Proceedings of the 2nd International Conference on Green Energy, Environment and Sustainable Development (GEESD2021), D. Dobrotă and C. Cheng (Eds.)

doi:10.3233/ATDE210329

Research on the Technology of Recovering Low Concentration Ni^{+} Metal Ion Solution

Huige CHEN[a], Hangyu CHEN[a], Kechi CHEN[a], Xinda WU[a,b,1], Wanyu ZHENG[a] and Linjing WANG[a]

[a] *School of Chemistry and Materials Engineering, Huizhou University, Guangdong, China*

[b] *Huizhou Zhongkai High-tech Zone ZongHua Battery Science and Technology Research Institute, Huizhou, China*

Abstract. Under environmentally friendly and environmental issues, wastewater treatment in laboratories and factories is an important international issue. Among them, wastewater from the chemical industry accounts for a large part of industrial wastewater discharge. The introduction of new technologies to treat chemical wastewater is of great significance. In particular, the amount of wastewater produced by inorganic chemistry experiments is relatively large, and the pollutants are mostly heavy metal salts. According to the characteristics of inorganic chemistry experimental wastewater, such as special nature, small amount, strong discontinuity, high hazard, complex and changeable composition, etc., design a chemical reaction to provide a practical and feasible method to treat wastewater with high efficiency and low cost. This research initially takes Ni+ metal ion waste liquid as the first stage of recycling and treatment to improve the traditional low-concentration non-economic treatment. The preliminary results of this research are neutralization reaction and optimal pH value control of Ni+ waste liquid to generate Ni^{+} precursors to increase the economic value of recycling will be the basis for providing in-house recycling systems for electroplating plants, panel plants, and semiconductor plants to achieve emission reduction, green chemical industry and green environmental protection.

Keywords. Factory wastewater, Ni^{+} metal ion, inorganic chemical experiment waste liquid, neutralization reaction, green environmental protection

1. Introduction

China is rich in water resources, but with the continuous growth of the economy and the rapid development of industry and agriculture, a large number of water pollutants flow into the water body, which greatly reduces the quality of the water environment and severely damages the ecological environment. According to statistics, China industrial wastewater treatment rate is 79.91%, and the compliance rate is only 60.23% [1]. About 1/3 of the waste water in the country flows directly into the human body without treatment. In industrial wastewater, chemical wastewater occupies a large part. If the inorganic chemical wastewater generated in chemical production is directly discharged, it will cause harm to the natural environment, because chemical wastewater

[1] Corresponding Author, Xinda WU, [a]School of Chemistry and Materials Engineering, Huizhou University, Guangdong, China; [b]Huizhou Zhongkai High-tech Zone ZongHua Battery Science and Technology Research Institute, China; Email: 13478511396@139.com; wutomp@hzu.edu.cn.

has certain volatility and poisonous and harmful characteristics. Therefore, it must be treated before the waste water can be discharged. Based on this, for the health, green and sustainable development of society and economy, analyze and strengthen the research on environmental protection treatment technology of chemical production wastewater, as well as the application of related environmental protection treatment methods, the effective treatment of chemical production wastewater, and the treatment effect Reasonable control is of great significance. At the same time, it is a prerequisite for the chemical industry to achieve social and economic benefits. Only continuous innovation in chemical wastewater treatment technology can ensure the healthy, green and sustainable development of China's economy.

Therefore, waste water must be treated and recycled or discharged up to the standard. However, some chemical substances in the waste water are not much or the recycling value is not great, so the treatment method must be selected according to the cost of the waste water, so as to ensure that chemical production can be carried out stably. Ensure that wastewater does not harm the environment. In addition, the serious pollution problems in recent years have caused widespread concern around the world for environmental protection. While focusing on development, people have also begun to pay attention to effective pollution prevention and control. The development of science and technology will be the technical support for future pollution control. It points out the way for waste disposal.

