Risk Assessment Form (3)

Must be completed before experimentation.

Student's Name(s) Ethan Horowitz, Joshua De Leeuw

Title of Project A Comparison of Photocatalysis and Electrocoagulation for Azo Dye Treatment and the Use of H2 PEM Fuel Cells to Increase Coagulation Efficiency

To be completed by the Student Researcher(s) in collaboration with Designated Supervisor/Qualified Scientist:
(All questions must be answered; additional page(s) may be attached.)

1. List all hazardous chemicals, activities, or devices that will be used; identify microorganisms exempt from pre-approval (see Potentially Hazardous Biological Agent rules).

Methyl Orange: 0.05% by mass aqueous solution, 1.2 L
Sodium Hydroxide: 0.1 Molar NaOH, approximately 20 mL
Hydrochloric Acid: 0.1 Molar HCl, approximately 20 mL
Titanium (IV) Oxide (Titanium Dioxide): Mixture of Rutile and Anatase: approx 2.5 g of TiO2 powder
Hydrogen- projected 1.4 mL of H2 gas per each 20 minute trial
Iron Metal: 6 electrodes
Voltage- 5 V will be applied
UV Light- UVB will be used for photocatalysis

2. Identify and assess the risks involved in this project.

Methyl Orange- not listed as a dangerous material according to GHS or OSHA hazards
Sodium Hydroxide- can cause skins burns and eye damage, harmful to aquatic life, listed as corrosive waste by RCRA
Hydrochloric Acid- can cause skin and eye irritation, toxic if inhaled; corrosive waste under RCRA classification
Titanium Dioxide- not listed as a hazardous substance or chemical, but can cause germ cell mutagenicity in mice/hamsters
Hydrogen Gas- extremely flammable and can form explosive mixtures when combined with air, incompatible with oxidizers; however, our study is projected to produce only a minimal amount of the gas (1.4 mL per 20 min. trial)
Iron Metal- not listed as a hazardous substance or dangerous good according to the GHS classification system
Voltage- can cause severe electric shocks if both electrodes are touched at the same time
UV Light- can cause eye damage/irritation if stared directly into

3. Describe the safety precautions and procedures that will be used to reduce the risks.

Methyl Orange- protective clothing (goggles, lab apron, vinyl gloves) will be worn and lab supervision will be maintained
Sodium Hydroxide- nitrile gloves, goggles, and a lab apron will be worn, when altering the pH of a solution this will be added to the solution, not the other way around; lab supervision is important and will always be present
Hydrochloric Acid- nitrile gloves, goggles, lab apron; HCl will only be added to solution, and lab supervision will be present
Titanium Dioxide- lab apron, goggles, nitrile gloves; lab supervision will always be in place, only low concentrations will be used
Hydrogen- will be kept away from any flames or hot places to avoid ignition, any hydrogen produced by the electrocoagulation will be contained within the system and not left open to air, gloves will be worn
Iron Metal- will be kept in a well ventilated area and be separated from ay oxidizing agents
Voltage- lab supervision will be present, voltage must be turned off before making any changes to the system (as in touching either of the electrodes)
UV Light- will be kept only in a closed cabinet when turned on, so it is never exposed to our eyes; light will be turned off before opening cabinet again

4. Describe the disposal procedures that will be used (when applicable).

Methyl Orange- must be disposed of in accordance with federal, state, and local regulations, and a permitted waste disposer will be contacted
Sodium Hydroxide- a permitted waste disposer will be contacted- this is important as NaOH is listed as a corrosive waste (RCRA)
Hydrochloric Acid- this is similar to NaOH; a permitted waste disposer will be called to mitigate its corrosive effects
TiO2- surplus and non-recyclable solutions- licensed disposal company; contaminating packaging- disposed of as unused product
Hydrogen Gas- there will be no disposal of hydrogen gas in this project, as all hydrogen gas produced will be used to power fuel cells, and all electricity generated from this will just be put back into the electrocoagulation system
Iron Metal- not a dangerous material, so can just be thrown out; all regulations must be followed though, according to the SDS
Voltage, UV Light- NA

5. List the source(s) of safety information.

Methyl Orange- www.carolina.com/teacher-resources/Document/msds-methyl-orange-005-percent/tr-msds-methyl-orange-005-percent.tr.
Sodium Hydroxide- https://www.carolina.com/pdf/msds/nach01mghs.pdf
Hydrochloric Acid- https://www.carolina.com/pdf/msds/hcl01mghs.pdf
Titanium Dioxide- https://www.sigmaaldrich.com/catalog/product/aldrich/700339?lang=en&region=US
Hydrogen- https://www.airgas.com/msds/001026.pdf
Iron Metal- https://docs.wixstatic.com/ugd/a804af_0d62a55937e04b0081db0345ac1e82be.pdf
Voltage- https://www.cui.com/catalog/resource/power-supply-safety-standards-agencies-and-marks.pdf
UV Light- http://www.uvprocess.com/msds/MERCURY_UV_LAMPS/MSDSlamps.pdf

To be completed and signed by the Designated Supervisor (or Qualified Scientist, when applicable):
I agree with the risk assessment and safety precautions and procedures described above. I certify that I have reviewed the Research Plan/Project Summary and will provide direct supervision.

Alison Huenger
Designated Supervisor's Printed Name

Alison Huenger
Signature

10/01/19
Date of Review (mm/dd/yy)

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degrees in chemistry and biology - past experience as a chemical engineer
Experience/Training as relates to the student's area of research