

PRELIMINARY REPORT

of the

CLARK INJURY

By:

Ronald D. Schaible, CIH, CSP

January 25, 2006

PRELIMINARY REPORT of the CLARK INJURY

PRELIMINARY REPORT

JANUARY 25, 2006

A. INTRODUCTION

Joe Clark was an employee of Alchemy Corp. Alchemy blended and produced products for others. Clark worked in the production area mixing and blending chemicals. On April 17, 2002, Clark was exposed to chemicals that reacted and escaped from a tank of Triple Dip product with which he was working. Clark was exposed to the chemicals and was injured.

The purpose of my investigation was to determine if Alchemy's failures to provide proper process controls, proper engineering controls, and proper personal protective equipment controls and training were defective in a manner that caused the incident.

B. MATERIALS AVAILABLE FOR REVIEW

1. Responses to Defendant's First Set of Interrogatories and Request for Production of Documents to Defendant Jones and Company (Books 1 and 2).
2. Transcript of the deposition of Billy Jones, Volume I, taken April 21, 2005.
3. Transcript of the deposition of Billy Jones, Volume II, taken November 15, 2005.
4. Transcript of the deposition of Joe Clark taken October 11, 2004.
5. Transcript of the deposition of William Smith taken March 30, 2005.

C. BACKGROUND

Alchemy manufactures products for the metal plating industry. Those products include cleaning supplies, cleaning pre- and post-treatment, and trivalent and conversion chromates (Smith, 7). Alchemy had two main production areas. They included a liquid blending area which included seven vessels (Smith, 30), and a powder blending area (Smith, 25).

Jones was the President/Owner, and Smith was the Plant Operations Manager. Jones knew the hazardous nature of the chemicals used (57-58, 61). He stated (59) that he was the person responsible for policies and procedures regarding the handling of hazardous materials at Alchemy. Jones stated (72) that he created the batch ticket for Triple Dip. Jones stated (85-87, 89)

that another company took two days to manufacture Triple Dip and that he wanted to shorten the production cycle to one day to control costs even though he knew the process which involved an exothermic reaction was difficult to control. The process was also vigorous in that it thinned the walls of the vessels, the mixer shaft, and the tank stirrers (Jones, 100, 107) and could emit a yellow plume of contaminant into the air (Jones, 125). The plume could contain methanol, oxides of nitrogen, and chromic acid (Jones, 143).

Smith had no chemical blending experience before working at Alchemy. He received on-the-job training from others while at Alchemy (Smith, 8, 10, 12, 14).

Clark was hired by Alchemy as a chemical blending employee in the liquid blending area of the factory. He had been working at Alchemy for more than one year at the time of this incident (Smith, 38). Clark stated (65- 66) that Smith was the only person who trained him and that Smith always told him what to do.

The Triple Dip Product

Triple Dip is a trivalent chrome process for conversion coatings for steel. It protects against corrosion (Smith, 30). Triple Dip is an acidic product and requires the use of an acid gas cartridge with the air-purifying respirator (APR) (Smith, 32-33). Triple Dip was blended in one specific large tank that contained a serpentine cooler in the tank (Smith, 38). The tank held 440 gallons of product (Smith, 39).

Alchemy also made ammonia-based products. One such product was PDQ. It was only blended in tank #1. Clark had previously made PDQ product (Smith, 36-37). The PDQ tank had a cardboard cover, an elephant trunk inserted through a hole in the top cover, and a small opening through which ingredients were added to the tank (Smith, 40).

The Triple Dip Process

The Triple Dip process was developed by Smith and Jones (Smith, 94). The Triple Dip batch ticket #0436 issued on April 16, 2002 contains the manufacturing instructions and safety precautions for the Triple Dip process. According to Smith (97, 103-109) deionized water was first added to the tank to cover the agitator blades in the tank. Then methanol, nitric acid, and a mixture of 212 pounds of chrome and water are mixed to form slurry. Approximately 110 gallons of slurry is pumped from floor level via PVC pipe (Clark, 81). Ingredients were lifted via a fork lift truck (Clark, 79) so that they could be added to the tank by the operator while standing on approximately 4-1/2 feet above ground level on top of a roll-around, three foot

wide stair platform at the top of the polypropylene receiving tank. The tank had markings so the quantity of material in the tank could be determined. Another 110 gallons of water are added to the tank, followed by the methanol and nitric acid. Based on the temperature rise that was monitored by the worker observing a thermometer, additional cooling water could be added. After mixing and coming to room temperature, the product is drained through a valve and into 55-gallon drums.

