

Chemical Safety, Fall 2015

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Abstract

Operators in the AguaClara water treatment plants in Honduras are required to work with the chemicals used for coagulation and chlorination, which raises concerns about chemical safety and occupational safety. The Chemical Safety Team this semester researched the safety hazards associated with these chemicals, which include PACl (polyaluminum chloride), HCl (hydrochloric acid), liquid chlorine, and calcium hypochlorite. Based on this research, the team developed safety training materials designed to supplement the existing AguaClara/APP operation manual. Training materials include information about the safety hazards associated with each chemical, proper techniques for handling, storage, and transportation of these chemicals, personal protective equipment required when working with the chemicals, and current occupational safety laws in Honduras related to chemical safety. Finished training materials will be presented to APP in January 2016.

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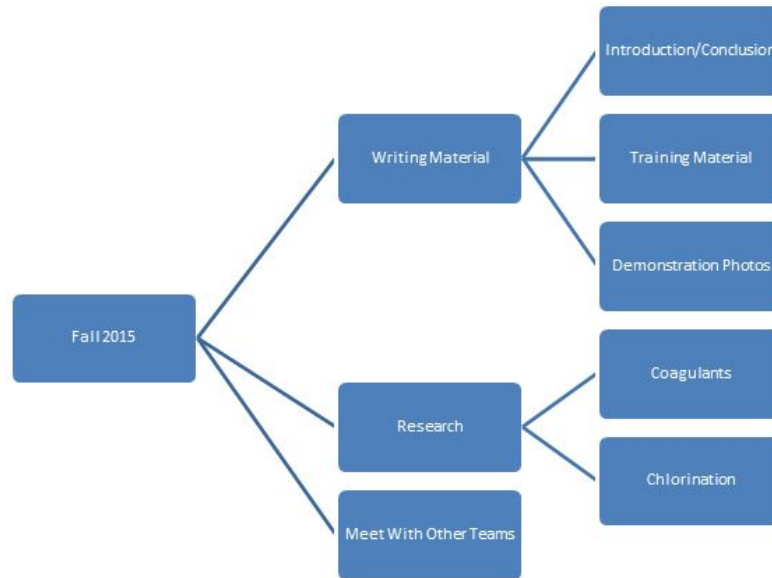
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Task List

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Task Details

1. Set up meetings with teams who have researched the chemicals we are studying so that we can learn more about them/9-9-15 - Deniz and Anna - Completed
2. Researched safety equipment information/9-16-15 - Anna and Deniz - Completed
3. Finished research for liquid and granular PACI/9-21-15 - Anna and Deniz - Completed
 - a. Researched safety hazards associated with PACI - Deniz - Completed
 - b. Researched protective equipment for PACI - Anna - Completed
4. Finished training materials for liquid and granular PACI/10-5-15 - Anna and Deniz - Completed
 - a. Graphic design - Deniz - Completed
 - b. Writing - Anna - Completed
5. Finished research for liquid chlorine, HCl, and calcium hypochlorite/10-26-15 - Anna and Deniz - Completed
 - a. Research safety hazards associated with chlorine - Anna - Completed
 - b. Research protective equipment for chlorine - Deniz - Completed
6. Contacted Jonathan Christensen (one of the engineers overseeing the plants) about the real-life safety issues in the AguaClara plants/10-27-15 - Anna - Completed

7. Researched eyewash options for the plants to implement/11-02-15 - Deniz - Completed
8. Designed safety information posters to be used in AguaClara plants/11-18-15 - Anna and Deniz - Completed
 - a. Poster demonstrating the plant in general and the necessary PPE for each part - Deniz - Completed
 - b. Specialized poster showing specific parts of the process - Anna - Completed
9. Finished training materials for liquid chlorine, HCl, and calcium hypochlorite/11-23-15 - Anna and Deniz
 - a. Graphic design - Anna
 - b. Writing - Deniz
10. Finished introduction/11-23-15 - Anna
11. Table of contents/11-23-15 - Deniz
12. Conclusion/11-23-15 - Anna

Introduction

The chemical safety team is a new team that aims to ensure the safety of the people that are working in AguaClara water treatment plants, especially those who work with hazardous chemicals. This semester training materials for the workers in the plants that explain the use of proper personal protection equipment were created. The first aid information regarding possible accidents was also given importance in case of an emergency.

