RESEARCH ON IMPROVING WASTEWATER TREATMENT PLANT PERFORMANCE: THE IMPACT OF HYPOCHLORITE AND FERRIC CHLORIDE ON AMMONIA AND CHLORINE LEVELS

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REVIEW

Abstract
This study aimed to address elevated levels of ammonia and chlorine in the Aleșd wastewater treatment plant. The objective was to enhance treatment efficiency by introducing Hypochlorite and Ferric Chloride. Over a four-month period, daily monitoring of ammonia and chlorine levels was conducted. The results demonstrated a significant reduction in both ammonia and chloride levels, meeting the required parameters. This study highlights the effectiveness of the implemented strategy in optimizing wastewater treatment plant performance.

Keywords: High ammonia levels, wastewater treatment plant
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INTRODUCTION

The pervasive presence of total ammonia in wastewater, predominantly stemming from anthropogenic activities, poses a significant environmental challenge. The consequences of rapid and uncontrolled industrialization, coupled with urbanization and technological advancements, have given rise to higher living standards and an increased abundance of products. Unfortunately, this affluence also contributes to a concerning trend of wastefulness, resulting in the augmented production of solid wastes (Quing, 2012).

Ammonia, a compund comrising nitrogen and hydrogen, emerges as a key pollutant in both municipal and industrial wastewaters. It is a byproduct of variois human activities, including industrial discharges, agricultural runoff, and domestic sewage.

This discharge of high concentrations of ammonia into water bodies can have detrimental effects on aquatic ecosystems, leading to eutrophication, oxygen depletion, and potential harm to aquatic life (Heisler, 2008). Municipal wastewater treatemnt plants often face the challange of efficiency removing ammonia to comply with enviromental regulations and safeguard water quality.

In the specific context of the Aleșd wastewater treatment plant, the elevated levels of ammonia underscore the critical need for targeted interventions. In response to this challangee, our study focuses on implementing strategies involving the addition of Hypochlorite and Ferric Chloride. By addresing the ammonia levels in wastewater, we aim to contribute to the optimization of treatment processes, minimizing the enviromental inpact of ammonia discharge and promoting sustainable water treatment practices. This research is not only imperative for the local context but also holds broader implications for wastewater management strategies globally.

MATERIAL AND METHOD

1.Material

This study was conducted at the Aleșd wastewater treatment plant in October 2023, prompted by the detection of elevated ammonia levels during a lab test. The initial ammonia concentration was determined to be 81.9 mg/dm^3.

Wastewater samples were collected in October 2023, immediately following the detection of high ammonia levels. The samples were drawn from various points within the treatment plant and were stored in glass jars for laboratory analysis.

2.Chemicals and Reagents

The chemicals used included Hypochlorite (sodium hypochlorite) and Ferric Chloride. Sodium hypochlorite is a commonly used disinfectant and oxidizing agent in wastewater treatment, known for its effectiveness in reducing ammonia levels (Zangeneh, 2021). Ferric chloride, a coagulant, has demonstarted efficiency in precipitating impurities, including phosphorus and nitrogen compound (Eskicioglu, 2018).

3.Method

3.1. Experimental design

The experimental design aimed the impact of Hypochlorite and Ferric Chloride additions on ammonia levels in wastewater while maintaining chloride concentrations within the required standard. The process involved the following steps:

a) Sample preparation:
   - Wastewater samples (100 ml each) were placed in glass jars.
   - Samples were collected daily over a four-month period from various points within treatment plant.

b) Reagent Addition:
   - Hypochlorite and Ferric Chlorite were added at concentrations ranging from 250 µl to 1000 µl.
   - The concentration range was selected based on preliminary tests and optimization experiments.

c) Monitoring Ammonia Levels:
   - The Ammonium Cell Test was performed on each sample using the photoLab 7100 Vis spectrophotometer.
   - Measurements were taken at regular intervals after reagent addition.

d) Monitoring Chloride Levels:
   - Chloride levels were monitored concurrently using Hanna HI 96701 spectrophotometer.
   - The concentration of Hypochlorite and Ferric Chloride was adjusted as needed to maintain chloride levels within the specified range.

Table 1

Ammonia and Chlorine Levels in the first month

Week	Ammonia Levels (mg /dm^3)	Chlorine Levels (mg/dm^3)
1	81.9	0.3
2	80.0	0.25
3	68.7	0.3
4	52.3	0.3

RESULTS AND DISCUSSIONS

The results obtained after comparing pictures taken of the samples and test s showed a significant difference compared to the values initially determined.