Smith stated (99) that he knew since Alchemy began blending Triple Dip that a plume of chemicals could evolve if the ingredients were not added properly. Improper addition of the ingredients would cause the mixture to go exothermic (i.e., give off heat) and drive off some of the chemicals from the tank. This was observed by him when test mixing Triple Dip before placing it in large scale production (Smith, 111). Smith stated (100) that the proper rate of cooling and the proper rate of mixing ingredients was learned by experience and by watching the temperature rise (111). The normal process temperature was 130-135 degrees Fahrenheit (Smith, 123).

Clark stated (68) that he had made Triple Dip on three occasions before the date of his incident. Clark stated (67) that he always followed the instructions on the batch tickets. Clark stated (82) that he had not been previously told by Smith or anyone else that the chemicals react with each other. He was simply told that heat was generated while pumping the slurry.

Process Controls

The Triple Dip tank had an "elephant trunk" [ductwork] that was mobile so that it could be moved from one tank to the other. Clark stated (84) that he used the elephant trunk, and placed it just below the lip (rim) of the tank (98) and turned it on. He also stated (85) that he turned the fans and exhaust system on every day. Smith stated (40) that the Triple Dip tank could not be covered because of the height of the tank, the presence of the cooling jacket and thermometer, and the need to add chemicals to the tank. Instead, the liquid blending area had wall fans and floor mounted fans (Smith, 42). Alchemy instructed workers to turn on the fans before doing anything (Smith, 42).

Employee Training

Alchemy retained a consulting firm named Safety Dudes to provide annual respirator training to their employees (Smith, 50). Alchemy also provided other personal protective equipment to their workers, including vinyl aprons, vinyl gloves, vinyl sleeves, and steel toed shoes (Smith, 55). Clark received a physical examination regarding his ability to wear a respirator on or about October 23, 2001.

Clark stated (155) that he had never looked at the Material Safety Data Sheets (MSDS) for the chemicals that he used, but he knew they were available. There is no indication in the materials available for review that Clark personally received proper hazard communication training or training in the proper selection and use of a respirator.

Personal Protective Equipment

Employees who mixed and blended chemicals at Alchemy were provided respirators. The respirators were one-half face mask, dual cartridge, air purifying respirators (APR) equipped with cartridges from Norton and 3M Company. In mid-2001, single cartridge respirators were introduced. Acid gas cartridges were color-coded yellow. Ammonia cartridges were color-coded green (Smith, 51). The cartridges were specific to the products being blended. Acid gas cartridges were not to be used when blending ammonia-based products and ammonia cartridges were not to be used when blending acidic products (Smith, 48). Respirators were made available to the chemical workers circa 1999-2000 (Smith, 49). Clark was issued both types of cartridges for his APR. Respirators were to be worn when working inside areas of the factory designated by yellow lines on the floor.

Clark received replacement cartridges for his APR from Smith (Smith, 56-57). Clark stated (61) that Smith never told him the significance of the color coded cartridges. Clark stated (113) that he was never told that there were different cartridges for the respirator. The need to wear APRs and a written statement as to which type of cartridge (“acid gas” versus “ammonia”) to wear during the production process was written on the batch tickets for each blend (Smith, 60), but the color of the cartridge to be worn was not mentioned (Smith, 79). APRs were not routinely required when transporting bulk chemicals on fork lift trucks. APRs were required if the worker was within 15 feet of where an open tank or other container of chemicals was located (Smith, 59). Full face mask respirators were also available to workers (Smith, 90).

OSHA Activity

Alchemy was cited by OSHA in a citation dated June 6, 2000 for (among other violations) not providing hazard communication training to employees and for failure to provide a ventilation system when working with certain hazardous materials (Bate 00554).

On July 17, 2000, OSHA sent Alchemy (Bates 00339-00346) correspondence that contained verbal recommendations and diagrams for process ventilation controls applicable to different operations. One diagram addressed “barrel filling operations” which is essentially similar to bulk tank filling/mixing operations.

Alchemy was again cited by OSHA for violations in a report dated July 22, 2000 (Bates 00259) for failure to have a written respirator program, failure to perform the various elements required by the OSHA respiratory protection regulation, and excessive concentrations of chromic acid and chromates in the workplace. The same OSHA report cited the lack of a hazard communication program and related employee training, failure to provide written documentation of personal protective equipment training, and other violations.