In recent years, with the continuous improvement of the level of industrial technology, electric vehicles have gained widespread popularity, and the number of used batteries has also grown rapidly. However, waste batteries contain heavy metals such as manganese, mercury, nickel, etc. Whether in the atoms pH ere or underground, their heavy metal components will overflow with the seepage, causing groundwater and soil pollution. However, heavy metals entering the soil are difficult to degrade naturally and will accumulate over time [2]. This will cause serious damage to the soil, affect sustainable development, and even seriously affect the health of animals and plants [3-4]. Therefore, from the perspective of environmental protection and resource utilization, the recovery of heavy metals in waste batteries is an inevitable trend. At present, the recycling and processing technology and system of waste batteries in foreign countries are relatively complete. However, in China, the processing technology of waste batteries is relatively backward [5], and most of the processing and recycling of waste batteries in China are limited to the recovery of heavy metals. However, the technology for the recovery and treatment of heavy metals with low concentrations such as nickel is relatively lacking [6-7].

There are many methods for the recovery of organic solvents [8], among which the more effective methods are absorption method, condensation method, adsorption method, membrane separation method and so on. These different recovery methods are often based on the characteristics of different organic solvents to select the most effective method for recovery, and sometimes two or more methods may be used in combination to recover organic solvents more effectively. Absorption method: The principle of the absorption method is to use the classic similarity and compatibility principle of chemical organics and use organics with similar chemical properties to recover organics in industrial production; Condensation method: The condensation method is mainly to condense organic solvents from the gas at low temperature. Direct recovery; adsorption method: the solid adsorption method actually uses some solids that can effectively absorb toxic organic solvents to absorb them. For example, we are all familiar with solid adsorption objects such as activated carbon; membrane separation method: this is used for membrane separation. Multiple membranes can be used at the same time. Different membranes can separate different toxic organic solvents, so multiple membranes are used. After the membrane, a variety of toxic substances can be fully and thoroughly recovered; neutralization method: processing by certain means, because the acidic substance and the alkaline substance can be neutralized to produce salt substances and converted into salt solutions After that, its pH will be greatly reduced and become neutral.

The recovery and treatment of nickel and the release and accumulation of nickel ions in nickel-containing wastes are the main causes of water pollution. To eradicate the pollution of nickel-containing wastewater, it must be controlled from the source, and appropriate interception measures must be taken to control the source of pollution. The waste batteries, waste catalysts, waste electroplating tanks, waste printed circuit boards, and the flushing water and waste residues in the production process of steel containing nickel are rich in metallic nickel. Traditional pyrometallurgy and hydrometallurgy are used to reduce pollution sources. At the same time, metal nickel can be recovered well [9-10].

2. Experimental Principle

A large amount of inorganic chemical waste water. This waste water is directly discharged, it will cause harm to the natural environment. However, some substances are small in quantity or have little recycling value. Therefore, treatment methods must be selected according to the cost of wastewater to ensure that chemical experiments can be carried out stably. At the same time, it is ensured that waste water will not harm the environment.

The total amount of laboratory wastewater is not large, but due to its strong periodicity, high instantaneous discharge concentration, concentrated discharge, high concentration of toxic substances, etc., it is necessary to select a suitable sewage treatment process for treatment, and confirm that it meets the requirements of Sewer Water Quality Standard (CJ343-2010) before discharge. But its small quantity, dispersion, the use of simple, efficient, low-cost, easy-to-operate decentralized integrated sewage treatment equipment will become the development trend of laboratory wastewater treatment, and it also has the value of promotion and application.

As shown in figure 1, the main core virtual box is the main reaction experiment. Take an appropriate amount of electroplating nickel concentrate, slowly add alkaline solution to it, stir it fully, and continue to check the pH value. When the pH is stable between 4.0-5.0, stop adding The lye, continue to stir for 10-30 minutes, followed by pressure filtration; continue to slowly add the lye to the filtrate obtained above, and continue to check the pH value to stabilize the pH value at about 9.0~10.0, fully stir, and the reaction time 1~2 hours; the reaction solution obtained above is transported to a filter press for pressure filtration, and the final solid obtained after pressure filtration is dried in a drying oven at 120-150°C. After drying, a nickel hydroxide product is obtained. The filtrate can be discharged directly, Ni^{2+}<0.1mg/L in the filtrate.

