

Magnesium ammonium phosphate precipitation method in the treatment of ammonia nitrogen in the landfill leachate analysis of influence factors

Runlei Cai¹ Xiang He¹ Jinxiang Fu¹ Fan Wang¹

1. School of Municipal and Environmental Engineering, Shenyang Jianzhu University, Shenyang 110168, China

E-mai:962189726@qq.com

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Abstract. Magnesium ammonium phosphate by adding magnesium salt and phosphate to ammonia nitrogen landfill leachate, The medicament and ammonia nitrogen landfill leachate Mg^{2+} PO_4^{3-} ions in NH_4^+ after chemical reaction of producing magnesium ammonium phosphate. In the whole reaction process is influenced by pH value, reaction time, reactant ratio etc.. The effects of pH, reaction time, reactant ratio and Calcium ions amount on ammonia-nitrogen removal efficiency and the residual concentrations of ammonia-nitrogen have been investigated respectively. The optimum reaction conditions by orthogonal experiment are $\text{Mg}^{2+} : \text{PO}_4^{3-} : \text{NH}_4^+ = 1.2 : 1 : 1$, $\text{pH}=9$, $t=15\text{min}$ and $\text{Ca}^{2+}/\text{Mg}^{2+}=0$. Ammonia-nitrogen removing tests of Laohuchong landfill leachate performed under the optimum conditions, and the best removal efficiency is above of 60%.

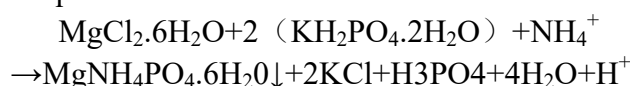
Introduction

As a kind of high concentration organic wastewater, landfill leachate, contains a lot of ammonia nitrogen lead to serious imbalance of the C/N in the water[1][2]. So, the conventional biochemical treatment technology of landfill leachate treatment is difficult to achieve the desired effect. At present, the remove method used in practical projects to remove ammonia nitrogen in leachate, but to remove method exist tail gas recovery, "secondary pollution" problem[3]. Chemical precipitation as wastewater denitrification technology widespread attention at home and abroad in recent years[4][5]. Therefore, the purpose of this experiment is represented by magnesium ammonium phosphate crystallization through research of chemical precipitation of garbage leachate in ammonia nitrogen removal effect and operating conditions, looking for a new feasible way to remove the garbage leachate, provide the certain reference value for practical engineering application[6].

Experimental principle

Magnesium ammonium phosphate by adding magnesium salt and phosphate to ammonia nitrogen landfill leachate, The medicament and ammonia nitrogen landfill leachate Mg^{2+} PO_4^{3-} ions in NH_4^+ after chemical reaction of producing magnesium ammonium phosphate[7].

Specific reaction equation is as follows:



Experimental materials

Landfill leachate used to the experiment is from shenyang laohuchong landfill
And the water quality indicators such as table 1.

Table.1.Water quality of landfill leachate(mg/L)

Indicator	COD	BOD	NH ₃ -N	pH	TP
numerical	24800	4500	2545	7.8	15

Experimental method

Putting 500 mL beaker containing landfill leachate in six league blender,with 5 mol/L NaOH solution the leachate PH value,then, plus MgCl₂.6.H₂O and KH₂PO₄. 2H₂O.Waiting for the fully dissolved in slow mixing, stirring speed of 150 r/min,After a certain reaction time, stop stirring.Static sink after take clear liquid on the determination of the concentration of ammonia nitrogen[8].

NH₃ - N adopts nessler's reagent spectrophotometry

COD adopts potassium dichromate method

Results and discussion

The influence of reactant ratio of ammonia-nitrogen removal rate

Adjusting the landfill leachate pH value of 9, adding to the leachate MgCl₂.6 H₂O,KH₂PO₄.2H₂O.Mg²⁺ : PO₄³⁻ : NH₄⁺=(1)1:1:1(2)1:1:0.8(3)1:1:1.2(4)0.8:1:1(5)1.2:1:1(6)1:0.8:1(7)1:1:1.4(8)1:1:1.4.Static sink after mixing time of 15min , supernatant on measuring the water content of ammonia-nitrogen.

