2nd International Conference Eco-Innovation in Science, Engineering, and Technology
Volume 2021
http://dx.doi.org/10.11594/nstp.2021.1406

NST PROCEEDINGS

OPEN ACCESS

Conference Paper

Isolation of Zn and Cr in Biosolid Waste by Extraction Process Using Sulfuric Acid

Novel Karaman[1]*, Susilowati[1], Mu'tasim Billah[2], Titi Susilowati[2]

[1]Master of Environmental Science Department, Universitas Pembangunan Nasional "Veteran" Jawa Timur, Surabaya 60294, Indonesia
[2]Department of Chemical Engineering, Universitas of Pembangunan Nasional "Veteran" Jawa Timur, Surabaya 60294, Indonesia

Corresponding author:
E-mail:
novel_karaman05@yahoo.com

ABSTRACT

This study investigates the separation of zinc and heavy chromium metals in biosolid waste by an extraction process using H2SO4 solvent. The extraction of the heavy chromium process was performed in biosolid waste of 100 mesh with various times and pH. The solid extracts were analyzed using the Atomic absorption spectrometry (AAS) analysis method. The most effective condition to decrease Zn and Cr levels were obtained at the extraction process 120 minutes, and the solvent concentration was 1.5 M with the efficiency of 98.80 % and 97.89 %, respectively.

Keywords: Solid waste, heavy metals, extraction

Introduction

Biosolid waste is a nutrient-rich organic solid waste that comes from the by-products of aerobic and anaerobic biological treatment of industrial and household wastewater. Industrial wastewater treatment involves biological processes or uses microorganisms. The wastewater can come from industry, household kitchens, laundry, and bathrooms. Biosolid solid waste of Waste Water Treatment Industry (Industri Pengolahan Air Limbah, IPAL) has contents of nutrients or complete nutrients, both macro and micronutrients (Said, 2010). Biosolid waste also contains many microorganisms because the wastewater treatment process uses biological processes. Besides that, biosolid waste also contains heavy metals depending on the wastewater treated.

Each industry can produce biosolid waste in relatively large quantities up to 30 tons/month. This biosolid waste is a serious problem for the industry because the amount is very large, and there are also some heavy metals in the biosolid waste. Contents of heavy metals, among which metals including arsenic (Ar), cadmium (Cd), chromium (Cr), lead (Pb), zinc (Zn), thus cause treatment and utilization of biosolid waste are not maximized (Setiyono, 2017). Biosolid management is currently only accommodated on empty lands and has not been handled and managed, which can pollute the environment and harm human life.

Based on contained biosolid waste quality, one alternative to reduce pollution/environmental damage is expected in late lowered ions of heavy metals in the biosolid waste. The reduction of heavy metal ions in biosolid waste can be reduced by further processing and utilized into goods with a higher use-value. Reducing the levels of heavy metal ions in biosolid waste can be done by an extraction (leaching) process. In the research of (Hutagaol, 2015), the solid-liquid extraction of ZnO from the dust filter of the steel-making process using acid by adding 50 grams of raw material to the solvent in the form of H2SO4 and HCL as much as 500 ml at different concentrations. In this study, the best conditions for separating ZnO using H2SO4 solvent

How to cite:
Karaman, N., Susilowati, Billah, M., & Susilowati, T. (2021). Isolation of Zn and Cr in biosolid waste by extraction process using sulfuric acid. *2nd International Conference Eco-Innovation in Science, Engineering, and Technology*. NST Proceedings. pages 30-34. doi: 10.11594/ nstp.2021.1406