On September 14, 2000, Alchemy replied in a letter (Bates 00301) to OSHA that they “will control the rate at which employees can add [chromic acid and/or sodium bichromate] to a mixer in order to use an administrative control to further ensure our employees are not overexposed.” Alchemy suggested this approach because industrial hygiene air quality monitoring performed by the Bureau of Workers Compensation, Division of Safety and Hygiene, indicated acceptable levels of chromic acid and chromates in air. However, the satisfactory industrial hygiene test results were obtained on a smaller batch of product which was not typical of normal production volumes.

D. DESCRIPTION OF THE INCIDENT

On April 17, 2002, Clark was directed to make a batch of Triple Dip. On this date, there was no cover on the Triple Dip tank with which Clark was working (Smith, 41). Clark was wearing a green ammonia gas cartridge with his APR (Smith, 74). Clark stated (88) that he made two blends of other product(s) in other tanks before he blended Triple Dip in the designated, pre-cleaned (Clark, 95) Triple Dip tank. He always made Triple Dip the same way by following the instructions on the batch ticket (Clark, 94).

Smith stated (138-140) that he saw Clark in the Triple Dip production area inside the yellow lined area that denoted a respirator must be worn. Clark was reading a batch sheet. Clark had the respirator hanging from his neck. He was not wearing it for protection at that time. Smith saw the respirator hanging from Clark’s neck and saw him inside the yellow lined area, but did not say anything to Clark about failing to comply with the rules for wearing a respirator inside the yellow lined area, or to ensure that Clark was wearing the correct respirator for the work he was performing.

During the Triple Dip process, Clark (106-107) needed to cool down the process by adding water to the tank. He was wearing his safety equipment, including his respirator. He walked up the stepladder, reached for the garden hose to add the water to the tank, and looked down into the tank. An orange mist came out of the tank. He breathed in the mist. He turned off the water

and started down the ladder. He could not breathe. He stated that he had never seen orange mist come off any product that he mixed, including Triple Dip.

E. CAUSES OF THE INCIDENT

The causes of the incident include:

1. Improper process controls that failed to prevent or control the exothermic chemical reaction.
2. Improper engineering controls to prevent known hazardous reactive chemicals from escaping from the Triple Dip vessel and injuring Clark.
3. Improper hazard communication and safety training, or the lack thereof, regarding the hazards of the Triple Dip process.
4. Improper training in the selection and use of personal protective equipment (i.e. respirators), or the lack of proper training in the selection and use of personal protective equipment (i.e., respirators).
5. Improper supervision that recognized that Clark had the wrong respirator around his neck and failed to correct the condition and ensure Clark wore the proper type of respirator for the task he would be performing.

F. THE SPECIFIC HAZARD INVOLVED IN THIS INCIDENT

Clark was injured by hazardous airborne contaminants that were generated in the Triple Dip mixing vessel. Alchemy's failure to provide process controls, engineering controls, safety education and training, proper personal protective equipment, and effective supervision of Clark exposed Clark to the hazard. The combination of hazard and exposure was the cause of Clark's injury.

G. ANALYSIS

1. Mixing Nitric Acid With Organic Compounds Such As Methanol Is Hazardous.

Nitric acid has a

... notable ability to oxidize most organic compounds to gaseous carbon dioxide, coupled with its own reduction to gaseous 'nitrous fumes' [oxides of nitrogen]...¹

The colors of the plumes described in the materials available for review indicate that oxides of nitrogen were likely released.

Addition of nitrating acid mixture led to a runaway exothermic reaction...²

Accident statistics reveal nitration as the most widespread and powerfully destructive industrial unit process operation. This is because nitric acid can, under certain conditions, effect complete and highly exothermal conversion of organic molecules to gases, the reactions often being capable of acceleration to deflagration or detonation.³

Additional information about the hazards of nitric acid and nitric oxide, and nitric acid's propensity to convert to oxides of nitrogen, was available in the contemporary, peer reviewed, professional and scientific literature.⁴

Alchemy knew of the hazards of nitric oxide in this kind of chemical process. Alchemy failed to respond to the known hazards and this was a cause of the incident.