Specific data as shown in figure.1

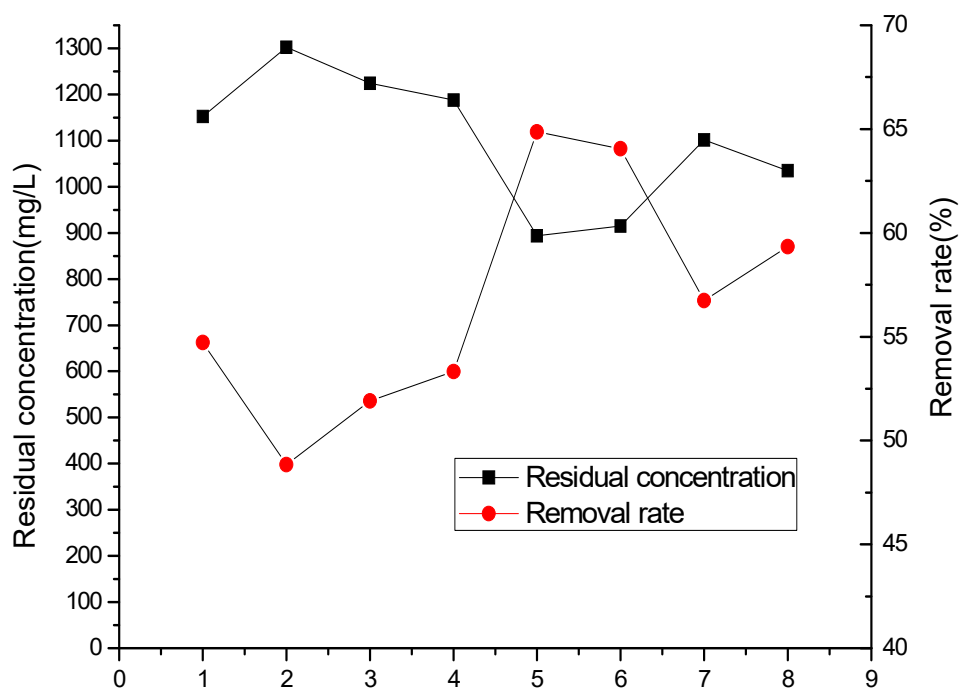


Fig.1.Effect of reactant ratio on ammonia-nitrogen removal and concentration of residual ammonia-nitrogen

We can have a conclusion that the best reactant ratio was (5).Ammonia-nitrogen removal rate had reached the 65%.

The influence of pH of ammonia nitrogen removal rate

Adding to the leachate $\text{MgCl}_2 \cdot 6\text{H}_2\text{O}$, $\text{KH}_2\text{PO}_4 \cdot 2\text{H}_2\text{O}$, $\text{Mg}^{2+} : \text{PO}_4^{3-} : \text{NH}_4^+ = 1.2:1:1$. With 5 mol/L NaOH solution the leachate PH value: (1)8.0(2)8.5(3)9.0(4)9.5

(5)10.0(6)10.5 (7)11. Static sink after mixing time of 15min , supernatant on measuring the water content of ammonia-nitrogen.