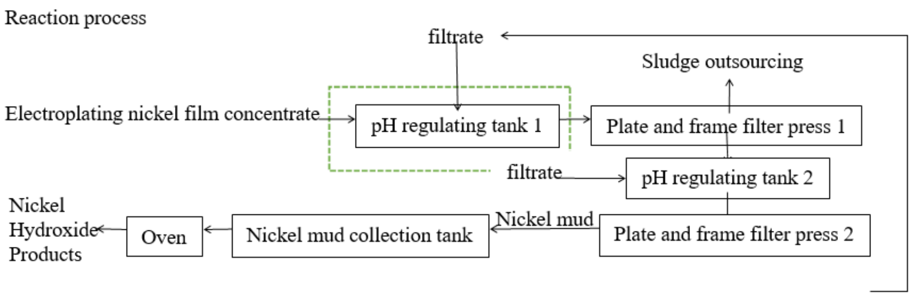
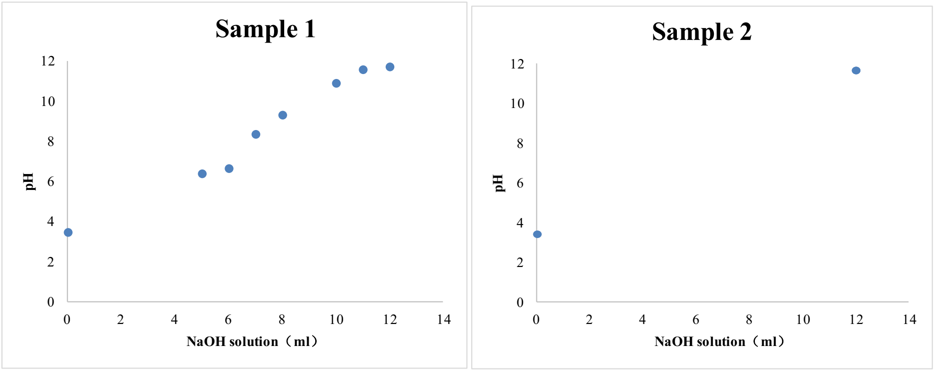


Figure 1. Factory reaction flow chart.

3. The First Stage Reaction Control Experimental Discussion

In this experiment, industrial wastewater was used to extract nickel to achieve the purpose of waste liquid utilization. Take 40ml Ni^+ waste liquid sample and use pH meter to measure pH 3.45; 80ml distilled water measured pH 7.15; Take 20g NaOH solid block into beaker and put it into distilled water. Dissolve to obtain 20g/100g NaOH solution and measure the pH to be 10.94. The preparation reagents are used as raw materials for mixed titration experiments. In the experimental group, the operation is: add 0ml, 5ml, 1ml, 1ml, 1ml, 2ml, 1ml NaOH solution to Ni^+ solution in batches, stir and make the reaction fully, observe that the color of the solution gradually changes from cyan to dark green and then to Yellow-green and become turbid to produce nickel hydroxide precipitation. The pH meter is used to measure the solution after each addition of NaOH solution and the reaction is complete. The measured pH is: 3.45, 6.38, 6.64, 8.39.31, 10.9, 11.58, 11.72, and the pH changes are shown in figure 2a.



(a) (b)

Figure 2. Low concentration Ni^+ reaction control experiment.

The first operation of the control group was: adding 0ml and 12ml NaOH solution to 40ml Ni^+ solution in batches and stirring to make it fully react. It was observed that the color of the solution changed from cyan to dark green and more nickel hydroxide precipitation was formed. The measured pH values are: 3.45 and 11.71 respectively, and the pH changes are shown in figure 2b.

