Research Article Open Acces

Keywords: Phenol; Biodegradation; Pseudomonas aeruginosa; Plackett-Burman Design; Central composite design

Introduction

Phenol is one of the most common toxic environmental pollutants, arising during the processing of resins, plastics, dyes, varnishes, pharmaceuticals and pesticides from several industrial processes and several chemical industries [1]. Phenol concentrations are toxic to sh if it is higher than 2 mg/L and concentrations between 10 and 100 mg/L would result in death of many aquatic lives within 4 days [2]. e Environmental Protection Agency (EPA) stated that less than 1.0 ppb of phenols in surface waters is good for health. e World Health Organization (WHO) has set a limit level of 1 mg/L to regulate the phenol concentration in drinking waters [3].

erefore, development of new methods has generated signi cant interest for phenol removal from industrial wastewater [4]. Chemical or physical methods for phenolic waste treatment were used conventionally such as chemical oxidation, solvent extraction and adsorption, but these processes are facing secondary e uent problems. Apart of these methods, biological treatment i.e. Biodegradation is good alternative. Biodegradation is versatile, inexpensive and can potentially turn a toxic material into harmless products [5].

e use of pure cultures microorganisms, especially for e cient metabolism of the contaminant, is advisable as a better alternative compare to mixed culture [6-9]. In general, the one-variable at a9(en)8(sina(l)(i TJ 0.025 Tw T* [(o)12(f va)9(r)-6(i)-3(a)8(b)7(les)(

was applied to evaluate nine factors (including tw5w2o dummy variable

one suggested by [15]. e medium was sterilized in two parts to avoid K

precipitation of ferrous salts during autoclaving. ese were denoted as $_2HPO_4$, KH_2PO_4, $MgSO_4$, $(NH_4)_2SO_4$, $MnSO_4$, $FeSO_4$, H_3BO_3, Nl

Part A and Part B with the following compositions:

and phenolselected for the screening process by PB design. Each variable was examined at tw5w2o levels:3 Tw8ir the slo Pvels:nd o(

Part A K_2HPO_4, KH_2PO_4, $FeSO_4 7H_2O$

Part B $(NH_4)_2SO_4$, $MgSO_4 \cdot 7H_2O$, $MnSO_4$, H_3BO_3, NaCl

A er autoclaving, the contents were cooled and then mixed together and kept as stock solution from which known quaogh kdog1m-9.9(r)15w2Um5oTm (2)g2Um5c 0 Tw T* tscn 45.56c kdor the cultm

500 mg/l. e pH of the medium thus obtined was 7.0±0.1.

Acclimatizaton

e primry cultm10(ur)13(e wa)3(s p)12(r)13(ep)-5(a)9(r)13(e)-4.9(d b)16(y t)-5(ra)6tsferring the two loops(2)g2Um5c73 Tw -1.575 -1.

e concentratn of phenoldegraded in the solution was 2determined by a UV-vis spectrophotometer using 4-.59(min)4(o a)6tog

Plackett-Burman design

Plackdt-Burmn design, an e cient way to identify the importnt factors .59(m)4(o)12(n)8(g a l)-3(a)9(r)8(g)8.1(e n)19(um)10(b)-9(er o)12.1(f va)9(r)-6(i)-3(a)8(b)7(les [19], wa)3(s u)3(s)-8(e)-4.9(d in t)-6(h

levels below 95%, were considered insigni cant and were not included in CCD experiments. e Pareto chart shows the signi cant variables in Figure 1.

e model equation for phenol degradation (Y) could be written as:

