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A New Cost-effective and Eco-friendly Way to Recover Sulfuric Acid Waste Using Bleaching Soil †

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Abstract: Sulfuric acid is one of the acidic wastes produced in the edible oil refining industry during testing to determine the oxidation stability of the oil. Sulfuric acid is required as a rinsing solvent to clean Rancimat glass tubes. This acid cannot be discharged directly into the environment. Use processing and acid consumption must be performed to comply with environmental quality standards. The aim of this study was to purify and recover acid waste. In this new method, first water and other solvents are removed under a vacuum system at 80 ° C, then bleaching soil is added to sulfuric acid and placed at 80 ° C for half an hour, and then white soil. The solvent is separated by centrifugation. Recovery was about 90%. An identical sample of oil with oxidation stability was tested with a Rancimat device and the results showed no change with fresh sulfuric acid. This study developed an innovative, effective, and simple method for the recycling of acid waste that can successfully resolve this significant problem in industry. This method both reduces carbon emissions and recycles valuable resources, which is of important environmental and economic significance.

Keywords: Sulfuric acid, Waste, Recovery, Environmental

1. Introduction

Industrial waste which is a range of different processes that may be obtained, exists in solid, liquid or gaseous forms. Their impact on environmental target is considered due to their intricate and perilous nature, which affects active and inanimate living environments that are of favor environmentalists. Increasingly popular important hard regulations on the discharge of acid and metal into the environment, and development on the recycling / reuse of these effluents after appropriate treatment, have drawn the consideration of the research community to the development approaches and find new methods of acid and acid recycling[1-3]. This paper presents a new approach to the recycling of acid waste generated by the edible oil refining industry, especially from oxidative stability experiments. We have examined various aspects of the production of these streams and the methods used to treat them to recover the acid for reuse or disposal [4-7].

Solvents determine axial attributes for chemical processing and chemical reactions. They can play as much as catalysts are changing the game. “Sustainable development”, similar the earlier “protection of the environment” or “ecology”, has become a very favorite phrase[8, 9].

Green chemistry is trying to achieve stability at the molecular level. Since this goal is not surprising, it has been applied to all sectors of the industry. As a result of the increasing quantities of "necessities" products and consumer goods in everyday life, the label of homo-technology has been used many times for contemporary human beings. They may use the environment and its resources in vain. Alternatively, they may be eco-friendly by

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using little-waste technologies and restricted media wheel, and by recycling waste and by-products. The small-measure activities of chemists, likewise laboratory experiments, It can also have a negative impact on the environment, e.g., by the uncontrolled disposal of chemical wastes and spent reagents[8, 9].

Recycling is a set of activities that involves collecting all kinds of recyclable materials and equipment. More than 5,000 recyclable materials are available worldwide based on economic, social and technological developments. Failure to reuse recyclable materials Meaning that they are spoiled or then perfect destroyed by nature, then demonstrating a great waste of resources and environmental damage[10].

Today, severe resource scarcity and environmental pollution remain a mystery of sustainable human development. Saving energy and reducing greenhouse gas emissions are inevitable historical trends[11].

Sulfuric acid is a highly corrosive mineral acid, formerly known as vitriol oil, is a mineral acid composed of the elements sulfur, oxygen and hydrogen with the molecular formula H_2SO_4. It is a colorless, odorless and viscous liquid that can be mixed with water. With over 200 million tons per year, it is the most widely consumed chemical in the world[12]. Chemical plant waste acid streams are often simply neutralized prior to transfer to waste water treatment facilities. Rising operating costs in difficult economical times creates the need to recover the sulfuric acid for further use. Stricter environmental regulations globally also mandate recovery of sulfuric acid rather than waste treatment[13-15].

In this study, Team R&D Behshahr Industrial Company (BIC) developed a method using decolorizing soil for sulfuric acid recycling, which is one of the positive points of non-emission of toxic gases, cheap, simple, up-to-date, effective and high efficiency.

2. Experimental Section

2.1. Materials and equipment

All commercially available chemicals were purchased from Merck or Aldrich companies and used without further purifications, 743 Rancimat model was used to determine the oxidation stability. Active bleaching soil was prepared from Iran Jam Mining Company.

2.2. Method of recycling sulfuric acid using bleaching soil

The 100 cc of sulfuric acid obtained during the washing of glass tubes was transferred to a 3-port balloon. Then raise the temperature to 80 ° C and close a trap in the path of the vacuum pump to prevent the release of possible toxic gases. Next, let the possible solvents be removed from the acid under vacuum, Turn off the vacuum and add 0.5% w/w by weight of bleaching soil in a vacuum at 80 ° C for 30 minutes .Cool the acid, separating the bleaching soil with a centrifuge. See a Figure of the new method of sulfuric acid recycling with the help of bleaching soil (**Figure 1**).

