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CHAPTER 14

SAFECLEAN: CHEMICAL FILTER SINK FOR SCHOOL

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ABSTRACT

Nowadays, science subjects including Chemistry and Biology are important for us. It is inline with our education policy to have more students in the Science stream. Experiments are the core activities for these subjects. However, the chemical waste disposal is to follow the correct procedure as well and avoid dumping it through the sinks. Without knowing the end of the discharge stream, it might compromise with the environment. Our objective is to create and suggest a chemical disposal sink specifically designed to reduce the chemical concentration of any solution from school experiments before it is eventually discharged to the environment. The sink is designed with important features capable of chemical filtration. The sink pipe is designed in such a way to reduce the water flow velocity with obstacles of high dosage activated carbon granules which is highly capable of reducing the chemical concentration through physical adsorption. With the combination of the slow velocity and activated carbon adsorbent, the contact time is maximized for the intake period, thus the adsorption efficiency is increased. Before the activated carbon, sand and gravel are placed to filter solid chemical wastes. Our novelty lies in the design of the filtration system to specifically target wastes produced from school experiments. With simple systems and installation, it can be implemented in schools in rural areas. Besides that, the activated carbon can be produced for replacement from agricultural wastes that can be found almost anywhere in Malaysia. This project will ensure the chemical wastes from schools are discharged with a minimized amount of chemical contents that will endanger or cause permanent damage to an ecosystem.

Key Words: Chemical waste, Filtration, Environment, Adsorbent, Activated Carbon.

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1. INTRODUCTION

The Chemical Sink Filter is the next-level of innovation for more safe chemical filtering. There's no doubt that chemicals are used often and continuously in Biology and Chemistry experiments held in school. However, the chemical waste disposal is to follow the correct procedure as well and avoid dumping it through the sinks. Without knowing the end of the discharge stream, it might compromise with the environment. For example, we just dispose of the chemicals through our lab sink just like that. Yes, that's the procedure that we must obey. But, we saw that this procedure lacks in the filtration process for those chemicals. We don't know if the chemicals go somewhere. Maybe it will go to our clean water resources and pollute it, just like what eutrophication had in their process as an example, where a progressive amount of minerals or nutrients enriched the water sources, or soils. Therefore, our objective is to create and suggest a chemical disposal sink specifically designed to reduce the chemical concentration of any solution from school experiments before it is eventually discharged to the environment. With the implementation of activated carbon and adsorbent processes in this project, it will greatly filter those chemicals, making it more safe for chemical disposal. This project will ensure the chemical wastes from schools are discharged with a minimized amount of chemical contents that will endanger or cause permanent damage to an ecosystem.

2. METHODOLOGY

Our project aims to give a safer and ideal way for chemical filtration and disposal. The sink is designed with important features that make it capable of filtering chemicals great and efficiently. Along with that, we introduce the so-called Horizontal Spring-like design for the sink pipe as you can see in Figure 1. This design provides such a way to reduce the water flow velocity which is great for in-depth filtering and adsorbing chemicals. The chemicals will take a long journey in that sink pipe to flow until the end. It has to go up and down many times and activated carbon will take advantage of this.

Now, with the obstacles of high dosage activated carbon granules added in the sink pipe, it will be highly capable of reducing the chemical concentration through physical adsorption. That spring-like sink pipe design helps a lot for this process. Chemicals would take time to flow through the activated carbons, so it would be filtered properly, carefully and more clean than before. Thus, there's no or literally slightly little amount of chemicals waste will go out from that sink.

To make sure that the chemicals will be filtered properly before it goes through activated carbon for a more detailed filtering process, we added a water filter as the start, directly below the sinkhole. It will filter out the large substances in the chemicals. Another reason is to not let solids ruin the activated carbons. Then before it will flow out from the sink, we put grainy sands and the last filter. It will ensure that activated carbons that accidentally follow the chemicals throughout the process didn't go out from the sink. In order to get a closer look and be more understanding of what we do, Figure 1 shows how this chemical sink filter works.

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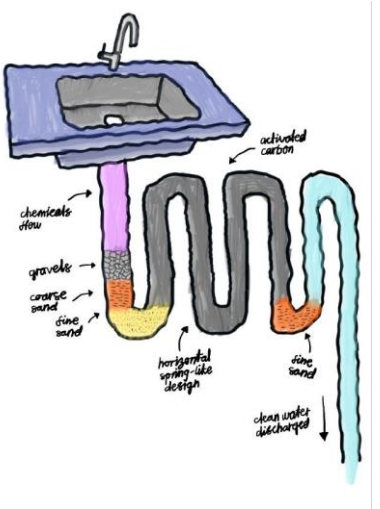

Figure 1: Sketched proposal for imagining how this chemical filter sink looks like

So that's how our chemical filter sink works. With the combination of the slow velocity with Horizontal Spring-like design and activated carbon adsorbent, the contact time is maximized for the intake period, thus the adsorption efficiency is increased. There's also no way for chemicals to ruin activated carbons throughout the process with the addition of the regular filters above and below the sink.