at a concentration of 0.75 M resulted in the extracted ZnO content of 97.73 %. (Latifa, 2016; Nugroho, 2013), conducted research on the influence of extraction duration and concentration of ethanol solvent on the physical-chemical properties extracts of stevia leaves with the MAE method. The method used was experimental descriptive by using 5 (five) times microwave extraction, namely 30, 60, 90, 120, and 150 seconds, and two variations of concentrations of ethanol solvent, which were 80 and 90 %. The results obtained from the extraction time at 60th to 90th minute experienced an increase in the extracted substance. At a concentration of 90%, the ability of the solvent to extract substances was better than the concentration of 80 %, in the research of (Pomantouw, 2011) with the title separation of heavy metals (Pb and Cd) in biosolids with an acid-base leaching process. In this study, the heavy metals in the biosolid waste were extracted by pulverizing the biosolid waste as much as 30 grams dissolved into a solution of H3PO4 and 500 ml of KOH. In this study, the best conditions for separating heavy metals Pb and Cd in biosolid waste were extracted using H3PO4 solvent at pH 6, stirring speed of 100 rpm, extraction time of 90 minutes. The percentage decrease in Pb was 97.43 %. Initial Pb was 362.33 mg/L; after processing was 9.57 mg/L. The percentage decrease in Cd was 97.20 %. Initial Cd was92.63 mg/L; after processing was 2.671 mg/L.

Material and Methods

Material

The raw material used in this research was biosolid solid waste from PT. Sier, Rungkut – Surabaya.

Tools

The raw material used in this research was biosolid solid waste from PT. Sier, Rungkut – Surabaya.

Research variables

Fixed variables in this study consisted of particle size of 100 mesh, a temperature of 25 °C, material weight and volume ratios of solvent 1:10, stirring speed of 100 rpm. While the independent variables of the study include concentrations of H_2SO_4: 0.5M; 0.75m; 1 M; 1.25M; 1.5M. And stirring time: 40, 60, 80, 100, 120 minutes.

Biosolid waste extraction procedures

The biosolid waste was dried and then crushed and sieved with 100 mesh and weighted with a weight of 50 grams. A solution of H_2SO_4 pH 3 was inserted with a concentration variation of 0.5 M; 0.75 M; 1 M; 1.25 M; 1.5 M. Put the biosolid waste into a glass beaker containing a solution of H_2SO_4, then stirred with a stirring speed of 100 rpm with time variations of 40; 60; 80; 100; 120 minutes. The mixture that had been stirred was filtered so that the residue and the filtrate were separated. The resulting residue was washed using demineralized water, so that residue and filtrate were formed from the washing. The washed residue was analyzed for Zn and Cr content by Atomic absorption spectrometry (AAS) analysis.

Results and Discussion

Elemental analysis was carried out quantitatively using the Atomic absorption Spectrophotometry (AAS) analysis method and the result shown in figure 1

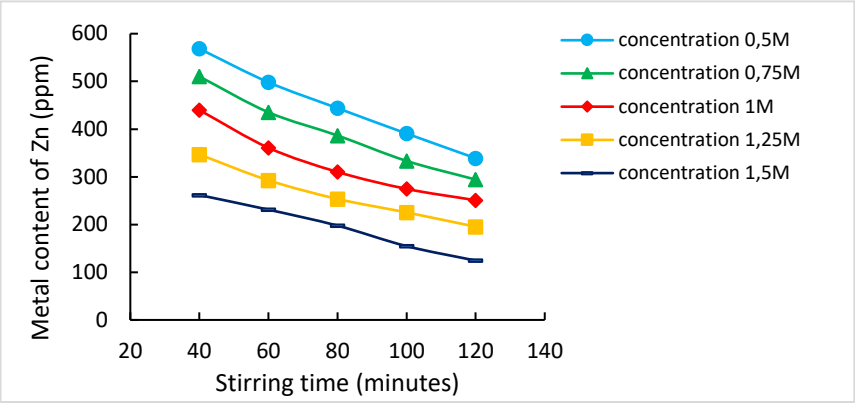

Figure 1. Relationship stirring time and levels of Zn metal

Initial conditions of the metal content of Zn 10, 400 ppm. After the extraction process, the Zn metal content decreased to 124.37 ppm, with an efficiency of decreasing 98.80 %. Figure 1 shows that the significant decrease of Zn content occurred at a solvent concentration of 1.5 M and a stirring time of 120 minutes. The data obtained show the longer the stirring time, the higher the metal content of Zn obtained. Due to the duration of the contact between the solvent with the extracted material, it increases the diffusion, and the mass transfer of Zn on the surface of the particles in the solution was also getting bigger.

