MIFACE INVESTIGATION REPORT #10MI032

SUBJECT: Sewer Administrator Died When Chop Saw Spark Caused a 55-Gallon Drum to Explode

Summary

In the Spring of 2010, a male township sewer administrator in his 50s died when a spark from a 14-inch chop saw entered a funnel that was used pour waste oil and other liquids into a 55-gallon drum, causing the vapors in the drum to ignite and the drum to explode. The chop saw the decedent was using to cut re-rod was located approximately two feet from the 55-gallon drum and was within 10 feet of a parts washer that contained lacquer thinner. The waste drum and another 55-gallon drum containing new motor oil were on a rack adjacent to the chop saw. Both barrels were lying horizontally on the rack, approximately 2-1/2 feet above the floor. The waste oil drum had a facet in one bung hole and the other larger hole had a firm-made 2-inch diameter spout, which extended approximately 2 inches and then turned upward at a 90-degree angle for approximately 8 inches. At the end of the spout there was an open funnel used for pouring liquids into the drum. The funnel height was approximately at the same level as the saw. The decedent had cut a piece of re-bar and had placed it on the ground against the building's overhead door rail track when the explosion occurred. Another employee had just arrived and was burned as a result of the explosion. Nearby businesses heard the explosion and saw the fire and called for emergency response. Emergency response arrived and transported the decedent to a nearby hospital where he died later that day.

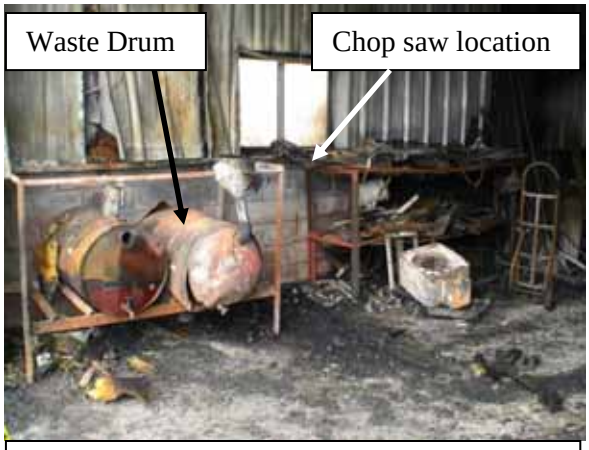

Figure 1. Position of chop saw table and drum rack with waste and motor oil drums.

RECOMMENDATIONS

- A competent employee should survey work areas to ensure flammables and combustibles are stored appropriately and are not located in the area where spark-producing equipment is used.
- Townships should utilize both in-house and external resources, such as building inspectors, fire departments, county departments, insurance risk managers, and MIOSHA Consultation, Education and Training (CET), to assist in identifying health and safety issues, such as flammable/combustible material storage and then develop and enforce control measures for these issues.
- The township should develop and implement a health and safety management system which includes a written health and safety plan, hazard analysis, and employee training for each township department.
- Employers should ensure drums containing flammable or combustible products are properly grounded when pouring flammable/combustible liquids into them and that the pouring containers are appropriately bonded to minimize static electricity buildup. If a

funnel is used to pour flammable/combustible materials into another container, the funnel should be equipped with a flame arrestor and properly bonded.

- The water and sewer district should develop a standard operating procedure (SOP) for emptying the waste drum.
- Fire Departments should review business/government agency-supplied hazardous materials data, prioritize this information, and conduct proactive site visits to assist in preventing a fire incident.

INTRODUCTION

MIFACE investigators were informed of this work-related fatality by the Michigan Occupational Safety and Health Administration (MIOSHA) personnel, who had received a report on their 24-hour-a-day hotline. The township clerk and a sewer district supervisor agreed to be interviewed by the MIFACE investigator in June 2010. Following the interview, the sewer district supervisor escorted the MIFACE investigator to the incident scene and permitted MIFACE to take incident scene pictures. During the writing of this report, the police and medical examiner reports, the death certificate and the MIOSHA investigation file were reviewed. Figures 1, 2, 4, and 5 are courtesy of the MIOSHA compliance officer incident file. Figure 3 was taken by the MIFACE investigator at the time of the site visit.

