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| Trace Elements | mg/L |
|---|------|
| EDTA-Sodium Salt | 500 |
| ZnSO ₄ .7H ₂ O | 10 |
| FeSO ₃ .7H ₂ O | 200 |
| MnCl ₂ .4H ₂ O | 3 |
| H ₃ BO ₃ | 30 |
| CoCl ₂ .6H ₂ O | 20 |
| CuSO ₄ .2H ₂ O | 10 |
| NiCl ₂ .6H ₂ O | 6 |
| Na ₂ MoO ₄ .2H ₂ O | 3 |

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| ماده مغذی | محلول ماده مغذی (mg/L) | محلول ماده مغذی (max) | محلول ماده مغذی (min) |
|---------------|--------------------------------------|-----------------------|-----------------------|
| | K ₂ HPO ₄ | 800 | 0/132 |
| | KH ₂ PO ₄ | 200 | 0/103 |
| Macro & Micro | KNO ₃ | 1000 | 1/7 |
| | MgSO ₄ .7H ₂ O | 200 | 200 |
| | CaCl ₂ .2H ₂ O | 100 | 100 |
| | NaCl | 100 | 100 |
| | FeCl ₃ .6H ₂ O | 10 | 10 |
| Trace | Trace elements | 1mL | 1mL |

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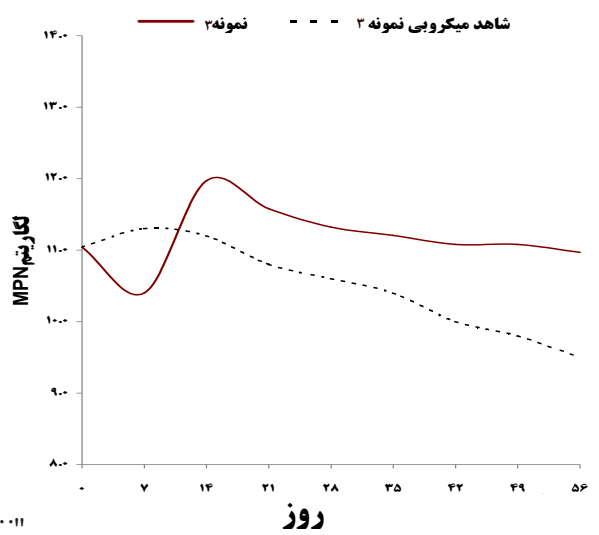
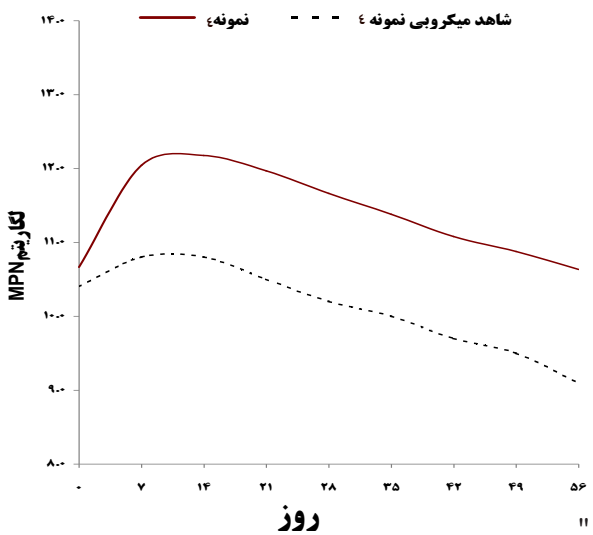
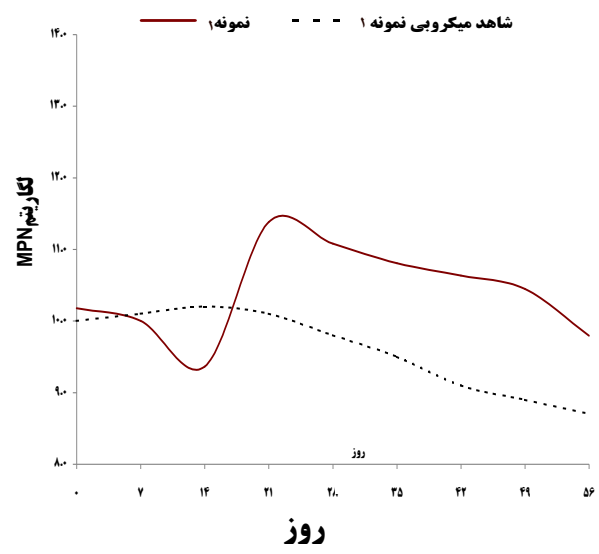
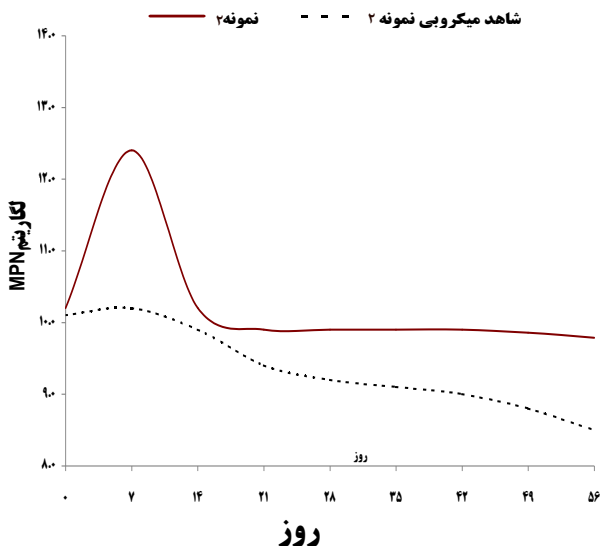
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| آزمایش | مواد مغذی (Nu.) | شوری (Sal.) | مخلوط میکروبی | فناثرین |
|----------------------|-----------------|-------------|---------------|---------|
| نمونه ۱ | +۱ | +۱ | + | + |
| نمونه ۲ | +۱ | -۱ | + | + |
| نمونه ۳ | -۱ | +۱ | + | + |
| نمونه ۴ | -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 | -۱ | -۱ | + | - |

