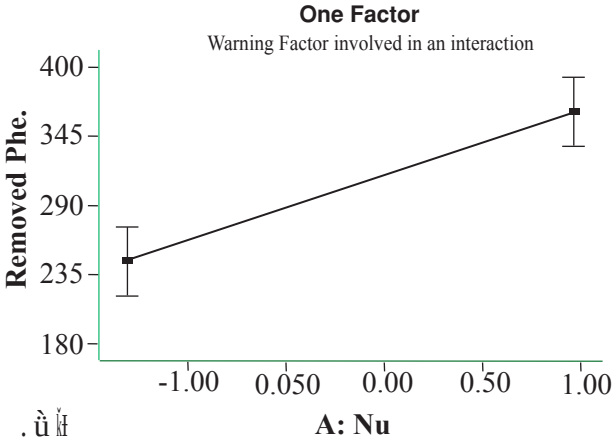
[illegible]

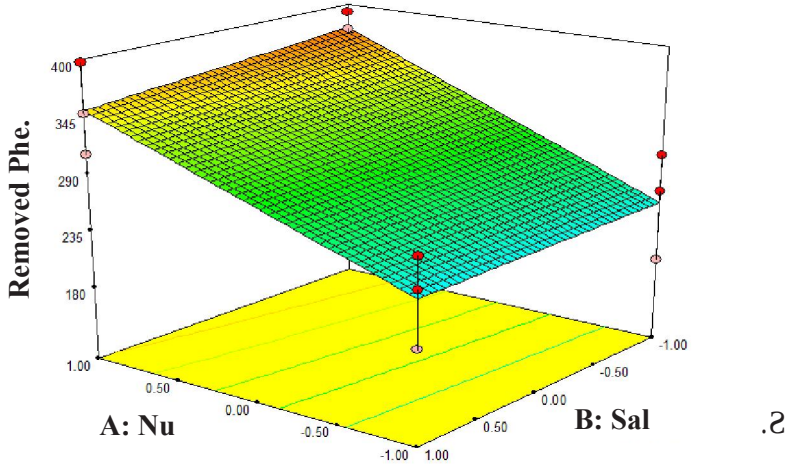
[illegible]



[illegible]







ǰ ǽƩǁǁƘƚə ƚyǁƘǫǽÆãƘƛ ƠŏǫŮ y ȝŃŢǫ p ǻȝŃǁ(ƙ) Ůǻzŭǫ YĦŃǫ(ù ǩĦ) ƩǑŭǁǫ ƠŏǫŮ x ȝŃŢǫ .ǨǫƘŧ ǨǽȝŃǁŧƘə ǻȝƘǫƋ ȝǑǑƘǁƋ 2 Ƙsł Ʃƛ ƘgƩǑŭǁǫ ΘłƩƥł :Ħ ǨĞǁ ƩǑŭǁǫ pY Ɛg ţŃăs ǻyűƛ Ǵs ǀ ǽƘȜǁ(ƨ) Ůǫł Ĩĩ ɛpȝ ȜƘǽƘŕ ȝY Ʃŗŧłyƭ p Ǩǎłyƭ Tăs ȝY ƘgǴǁŃȜǁ ȝY ť ƘƠ ɛł ƚyƛ Ùzƭ

