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UNITED STATES
DEPARTMENT OF LABOR
MINE SAFETY AND HEALTH ADMINISTRATION
Metal and Nonmetal Mine Safety and Health

REPORT OF INVESTIGATION

Surface Nonmetal Plant
Kaolin Clay

Fatal Other Accident
July 15, 2015

CVB Industrial Contracting, Inc.
Contractor ID No. 5BR
At
Main Processing Plant
Thiele Kaolin Company
Sandersville, Washington County, Georgia
Mine ID No. 09-00337

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OVERVIEW

Travis A. Barnes, Railcar Washer, age 25, was fatally injured on July 15, 2015 after entering a railroad tank car to wash out the residual material left inside. Barnes was found inside the railcar by a co-worker, unresponsive.

The accident occurred due to management's failure to properly train railcar washers in the health and safety aspects of their job. Management failed to prevent a railcar washer from being exposed to an atmosphere that was below the minimal oxygen content of 18%. Management failed to conduct exposure monitoring to determine the adequacy of control measures. Management failed to have a second miner available with backup equipment and rescue capability in the event of failure of the respiratory equipment. Finally, management failed to have a second person tend a lifeline when a miner was entering a tank.

GENERAL INFORMATION

Thiele Kaolin Company is a kaolin processing facility located in Sandersville, Washington County, Georgia. Eric Tillirson is President and Greg Frazier is Manager of Safety. The plant operates four twelve hour shifts, seven days a week. There are a total of 314 employees at this facility.

Kaolin is initially processed at the mine facilities and then pumped into the plant thru pipelines for further processing. The kaolin material is classified according to particle size and brightness enhanced through chemical and mechanical means and then filtered using rotary vacuum filters to produce the final product. The finished product is then spray dried, made into slurry, or calcined. The finished product is shipped by railroad tank cars, tank trucks, hopper cars, or bags. Thiele contracts CVB Industrial Contracting, Inc. (CVB) to conduct various tasks at the plant, including bagging kaolin and washing railcars.

The Mine Safety and Health Administration (MSHA) completed the last regular inspection at this operation on June 25, 2015.

DESCRIPTION OF THE ACCIDENT

On the day of the accident, July 15, 2015, Travis Barnes (victim), contract employee with CVB, reported to work at approximately 6 a.m. his normal starting time. Barnes first reported to the track shed. At 6:05 a.m., Barnes and Tony Butts, both car washers for CVB, left the track shed to start sealing loaded railcars to prepare for shipment. At approximately 6:40 a.m., Barnes went back to the track shed to complete paperwork, wait for the train to pull out the loaded railcars and spot the empty railcars in the wash area of the plant. At 7:30 a.m., the train arrived to pull out the loaded cars but did not have any empty cars to leave. The train did not return with the empty cars until 10 a.m. At that time, the car washers left the track shed to go and wash the empty cars. Jim Dunn, Thiele Track Supervisor, saw Barnes at approximately 11:00 a.m., preparing to move five cars down the track to the washing area. Barnes was seen again on top of the accident car on track #2 by Antonio Watts, Thiele car washer, who had been on the adjacent track #3 washing cars. Watts went to track #6 to talk to Terry Gilmore, Track Leadman with Thiele. When Watts returned to the wash area, he noticed that Barnes had not started to wash the railcar. Watts was concerned that Barnes was inside the railcar longer than usual. Watts then climbed the railcar access ladder to check on Barnes. Watts saw Barnes was inside the railcar unresponsive. Barnes was not equipped with a lifeline and there was not a second person present. Watts called Dunn, who was off site at lunch. Dunn called Ronnie Adams, Production Foreman, and told him to call 911. Emergency services were called at 12:06 p.m. Willie Durden, Thiele employee and volunteer fireman, was working at the plant and received the call on his fire pager at 12:08 p.m. Durden was the first on the scene and immediately entered the railcar. Police and EMS arrived right after Durden. A rope was dropped into the railcar and Durden hooked it to Barnes' fall protection harness. Barnes was lifted out of the railcar and CPR was immediately started. Barnes was transported by ambulance to Washington County Regional Medical Center where he was pronounced dead by E. K. May, Washington County Coroner. The cause of death was attributed to environmental suffocation.