Specific data as shown in figure.2

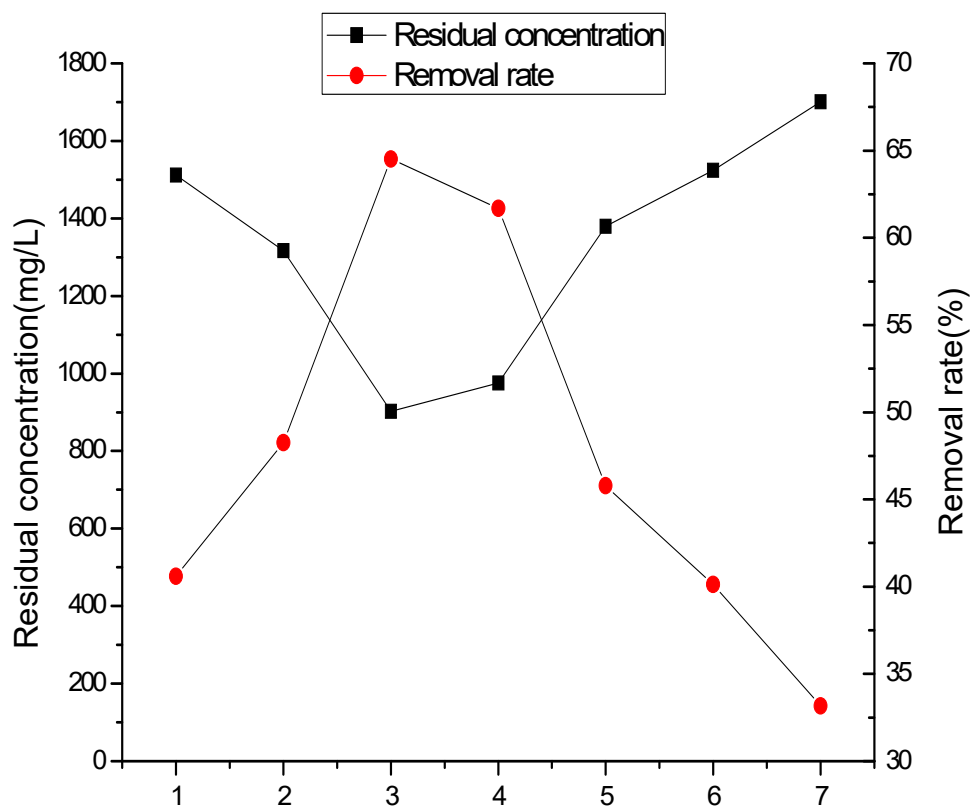


Fig.2.Effect of pH on ammonia-nitrogen removal and concentration of residual ammonia-nitrogen

We can have a conclusion that the best pH was(3) .Ammonia-nitrogen removal rate had reached the 64%.

The influence of reaction time of ammonia nitrogen removal rate

Adding to the leachate $\text{MgCl}_2 \cdot 6\text{H}_2\text{O}$, $\text{KH}_2\text{PO}_4 \cdot 2\text{H}_2\text{O}$, $\text{Mg}^{2+} : \text{PO}_4^{3-} : \text{NH}_4^+ = 1.2:1:1$, with 5 mol/L NaOH solution the leachate PH value of 9.0. Static sink after mixing time of : (1)5min(2)10min(3)15min(4)20min(5)25min(6)30min, supernatant on measuring the water content of ammonia-nitrogen.