The sanitary sewer district was organized under the Drain Code and has been under the administration and operation of the township for 32 years. The sewer district was a separate entity from the township and was a designated county drain, under the control of the County Drain Board. The decedent was the only sewer district employee. He had 26 years of experience as the administrator and operator of the sewer district. He was state certified as a Class I operator to run the water and sewer department and had received the appropriate permit from the Michigan Department of Environmental Quality.

Recently, the decedent had been re-hired to serve as sewer administrator. The decedent worked full time. His 8-hour work shift began at 7:00 a.m. and concluded between 3:00-3:30 p.m., but would work longer than eight hours if the work required it. The decedent reported to the township board.

Neither the township nor the sewer district had a written health and safety plan. Safety meetings were not held either by the decedent or the township. The sewer district did not have a Procedure Manual as required. The township had an employee handbook with limited safety references. The township was in the process of developing an employee handbook with position descriptions and position responsibilities; the position of sewer administrator was included in this effort.

At the time of the incident, the building where the incident occurred was owned by the county but insured by the township. The township relied upon its insurance risk management representatives to perform site evaluations to identify health and safety concerns. MIFACE was informed that the insurance representative did not identify the barrel storage location next to the chop saw as a “hazardous” location and one that should be corrected.

Tax assessments for the sewer district were made at a local level and paid for the decedent’s wages and the sewage system’s equipment, maintenance and repairs. The township clerk

indicated that the assessments were the lowest in the state, and were not enough to cover the costs of operating the sewer district. The decedent, in an effort to keep costs down and to perform the necessary maintenance and repairs, developed his own tools, made his own equipment modifications, etc. He was described as a "cobbler"; he helped to keep rates low by his ingenuity, experience, and equipment knowledge to avoid the costs of new equipment.

Township Remediation

The township has developed and approved position descriptions as part of their employee handbook.

MIOSHA Citations

The MIOSHA General Industry Safety and Health Division issued the following Serious citations at the conclusion of its investigation.

FLAMMABLE AND COMBUSTIBLE LIQUIDS, PART 75

- RULE 1910.106(e)(2)(ii):

  In an industrial plant, flammable or combustible liquids were not stored in tanks or closed containers:

  (Funnel inserted into 55-gallon open container of flammable/combustible liquids)

- RULE 1910.106(e)(6)(i):

  Ensure that adequate precautions shall be taken to prevent the ignition of flammable vapors. Sources of ignition include but are not limited to open flames; lightning; smoking; cutting and welding; hot surfaces; frictional heat; static, electrical and mechanical sparks; spontaneous ignition, including heat producing chemical reaction; and radiant heat.

  (Employee cutting metal rod with a spark producing saw within 2 feet of drum and 10 feet of parts washer)

INVESTIGATION

The decedent performed some other work-related tasks that morning prior to arriving at the water and sewer facility's shop building (incident site). The building was approximately 2,700 square feet in size. The day before the incident, a rototiller broke down and he had performed welding to repair the rototiller. When the incident occurred, he was in the process of cutting re-rod for the rototiller with a 14-inch chop saw mounted on a wooden bench on the north side of the building. The chop saw was located approximately seven feet from the shop's overhead

Figure 2. Looking into shop building through overhead door

door and had been in that location since the mid 1980s. A window located north of the chop saw was extensively pitted from the sparks generated by the saw.

Against the east wall of the building, approximately 10 feet away from the chop saw, was an open-lidded parts cleaner that allegedly contained waste thinner along with mineral spirits.

On either side of the wooden bench/chop saw were two metal frames with two tiers. A frame holding scrap metal was located on the east side of the saw and the west frame stored 55-gallon drums and other chemicals. The west frame was approximately 45 inches high by 37 inches wide by 72 inches long. The second tier of the frame was located approximately two feet above the ground.

Figure 3. Frame holding waste and motor oil drums.