INVESTIGATION OF THE ACCIDENT

Trey Turner, CVB Industrial Contracting EHS Manager, notified MSHA of the accident at 12:23 p.m. July 15, 2015, by calling the Department of Labor's National Contact Center (DOLNCC). The DOLNCC notified Judith Etterer, Staff Assistant, and an investigation was started the same day. In order to ensure the safety of all persons, MSHA issued a 103(j) order and later modified to section 103(k) of the Mine Act when the first Authorized Representative arrived at the mine. MSHA's accident investigation team traveled to the mine and conducted a physical inspection of the accident scene, interviewed employees, conducted air sampling and reviewed training and work procedures relevant to the accident. MSHA conducted the investigation with the assistance of mine and contract management and employees.

PHYSICAL FACTORS

ACCIDENT DESCRIPTION:

On July 15, 2015, a fatality occurred at Theile Kaolin Company's (Thiele) Main Processing Plant in Sandersville, Georgia. The victim, a 25 year-old male, was found unresponsive inside of an empty rail tank car (GATX 22394) that transported a kaolin slurry product to a Chempak Transload Facility (Chempak) in Pennsylvania. The railcar initially shipped from Thiele on June 1, 2015, was off-loaded at Chempak on July 6, 2015, and arrived back at Thiele on the morning of the accident.

The victim was preparing to wash residual slurry product out of Railcar GATX 22394, his first railcar of the day. The victim entered the railcar through the manway and climbed approximately 10 feet down an access ladder. The victim was later found unresponsive at the bottom of the car (Appendix A, Figures A1-A4). As shown in Figures A3 and A4, the victim's railcar did not contain much residual product upon its return to Thiele.

The victim was found wearing a full-face chemical cartridge respirator with organic vapor/acid gas cartridges. A Thiele RKI GX-2009 Portable Gas Monitor and Vertex Standard radio were also found on the victim. A fall protection harness was worn by the victim without a lanyard. Based on interviews, it is believed that the victim was alone in the railcar for at least 45-60 minutes before he was discovered. There was no evidence that the victim started washing the railcar, indicating that he may have been quickly incapacitated following entry. Data files obtained from the victim's monitor revealed that the monitor was never turned on the day of the accident.

A Thiele employee entered the victim's railcar for approximately 20 minutes to assist in the extrication of the victim via a lifeline. Upon removing the victim from the railcar, a Thiele RKI GX-2009 monitor was placed at the top of the manway. The oxygen concentration at the opening was reported to be approximately 16.7%. During interviews, it was determined that the Thiele employee who assisted with the rescue did not test the air quality inside of the railcar prior to entry.

RKI GX-2009 DATA ANALYSIS:

Troy Hart, Industrial Hygienist, Physical and Toxic Agents Division, PS&HTC, Denver, CO conducted an analysis of data recovered from five Thiele RKI GX-2009 monitors. Data from the five instruments, along with additional details from the investigators, is provided in Appendix C.

PRODUCT DESCRIPTION AND LOADING/UNLOADING PROCESS

Thiele manufactures various kaolin slurry mixtures that are shipped via railcar to customers. The product transported in the victim's railcar was Kaogloss Plus, a kaolin slurry product manufactured for the PaperWorks paper mill in Philadelphia, Pennsylvania. Bulk samples of the slurry transported in the victim's railcar were obtained from Thiele's on-site production laboratory. The product did not have a noticeable odor.

A list of constituents for the kaolin slurry product transported in the victim's railcar is provided in Table 1.

Table 1. Kaogloss Plus Constituents

Chemical	CAS	Amount (%)
Kaolin	1332-58-7	65-95
Kaolin-Anhydrous	92704-41-1	5-35

Sodium Carbonate	497-19-8	0.30
Sodium Polyacrylate (BCS 4010)	9003-04-7	0.15
Sodium Carboxymethylcellulose (Aqualon CMC)	9004-32-4	0.15
Dazomet/Thione (BCS 3243)	533-74-4	0.007
Xanthan Gum (Kelzan)	11138-66-2	0.003

Kaolin slurry products may be held in railcars up to 30 days prior to being off-loaded; therefore, a low dose biocide (i.e., Thione) is routinely added to prevent bacteria growth. The active dose of Thione in Kaogloss Plus is approximately 70 parts per million. Methyl isothiocyanate (MITC), methylamine, and carbon disulfide are potential decomposition products of Thione. Approximately 7 pounds of xanthan gum is added to each Kaogloss Plus railcar to prevent the kaolin from settling. All slurry additives are well below the Safety Data Sheet (SDS) reporting threshold of 1%. Chemical concentrations above 1% are required to be reported on the SDS.