Specific data as shown in figure.3

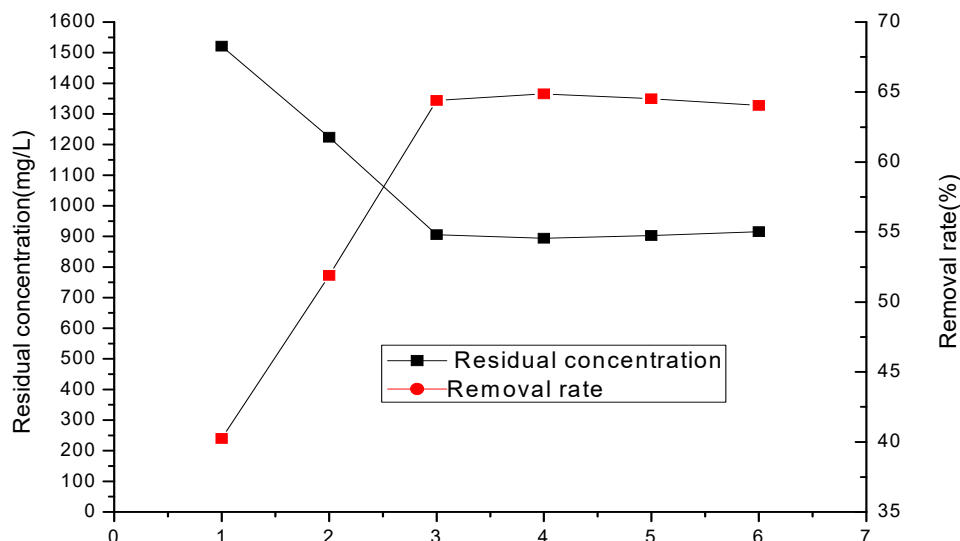


Fig.3.Effect of reaction time on ammonia-nitrogen removal and concentration of residual ammonia-nitrogen

With the increase of mixing time, fully contact reaction between reactants, ammonia nitrogen removal rate was gradually improved. But more than 15min after mixing, ammonia nitrogen removal rate of growth is not much, long time at the same time will stir established MAP crystal broken, is not conducive to precipitation, affect water quality. Therefore, from the practical application and economic considerations selected mixing time of 15min, The ammonia nitrogen removal rate is about 64%.

The influence of $\text{Ca}^{2+}/\text{Mg}^{2+}$ of ammonia nitrogen removal rate

Adding to the leachate $\text{MgCl}_2 \cdot 6\text{H}_2\text{O}$, $\text{KH}_2\text{PO}_4 \cdot 2\text{H}_2\text{O}$. $\text{Mg}^{2+} : \text{PO}_4^{3-} : \text{NH}_4^+ = 1.2:1:1$, with 5 mol/L NaOH solution the leachate PH value of 9.0. Static sink after mixing time of 15min, Adding to the leachate $\text{Ca}^{2+}/\text{Mg}^{2+}$: (1)0 (2)0.1 (3)0.2 (4)0.3, supernatant on measuring the water content of ammonia-nitrogen.

Specific data as shown in figure.4

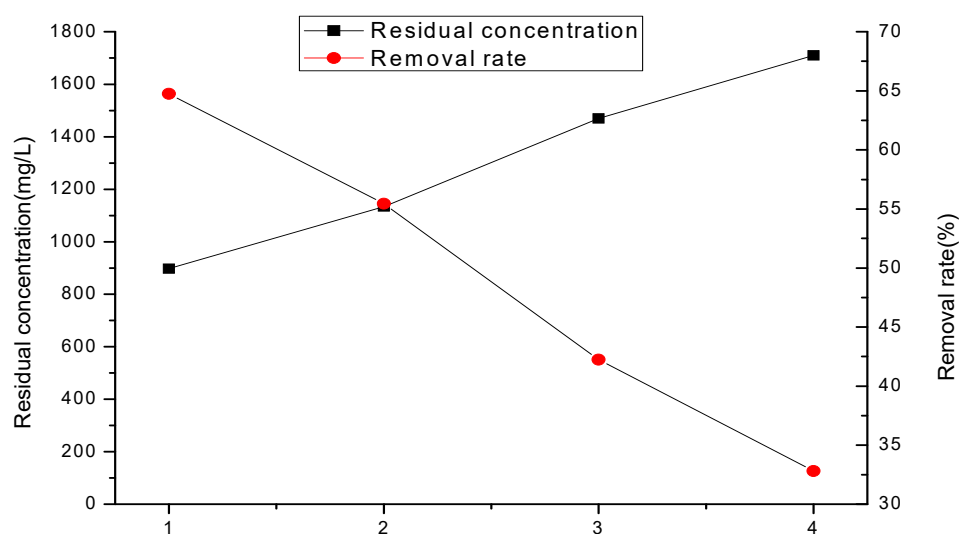


Fig.4.Effect of $\text{Ca}^{2+}/\text{Mg}^{2+}$ on ammonia-nitrogen removal and concentration of residual ammonia-nitrogen

We can have a conclusion that the best $\text{Ca}^{2+}/\text{Mg}^{2+}$ was (1). Ammonia-nitrogen removal rate had reached the 64%.