The work the team completed this semester made working in one of the AguaClara plants safer for the employees. It eliminated possible incidents that may be damaging for people or the environment. It also was effective in case of an accident by providing the necessary steps to deal with the problem with least damage. It ensured that while providing safe drinking water, the safety of the workers is not compromised.

The team was prompted to eliminate possible future accidents, injuries and even deaths before they happen. Even though none of the AguaClara plants experienced a situation where the safety of its workers was at risk, taking steps before the risk is even present is the reason this team was created.

Literature Review

Existing training materials for the AguaClara plants did contain some information regarding chemical safety. This information included the risks associated with the inappropriate use of the

chemicals, photographs of chemical burns and of workers practicing unsound safety habits, and fire diamonds for the chemicals utilized in the plant (AguaClara, n.d.). There was also material regarding Materials Safety Data Sheets and personal protective equipment in the existing training manuals.

The Materials Safety Data Sheets provided the necessary information regarding the chemical hazards related to each chemical, the first aid measures and the required equipment in the use of the material (Ixom Operations Pty Ltd, 2013).

The principal goal of the team was to amend to the existing training materials by incorporating more practical information. The team removed the photographs of workers performing tasks unsafely, as they might have suggested to new workers that the actions shown in the photos are acceptable because they had been previously performed by other workers. In its place, new photographs that show the correct use of the chemicals and the protective gear were provided to encourage the use. Spanish training videos about the use of the PPE that were prepared by OSHA were also incorporated in the training materials to make it more interactive. The main focus was on the chemical hazards themselves, how to prevent them and the first aid measures to be taken in case of an accident. Additionally, more information regarding the handling, storage and transportation of the chemicals were added to the manuals. Furthermore, the fire diamonds for all the chemicals used in the plants and information regarding how to read them were included to make the materials more inclusive. Finally, more information regarding the use as well as the handling of the personal protective equipment, especially the necessary maintenance requirements for each, were provided for an effective protection.

Methods

To collect the data, materials safety data sheets for the chemicals that were used in the plant, namely PACI (Ixom Operations Pty Ltd, 2013), HCl, Calcium Hypochlorite and liquid chlorine were inspected. The regulatory resolutions of Honduras government regarding occupational safety that were obtained from the official portal on the Honduran Ministry of Labor and Social Security's website were also used to ensure full incorporation of the required standards in the material (Secretaria de Trabajo y Seguridad Social, 2004). The value for the concentration of PAC, the coagulant used in the plants, was gathered from the Chemical Dose Controller Spring 2015 Research Report, and the concentration of HCl was provided in the Fall 2015 Challenges document. The personal protective equipment available was researched to ensure that maximum possible protection was provided for the employees (OSHA, 2003). Training videos produced for Spanish-speakers related to the safety and maintenance of gas masks were obtained from OSHA's website and will be included in the training materials (US Department of Labor, 2009; 2012). Lastly, the photographs taken during the construction of the newest AguaClara plant in San Matías were used to gauge potential safety hazards in the plants' structural design (AguaClara, 2015).

Analysis

The research revealed that different chemical uses require different protection measures. It was found that chlorination chemicals were more dangerous than the coagulant PACl. Also, the granular chemicals were found to have different safety hazards than liquid ones. Granular chemicals require the use of a dust mask, whereas in liquid form that is not a necessity. It was also found that a face mask and a respirator should be used when mixing the chlorine. Most importantly, use of gloves were found to be of great importance all through the plant.

The team's research also revealed that the use of closed toed shoes were not highly required in the plants. The concentrations of the chemicals used are relatively low compared to industrial use. It would take prolonged contact with the chemicals for the employee to suffer injuries. Thus, the closed toed shoes are not indispensable if the employee would immediately perform the necessary first aid measures in case of an accident.

Conclusions

Necessary steps for the future were established for the coming steps of the research. The information that was required to produce a conclusive safety materials was also clarified.

The team created separate safety training presentations for PACl and the chlorination chemicals. Some examples from these material can be seen below.

Peligros Para la Salud

- ❖ Inhalación: Irritación respiratorio
- ❖ Ojos: Irritación
- ❖ Piel: Irritación
- ❖ Ingestión: Náusea, vómito, diarrea, problemas gastrointestinales



Figure 1: Safety Hazards

Medidas de Primer Auxilio: Inhalación

- ❖ Lleve la víctima a un lugar seguro inmediatamente. Afloje cualquier ropa apretada.
- ❖ Si la víctima tiene problemas respirando, administra oxígeno.
- ❖ Si la víctima no está respirando, de resucitación pulmonar si el material inhalado no es tóxico.
- ❖ Llame para un médico inmediatamente.