Figure 1. New sulfuric acid recycling system with bleaching soil

3. Results and Discussion

3.1. Optimization of conditions for sulfuric acid recycling using bleaching soil

To demonstrate the efficiency of this method, we optimized the amount of bleaching soil used for 100 cc of sulfuric acid recycling, which yielded an optimized amount of 0.5% w/w of bleaching soil at 80 ° C under vacuum (**Table 1**).

Table 1. Optimization of conditions for sulfuric acid recycling using bleaching soil

Entry	Bleaching soil loading (w/w%)	Conditions	Temperature(°C)	Time (min)	Yield (%)
1	0.25	vacuum	80	70	50
2	**0.5**	**vacuum**	**80**	**30**	**90**
3	1	vacuum	80	45	81
4	2	Vacuum	80	40	78
5	0.25	Reflux	80	120	30
6	0.5	Reflux	80	100	45
7	1	Reflux	80	90	55
8	2	Reflux	80	80	60

3.2. Comparison of fresh and recycled sulfuric acid and not recycled, by means of oxidative stability test of sunflower oil

To compare recycled sulfuric acid with fresh sulfuric acid and unrecycled sulfuric acid, we transferred a certain amount of the same amount of sunflower oil to the pipes of the Rancimat device, which were washed with each of these three types of sulfuric acid. We

measured its oxidative stability using a Rancimat device and found that there was no difference between recycled sulfuric acid and fresh sulfuric acid. The oxidative stability value for sunflower oil, the tubes of which were washed with freshly recycled sulfuric acid, was about 11.7 hour, which confirms the correctness of this method (**Figure 2**).