In January 2015, PaperWorks began using Chempak to off-load the kaolin slurry from railcars into tank trucks for delivery to the paper mill in Essington, Pennsylvania. This was due to a weight limit on a railway bridge, which prevented Thiele railcars from shipping at full capacity to the PaperWorks paper mill. During the off-loading process, railcars are pressurized to convey the slurry into tank trucks via transfer lines. According to a Thiele representative, plant air and nitrogen are used at the Chempak facility; however, only compressor-supplied plant air is used during the off-loading of kaolin slurry.

Thiele's railcar wash crew employees are responsible for cleaning empty railcars that have been returned to the facility. The wash crew consists of three CVB contract employees and two Thiele employees. From the statements provided by the wash crew the following work practice was in place: Prior to cleaning a railcar, a relief valve is opened to relieve pressure from the car. A bottom drain plug is opened to drain residual product from the car. A 20 inch diameter railcar manway cover is opened using a wrench. Upon opening the manway, an RKI GX-2009 Portable Gas Monitor is used to check the railcar's atmosphere. The monitor is equipped with sensors for oxygen (O_2), carbon monoxide (CO), hydrogen sulfide (H_2S) and combustible gas (LEL). A rubber band is attached to the monitor clip and the monitor is lowered into the car at arm's length. Following the air quality check, the manway seal and hole are hosed off. The bottom of the car is also hosed to clear a spot for the wash crew employee to stand. An access ladder is placed on the manway hole and the employee climbs into the railcar. Mechanical ventilation is not used during the cleaning process. According to CVB management, washing facilitates the movement of atmospheric air into the railcar.

SAMPLING PROCEDURES AND METHODS

During the investigation, MSHA conducted air monitoring inside of the victim's railcar and in seven empty and pressurized kaolin slurry railcars that were returned to Thiele. Four of the seven railcars had been off-loaded at Chempak, while the other three railcars were unloaded at customer locations. A summary of monitoring conducted in each railcar is provided at the end of this section in Table 2.

Industrial Scientific iBRID™ multi-gas monitors with integral sampling pumps were used to sample the atmosphere inside of each railcar. The iBRIDs were fully calibrated prior to use and were configured to monitor O_2, CO, carbon dioxide (CO_2), H_2S, nitrogen dioxide (NO_2), and sulfur dioxide (SO_2). Prior to opening the railcar manway cover, the detectors were placed at the top relief valve to monitor the air relieved from the car. Immediately after the manway was opened, the detectors were placed at arm's length in the manway opening. Remote monitoring was conducted inside of each railcar via a Tygon sampling line connected to the pump inlet of each iBRID. Monitoring was conducted near the bottom of each railcar and at breathing zone height (BZH) for at least 60 minutes. The average concentration of each gas over a ten second period was recorded on each monitor.

If an oxygen deficient atmosphere was detected inside of a railcar, air from the railcar was collected into SKC FlexFoil® 1 liter bags using an SKC sampling pump and Tygon® sample line. Prior to sample collection, the sampling line was purged with air from the railcar for approximately 10 minutes. Additionally, each sample bag was filled and purged three times. Some air samples were also collected into 50 mL glass sample bottles. Gas chromatography analysis of the sample bags and bottles was conducted by the Pittsburgh Safety and Heath Technology Center's (PS&HTC) Physical and Toxic Agents Division.

Sorbent tube sampling was conducted by MSHA for organic vapors, MITC, methylamine, and carbon disulfide in the victim's railcar (GATX 22394) and inside of railcar GATX 29235. Air samples were collected onto sorbent tubes attached to calibrated SKC low flow sampling pumps. MITC samples were collected at a flow rate of 100 cubic centimeters per minute (cc/min) onto charcoal tubes and analyzed in accordance with OSHA Method ID 7. Methylamine samples were collected at a flow rate of 200cc/min onto XAD-7 tubes and analyzed in accordance with a modified OSHA Method ID 40. Carbon disulfide samples were collected at a flow rate of 200cc/min onto charcoal tubes and analyzed in accordance with NIOSH Sampling and Analytical Method 1622

Draft. Organic vapor samples were collected at flow rate of 100cc/min onto charcoal tubes and analyzed in accordance with MSHA Method P-30.