2. Manufacturing Triple Dip Involves Hazardous Chemicals and Alchemy Knew Of those Hazards

Triple Dip is made by combining known hazardous chemicals that include chromic acid, methanol, nitric acid with other chemicals such as ammonium bifluoride and sulfamic acid and deionized water. Alchemy recognized these chemicals as hazardous materials in its process documentation and its personal protective equipment requirements for employees. Alchemy knew of the chemical hazards, the process hazards, and the production problems associated with Triple Dip's manufacture because of Jones's familiarity with Triple Dip when it was produced by Chemical Company. Jones developed the policies and procedures (i.e., batch sheet) for handling hazardous materials at Alchemy. Alchemy knew of the hazards because of previous OSHA inspections and notices of violations regarding chemical hazards and their control, including engineering controls and personal protective equipment controls. Alchemy knew of the hazards and failed to properly instruct Clark about those hazards, and this was a cause of his injury.

3. Performing Manufacturing Processes That Contain Hazardous Chemicals Without Proper Process And Engineering Controls Is a Dangerous Condition.

The Triple Dip process relied on the operator manually adding hazardous chemicals to a mixing vessel where a hazardous exothermic reaction could develop and possibly release a plume of airborne contaminant to which the worker could be exposed. The worker was at or near the top of the vessel adding hazardous chemicals while monitoring the temperature to make sure it did not rise excessively or quickly. This was done without any controls that would have properly monitored the chemical process while the worker was removed a safe distance from the hazard area.

Process equipment was available that could have automated this process. Pumps with metering devices would have provided a safer method to mix the hazardous chemicals. The use of sensors to measure gas phase NO₂ concentration, electrical conductivity of the reaction mass, and gas phase temperatures, and proper liquid levels⁵, was technologically feasible. Alchemy failed to use process controls that would have prevented or minimized the incident.

Proper engineering controls to eliminate or minimize worker exposure to process chemicals and their airborne contaminants were also technologically and economically feasible. Alchemy knew from OSHA inspections before Clark's injury that their ventilation was improper. They also knew that superior local exhaust ventilation controls were available as indicated in the report dated July 17, 2000 from OSHA. Diagrams of applicable local exhaust ventilation configurations and design parameters were provided in that report. The source document for those diagrams was a publication that is, to this day, an authoritative text⁶ on industrial ventilation. Alchemy failed to use proper engineering controls that would have prevented or minimized Clark's exposure and injury, and this was a cause of Clark's injury.

4. Performing Manufacturing Activities Using Hazardous Chemicals Without Proper Training and Education Is a Dangerous Condition.

Alchemy was required to provide Clark with proper training in the Triple Dip manufacturing process. Clark received his directions from Smith. Clark relied on and followed the instructions in the Triple Dip batch ticket.

Step 2 of the batch ticket states that the operator is to "Charge Mixer Tank With Sufficient DI Water To Cover Agitator." The word "sufficient" is too vague to be effective. It does not specify how many gallons of water should be added to the vessel. This was easily done since the same vessel was always used to make Triple Dip. Therefore, the specific number of gallons that it would have taken to provide the proper initial amount of water could have been determined. Alchemy failed to provide proper mixing instructions on the batch ticket and this was a cause of the incident.

Step 4 of the batch ticket states that “Pump Chromic Acid Solution (from step #1) Into Mixer Tank At A Rate That Maintains Temp. b/w 145 – 155F. (USE CAUTION).” This step relies on the worker to properly monitor temperature rise to stay within the parameters for safety and quality. Process controls were technologically feasible and available to remotely sense and control the addition of chemicals in a safe manner without relying on human intervention. Alchemy failed in its responsibility to provide proper process controls and this was a cause of the incident.

The “Safety Precautions” of the batch ticket indicate that an acid-gas respirator should be worn. This statement is of little value since there is no indication that Clark received training on the proper selection and use of his respirator. Further, he was unsure what the color codes on the cartridges meant. The batch ticket failed to provide complete information regarding the use of respiratory protection. Alchemy failed in its responsibility to provide complete information on the use of respiratory protection and this was a cause of Clark’s injury.

The phrase on the batch ticket, “Use elephant trunk for ventilation over tank” instructs the worker to use a form of ventilation that was improper and substandard compared to the forms of local exhaust ventilation recommended to Alchemy by OSHA in July 2000. Using improper or less effective process ventilation can expose workers to injury. Alchemy failed in its responsibility to provide proper instruction to Clark to use proper exhaust ventilation and this was a cause of Clark’s injury.