Figure 2: First Aid Measures

Transportación y Disposición de PAC

- ❖ **Transportación:** No se clasifica PAC como sustancia peligrosa para transporte por ferrocarril o carretera, transporte marina, o transporte aéreo.



- ❖ **Disposición:** Se puede echar en un sitio oficial de desecho



Figure 3: Transportation and Disposition Information

Figure 1 demonstrates a slide from PACI material that shows the safety hazards associated with the chemical. Figure 2 demonstrates a slide from chlorination chemicals material that shows the

first aid measures to be taken if the chemicals are inhaled. Figure 3 demonstrates a slide from PACI material that shows the transportation and disposing of the chemical.

The team also created fire diamonds for the plants to use. In the Figure 4 below, the fire diamond for granular chlorine may be seen as an example.

Cloro Granular

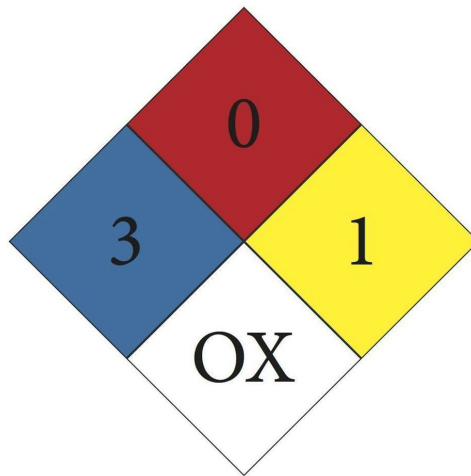


Figure 4: Fire Diamond for Granular Chlorine

The team also created posters to be used in the AguaClara plants that would act as a reminder for the employees to use necessary PPE for the specific task they undertake. Some examples can be seen below. Figure 5 presents the overall plan of the plant and show the PPE necessary in each part while Figure 6 presents correct use of the PPE while performing a common task in the plant.

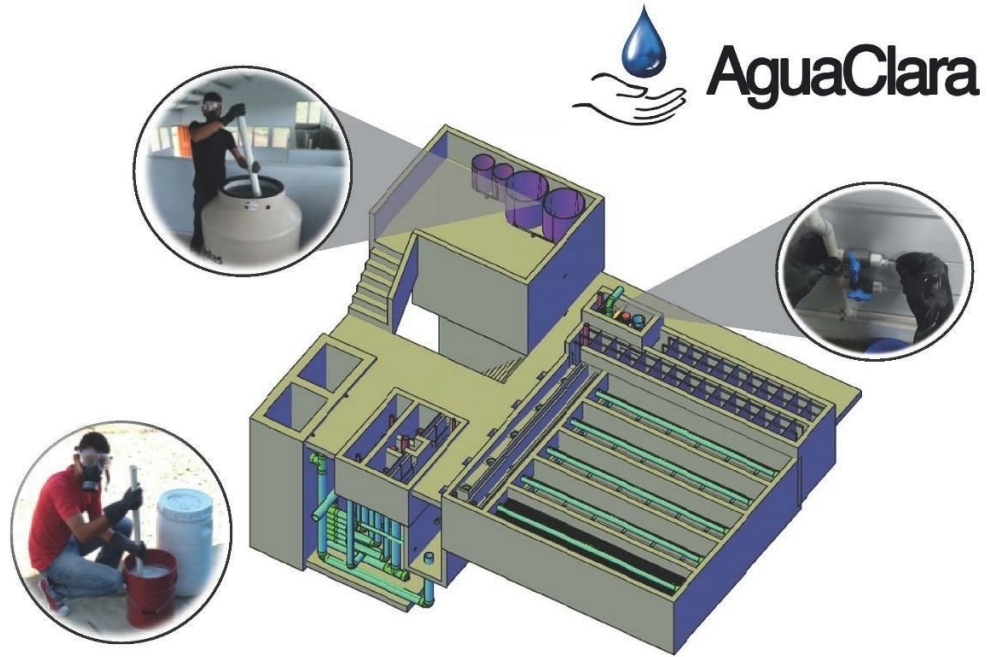


Figure 5: Full Plant Poster



Figure 6: Use of PPE Poster

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