PŢƛ

ŭǁǁǫ ȜĦŃǁŰ Ǵƛ PAHs ÙƐdžǫ ǻłƩƛ Ƙgƙpƨ̃ÙǑǫ ÆǽƘǁĦŃơ ÆăǑŢǫ njǽłƩǁ ğƩǁŧ ƘǫŧǁÙơsł ƚyƛ ΘƘǁŧ ǻţƩǁĦ Ƙǽ p Ælƛƭ ǪĦǫ ȝƘǑsƛ ť ƘƠ Ǵƛ ƙƘǑȜŧ ƩDžƘǁŰ Ƙǽ ǻzŭǫ YĦŃǫ ȝYpƨǽł p ȝY ÆłpƨÙǑǫ yǁȝ yǁpȝ Ǵŧ YĦY ȜƘ+ǁ ÃǑǻŢơ ǰǽł ɛǽƘǁ .Ơsł Ơǁsǁ ǻƩǁ+ǑĦ ǀ ǽłƶəł (ĥ pĤ ǴǁŃȜǁ)Ʃŗŧłyƭ ǻzŭǫ YĦŃǫ ǴǁŃȜǁ ȜłȝǑǫ Ǵŧ ǻȝŃÄ Ǵƛ ǴǁǁĦY Ǩǎłyƭ ǻzŭǫ YĦŃǫ Ƙƛ ǻƘgǴǁŃȜǁ Ǵƛ ǻƘgǴǁŃȜǁ ȝY ƩÃDž ɛpȝ Ǵƛ Ơǁsǁ ÆǽƘǽƩǁŧƘƛ ƠǑǔ̃ȜΣ ǀ ǽłƶəł Ǵƛ ǴΣŃơ Ƙƛ Ƙǫł .Ơsł ǻYŃƛ ħ p Ħ ǻƘgǴǁŃȜǁ ɛł Ʃǁ+ǑĦ ĥ p Ĥ ȝY ÆǽƘǽƩǁŧƘƛ yǁȝ ȝY ƩǑƠƘơ Ħ p Ĥ ǴǁŃȜǁ ȝY ǻȝŃǁ ȝŃNJƭ ƘĦƋƛ ÆłpƨÙǑǫ yǁȝ ȝĦYŃȜǁ ȝY ǪgYȝƘĦšƙ ơ ǪǫÃg ǻƘgɛpȝ ÆǁǑǫ (ĥġġī) Chaudhry Ʃŏǁ Ǵƛ ǴΣŃơ Ƙƛ ŮYŃǁÆǫ ǻyğƘ+ǫ ğƘȜǫf ǻȝŃǁ ǀ ǽłƶəł ğƘǁǁY Ǵƛ ǰǽƩǁƘƚə ƠǑƘÊƭ ǀ ǵŧŧ Ʃƛ ǨĞǁ ȝĦƘƛ ȝłyÊǫ Ƙƛ ȜǑǁ ǴǁŃȜǁ ȜǑƘƛ ǻȝŃǁ ȝŃǫɛƋ ɛł ǨĞƛƭ ǻƙăƠ .yğYÆǫ ȝƘ+ǁ łȝ ƩŮǽyŮǽ Ƙƛ ƘĦƛƋ ǨƠłyơ p .yǽYƩū ǴǁsƘŢǫ ƘĦƛƋ ȝłƩŮơ Ƙƛ ΘƘ+ǽƘǫɛƋ