$$Y = 82.53 – 1.14\ A – 2.43\ B - 11.53\ C + 0.56\ D + 25.75\ E + 61.27\ F – 13.72\ G – 6.80\ H – 0.33\ J$$

Optimization by response surface methodology and regression analysis

CCD was employed to study the interactions between the signi cant

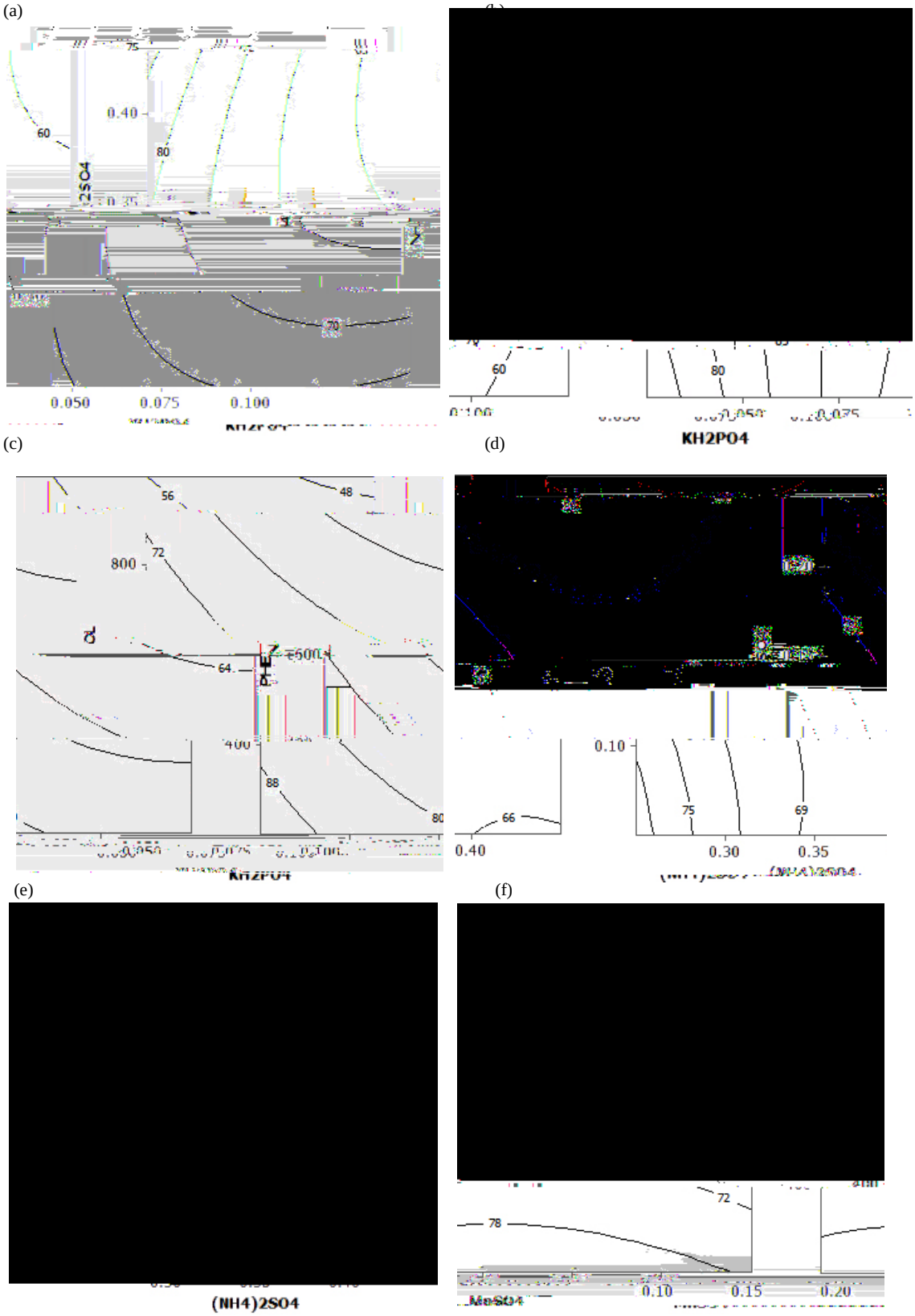

Figure 2: Contour plots showing the interaction effect between pair of variables (a) KH2PO4 and (NH4)2SO4, (b) KH2PO4 and MnSO4, (c) KH2PO4 and phenol, (d) (NH4)2SO4 and MnSO4, (e) (NH4)2SO4 and phenol, (f) MnSO4 and phenol on phenol degradation (%) by keeping the other two variables constant at middle level.

of phenol. Four medium variables out of nine were identi ed to be signi cant on phenol degradation by PB experiment. e results obtained from RSM were clearly explained that optimum values of signi cant variables had a signi cant e ect and promotes an increase in percentage of phenol degradation. e optimization results shows that the maximum phenol degradation of 81.62 (%) was obtained when KH_2PO_4, $(NH_4)_2SO_4$, $MnSO_4$ and phenol were kept on optimized concentrations 0.05 g/L, 0.35 g/L, 0.15 g/L and 500 mg/L respectively.