The third operation of the control group is: first add 5ml HCl original solution to 40ml to make the reaction fully, then add 12ml, 5ml, 5ml NaOH solution in batches and stir to make the solution react fully. Observe that the color of the solution changes from light green to cyan and then to ink It is green and nickel hydroxide precipitates. The measured pH values are 0.74, 3.45, 6.26, and 9.55 respectively. The pH changes are shown in figure 3.

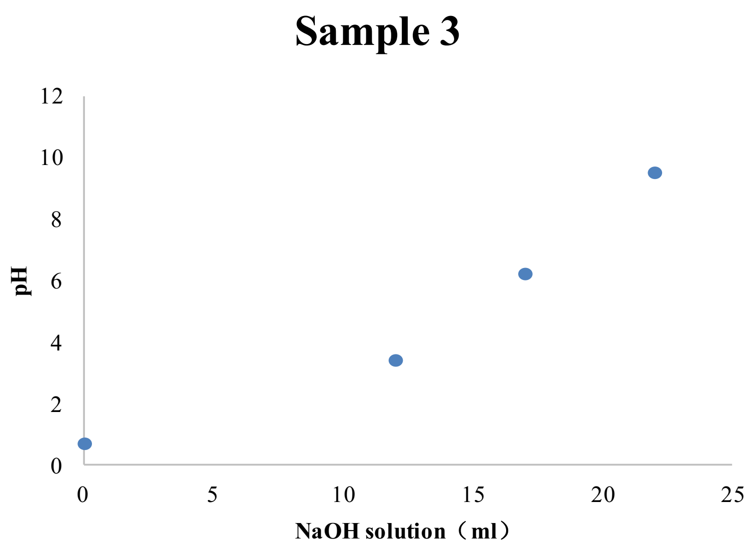


Figure 3. Reaction control experiment of low-concentration nickel pretreatment with hydrochloric acid.

The reaction solution obtained in the above three experiments was filtered, and the solid obtained after filtration was placed in a drying oven at 120-150°C and dried, and the precursor monomer Ni(OH)x was obtained after drying. yH2O, the best reaction ratio is currently about 1:0.12~0.16. The filtered filtrate is a transparent liquid, which will be stored as thinner for the next reaction. It is also a design for recycling and reuse in this experiment. This will be the best data reference for an industrial design recycling tank.

4. Conclusion

For the treatment plan with a small total content of waste liquid metal, it will solve the characteristics of non-economic value, instantaneous discharge, concentrated sewage discharge, and toxic substances. It is necessary to select a suitable sewage treatment process for treatment, and confirm that it meets the "Sewage Discharged into Urban Sewer Water Quality Standards" (CJ343-2010). However, its small quantity, dispersion, and the use of simple, efficient, low-cost, and easy-to-operate decentralized integrated sewage treatment equipment will become the development trend of laboratory wastewater treatment, and it also has the value of promotion and application. The preliminary results of this study are the neutralization reaction, the control of the liquid concentration after the pre-treatment of the liquid, the reproducible addition reaction, and the effective synthesis of the precursor monomer Ni(OH)x. yH_2O, currently about 1:0.12-0.16 is the best reaction ratio, which will be the best data reference for industrial design of recycling tanks. In the future, different reactions and different methods of metal ion synthesis precursors will be carried out, so as to realize the technology of environmentally friendly reuse.

Acknowledgment

The study special thanks, supported by The Professorial and Doctoral Scientific Research Foundation of Huizhou University (2020JB034), FERRY READING CAFE and Staff canteen provide space for this discussion. Thanks to Huizhou Minyi Industry Co., Ltd. for providing the experimental site, Huizhou TCL Environment Technology Co., Ltd. and Huizhou Zhongkai High-tech Zone ZONGHUA Battery science and technology Institute for Project support.

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