A 10-foot plywood board that functioned as a shelf was the top tier of the west rack. The plywood stored various chemicals such as anti-fog, washer fluid, de-icer, brake fluid, dry gas bottles and numerous other general maintenance products. The plywood shelf was approximately one foot higher than the wood bench on which the chop saw was mounted and located within two feet of the mounted chop saw.

On the bottom tier were two standard, welded-top 55-gallon drums lying horizontally on the rack. Each drum had one 2-inch and one 3/4-inch threaded bunghole on opposite sides of the top head. One drum held new motor oil and the second drum held approximately five gallons of waste oil and other liquids, such as transmission fluid, gear oil, and hydraulic fluid. The decedent had previously added lacquer thinner to the parts cleaner. It is unknown if the decedent placed any waste thinner into the waste barrel.

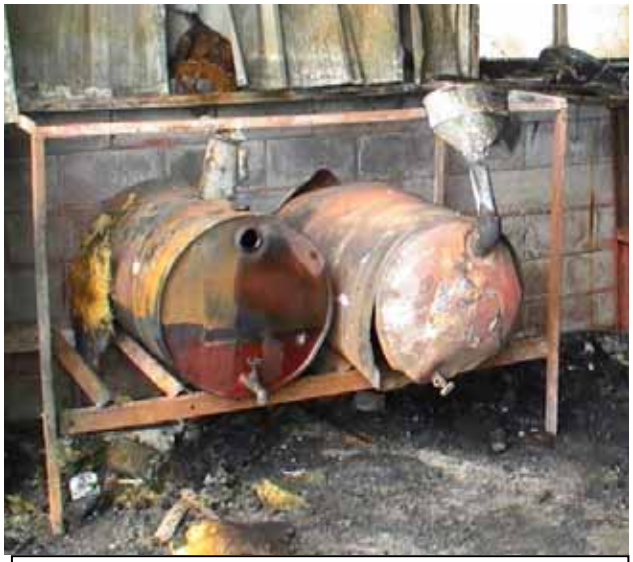

Figure 4. Re-enactment of drum storage and waste drum funnel configuration.

The waste oil drum, which was positioned closest to the chop saw bench, had a faucet in the 3/4-inch bung hole and the 2-inch bunghole had a 2-inch diameter spout made by the decedent. The spout extended out from the barrel approximately 2 inches, then elbowed upward at a 90 degree angle for approximately 8 inches. Inside of the 2-inch pipe was a 1½-inch diameter pipe into which a funnel was set to permit liquids to be easily poured into the drum. The height of the spout and funnel was approximately the same height at the saw table. The funnel was not covered. The drum had been emptied in November by

pumping its contents into another drum.

Conflicting reports were received about the sequence of events. It is unclear who opened the shop's overhead door. One report indicated it was an arriving township Department of Public Works (DPW) employee and one report indicated it was the decedent. A slight breeze was entering the open door; the southeast wind was approximately 2-5 mph. The DPW worker arrived and parked in front of the open garage door in his pickup truck. One report indicated that the explosion occurred as the DPW employee was walking toward the decedent. Another report indicated that the explosion occurred as the decedent was placing several pieces of rebar he had just cut against the garage door rail track. MIFACE was informed during the site visit that that the arriving DPW employee had taken a piece of cut re-bar from the decedent and placed it by the door track, and as he turned around, the explosion occurred.

As a result of the explosion, both ends of the waste drum were deformed. A possible event scenario was developed. This type of saw throws extensive sparks. Because there were only five gallons of waste material in the drum, and the funnel was uncovered, there was ample space for vapors to collect and ignite if a spark had entered through the funnel. Both ends of the waste drum were ruptured.

Figure 5. Waste drum after explosion.

The resulting explosion sprayed the decedent with the contents of the drum and he was severely burned from the products and the heat caused by the explosion. The DPW worker also received burn injuries. The shop as a whole suffered extensive burning and most of the equipment was reduced to ashes. The heat generated melted the tail light of the DPW pickup truck.