Each sampling train was pre-calibrated with a Bios Defender® primary calibrator using representative sample media in-line. The ends of the sorbent tubes were opened and attached to each sampling train at the beginning of the sampling period and immediately capped at the completion of sampling. A post flow-rate check was conducted at sampling completion. Samples were refrigerated and shipped overnight to the laboratory. MITC, methylamine, and carbon disulfide samples were submitted for analysis to TestAmerica, an American Industrial Hygiene Association (AIHA) accredited laboratory. Organic vapor samples were submitted for analysis to the PS&HTC's AIHA-accredited Organics Laboratory in the Physical and Toxic Agents Division.

To determine if heat was a potential contributing factor to the fatality, a QuestTemp™ 34 wet bulb globe temperature (WBGT) monitoring device was lowered into railcar GATX 29235 to monitor temperature and humidity inside of the car. The instrument remained inside of the railcar for approximately one hour.

Table 2. Railcar Sample Overview

Railcar	Unload Date	Description	Sample Date	Sample Description
GATX 22394	7/6/15	Victim's railcar. Transported kaolin slurry to Chempak	7/21/15	iBRID: O_2, CO, CO_2, H_2S, NO_2, SO_2 MITC Methylamine Carbon Disulfide Organic Compounds
GATX 29235	7/8/15	Identical to victim's railcar. Transported kaolin slurry to Chempak	7/21/15	iBRID: O_2, CO, CO_2, H_2S, NO_2, SO_2 MITC Methylamine Carbon Disulfide Organic Compounds WBGT
UTLX 300465	Not provided	Transported kaolin slurry to PaperWorks	7/22/15	iBRID: O_2, CO, CO_2, H_2S, NO_2, SO_2
GATX 64799		Transported kaolin slurry to customer	7/22/15	iBRID: O_2, CO, CO_2, H_2S, NO_2, SO_2
ACFX		Transported kaolin	7/22/15	iBRID: O_2, CO, CO_2, H_2S, NO_2,

72913		slurry to customer		SO_2
ACFX 79198	7/14/15	Transported kaolin slurry to Chempak	7/24/15	iBRID: O_2, CO, CO_2, H_2S, NO_2, SO_2
UTLX 300466	7/18/15	Transported kaolin slurry to Chempak	7/29/15	iBRID: O_2, CO, CO_2, H_2S, NO_2, SO_2
UTLX 300467	7/21/15	Transported kaolin slurry to Chempak	7/30/15	iBRID: O_2, CO, CO_2, H_2S, NO_2, SO_2

SAMPLING RESULTS

Sampling results are discussed in this section and presented in Tables 3 and 4 below. Additionally, iBRID monitoring graphs are provided in Appendix B for the oxygen-deficient railcars.

On July 21, the oxygen concentration inside of the victim's railcar (GATX 22394) was 20.9%. No hazardous gases or other contaminants were detected inside of the car. A hazardous atmosphere was not anticipated inside of the victim's railcar since the manway had remained opened following the incident on July 15.

On July 21, MSHA detected an oxygen-deficient environment inside of railcar GATX 29235 immediately upon opening the manway using an iBRID and a Thiele RKI GX-2009 monitor. The oxygen concentration ranged from 4-5% after the sampling line was dropped into the bottom of the car around 12:03 p.m. The sample line remained inside of the railcar until approximately 13:15 p.m., at which time the oxygen concentration was approximately 15% (Appendix B, Figure B1). Gas chromatography analysis of two air samples collected from the railcar confirmed a low oxygen and high nitrogen atmosphere inside the railcar. The first bag sample was collected at 12:35 p.m. and had an oxygen concentration of 14.8% and a nitrogen concentration of 84.2% (Table 4). The average WBGT was 92.3°F inside of railcar GATX 29235. Note: The average temperature on July 21, 2015, was 87°F. The average temperature on July 15, 2015, was 83.1°F.

On July 22, monitoring was conducted in three railcars that were unloaded at customer locations (UTLX 300465, GATX 64799, and ACFX 72913). Oxygen was within normal range and no hazardous gases or compounds were detected inside of these railcars.