Orthogonal experiment

In order to determine magnesium ammonium phosphate precipitation optimum reaction condition of removing $\text{NH}_3\text{-N}$ orthogonal experiment was carried out. Do the orthogonal experiment with pH value, reaction time, reactant ratio and $\text{Ca}^{2+}/\text{Mg}^{2+}$ four factors three levels.

And the results are shown in table 2

Table.2.the orthogonal experiment

serial number	reactant ratio	pH	$\text{Ca}^{2+}/\text{Mg}^{2+}$	reaction time
(1)	1:1:1	8.5	0.0	10min
(2)	1:1:1	9.0	0.1	15min
(3)	1:1:1	9.5	0.2	20min
(4)	1.2:1:1	8.5	0.2	15min
(5)	1.2:1:1	9.0	0.0	20min
(6)	1.2:1:1	9.5	0.1	10min
(7)	1:1:1.2	8.5	0.1	20min
(8)	1:1:1.2	9.0	0.2	10min
(9)	1:1:1.2	9.5	0.0	15min

Specific data as shown in figure.5

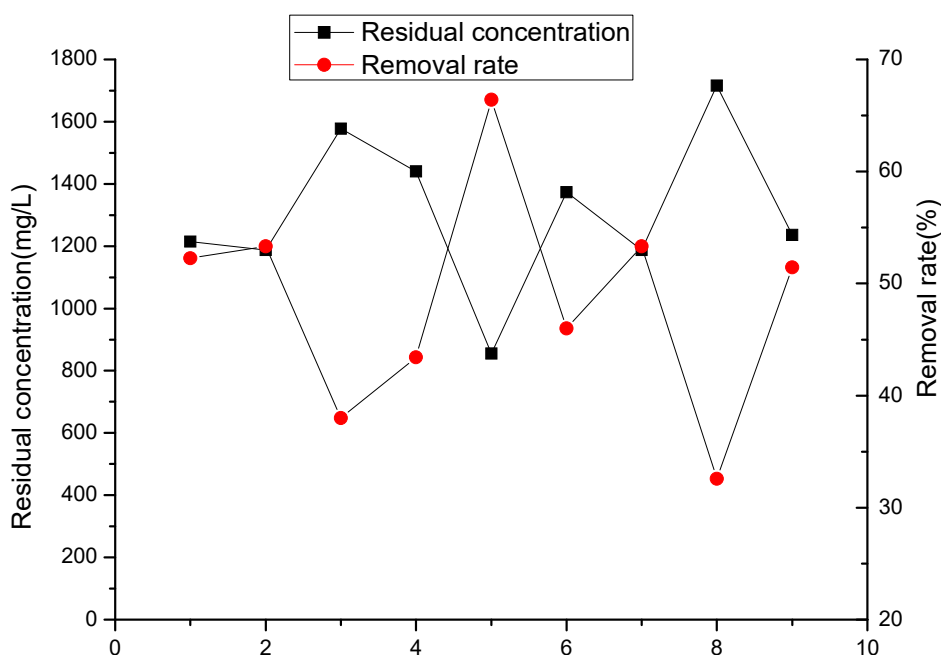


Fig.5.Effect of four factors on ammonia-nitrogen removal and concentration of residual ammonia-nitrogen

We can have a conclusion that the optimum reaction conditions was(5). Ammonia-nitrogen removal rate had reached the 66%.

Conclusion

Magnesium ammonium phosphate method and treatment of ammonia nitrogen in the landfill leachate research for effective treatment of landfill leachate ammonia nitrogen to provide reliable experimental data and theoretical basis.

The experiment results showed that:

- (1) Ca^{2+} is not conducive to the formation of magnesium ammonium phosphate precipitation;
(2) The optimum reaction conditions by orthogonal experiment are $\text{Mg}^{2+} : \text{PO}_4^{3-} : \text{NH}_4^+ = 1.2 : 1 : 1$, $\text{pH}=9$ and $t=15\text{min}$.

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