3. RESULT AND DISCUSSION

An experimental test was conducted to observe the effectiveness of adsorption using activated carbon in removing or minimizing the chemical waste concentration. In this case, the chemical waste we used to simulate the process is the KMnO4 solution. The KMnO4 solution is a purple solution used in one of the experiments in chapter REDOX in Chemistry KSSM textbook. It functions as an oxidizing agent to prove electron transfer when a chemical reaction occurs. The KMnO4 is reduced in the experiment as the following chemical equation;

$$2KMnO_4 \rightarrow K_2MnO_4 + MnO_2(s) + O$$

Most of the time, not all the KMnO4 is reduced, thus the purple colour of the solution remains with other byproducts which are unsuitable to the environment. The accumulation of such chemical waste will eventually cause a negative impact to the environment and ecosystem. As shown in Figure 2, the test bench consisted of the KMnO4 solution in a 500mL beaker, a peristaltic dosing pump, two adsorption chambers loaded with activated carbon, and a 250mL conical flask as the receiving container. Briefly, the peristaltic pump continuously injected the KMnO4 solution from the beaker to the first (granular activated carbon) and second adsorption chamber (powdered activated carbon). Here, adsorption is taking place, adsorbing all the KMnO4 molecules from the water. The flowrate was set at 20 mL/min. After the second chamber, the treated solution is filtered using a filter paper to

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separate the leached activated carbon powders. Finally, the solution is collected in the conical flask.

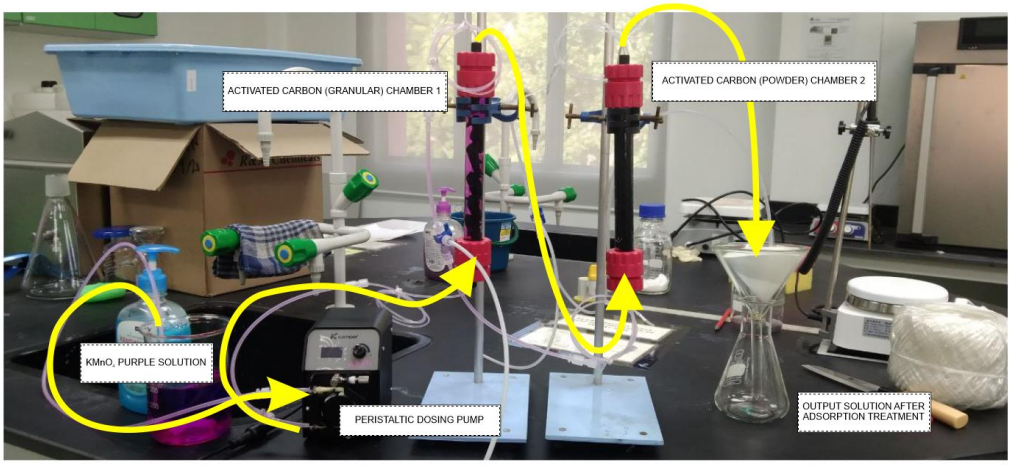

Figure 2: Experimental setup to simulate adsorption of chemical waste solution

As seen in Figure 3, the collected solution appeared to be more clearer than the original purple colour of the KMnO4 solution. It shows that the adsorption techniques applied in our innovation is able to accomplish the task in adsorbing the chemical waste. Therefore, the discharged water has a lesser concentration of chemical waste.

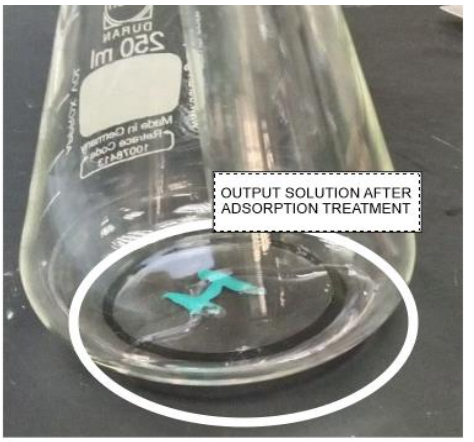

Figure 3: Cleaner solution after adsorption treatment from the experiment

4. COMMERCIAL VALUE

The filter has simple operation and low cost in terms of maintenance since the materials are naturally available and easy to prepare.The activated carbon can be produced from agro waste. Fine sand, coarse sand and gravel are abundantly available

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and easily found naturally. It can be mobile to accommodate science study in schools of rural areas. The installation is simple and easy and no major renovation is required.

5. CONCLUSION AND RECOMMENDATION

Our innovation, The Chemical Sink Filter ensures that the motivation of learning sciences and experiments do not necessarily have to compromise with the safety for the environment around the schools in the long term. It has smart design and high commercial values. Based on the experiment we carried out, the concept we suggested which is adsorption technique is highly workable, indicating the innovation has high feasibility value as well. We hope that our ideas and prototype will keep the science experiments conductible without jeopardizing the environment.

REFERENCES

Wikipedia contributors. (2021, August 19). Adsorption. Wikipedia. https://en.wikipedia.org/wiki/Adsorption#:%7E:text=Adsorption%20is%20the%20adhesion%20of,or%20solid%20(the%20absorbent).

Aziz, A., Nasehir Khan, M. N., Mohamad Yusop, M. F., Mohd Johan Jaya, E., Tamar Jaya, M. A., & Ahmad, M. A. (2021). Single-Stage Microwave-Assisted Coconut-Shell-Based Activated Carbon for Removal of Dichlorodiphenyltrichloroethane (DDT) from Aqueous Solution: Optimization and Batch Studies. International Journal of Chemical Engineering, 2021, 1–15. https://doi.org/10.1155/2021/9331386

Tran, T. H., Le, H. H., Pham, T. H., Nguyen, D. T., La, D. D., Chang, S. W., ... & Nguyen, D. D. (2021). Comparative study on methylene blue adsorption behavior of coffee husk-derived activated carbon materials prepared using hydrothermal and soaking methods. Journal of Environmental Chemical Engineering, 9(4), 105362.

Wang, Y., Lin, C., Liu, X., Ren, W., Huang, X., He, M., & Ouyang, W. (2021). Efficient removal of acetochlor pesticide from water using magnetic activated carbon: Adsorption performance, mechanism, and regeneration exploration. Science of The Total Environment, 778, 146353.