On July 24, monitoring was conducted inside railcar ACFX 79198. Immediately upon opening the manway, an oxygen-deficient environment was detected on two different iBRIDs and a Thiele RKI GX-2009 monitor. The oxygen concentration in the car ranged from 6-7% at 11:14 a.m. to 15% at 12:32 p.m.

(Appendix B, Figures B2 and B3). Gas chromatography analysis of four air samples collected from the railcar confirmed a low oxygen, high nitrogen atmosphere inside of the railcar. The first bag sample was collected at 11:22 a.m. and had an oxygen concentration of 7.8% and a nitrogen concentration of 91.2% (Table 4).

On July 29, atmospheric monitoring was conducted inside railcar UTLX 300466. Immediately upon opening the manway, an oxygen-deficient environment was detected on two iBRID monitors and on a Thiele MSA Altair multi-gas monitor. The oxygen concentration in the car ranged from 7-8% at 15:24 to 16-17% at 16:36 on two different iBRID monitors (Appendix B, Figures B4 and B5). Gas chromatography analysis of six air samples collected from the railcar confirmed a low oxygen, high nitrogen atmosphere inside of the railcar. An air sample was collected in a bottle at the manway when it was opened at 15:22. The sample had an oxygen concentration of 10.9% and a nitrogen concentration of 88.0%. The first bag sample was collected inside of the car at 15:42 and had an oxygen concentration of 9.8% and a nitrogen concentration of 89.1% (Table 4).

On July 30, atmospheric monitoring was conducted inside railcar UTLX 300467. Immediately upon opening the manway cover, an oxygen-deficient environment was detected on an iBRID monitor and a Thiele MSA Altair monitor. The oxygen concentration ranged from 3% at 10:11 a.m. to 20% at 16:28 (Appendix B, Figures B6 and B7). Gas chromatography analysis of nine air samples collected from the railcar confirmed a low oxygen, high nitrogen atmosphere inside the railcar. An air sample was collected in a bottle at the manway when it was opened at 10:10 a.m. The sample had an oxygen concentration of 3.3% and a nitrogen concentration of 95.6%. The first bag sample was collected inside of the car at 10:25 a.m. and had an oxygen concentration of 4.6% and a nitrogen concentration of 94.5%.

Table 3. Railcar Sampling Data Summary

Compound	**GATX 22394**	**GATX 29235**	**UTLX 300465**	**GATX 64799**	**ACFX 72913**	**ACFX 79198**	**UTLX 300466**	**UTLX 300467**
O_2 initial (%)	20.9	4.5	20.9	20.9	20.9	5.4	7.8	3.4
O_2 final (%)	20.9	15.1	20.9	20.9	20.9	15.7	16.4	20.9
CO range (ppm)	0-4	14-29	0-7	3-17	3-5	0-11	5-6	2-18
CO_2 range (%)	0-0.08	0.03-0.11	0.03-0.09	0.03-0.6	0.03	0.06-0.11	0.02	0.02-0.11
H_2S range (ppm)	0-0.7	0.1.1	0-1	0-0.5	0-0.6	0-1.2	0-0.9	0-1.5
NO_2 range (ppm)	0	ND	ND	ND	ND	ND	ND	0-1
SO_2 range (ppm)	0-0.2	1.9-3.5	0-2	0.3-1.7	0.5-1.4	0.6-2.5	0.3-0.4	0-1

MITC (ppm)	ND	2-2.4	ND	Not Sampled
Methylamine (ppm)	ND	ND	ND	
Carbon Disulfide (ppm)	ND	7.4-7.8	0.7	
Organic Compounds (ppm)				
Hexane	ND	ND	ND	Not Sampled
Octane	ND	ND	ND	
Acetone	ND	ND	Trace	
Methyl Chloroform	ND	ND	ND	
Nonane	ND	ND	ND	
Methyl Ethyl Ketone	ND	ND	Trace	
Benzene	Trace	Trace	Trace	
Propyl Acetate	ND	ND	ND	
Trichloroethylene	ND	ND	ND	
Hexone	ND	ND	ND	
Perchloroethylene	ND	ND	ND	
Chloroform	ND	ND	ND	
Toluene	ND	Trace	0.03-0.7	
Ethylene Dichloride	ND	ND	ND	
Ethyl Benzene	ND	Trace	ND	
p-Xylene	ND	Trace	ND	
m-Xylene	ND	0.5	ND	
Dibromomethane	ND	Trace	Trace	
o-Xylene	ND	1.4-1.5	ND	
Mesitylene	ND	Trace	ND	
Cyclohexanone	ND	ND	ND	
Heptane	ND	ND	ND	
Trimethylbenzenes (2 isomers)	ND	Trace	ND	
Bromoform	ND	ND	ND	
Xylene	ND	1.9-2.0	ND	
ND - Compound not detected above the analytical limit of detection (LOD) Trace - Above LOD, below analytical limit of quantification (LOQ)				