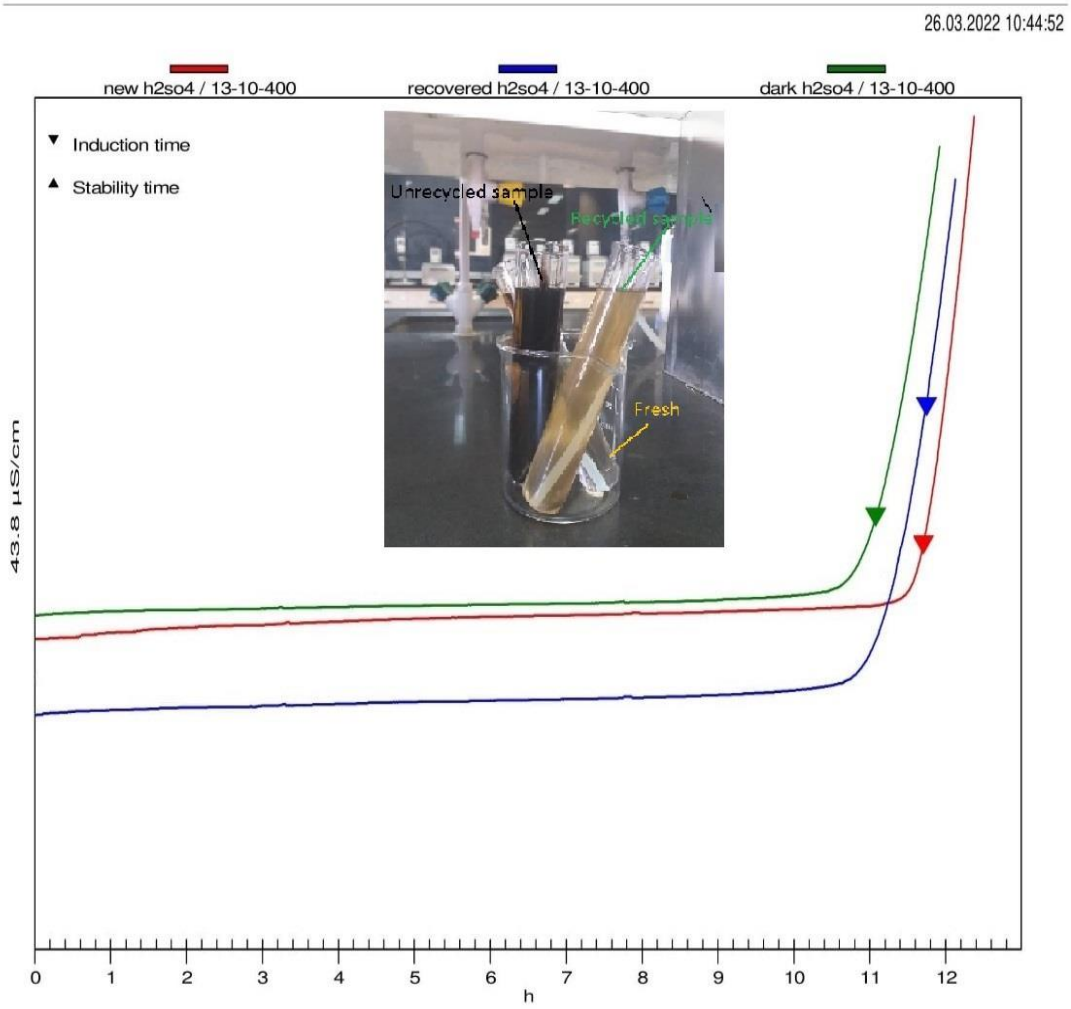

Figure 2. Comparison of fresh and recycled sulfuric acid and not recycled, by means of oxidative stability test of sunflower oil

4. Conclusions

Sulfuric acid is one of the acidic wastes produced in the edible oil refining industry during testing to determine the oxidation stability of the oil. Sulfuric acid is required as a rinsing solvent to clean Rancimat glass tubes. This acid cannot be discharged directly into the environment. Use processing and acid consumption must be performed to comply with environmental quality standards. The aim of this study was to purify and recover acid waste. In this new method, first water and other solvents are removed under a vacuum system at 80 ° C, then bleaching soil is added to sulfuric acid and placed at 80 ° C for half an hour, and then white soil. The solvent is separated by centrifugation. Recovery was about 90%. An identical sample of oil with oxidation stability was tested with a Rancimat device and the results showed no change with fresh sulfuric acid. This study developed an innovative, effective, and simple method for the recycling of acid waste that can successfully resolve

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References

1. Hu, X., et al., *The Recycling of Acid Wastewater with High Concentrations of Organic Matter: Recovery of H2SO4 and Preparation of Activated Carbon*. Water, 2022. **14**(2): p. 183.
2. Xu, J., S. Lu, and D. Fu, *Recovery of hydrochloric acid from the waste acid solution by diffusion dialysis.* Journal of hazardous materials, 2009. **165**(1-3): p. 832-837.
3. Song, K., et al., *Recovery of high purity sulfuric acid from the waste acid in toluene nitration process by rectification.* Chemosphere, 2013. **90**(4): p. 1558-1562.
4. Asof, M., et al. *Recovery of H2SO4 from spent acid waste using bentonite adsorbent*. in *MATEC Web of Conferences, 02007 (2017) DOI: 10.1051*. 2017.
5. Jeong, J., et al., *Recovery of H2SO4 from waste acid solution by a diffusion dialysis method.* Journal of hazardous materials, 2005. **124**(1-3): p. 230-235.
6. Yun, T., J.W. Chung, and S.-Y. Kwak, *Recovery of sulfuric acid aqueous solution from copper-refining sulfuric acid wastewater using nanofiltration membrane process.* Journal of environmental management, 2018. **223**: p. 652-657.
7. Lei, S., W. Sun, and Y. Yang, *Solvent extraction for recycling of spent lithium-ion batteries.* Journal of Hazardous Materials, 2022. **424**: p. 127654.
8. Anastas, P. and N. Eghbali, *Green chemistry: principles and practice.* Chemical Society Reviews, 2010. **39**(1): p. 301-312.
9. Tobiszewski, M., A. Mechlińska, and J. Namieśnik, *Green analytical chemistry—theory and practice.* Chemical Society Reviews, 2010. **39**(8): p. 2869-2878.
10. Asmatulu, R. and E. Asmatulu, *Importance of recycling education: a curriculum development at WSU.* Journal of Material Cycles and Waste Management, 2011. **13**(2): p. 131-138.
11. Ouyang, T., et al., *A novel design of low-grade waste heat utilization for coal-fired power plants with sulfuric acid recovery.* Energy Conversion and Management, 2021. **227**: p. 113640.
12. Ali, A.H.M., *Production of Sulfuric Acid*. 2016, University of Diyala.
13. Zeng, T., et al., *Removal of arsenic from "Dirty acid" wastewater via Waelz slag and the recovery of valuable metals.* Hydrometallurgy, 2021. **200**: p. 105562.
14. Wei, C., et al., *Recovery of H2SO4 from an acid leach solution by diffusion dialysis.* Journal of hazardous materials, 2010. **176**(1-3): p. 226-230.
15. Xu, W. and U.M. Diwekar, *Multi-objective integrated solvent selection and solvent recycling under uncertainty using a new genetic algorithm.* International journal of environment and pollution, 2007. **29**(1-3): p. 70-89.