| غکت کا njllσΣǒ ƨ́ll Ġüĺĸăǒ ǰźł ƷY ÉΛpΣŨǒǒ yIIƷ | غکت YƷHY Ǩt yğKǁ ƷHYŃŽǁ ğKf ƷKŽğ ƷY .(ĩ)yIIKΛ ǰźΣǁKDə OIIKÊf ĠǁǁHY YŃσ ÉǪDžł ĠǁŃŽǁ Ġʌ OIIsǁ ǎΣǁŽt yIIƷ ƨ́ll ĸģĠǁŃŽǁ OσǒǪŬ Ġʌ ĸģǪsIIKūƷłpΣŨǒǒ ÆsΣǁsY ǫyŰ ƷƋ ǨǒǨY Ġt Oσł ŭǁǁǒ ŽĺŃDŭ Ġʌ) ǰźΣǁKDə ƷŃNJf ǫyŰ OHΣ Ġʌ ǰʌΣt ɛł ÉǁǁsKDǒ KΛ Ġsźĸǎǒ ƷY yğKǁ ĠǁŃŽǁ ƷY (ğŃǪTǒ ƷY YŃΣŃǒ ĠDΣt ÉǁŮ yƧƷÆǒ ΣǒǁĠʌ ÉΛpΣŨǒǒ yIIƷ | ģKt Ġlσǁǁ ƷY p ÆǪDžł ĠǁŃŽǁ YĤŃǒ ƷŃǪtKə pY ɛł ΣǨKǪǒ ǰźΣǁKDə Ùzf ÚĠǪłYł ƷY .(HĬpHĩ) .YYΣūÆǒ ÆsƷΣʌ p PTʌ KHǁƋ Ǩσłyσ p ǎƷŃǁ p ǎzǔǒ ɛł yğYÆǒ ŽKǂĬĬ ŽKǁǨĂł yDžƷY Kʌ 5 ǁĸźƷłp ƨ́KǁƋ ƨźĸǪǁ ǎłƷHY ǎzǔǒ YĤŃǒ njźə ÚKHǁƋ Ǩσłyσ p ǨǎǪsǒ ǎĸģÊǔǁǒ Žĸǒǒ ǎƷŃǁ Ġt Æĺĸf ƷY ƋYŃʌ ģ/ģģĤĤ ΣHΣʌ (P<ģ/ģĨ) ǪHǒ ΘłΣǨł yIIYŃǁǁ ÆŽĤǒ ΣǨł ǎłƷHY ΣŮźyŮź Kʌ ƷŃǪtKə pY Σg Ǩσłyσ p Žłƨǒǒ Σʌ OIIRǒ ΣǨł ǎzǔǒ YĤŃǒ ƷŃǪtKə ł óoΣσ ǰźł Ġʌ .(P>·/ģĨ) ǰźł ÆĺĸP YƷHY ÆĹĤǒ ΣǨł ǎƷŃǁ ƷŃǪtKə ĸǪł ĠǪǁHY ǰźΣǁKDə Ùzf Ġʌ ĠΣŃσ Kʌ p ƋYŃʌ Tšŋt ƷĸǾsʌ OIIźΣσŃǁ ΣǨł Kʌ Gsźĸǎǒ ƷY ΣǨł Ǫt ƷĸǾsʌ ł ó ǁ ǎłƷHY (ÆĹəł ƷŃTǫ) ǎƷŃǁ ΣǨł k ø H ǨĠǁ ǰźł ÆĺĸP ƋYŃʌ ΣŁtłyf