Table 4. Gas Chromatography Results

Railcar /Date	Sample ID	Time	Location	O_2 (%)	N_2 (%)	CO (ppm)	CO_2 (%)

GATX 29235 7/21/15	TS00703	12:35	Bottom	14.8	84.2	2	0.10
	TS00704	12:40	Breathing Zone Height (BZH)	16.8	82.2	1	0.08
ACFX 79198 7/24/15	TS00732	11:22	Bottom	7.8	91.2	1	0.10
	TS00733	11:27	BZH	9.8	89.2	1	0.10
	TS00734	11:30	BZH	12.6	86.4	1	0.09
	TS00735	11:39	Bottom	11.7	87.3	1	0.09
UTLX 300466 7/29/15	TS00736 (Bottle)	15:22	Manway	10.9	88.0	1	0.12
	TS00737	15:42	BZH	9.8	89.1	2	0.13
	TS00738	15:45	BZH	10.0	89.0	2	0.14
	TS00739	16:25	BZH	15.6	83.4	1	0.09
	TS00740	16:31	BZH	16.0	83.0	1	0.08
	TS00741 (Bottle)	16:33	Manway	17.1	81.9	1	0.07
UTLX 300467 7/30/15	TS00742 (Bottle)	10:10	Manway	3.3	95.6	2	0.13
	TS00744	10:25	BZH	4.6	94.5	2	0.13
	TS00745	10:30	BZH	5.3	93.7	2	0.12
	TS00746	11:12	BZH	11.2	87.8	1	0.09
	TS00747	11:16	BZH	11.7	87.3	1	0.09
	TS00743 (Bottle)	11:18	Manway	14.9	84.1	1	0.08
	TS00748	12:45	BZH	16.3	82.7	1	0.07
	TS00749	12:49	BZH	16.5	82.5	1	0.07
	TS00750	16:21	BZH	Sample voided - bag damaged			
	TS00751	16:25	BZH	20.1	79.0	0	0.05

DISCUSSION

American National Standards Institute (ANSI) Z88.2-2015, Practices for Respiratory Protection, defines an Oxygen-Deficiency (Immediately Dangerous to Life and Health) as less than 16% oxygen at sea level[1].

Atmospheric air contains approximately 78.0% nitrogen and 20.9% oxygen. If the nitrogen concentration is too high, it displaces the oxygen and asphyxiation can occur. Nitrogen is safe to breathe only when it is mixed with the appropriate

[1] American National Standards Institute (ANSI)/American Society of Safety Engineers (ASSE), 2015. Practices for Respiratory Protection, Z88.2-2015

amount of oxygen. The Occupational Safety and Health Administration (OSHA) requires employers to maintain workplace oxygen levels between 19.5 and 23.5%. As shown in Table 5, the human body is adversely affected by low concentrations of oxygen. An atmosphere of only 4-6% oxygen causes a victim to fall into a coma in less than 40 seconds. Oxygen must be administered within minutes to offer a chance of survival.

Table 5. Effects of Oxygen Deficiency on the Human Body

Atmospheric Oxygen Concentration (%)	Possible Results
20.9	Normal
19.0	Some unnoticeable adverse physiological effects
16.0	Increased pulse and breathing rate, impaired thinking and attention, reduced coordination
14.0	Abnormal fatigue upon exertion, emotional upset, faulty coordination, poor judgement
12.5	Very poor judgement and coordination, impaired respiration that may cause permanent heart damage, nausea, and vomiting
<10	Inability to move, loss of consciousness, convulsions, death
Source: Compressed Gas Association, 2001[2].	

