Hong Kong Student Science Project Competition 2022

Extended Abstract (Investigation Design Proposal)

Team Number: SDBC266

Project Title: Easy and Effective - Remove Methanal at Anytime You Want

Project Type: Investigation Design Proposal

To our best knowledge and after thorough literature research, as at **30/06/2022**, there are **no** similar works.

I. Background

Formaldehyde is a toxic gas that is widely encountered in our lives such as construction. Prolonged exposure can cause harm to humans such as irritation of the respiratory tract. Therefore, this proposal aims at exploring more ways of removing formaldehyde by investigating the effectiveness of daily materials in removing formaldehyde.

A considerable amount of research related interactions between formaldehyde and amino acids (Bernard Metz, et al., 2004), ammonia (Ogata Yoshiro, Atsushi Kawasaki, 1963) and activated charcoal (H N Wang, et al., 2019) are found. Yet, research have not related the interactions between daily materials containing the above substances and formaldehyde. Thus, this proposal aims at filling the research gap: whether chemicals in daily materials can also remove formaldehyde.

II. Objective(s)

- To design an experiment to investigate in the variety in effectiveness of different daily materials in removing formaldehyde
- To seek for the daily material that is most effective in removing formaldehyde
- To reuse food waste and unused daily materials to absorb formaldehyde. Waste materials and the burden of landfills can be reduced
- To raise consumers' awareness towards responsible food and daily materials consumption
- To take immediate climate action to ease the issue of food wastage

III. Hypothesis

In the investigation, we suggest that the certain substances in daily materials will interact with formaldehyde as follows:

The formaldehyde will be attracted to the surface of activated charcoal due to the weak intermolecular Van der Waals' force.

The N terminal amino group and side chain R of amino acid will bond with formaldehyde. Methylol groups, Schiff-bases and methylene. Bridges were formed due to its peptide sequence.

Condensation reaction occurs between ammonia solution and formaldehyde in which hexamine is formed as main product while water is formed as a byproduct.

IV. Methodology

Materials to be used

- Data logger and formaldehyde gas detector for recording the change in the concentration of formaldehyde
- Evaporating dish for holding the reactant to absorb formaldehyde
- Rectangular glass box with three closable openings
- Mortar and pestle
- Soy sauce, glass cleaner and activated charcoal

Experimental set-up

Experiment I

Place the reactant in an evaporating dish in the glass box, which is filled with Exper mg/m3 of formaldehyde. Must the box be well-sealed to prevent leakage of formaldehyde throughout the experiment, and hence accurate measurements of the concentrations of formaldehyde are obtained.

Experiment II

Apparatus required, experimental set-up and control set-up are the same as in experiment I. Yet, the concentrations of formaldehyde ranges from 25mg/m^3 to 500mg/m^3.

Control set-up

Place an empty evaporating dish in the glass box, which is filled with 150 mg/m^3 of formaldehyde. Must the box be well-sealed to prevent leakage of formaldehyde throughout the experiment, and hence accurate measurements of the concentrations of formaldehyde are obtained. The control set-up ensures that the experimental result is only due to the variety in the type of reactants used to absorb formaldehyde and fair test can be attained.

V. Expected Results and Impact of research

We anticipated that the set-up of glass cleaner with ammonia would be the most effective out of the 3 experimental set-ups in removing methanal. Activated charcoal would come second while that of amino acid is the least effective. However, when it comes to implementing in real practices, activated charcoal would be the best material due to its user-friendliness and safety concerns associated with the other materials. However, there are limitations to all 3 materials, that activated charcoal might absorb moisture in air, amounts of different amino acids vary from food to food, and that ammonia is volatile. These all may cause experimental errors in which the absorption rate of formaldehyde by the materials may be measured as lower than actual.

VI. Conclusion

Concluding the safety issues and effectiveness, we prospect that activated charcoal is the best daily material in removing formaldehyde among the three materials investigated due to its high effectiveness, accessibility and relatively few safety concerns associated. We hope that the further usages and applications of activated charcoal could effectively and successfully ease the issue of excess formaldehyde in the environment. We also hope that the experimental set-up that we designed can be implemented to experiment with more daily materials to determine their ability in absorbing formaldehyde.