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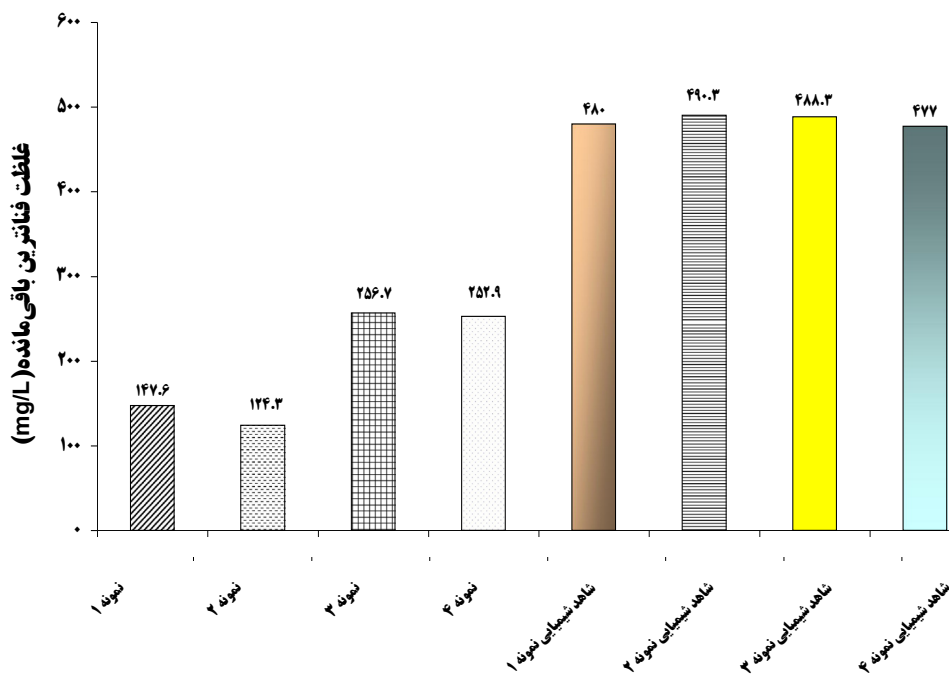
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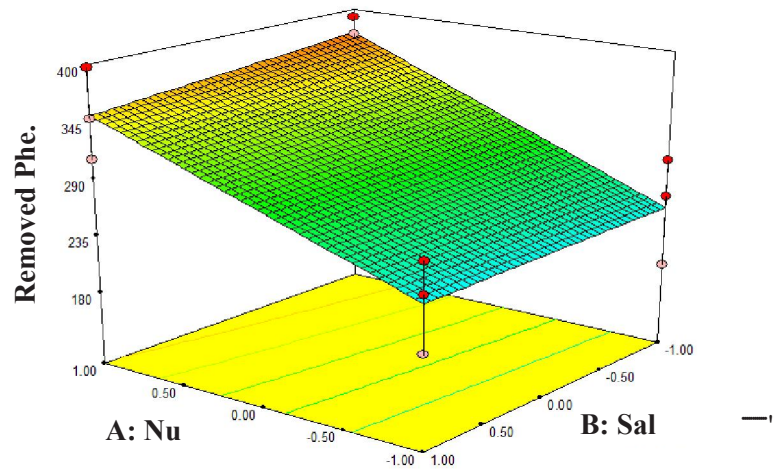
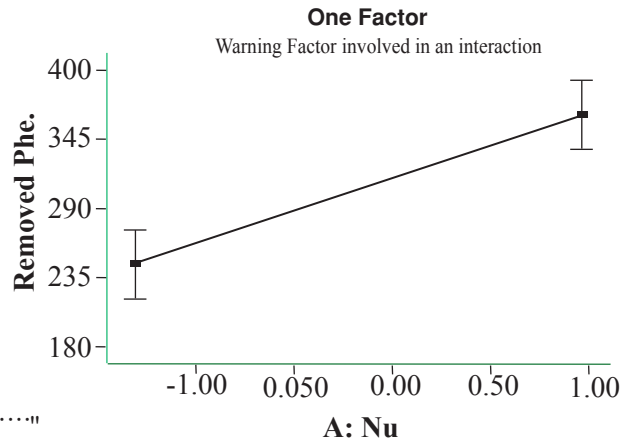
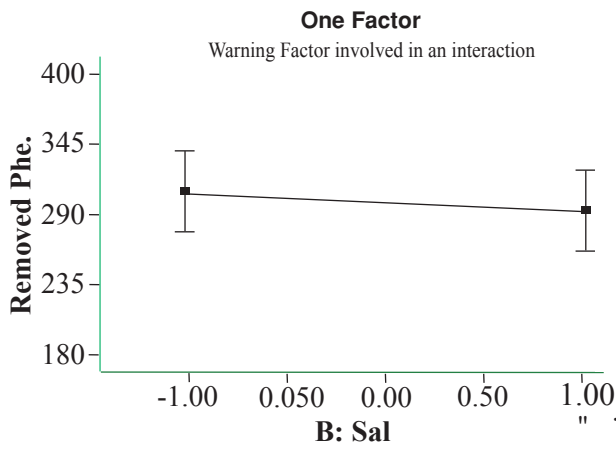
| Source | Effects | Sum of Square | df | Mean Square | F-Value | P Value Prob > F | |
|------------|---------|---------------|----|-------------|---------|------------------|-------------|
| Model | | 43228/1 | 3 | 14409/4 | 8/464 | 0/0073 | significant |
| A-Nu | 118/87 | 42387/9 | 1 | 42387/9 | 24/900 | 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 | | | | |