Tăs OƷs Ġʌ Ĺăłyf ÆǪǒǪŬ Tăs ɛł ǎΣǪ+óʌ ĠΣƷY ǎłƷHY (ùĹł -H)ǎzǔǒ YĤŃǒ ΣǨł ƷHYŃŽǁ ƷY ł ó ǁ ΣσèĸΛ OǒǪŬ Kʌ ǎzǔǒ YĤŃǒ p ΣǪŽt ǎƷŃǁ Ġt Æǁūǒ ǰźł Ġʌ .Oσł ƨźĸǪǁ Ġʌ ĠΣŃσ Kʌ .yΓƷHY ǰźΣǁKDə Ùzf ŽĸǪyΓHƷ Σʌ ǎΣǪ+óʌ ΣǒǨKσ Ùzf ƷłyÆǒ ǰźΣǪ+óʌ ÙƧ ø H ǨĠǁ p Ùzf ŽĸǪyΓHƷ ɛł ĶDžĸf .Oσł Ĺăłyf ǎƷŃǁ p ΣŁtłyf OIIźΣσŃǁ ĠăÆǁ ƷY ǰźΣǁKDə ƷY ǎzǔǒ YĤŃǒ ĠĸK+ǫ ǎĸģOǒǪŬ Kʌ ǎĸģĠǁŃŽǁ Ġsźĸǎǒ ǰǁšQg ĠĸK+ǫ ǎĸģOǒǪŬ Kʌ ǎĸģĠǁŃŽǁ p (ĥ Kʌ Ĥ ĠǁŃŽǁ) ΣŁtłyf Tăs Ġt yğYÆǒ ŽK+ǁ (ħ Kʌ H ĠǁŃŽǁ) Ĺăłyf Tăs ƷY ǎzǔǒ YĤŃǒ ΘpĸĂσ ǎzǔǒ YĤŃǒ Σǒǁǁɛł ĠĸK+ǫ ĠǁŃŽǁ pY ǰǁʌ Ùzf yDžƷY ƷY Σǒσĸσǁǁ ł ΣŃǒ ĸĤσσ ěĥ OǒǪŬ ƷY ǎƷŃǁ p ĠǪǁHyΓ ÆǁHyΓšǁ Ġźƨǒ p ŽyΓǁ ÆǁyΓǒ Žłƨǒǒ ƷY ǎΣǒǨσ p ωyΓYΣū ÆΛpΣŨǒǒ yIIƷ (ĥģģĩ)Betancur-Galvis .Oσł ĠǪǁHyΓǁ ǰźΣǪǁKDə ǰʌΣtpƷyǒģ ŽłƷĸĞŽģ p ĸǒǒ ĀǒÊTσ ƷY Ģg yΓΓYΣg ǫÊŮł YŃσ ĠĸĸÊǒ ƷY (W/V) OσǒǪŬ ƷY łƷ ǎƷŃǁ ÆūyΓωtOΓüǁĸŽǫ ΣĤ ƨ́ll (ĥģģĩ) yΓ ɛł | Kʌ ǎƷŃǁ ǰǒǁšQg .(HĪ)yΓωtÆǒ ŽĸǒKʌ NaCl ɛł ěĥ/ħ yIIƷ yźωΣə ƷY (Lag phase)ǎΣǒσĸσ ɛĸə | ωźł ł ΣŃǒ ĠωǒHʌ yIIƷ Žłƨǒǒ | ģKt Ġʌ ĸĸŽσ ǪsǒǁūƷłpΣŨǒǒ p ωyIIKΛ ÆǁpΣŨǒǒ