Alchemy was required to provide Clark with proper training in the safe use of hazardous chemicals and in the proper selection and use of personal protective equipment such as respirators. Alchemy failed in its responsibility to provide Clark with proper training in the safe use of hazardous chemicals and in the proper selection and use of personal protective equipment such as respirators. This was a cause of Clark’s injury.

5. Performing Manufacturing Activities Using Hazardous Chemicals Without Proper Personal Protective Equipment Is a Dangerous Condition.

Alchemy failed to provide Clark with training on the proper selection and use of his respirator. He was unsure what the color codes on the cartridges meant. The batch ticket failed to provide complete information regarding the use of proper respiratory protection and this was a cause of Clark’s injury.

Clark also wore a face shield. However, the rising plume of contaminants from the vessel was not prevented from reaching his unprotected breathing zone by using a face shield. Supplied air respirators are recommended for protection against oxides of nitrogen.⁷ Air purifying respirators provide no protection for the hazardous chemical that was known to be emitted in this situation. This further emphasizes the need for Alchemy to have provided proper local exhaust ventilation as an engineering control. Alchemy failed to provide Clark with proper personal protective equipment and this was a cause of his injury.

6. Performing Manufacturing Activities Using Hazardous Chemicals Without Proper Supervision Is a Dangerous Condition.

Smith saw Clark inside the yellow lined area of the factory that indicated respiratory protection must be worn. Smith saw this and said nothing to Clark about wearing his respirator. Smith also did not take notice if Clark was wearing the proper respirator for the process he was working with to determine if it was consistent with the information on the batch ticket Clark was reading. Smith was Clark's chance to determine that he was wearing the correct respirator as specified on the batch sheet. Alchemy failed in its responsibility to ensure that Clark wore the proper respiratory protection equipment for the job he was performing, and this was a cause of Clark's injury.

7. Discussion Of Actions And/Or Inactions Of Alchemy

a. The Specific Unsafe Working Conditions

Clark was exposed to a concentration of oxides of nitrogen sufficient to cause illness or injury.

Clark was working with a hazardous chemical process without the benefit of proper engineering controls, specifically local exhaust ventilation, as indicated in the July 2000 OSHA report.

Clark was working with hazardous chemicals and had not received proper training in the properties of those chemicals, their health effects, and the measures that he could take to protect himself.

Clark was not provided proper training in the selection and use of personal protective equipment (i.e. respirators) so that he would be protected from the hazardous chemicals with which he worked.

b. Knowledge And Appreciation Of Dangers

Alchemy knew of the hazards of the process from Jones's experience with manufacturing Triple Dip, including the need to monitor the process closely to eliminate or minimize the generation of plumes of hazardous air contaminants. Jones wrote the batch ticket that included process hazard information.

Alchemy knew of the hazards of the individual hazardous chemicals used in the Triple Dip manufacturing process because it was widely available in the professional literature as indicated in the earlier cited references, and because Jones was a chemist with extensive chemical training.

Alchemy knew that proper local exhaust ventilation was not only needed but technologically and economically feasible when they received the notice of violation form the June 6, 2000 OSHA citation, and the July 2000 OSHA report.

Alchemy knew of the requirement to provide hazard communication training and training in personal protective equipment (i.e., respirators) when they received the notice of violation in the July 22, 2000 OSHA citation.

c. Unsafe Working Conditions Were A Violation Of OSHA

These unsafe working conditions were violations of numerous portions of OSHA as previously mentioned with respect to the June 6, 2000 and July 22, 2000 OSHA inspection reports and the July 17, 2000 correspondence from OSHA. The applicable OSHA violations included:

29 CFR 1910.1000, Air contaminants, which states in the opening paragraph "An employee's exposure to any substance listed in Tables Z-1, Z-2, or Z-3 of this section shall be limited in accordance with the requirements of the following paragraphs of this section." Nitric acid, nitric oxide, and nitrogen dioxide are three nitrogen compounds listed in table Z-1 of this section.

Alchemy was in violation of 29 CFR 1910.1000(b) by allowing Clark to become overexposed to hazardous airborne chemical contaminants that likely included oxides of nitrogen.

Alchemy was in violation of 29 CFR 1910.1000(e) by not determining and implementing feasible administrative or engineering controls to achieve compliance with the limits prescribed in 29 CFR 1910.1000(a) through (d).

