Processing of Inorganic Waste using Chemical Compounds (HCl and H$_2$SO$_4$) Method

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Abstract. The processing of infectious waste is still less effective in Indonesia. It is given to the third parties to be reprocessed by using incinerator. The result of this process can cause negative impacts on the environment in the form of gases (CO$_2$, SO$_2$, and NO$_2$). The waste processing by using the chemical compound (HCl and H$_2$SO$_4$) is an alternative method to minimize environmental pollution. The purpose of this research as an innovative and an effective method in processing inorganic waste in order to minimize the air pollution that released from the waste burning process and also to reduce the impact of it to the environmental pollution. This research is experimental by using chemical compounds. The sample was taken from the laboratory. Samples are students' practicum remainders in the form of masks and gloves. The process includes several stages, they are mixing acid, soaking, neutralization, solidification, and stirred until the form a solid. The results of the research showed that this method was effective to minimize pollution.

1. Introduction
Waste are remainders from the process of production both industrial and domestic, even of the health institution. Solid waste is known as garbage which is often thrown away because it has no economic value. Chemically, waste consists of chemical organic compounds and inorganic compounds. In a certain concentration and quantity, waste can lead to negative impacts on the environment if it is not managed and treated properly [1].

Waste processing is still less effective in Indonesia. Especially, the waste processing in a health institution, both hospital, health, and health clinic. A lot of the process is given to the third parties to be reprocessed by using incinerators [2].

The incinerators process can lead to health problems due to flue gas released. This is because there is a fly ash in the flue gas in the form of particles that follow the flow of gas, acids and precursor acids (sulfur dioxide, nitrogen oxides, and hydrochloric acid), dioxin and analog which are compounds formed by radical recombination with a polychlorodibenzindioxin structure and analog furan. Although in some incinerators had already air pollution control system, however, the air released from it still consists of pollution which can increase the CO$_2$ levels in the atmosphere that impact the atmospheric ozone layer.

To minimize the levels of air pollutions caused by the incineration process, the researcher uses the alternative method in infectious waste processing by adding the chemical compounds in the
processing. The results of the processing can be a product which can be used as flowers pot or containers, by mixing sands into it [3].

The other research examines the processing of organic waste or liquid waste that has been released by the industry. While this research that will be conducted by the researcher is to treat infectious medical waste using concentrated acidic chemical compounds in the process of its destructions. By utilizing the high acidic properties of these chemicals. In high concentration can destroy a material that is formed from a combination of other compounds [4].

2. Methods
2.1 Sample preparation
Masks and gloves from several trash cans are collected in a yellow crackers container.

2.2 Preparation of the container
1. Fill the container with 36% of HCl solution as much as 250 mL, and idle it for 15 minutes
2. Then added 96% H2SO4 through the container wall as much as 750 ml.
3. After that, mixture solution is stirred until smooth and idle it again for 15 minutes and close the container using wrap plastic.

2.3 Processing
1. Insert waste (masks and gloves) into the pre-prepared container in a sequence with a total of 100gr.
2. Waste soaked for 3 hours, once every 1 hour the bath is viewed and stirred evenly.
3. Add 50% NaOH solution as much as 600ml to the destroyed waste and stirred again.
4. Then add the lime powder to the bath little by a little while stirring evenly, ± 1Kg until the bath becomes a solid form.

3. Results and discussions
During the waste treatment process, several chemical solutions have been added. They are H2SO4, HCl, and CaO. Chemical reactions that occur at each stage of the processing process:

| No | Stages          | Results                                                                                       |
|----|-----------------|-----------------------------------------------------------------------------------------------|
| 1  | Mixing of acid  | In this stage, there is no reaction. But both solutions can become more acidic to damage waste. |
|    |                 | \( H_2SO_4 \rightarrow 2H^+ + SO_4^{2-} \)  \( HCl \rightarrow H^+ + Cl^- \)                  |
| 2  | Immersion       | Gloves and masks that are soaked or mixed with acidic solutions become shriveled, damaged, and crushed |
| 3  | Neutralization | Some reactions that occur when adding 50% NaOH reagent to the solution are as follows:         |
|    |                 | \( HCl + NaOH \rightarrow NaCl + H_2O \)  \( acid + base = salt + water \)                    |
|    |                 | \( H_2SO_4 + 2NaOH \rightarrow Na_2SO_4 + 2H_2O \)  \( acid + base = salt + water \)            |
The process of solidification, Salt and water + coagulant material which is lime powder, if stirred it will settle and clump so that it becomes a solid (solid) [5]

After several stages, solid waste from masks and gloves gets good results. If it processed using the chemical method into several items such as flower pots.