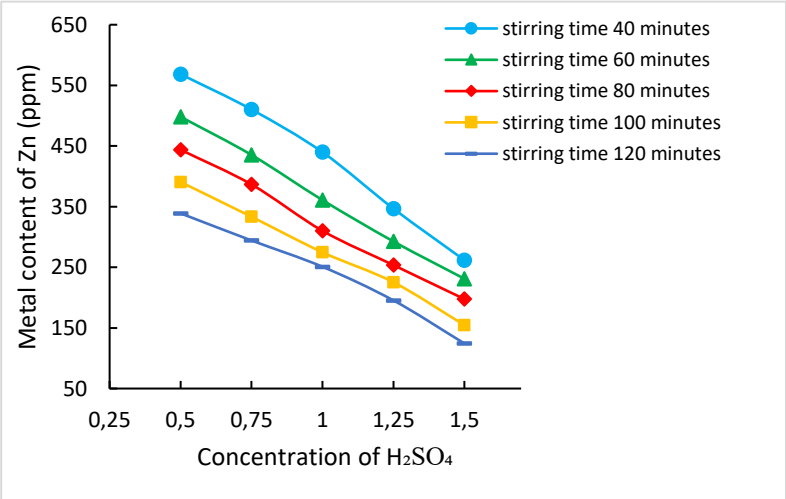

Figure 2. The relationship between the concentration of H2 SO4 and the metal content of Zn

The data obtained showed that the greater the solvent H2SO4 concentration, the more zinc levels decreased. Figure 2 shows that the largest decrease in Zn content was at a time of 120 minutes of stirring and the concentration of the H_2SO_4 1.5 M solvent was 124.37 ppm with a decreased efficiency of 98.80 %, so this indicated that the biosolid waste which was treated by extraction was able to reduce the Zn content by 10,120.96 ppm. Because of a high concentration of H_2SO_4, Zn would be easily soluble, and the extraction results would be more effective.

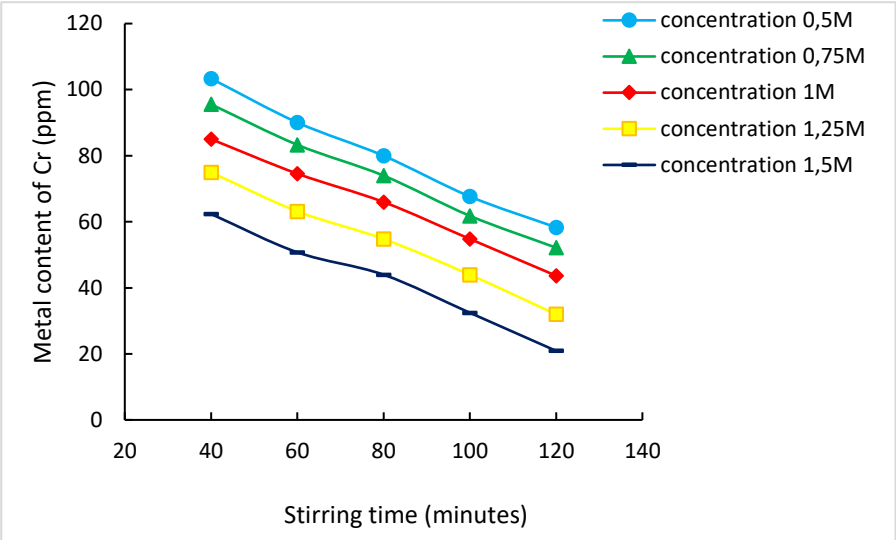

Figure 3. Relationship between stirring time and Cr metal content

Figure 3, showed decreased levels of Cr most likely in a solvent concentration of 1.5 M was at a stirring time of 120 minutes. The initial condition of the Cr content of 990 ppm after processing the Cr metal content decreased to 20.91 ppm with a decreasing efficiency of 97.89%. The data showed that the stirring time greatly affects the decrease in Cr metal content, the longer the stirring time, the greater the decrease in Cr metal concentration obtained. This was due to the duration of contact between the solvent with materials in the extract can increase the diffusion, mass transfer of Cr from the surface of the particles into solution was also more.