Nearby businesses heard the explosion and saw the fire and called for emergency response. Emergency response arrived and transported the decedent to a nearby hospital where he died later that day.

CAUSE OF DEATH

The death certificate indicated that the cause of death was medical complications of post explosive and thermal injuries. Toxicology results were consistent with medical treatment.

RECOMMENDATIONS/DISCISSION

- A competent employee should survey work areas to ensure flammables and combustibles are stored appropriately and are not located in the area where spark-producing equipment is used.

Routine hazard assessments of the work site should be performed to identify new or existing as well as continuing hazards. Scheduled and unscheduled inspections should be conducted and include a review of the work area, materials, and equipment to identify hazardous conditions. One of the areas to assess at a work site is the location and storage of flammable and combustible materials and waste products and the types of operations nearby, such as operations that may produce an ignition source.

MIFACE reviewed the MSDS for No. 2 Fuel Oil which was in the drum. OSHA/NFPA had classified No. 2 Fuel Oil as a Class II Combustible liquid. OSHA defines a Class II Combustible Liquid as including those with flashpoints at or above 100 deg. F. (37.8 deg. C.) and below 140 deg. F. (60 deg. C.), except any mixture having components with flashpoints of 200 deg. F. (93.3 deg. C.) or higher, the volume of which make up 99 percent or more of the total volume of the mixture.

The No. 2 Fuel Oil MSDS stated: "Vapors may be ignited rapidly when exposed to heat, spark, open flame, or other source of ignition. When mixed with air and exposed to an ignition source, flammable vapors can burn in the open or explode in confined spaces. Being heavier than air, vapors may travel long distances to an ignition source and flash back". Additionally, the MSDS Handling Precautions as: "Handle as a combustible liquid. Keep away from heat, sparks, and excessive temperatures and open flame! No smoking or open flame in storage, use or handling areas. Bond and ground containers during product transfer to reduce the possibility of static-initiated fire or explosion. The No. 2 Fuel Oil Storage Precautions were: Keep containers closed and clearly labeled. Use approved vented storage containers. Empty product containers or vessels may contain explosive vapors. Do not pressurize, cut, heat, weld or expose such containers to sources of ignition. Store in a well-ventilated area. This storage area should comply with NFPA Flammable and Combustible Liquid Code."

Employers should prohibit all ignition sources, such as smoking, matches, lighters, or flame- or spark-producing equipment in any area where flammable liquids are used, handled or stored. The drum storage area did not have a NO SMOKING sign or other signage indicative of a flammable storage area.

The drum storage area did not have a spill pallet, and in the event of a spill, contents could not be contained. A high density polyethylene spill pallet containment system should be selected. It is important to consider the load capacity (number of pounds placed on it) and its spill capacity when selecting a spill containment system to ensure it fits the facility's needs.

Employers should include employees to participate in the worksite hazard analysis. Employee participation will help provide the means, through which workers identify hazards, recommend and monitor abatement, and otherwise participate in their own protection. In addition, employees may recognize or may know of potential hazards that the employers might overlook. Regular

inspections of the work site by a competent person will ensure that safety procedures are being followed, and demonstrate that the employer is committed to the safety program and prevention of injuries.

- Townships should utilize both in-house and external resources, such as building inspectors, fire departments, county departments, insurance risk managers, and MIOSHA Consultation, Education and Training (CET), to assist in identifying health and safety issues, such as flammable/combustible material storage and then develop and enforce control measures for these issues.

Townships, although a part of a county system, may not know of or have the resources available to implement necessary health and safety programs. The township sewer district operation was funded solely by water and sewer rates charged to consumers. Health and safety issues and remediation costs had a lower priority to procuring and maintaining equipment necessary to run the sewer operation.

MIFACE recommends townships utilize in-house resources to assist them in developing and implementing a health and safety management system and to identify health and safety issues within the many township departments, such as parks and recreation, public works, sewer, etc. Resources available in the township could include the fire chief, building inspector, or their insurance carrier. County resources could include the drain commissioner office, human resources, risk management, or the health department. MIOSHA Consultation, Education and Training (CET) division conducts free, non-enforcement hazard surveys as a training tool that provides the employer and employees an opportunity to learn how to identify unsafe or unhealthy acts or conditions, and MIOSHA violations.