A Minimization of waste is an effort to reduce the volume, concentration, toxicity, and level of danger of waste originating from the production process by reducing it at the source and/or utilizing waste in the form of 3R. To treat waste, at least do 3R, they are Reuse (reuse of trash that can still be used or can function other), Reduce (reduce everything that causes or raises waste) and Recycle (reprocessing waste or recycled into a product or items that can be useful).

The process of processing inorganic waste using chemical compounds carried out on mask and gloves waste is done in a closed manner and in a special room. This waste treatment meets the requirements of all three of these waste minimization matters. Because of the minimization of accumulation of waste and the level of pollution, then in the processing of this waste does not use incinerators but uses chemical solutions, so as to minimize air pollution produced by the equipment, and the results of the treatment process can be recycled.

The following is the process of chemical B3 waste treatment, including Reduction-Oxidation, Electrolysis, Neutralization, Precipitation, Solidification, Absorption, Ion Exchange, and Pyrolysis.

This waste treatment includes the processing of B3 waste chemically as well. Because in the process used several chemical compounds to destroy garbage. There are even several methods involved in this process, namely the neutralization and solidification method. Based on the waste treatment process that has been carried out, this processing has several stages, including the acid mixing stage, immersion stage, neutralization stage, and solidification stage. In the initial stage of the mixing stage, this mixing is between the solution of 36% and 96% with a ratio of 1: 3. With the mixing of acidic solution aims to strengthen the destruction of waste so that it can be destroyed. At the time before the addition of the solution gave separation 15 minutes, to reduce the level of an explosion that occurs due to reactivity to the acid.

The second stage is the process of soaking waste by the acid solution that has been mixed. Soaking is done, it aims the waste can be completely destroyed by acid. For the perfect result of trash crushing, the waste is also inserted sequentially. If masks and gloves are inserted together, rubbish destruction will not be evenly distributed. Because masks take longer to break with acids than gloves. The characteristics of damage or destruction of waste by acid, the form of waste are no longer intact, wrinkled, brittle, even like ash as waste is processed through the combustion process. At the immersion stage, bacteria and other germs found in the waste can die due to the very acidic pH 1 of the solution. In reference to environmental factors that affect microbes written by Agus K, B (2010) that the threshold is comfortable to classify acidic substances such as pH 5, 5 or less. Microbes can grow well in certain pH areas, for example, bacteria 6.5 to 7.5. Every microbial has a minimum, optimum and maximum pH for its. In the next stage, the neutralization stage. At this stage, the waste is added with 50% NaOH solution. The addition of alkaline solution is carried out with the aim that the acidic properties of the two solutions can be decreased or in other words, the pH rises until it can be said to be neutral (pH 7) so that the waste can be disposed of safely.
The solidification stage is the final stage of the waste treatment process. At this stage, the neutralized waste is then added with lime powder until the waste turns into sediment and then thickens and turns into a solid (solid). The addition of lime powder is intended as an ingredient to help increase the pH of the solution. Lime also when reacted with acids, especially sulfuric acid can produce very high heat. Therefore, it can help in the process of garbage destruction, if the process of soaking garbage has not been completely destroyed. The main purpose is the addition of lime powder, which is as a coagulant material for the solidification process. By using this method of solidification, the treated waste can be reprocessed with the addition of a little sand and cement can be a different solid, which is formed into flower pots and other containers.

The advantages of the processing using this chemical method are can be done in a simple way, takes ±4 hours, the price of the solution is affordable. The final result can be added with some crafting materials, the results of processing have economic value. While the shortcomings of the processing process by using this chemical method are the limitations of a special room, the danger level of direct contact is still high.

According to an article written by Manis Yuliani (2016) about incineration for municipal solid waste processing, it can be seen that the advantages and disadvantages of using incineration methods are waste treatment using more effective incinerators because it can process various types of waste. But with this tool can also emit dangerous fumes, therefore processing by means of incineration can still cause pollution to humans and the surrounding environment. And the processing costs are relatively expensive while using this chemical method, the results of processing can be reused and not cause air pollution. So by using chemical methods with this process can minimize in terms of.

4. Conclusion
Based on the results of the study, it can be concluded that the process of inorganic waste treatment using chemical compounds is effective in waste minimization.

5. References
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