Table 1 illustrates the weekly progress in ammonia levels over the course in ammonia levels over the course of the first month.

Commencing with an initial concentration of 81.9 mg/dm^3, a notable reductio to 52.3 mg/dm^3 was achieved by the end of the first month. This improvement underscores the efficacy of the applied Hypochlorite and Ferric Chloride treatments in mitigating ammonia concentrations in the wastewater.

Chlorine levels remained consistently within the required standard range throughout the first month.

Table 2

Ammonia and Chlorine Levels in the second month

Week	Ammonia Levels (mg /dm^3)	Chlorine Levels (mg/dm^3)
1	52.3	0.4
2	31.2	0.3
3	21.6	0.3
4	15.7	0.3

The results presented in Table 2 showcase a continued reduction in ammonia levels throughout the second month. Commencing with a value of 52.3 mg/dm^3 in week 1, the concentration further decreased to 15.7 mg/dm^3 by the last week of the month. Chlorine levels remained steadfast within the
required standard range of 0.5 mg/dm^3 throughout the second month. This sustained

control over chloride concentrations highlights the reliability and stability of the applied treatment methodology.

Table 3

Ammonia and Chlorine Levels in the third month

Week	Ammonia Levels (mg /dm^3)	Chlorine Levels (mg/dm^3)
1	15.7	0.3
2	7.4	0.2
3	4.0	0.2
4	2.8	0.2

The results presented in Table 3 showcase a continuous and substantial reduction in ammonia levels on the third month. Beginning with the second week.

The Value of 15.7 mg/dm^3 was recorded in week 1, the concentration steadily decreased to 2.8 mg/dm^3 by the last week of the month. This reduction brings the ammonia levels close to the required standard of 2.0 mg/dm^3.

Consistent with the previous months, chlorine levels remained well within the required standard range throughout the third month.

Table 4

Ammonia and Chlorine Levels in the fourth month

Week	Ammonia Levels (mg /dm^3)	Chlorine Levels (mg/dm^3)
1	2.8	0.3
2	2.0	0.3
3	2.0	0.2
4	1.9	0.2

The results presented in Table 4 signify the successful culmination of the experiment, particulary in achieving the targeted standard of ammonia levels. Starting with a concentration of 2.8 mg/dm^3 in week 1, the levels progressively decreased, reaching 1.9 mg/dm^3 by the last week of the month, in adherence to NTPA 001 standard.

Throughout the last month, chlorine levels-maintained consistency within the required standard range. This sustained control over chloride concentrations underscores the precision and reliability of the applied Hypochlorite and Ferric Chloride treatment methodology.

CONCLUSIONS

The present study embarked on a comprehensive exploration of wastewater treatment enhancement, targeting the reduction of ammonia and the maintenance of chloride levels within regulatory standards. Leveraging the application of Hypochlorite and Ferric Chloride, our investigation unfolded over a four-month period, delving into the nuanced dynamics of ammonia and chlorine concentrations at wastewater treatment plant in Aleșd.

Commencing with an alarming initial ammonia concentration of 81.9 mg/dm^3, our sesonal variations, and potential synergies with existing treatment processes, guiding the study showcased a remarkable journey toward effective treatment. The first month witnessed a substantial reduction, bringing the concentration down to 52.3 mg/dm^3, with chlorine levels steadfastly adhering to the required standards. The positive trend persisted into the second month, where ammonia levels continued their descent to 15.7 mg/dm^3, still maintaining optimal chloride control. As the study advanced, the third month saw a continuous reduction to 2.8 mg/dm^3, with the final month meeting the stringent standard of 2.0 mg/dm^3 set by NTPA 001.

Throughout the four-month period, the application of Hypochlorite and Ferric Chloride demonstrated exceptional control over chloride concentrations, consistently meeting the required standard of 0.5 mg/dm^3. This steadfast stability in chloride levels is indicative of the precision and reliability of the applied treatment strategy, ensuring that the introduction of regents did not compromise the overall quality of the treated water.

The success observed in our study has far-reaching implications for practical applications in wastewater treatment. Achieving and sustaining compliance with stringent regulatory standards for ammonia levels suggested the potential scalability and adaptability of the Hypochlorite and Ferric Chloride treatment methodology. As our study concludes, the door opens for the future research to explore long-term sustainability, evolution of comprehensive wastewater management practices.

ACKNOWLEGMENTS

The present research was supported thank to the grant **Good teaching practices in experiential learning for effective education in embedded food systems – GOODFOOD - 2020-1-PL01-KA203-082209**, conducted by the University of Oradea.

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