- Employers should ensure drums containing flammable or combustible products are properly grounded. When pouring flammable/combustible liquids into the drum, ensure the pouring container and the drum are bonded to minimize static electricity buildup. If a funnel is used to pour flammable/combustible materials into another container, the funnel should be equipped with a flame arrestor and properly bonded.

Grounding connects a piece of conductive equipment to an earth electrode (such as a driven rod (copper clad), buried plate, or underground metal water pipe) or to a building grounding system to prevent static sparking. Bonding connects pieces of conductive equipment together to keep them at the same potential so that static sparking cannot occur. Durable, low-resistance bonding and grounding cables should be used. Clamps should be single-point to ensure contact with the metal surface, even those surfaces that are painted or rusted. Alligator-type clamps do not provide the assurance of contact compared to single-point clamps.

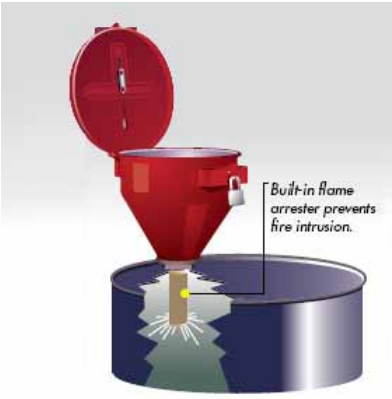

Figure 6. Example of flame arrestor-equipped funnel for 55-gallon drum.
Photo courtesy of Justrite.

Both in the MIOSHA file and during the MIFACE site visit, mention was made of pouring flammable/combustible liquids into the waste drum. The drum was not grounded and the

pouring container was not bonded to the drum. To reduce the likelihood of an ignition from static electricity, proper bonding and grounding is necessary.

Funnels used to pour flammable/combustibles materials from one container to a drum should be equipped with a flame arrester. A flame arrestor prevents an ignition source from reaching the drum's flammable contents and works by providing rapid dissipation of heat from an ignition source so that the vapor temperature on the inside of the drum remains below the ignition point. An example of a flame arrestor for a 55-gallong drum is shown in Figure 6.

- The township should develop and implement a health and safety management system which includes a written health and safety plan, hazard analysis, and employee training for each township department.

The township is comprised of many departments with different functions and different safety and health issues. The township should develop and implement a general, written health and safety plan and, in addition, a specific health and safety plan for each department.

The implementation and enforcement of a comprehensive safety program is designed to prevent worker injury. The safety program should include task-specific safety procedures and employee training. Training is a critical element in a safety program and should include the communication of task-specific safety procedures.

New safety training topics can be based on the findings of hazard assessments as discussed in the second listed recommendation of this report. In addition, training should be conducted when new hazards are introduced into the work environment, such as new chemicals and equipment. It is the employers' responsibility to routinely assess their employees work practices and to ensure that they are following the safe work procedures in which they were instructed.

- The water and sewer district should develop a standard operating procedure (SOP) for emptying the waste drum.

A worker described the existing waste barrel emptying procedure. The procedure involved the use of compressed air. The spigot placed at the bottom of the barrel was opened. Approximately 1/2-1 pound of compressed air was applied to the top of the barrel. Barrel contents were forced out the spigot. The individual MIFACE spoke with indicated the air would be applied until the barrel ran dry. During this procedure, both ends of the barrel would "pop out" and the decedent would use a rubber mallet to "push" the barrel ends back into position.

By law, transferring liquids by means of air pressure on the storage container is prohibited. Using air pressure to empty (transfer) the 55-gallon barrel can result in an overpressure that could exceed what the container or tank is designed to withstand. Additionally, a flammable atmosphere could be created within the container and would be particularly sensitive to ignition because of the increased pressure.