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PAHs

Linear ANOVA

(Significant $P < 0.05$)

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(Chaudhry)

Børresen et al. (2005) reported that the removal of NH_4^+ from the soil solution by plants is related to the soil pH. In acidic soils, the high concentration of H^+ ions leads to the protonation of the amino groups of the amino acids, which are then taken up by the plants. In alkaline soils, the high concentration of OH^- ions leads to the deprotonation of the amino groups, which are then taken up by the plants. The removal of NH_4^+ from the soil solution by plants is also related to the soil salinity. In saline soils, the high concentration of Na^+ ions leads to the displacement of NH_4^+ ions from the soil solution by the plants. The removal of NH_4^+ from the soil solution by plants is also related to the soil organic matter. In soils with high organic matter, the amino groups of the amino acids are adsorbed to the soil particles, which are then taken up by the plants. The removal of NH_4^+ from the soil solution by plants is also related to the soil texture. In soils with high clay content, the amino groups of the amino acids are adsorbed to the clay particles, which are then taken up by the plants. The removal of NH_4^+ from the soil solution by plants is also related to the soil moisture. In soils with high moisture, the amino groups of the amino acids are more available to the plants, which leads to a higher removal of NH_4^+ from the soil solution. The removal of NH_4^+ from the soil solution by plants is also related to the soil temperature. In soils with high temperature, the amino groups of the amino acids are more available to the plants, which leads to a higher removal of NH_4^+ from the soil solution. The removal of NH_4^+ from the soil solution by plants is also related to the soil nutrient status. In soils with high nutrient status, the amino groups of the amino acids are more available to the plants, which leads to a higher removal of NH_4^+ from the soil solution. The removal of NH_4^+ from the soil solution by plants is also related to the soil pH. In acidic soils, the high concentration of H^+ ions leads to the protonation of the amino groups of the amino acids, which are then taken up by the plants. In alkaline soils, the high concentration of OH^- ions leads to the deprotonation of the amino groups, which are then taken up by the plants. The removal of NH_4^+ from the soil solution by plants is also related to the soil salinity. In saline soils, the high concentration of Na^+ ions leads to the displacement of NH_4^+ ions from the soil solution by the plants. The removal of NH_4^+ from the soil solution by plants is also related to the soil organic matter. In soils with high organic matter, the amino groups of the amino acids are adsorbed to the soil particles, which are then taken up by the plants. The removal of NH_4^+ from the soil solution by plants is also related to the soil texture. In soils with high clay content, the amino groups of the amino acids are adsorbed to the clay particles, which are then taken up by the plants. The removal of NH_4^+ from the soil solution by plants is also related to the soil moisture. In soils with high moisture, the amino groups of the amino acids are more available to the plants, which leads to a higher removal of NH_4^+ from the soil solution. The removal of NH_4^+ from the soil solution by plants is also related to the soil temperature. In soils with high temperature, the amino groups of the amino acids are more available to the plants, which leads to a higher removal of NH_4^+ from the soil solution. The removal of NH_4^+ from the soil solution by plants is also related to the soil nutrient status. In soils with high nutrient status, the amino groups of the amino acids are more available to the plants, which leads to a higher removal of NH_4^+ from the soil solution.

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Comparison of Nutrients and Salinity on Phenanthrene Removal from Polluted Soil

Maasoumeh Ravanipour¹, *Roshanak Rezaei Kalantary², Mahdi Farzadkia², Samireh Hashemi-Najafabadi³, Ali Esrafiy²

¹Department of Environmental Health Engineering, Faculty of Health, Bushehr University of Medical Sciences, Bushehr, Iran

²Department of Environmental Health Engineering, Faculty of Public Health, Tehran University of Medical Sciences, Tehran, Iran

³Department of Biotechnology, Faculty of Chemical Engineering, Tarbiat Modares University, Tehran, Iran

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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 population using 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

*Corresponding Author: r-rezaei@tums.ac.ir

Tel: +98 21 88779118 Fax: +98 21 88779487