29 CFR 1910.1200, Hazard communication. (a) Purpose. (1), “The purpose of this section is to ensure that information concerning [chemical] hazards is transmitted to employers and employees... this transmittal of information is to be accomplished by means of comprehensive hazard communication programs, which are to include container labeling and other forms of warning, material safety data sheets and employee training.”

Alchemy was in violation of 29 CFR 1910.1200(e) that required Alchemy to develop, implement, and/or maintain at the workplace a written hazard communication program which describes how the criteria specified in 29 CFR 1910.1200(f), (g), and (h) will be met.

29 CFR 1910.132, Hazard assessment. Alchemy was required to develop a written hazard assessment for the Triple Dip process due to the known process hazards. There is no indication in the materials available for review that a written hazard assessment was developed that accurately identified the hazards of the process and how those hazards would be controlled.

Alchemy was in violation of these sections which require:

1910.132(d)(1) The employer shall assess the workplace to determine if hazards are present, or are likely to be present, which necessitate the use of personal protective equipment (PPE). If such hazards are present, or likely to be present, the employer shall:

1910.132(d)(1)(i) Select, and have each affected employee use, the types of PPE that will protect the affected employee from the hazards identified in the hazard assessment;

1910.132(d)(1)(ii) Communicate selection decisions to each affected employee; and,

1910.132(d)(1)(iii) Select PPE that properly fits each affected employee.

29 CFR 1910.134, Respiratory protection. (a) Permissible practice. (1) In the control of those occupational diseases caused by breathing air contaminated with harmful dusts, fogs, fumes, mists, gases, smokes, sprays, or vapors, the primary objective shall be to prevent atmospheric contamination. This shall be accomplished as far as feasible by accepted engineering control

measures (for example, enclosure or confinement of the operation, general and local ventilation, and substitution of less toxic materials). When effective engineering controls are not feasible, or while they are being instituted, appropriate respirators shall be used pursuant to this section.”

Alchemy was in violation of 29 CFR 1910.134(a) that required Alchemy to provide sufficient exhaust to prevent atmospheric contamination.

Alchemy was in violation of 29 CFR 1910.134(c) that required Alchemy to establish and implement a written respiratory protection program with specific procedures in a workplace where respirators are necessary to protect the health of the employee or whenever respirators are required by the employer.

Alchemy was in violation of 29 CFR 1910.134(d) that required Alchemy to select and provide respirators based on the respiratory hazards to which the employee is exposed.

d. Clark Was Exposed to Dangerous Conditions

Clark was exposed to a manufacturing process using hazardous chemicals that made a hazardous product while working as directed by Alchemy without proper process controls that would have eliminated or minimized his exposure to the hazards of the process and without proper engineering controls that would have prevented or minimized his exposure to the chemical hazards and without proper training in the hazards of the process and without proper respiratory protection and without proper training in the selection and use of the respiratory protection.

Clark was exposed to the dangerous conditions because of Alchemy’s failure to prevent his exposure due to the lack of process and engineering controls, training, and personal protective equipment.

e. The Exposure To The Hazard Was A Cause Of Clark’s Injury

Exposure to the hazardous plume of airborne contaminant because of improper process and engineering controls, lack of proper training in chemical safety, and the lack of proper respiratory protection were causes of Clark’s injury.

This Dangerous Procedure Was Substantially Certain To Cause Serious Injury Or Death.

Alchemy failed to follow the basic measures for preventing injury. Alchemy failed to:⁸

1. Eliminate the known hazards from the machines, methods, materials, and plant structure.
2. Control the hazard by enclosing or guarding it at its source.
3. Train personnel to be aware of the hazard and to follow safe job procedures to avoid it.
4. Prescribe personal protective equipment for personnel to shield them against the known hazard.

Alchemy knew of the need to eliminate or minimize the hazard created by hazardous chemicals that were known to create a hazardous reaction and toxic byproducts in a vessel that was not equipped with proper process and engineering controls, by a worker who was not properly trained in the use of the hazardous chemicals, and who was not properly trained in the use nor provided with proper respiratory protection.

Alchemy also knew of the potential to release toxic oxides of nitrogen because of their knowledge of chemistry and the process. Alchemy should have developed and implemented proper information and process steps on their batch sheet. Alchemy should have implemented proper process controls that would have minimized Clark's direct involvement with the chemicals and the plume from the reaction inside the vessel. Alchemy knew about the existence of proper local exhaust ventilation configurations but failed to implement them for the Triple Dip process. Alchemy was required to provide proper respirator protection and proper training in the selection and use the respirator.