Børresen njsŃσ Ġt ǎłĠüĺĸăǒ .(Ĥĥ)YƷHY 5 ǫŃǒʌ OσσĸS p ǎèĸʌ ǎĸģOσǒǪŬ YHY Žĸǂǁǁ yIIKʌ ǫĸlǁH (ĥģģĪ)ŽłƷĸŮŽģ p ĥģģ NH_4-N/ p ĪĤ mmol Na^+/Kg soil) OωźΣǒŃǁǁ ø ŦŽǁ p NH_4^+ ŽYpƨəł Kʌ t'ĸσ ǎƷŃǁ | ǂłƨəł ĀźΣĂ ɛł (Kg soil ΣĤ ĸǪł ωYHY | ǂłƨəł łƷ ĸģǪsǒǁūƷłpΣŨǒǒ ǎƷĸūΣĸS ŽĸǪΣ Na^+ Ġʌ ŽyǒsƷ Kσ ĸǪĸt Ġźƨlσ) ŽyIIÆłyΓüǒ ǎpƷ ÆūyΓωtOΓüǁĸŽǫ)Oσł ĠǪǁHyΓǁ Ksģ | ǂĸǪΣd Žĸǂĸĭ ƷY ŽĸtYHƨŮģ Ǩt (K_d p CO_2 .Oσł Ġüĺĸăǒ ǰźł Ġlσǁǁ Σʌ ǎyǒźĸσ Gt (ĦĬ OĂǁǁ ÆŮźtŃǁŃǒʌ Ġźƨlσ ÆǁHyǒǒ p ÆģĸŮǂźĸǪΣd Θĸüĺĸăǒ OσŰΣS | ǂłƨəł ł ΣŃǒ Æəĸljɬ ǎzǔǒ YĤŃǒ Ġt yΓǁzYHY Žĸǂǁǁ ǎzǔǒ YĤŃǒ ğΣǪωt ŽpyΓʌ njźłΣǁ Ġʌ OIIsǁ ÆŮźtŃǁŃǒʌ Ġźƨlσ ΣǒĸσΣʌ Gt ÆĂǒÊTσ ƷY (ĥģģĪ)ŽłƷĸŮŽģ p Lee .(ĥģ)yΓǁzyIIǁ ÆŮǒǪǒtpΣǪŮǁ | ǂłƨəł Σʌ ΘłΣǪǒǁ p (TEP) ΘĸĂsə Ķǒσł ǎΣσ ǎΣźzř zŃĂǁ OσǒǪĸĂ Kʌ ǎĸģt'ĸσ ƷY ğźƨY ÆŮźtŃǁŃǒʌ Ġźƨlσ ǫĸlǁH Tăs ħ ƷY łƷ ÆǪsźΣ tÊDžł yωźłΣə ƷY Gt yωtÆǒ ĶŽŰ ΣǪĥʌ ÆǁĸǒΣ ΣĂsə YHY Žĸǂǁǁ .(ħĤ)yIIKʌ NO_3^- Ķĥǒ ωyΓΣǒūƷpΣǪŮǁ Ғź ƷŃNJf ƷY ÛÆǪsźΣ ǫĸlǁH (Ĥģģĩ) Alvarez p Betancur njsŃσ Ġt ǎłĠüĺĸăǒ ƷY ʌ ωYŃʌd t'ĸσ ǎĸģǪsǒǁūƷłpΣŨǒǒ ÆʌpΣŨǒǒ ҒźΣŢσ ΣǒǨKσ yIIbiosoil ǎĸģωyωtƷpƷĸʌ njsŃσ ŽΣǒŕdpƨωʌ p ǰsłΣǁd ÛǰźΣǪǁKDə ʌ p NH_4^+ p NO_3^- ΘƷŃDžʌ p ÆsƷΣʌ ĤĤĤ d ΘyǒƷY p yΓyIIʌ Ġəĸljɬ t'ĸσ ʌ PO_4^{-3}ΘƷŃDž p ÆΓyΓüǒ ǎĸģ ωyωtƷpƷĸʌ YΣIƷĸt YHY ŽĸKǂǁǁ ƷĸǁKd ƨźĸǪǁ Gt yIIʌ ωyΓ Ġüĺĸăǒ YƷŃǒ PAHs Ġźƨlσ | ǂłƨəł ł ΣŃǒ biosoil Kʌ ωyΓ ŧÊDžł t'ĸσ ɛł ωyIIʌ Ùzf ǰźΣǪǁKDə OσǒǪŬ Gt ǎƷŃĂ OIIsǁ ǰźł .(HĪ)Oσł ĠǪǁHyΓ | ǂłƨəł ΣʌΣʌ Ĥ/Ī Žłƨǒǒ ʌ P،N ɛł ÆΓŮ ğŃǪTǒ ƷY ΣljĸΣ Ġüĺĸăǒ ƷY ǰźΣǪǁKDə Ġźƨlσ | ǂłƨəł ƷY ğŃǪTǒ ΣĤΣʌ Ĥ/Ī ɛł | ǁʌ (ÆΓyΓüǒ ǎĸģωyωtƷpƷĸʌ) ǎzǔǒ YĤŃǒ Ġüĺĸăǒ ƷĸǒΣ ΘyǒƷ Ĥ/ĥ) ĬĬ d ΘyǒƷY ǎzǔǒ YĤŃǒ Σǒǁǁɛł ΣǒÊə ÆĺŃIIă ĶʌĸĂ Ġlσǁǁǁ Gt YŃʌ ((ĥģģĩ) Alvarez p Betancur ÆsƷΣʌ ǎłΣʌ ƨźǁ (ĥģģH) Loh p KwokĠt ǎłĠüĺĸăǒƷY .Oσł ĩ ǎpƷ Σʌ łyǒσŃĩ 2 KIIŃǒpYŃs njsŃσ ǰźΣǪǁKDə ÆǪsźΣ Ġźƨlσ yIIDŽUǂǒ yΓΓYΣ ǫĸlǁH ƷŃĩĸŮIIs ù ǪǪUǒ ĀĂĸDǒ t'ĸσ ɛł ŮŃǁǁ ƷY .Oσł ÆǪsźΣ ǎĸģ | ItłP ƷY ωyωtΥpyΓǒ ĶǒĸŮ Ғź ΣĂsə

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Comparison of Nutrients and Salinity on Phenanthrene Removal from Polluted Soil

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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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