The township should develop a standard operating procedure to safely empty the waste drum. If the waste drum is to be stored vertically, a drum pump system (drum pump, pump tube construction, motor type, other accessories as needed) should be selected and utilized. Finish

Thompson Inc (http://www.finishthompson.com/) has information on their website that can assist drum pump system purchasers with selecting a system to meet their needs. If the drum is to be stored horizontally, a drum siphon adaptor should be used to empty the container. Justrite Manufacturing (http://www.justritemfg.com/), in their drum handling equipment section, offers many products to safety utilize 55-gallon drums for flammable/combustible liquid storage, including dispensing and draining.

- Fire Departments should review business/government agency-supplied hazardous materials data, prioritize this information, and conduct proactive site visits to assist in preventing a fire incident.

Fire departments under Section 14(i) of the Michigan Occupational Safety and Health Act (MIOSHA), Public Act 154 of 1974, as amended (Act 154) requires the Fire Chief of an organized fire department to prepare and disseminate to each firefighter information on facilities within their jurisdiction that use or produce hazardous chemicals.

The Michigan's Firefighter Right to Know Law and Section 5(p) of the Michigan Fire Prevention Code, Public Act 207 of 1941, as amended provides the fire chief the right to request and receive a list of chemicals and the Material Safety Data Sheets used at a specified location. Under the law, if the fire chief requests it, the following information must be provided within ten working days of the query:

- A listing of all hazardous chemicals at the location,
- MSDSs for all hazardous chemicals at the location and,
- Information pertaining to the quantity and location of the chemicals.
- An employer must provide the fire chief with a written update "when there is a significant change relating to fire hazards and the quantity, location or presence of hazardous chemicals in the workplace."

With this information in hand and with the permission of the site owner(s), fire departments could visit the facility and determine if the hazardous materials are stored in a manner that would minimize the potential of a fire. A fire department visit most likely would have identified the close proximity of the drums containing the flammable/combustible materials and the parts washer to the spark-producing saw.

REFERENCES

MIOSHA standards cited in this report may be found at and downloaded from the MIOSHA, Michigan Department of Licensing and Regulatory Affairs (MDLARA) website at: www.michigan.gov/mioshastandards. MIOSHA standards are available for a fee by writing to: Michigan Department of Licensing and Regulatory Affairs, MIOSHA Standards Section, P.O. Box 30643, Lansing, Michigan 48909-8143 or calling (517) 322-1845.

- MIOSHA General Industry Safety Standard, Flammable and Combustible Liquids, Part 75
- *Arc Welder Dies in Explosion While Using an Old Barrel as a Worktable.* Iowa FACE Report http://www.public-health.uiowa.edu/face/Reports/REPORT-033.html

- *Bonding and Grounding of Flammable Liquid Containers.* Harleysville's Risk Control Department. http://www.harleysvillegroup.com/losc/PDFs/LCT1025.pdf
- *Massachusetts Mechanic Killed When a 55-Gallon Drum Exploded.* Massachusetts FACE Investigation #00-MA-042-01. http://www.cdc.gov/niosh/face/stateface/ma/00ma042.html
- *Grounding and Bonding Applications for Control of Static Electricity.* Stewart R. Brown Manufacturing Company, 1165 Hightower Trail, Atlanta, Georgia 30350. http://www.srbrowne.com/booklet/index.html
- *Checklist for Dangerous Liquids.* National Safety Council. http://www.nsc.org/safetyhealth/Pages/checklist_for_dangerous_liquids.aspx
- Finnish Thompson Inc. 921 Greengarden Road, Erie, PA 16501-1591 http://www.finishthompson.com/
- *Red Book – Your Guide to Handling Flammable Liquids Safely.* Justrite Manufacturing, 2454 Dempster St., Des Plaines, IL 60016 http://www.justritemfg.com/RedBook/Redbook%20All%20Pages_2%20files/RedBkpgs1-20_LO_RES.pdf

Key Words: 55-gallon drum explosion, chop saw spark, township water and sewage department, flammable and combustible liquids storage

10/27/2011