On September 14, 2000, Alchemy replied in a letter (Bates 00301) to OSHA that they "will control the rate at which employees can add [chromic acid and/or sodium bichromate] to a mixer in order to use an administrative control to further ensure our employees are not overexposed." Alchemy suggested this approach because industrial hygiene air quality monitoring performed by the Bureau of workers Compensation, Division of Safety and Hygiene, indicated acceptable levels of chromic acid and chromates in air.

Alchemy violated the accepted "safety hierarchy" mentioned above. Alchemy should have pursued proper process controls that would have positively controlled the rate at which chemicals were added to the vessel to prevent the hazardous reaction from occurring. Second, Alchemy should have implemented proper engineering controls to ensure that overexposures to airborne contaminants would not affect workers if they were generated by a reaction. Alchemy failed to pursue proper process and engineering controls and instead Alchemy relied on less effective controls as their primary safeguard.

These failures were substantially certain to cause serious injury or death.

It Was The Dangerous Manner In Which Clark Was Instructed To Work With The Triple Dip Process That Caused His Injury.

To a reasonable degree of professional certainty, and subject to modification if additional information becomes available, it is my professional opinion that Clark was injured due to his exposure to hazardous chemicals from a reaction in the Triple Dip vessel.

Clark was working as he was directed by Alchemy at the time of his exposure at the Triple Dip vessel. Alchemy failed to develop and enforce competent safety policies, work rules and procedures for this type of hazardous work. The failure of Alchemy to eliminate or control the known hazards of the Triple Dip process and the failure of Alchemy to implement proper process and engineering controls, and their failure to provide proper respiratory protection created a dangerous exposure to toxic airborne contaminants from the mixing process. This combination of hazard and risk was the direct and proximate cause of Clark's injuries.

Given The Manner In Which Alchemy Instructed Clark To Manufacture Triple Dip, It Was Substantially Certain That An Employee Would Sustain Serious Injury or Death.

Requiring employees to work with a hazardous chemical product using hazardous chemical ingredients without proper process and engineering controls, and without proper training and instructions to safely manufacture the hazardous product, and without proper training in the use of respiratory protection and without providing proper respiratory protection, was substantially certain to cause serious injury or death.

H. FINDINGS

To a reasonable degree of professional certainty, and subject to modification if additional information becomes available, it is my professional opinion that:

1. Manufacturing Triple Dip using a process that was not equipped with proper process and engineering controls is a dangerous procedure.
2. This dangerous procedure was substantially certain to cause serious injury or death.
3. It was the dangerous manner in which Clark was instructed and allowed to manufacture Triple Dip using a process for which a proper hazard assessment had not been performed, and on a process that was not equipped with proper process and engineering controls and without proper instructions and training in that process, and without proper training in the selection and use of respiratory protection, and without being provided proper respiratory

protection that caused his exposure.

4. Given the manner in which Alchemy instructed Clark to manufacture Triple Dip, it was substantially certain that an employee would sustain serious injury or death.



Digitally Signed By: Ronald D. Schaible

Ronald D. Schaible, CIH, CSP

¹ Urban, P. G., Editor. *Bretherick's Handbook of Reactive Chemical Hazards, Sixth Edition – Volume 1.* (1999). Butterworth Heineman, Boston, MA. 1567.

² Ibid. 1591.

³ Urban, P. G., Editor. *Bretherick's Handbook of Reactive Chemical Hazards, Sixth Edition – Volume 2.* (1999). Butterworth Heineman, Boston, MA. 246.

⁴ *Documentation of the Threshold Limit Values and Biological Exposure Indices, Sixth Edition.* (1991). American Conference of Governmental Industrial Hygienists, Cincinnati, OH.

⁵ Ibid. 246.

⁶ *Industrial Ventilation: A Manual of Recommended Practice.* American Conference of Governmental Industrial Hygienists, Cincinnati, OH.

⁷ NIOSH Pocket guide To Chemical Hazards (June 1997). U.S. Department of Health and Human Services, Public Health Service, Centers for Disease Control, National Institute for Occupational Safety and Health, Cincinnati, OH. 228-229.

⁸ *Accident Prevention Manual for Industrial Operations, 5th Ed.* National Safety Council, Chicago, IL 1964. P. 4-1.