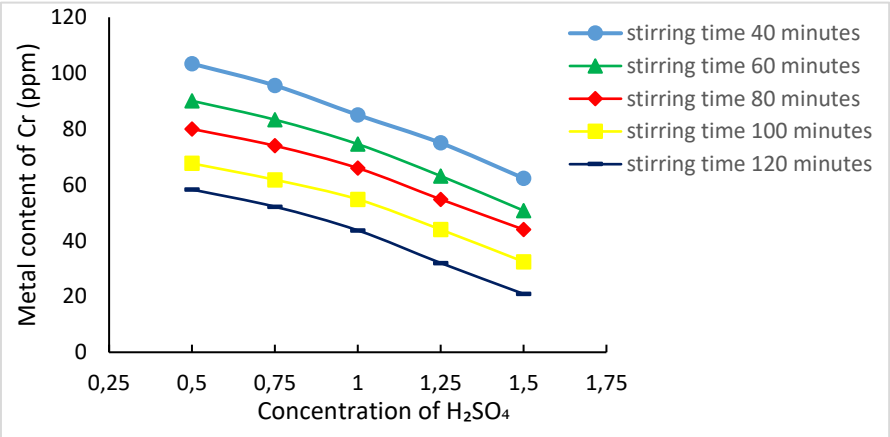

Figure 4. Relationship of H2 SO4 Concentration and Cr metal content

Based on Figure 4, it showed that the initial Cr content in the biosolid waste was 990 ppm after extraction with H_2SO_4 solvent, the largest decrease in Cr content was obtained at 120 minutes of stirring time and the concentration of H_2SO_4 solvent of 1.5 M was 20 .91 ppm with a decrease of 97.89% efficiency. This showed that the biosolid waste which was treated with the extraction process using H_2SO_4 was able to reduce the Cr content of 969.09 ppm. The data obtained showed that the greater the concentration of the solvent H_2SO_4, the decrease of Cr also getting bigger, this was due to that the concentration of H_2SO_4 was high then the more samples were contacted with H_2SO4 so that Cr would be easy soluble and the extraction yield was greater.

Conclusion

The reduction in the levels of Zn and Cr can be done by an extraction process using H_2SO_4 and influenced by stirring time and solvent concentration. The higher the stirring time, the greater the decrease in Zn and Cr metal contents, and the higher the solvent concentration, the greater the decrease in Zn and Cr metal contents. The Zn metal decreased levels obtained at 120 minutes stirring time and solvent concentrations of 1, 5 M, with the result of Zn metal content of 124.37 ppm with reduction efficiency of 98.80 %. The largest decrease in Cr metal concentration was obtained at a time of stirring for 120 minutes and solvent concentration of 1.5 M, with the final result of Cr metal content of 20.91 ppm with a reduction efficiency of 97.89 %.

References

Hutagaol. (2015). *Ekstraksi padat-cair zno dengan asam dari debu filter proses pembuatan baja.* Bogor: Laboratorium Kimia Universitas Nusa Bangsa.

Latifa, I. N. (2016*). Ekstraksi Padat Cair* .(https://indrienola.wordpress.com/2016/03/14/ekstraksi-padat-cair-kimia-organik/). Accesed 25 November 2018

Nugroho, D. (2013). Pemanfaatan limbah padat industri tahu dan reaktor biosand filter untuk menurunkan kadar logam ion Fe dan Zn pada Industri Galvanis. Semarang: Universitas Negeri Semarang.

Pomantouw, A.H. (2011). *Pemisahan Logam Berat (Pb dan Cd) dalam Biosolid dengan Proses Ekstraksi (Leaching) Asam-Ba*sa. Surabaya: UPN "Veteran" Jawa Timur.usa Bangsa.

Said, N. I. (2010). *Metoda penghilangan logam berat di dalam air limbah industri*. Jakarta: BPPT.

Setiyono, (2017). *Pengendalian kromium yang terdapat di limbah batik dengan metode fitoremediasi*. Tasikmalaya: Universitas Siliwangi.