The testing of an atmosphere is a key element in any confined space entry. Adequate monitoring primarily involves the following: properly calibrated instruments, employee task training, representative monitoring, and proper interpretation of the results. The number of sensor and battery failures, infrequent calibrations, and general calibration problems indicate that Thiele's GX-2009 instrument calibration and maintenance program was inadequate. Thiele had only one instrumentician responsible for the calibration and maintenance of the facility's monitors, Rogers Anderson, Corporate Maintenance Manager. No other Thiele or CVB employees were trained on maintenance or calibration of the monitors. Anderson indicated during interviews with MSHA, that the GX-2009 monitors were being phased out due to numerous problems with oxygen sensor failures.

A significant number of alarms and warnings were recorded by the GX-2009 monitors. There is a potential for employees to disregard alarms and warnings that frequently occur. MSHA's technical support staff analyzed the data that was recorded and stored in the internal memory of the victim's monitor. The victim's

[2] Compressed Gas Association, Inc., 2001. Safety Bulletin, Oxygen-Deficient Atmospheres, SB-2, 4th edition.

monitor had the highest number of alarms and warnings. Oxygen warnings (<19.5%) were the most prevalent. A significant number of oxygen alarms (>23.5%) were also observed which indicates that the monitor was improperly zeroed in contaminated air that contained less than 20.9% oxygen.

During the investigation, numerous respiratory protection deficiencies were observed. Thiele and CVB wash crew employees were provided full-face chemical cartridge respirators. Thiele and CVB did not have respiratory protection procedures in place to address employee medical clearance, fit testing, respirator maintenance, and cartridge replacement. Several dirty respirators were observed lying around and hanging inside of the track shed lockers. The respirators and organic vapor/acid gas cartridges were observed with kaolin slurry splatter. Thiele and CVB employees were observed with significant facial hair and none of the employees had been fit tested or given medical clearance to wear a respirator. Additionally, employees had not been provided with replacement cartridges. Based on the observed condition of the respirator cartridges, breathing would have been significantly restricted when employees wore their respirators.

WEATHER

The weather condition around the time of the accident was clear with a temperature of 87 degrees Fahrenheit and light winds. Weather was not considered to be a factor in the accident.

SUMMARY

During the investigation, direct-read monitoring and gas chromatography analysis of air samples confirmed the presence of an oxygen-deficient environment inside of four railcars that had been off-loaded at the Chempak facility. Chempak uses plant air and nitrogen at the facility; however only compressor-supplied plant air is used during the off-loading of kaolin slurry at this site. Other compounds were detected during monitoring; however, those compounds were not detected at concentrations considered immediately Dangerous to Life and Health.

Oxygen-deficient environments can be easily detected through the use of portable gas detectors. Analysis of data recovered from the victim's GX-2009 monitor indicated that the monitor was not turned on when the victim entered the railcar. Further analysis of data from the victim's monitor, as well as four other Thiele-owned RKI GX-2009 monitors, revealed numerous problems including: battery and sensor failures, infrequent calibration, no bump testing, and numerous alarms and warnings. The victim's monitor had the highest number of oxygen sensor failures and oxygen alarms/warnings. At the time of the incident, the victim's monitor had a bad oxygen sensor that indicated it failed on July 7, 2015 and had not been replaced.

Thiele was aware of the numerous oxygen sensor failures and problems encountered with the GX-2009 monitors. The victim either forgot to turn the monitor on or intentionally chose to keep the monitor turned off due to the frequency and aggravation of the alarms. Either way, the victim had not been trained on the importance of air monitoring prior to entering a railcar. Appropriate maintenance of Thiele's gas monitors and training of personnel on confined space monitoring procedures would have prevented this fatality.

Training and Experience

Travis Barnes, victim, had 6 months mining experience all at this facility. Thiele employees were responsible for conducting the contractor's task training. A representative of MSHA's Educational Field Services staff conducted an in-depth review of the contractor's training records. Although the training records documented that task training had been conducted, it was determined by the investigative team that the training was not adequate. Barnes and four other contract car washers were not trained on the health and safety aspects of their job. During the interviewing process, it was discovered that the persons responsible for air monitor training, Jim Dunn and Terry Gilmore, could not verify they had conducted the training. When asked, Gilmore said Dunn does the training and when Dunn was asked, he said Gilmore did the training and he gave an overview of the subject. As an example of the lack of training, the employees each day were to check off on a sheet of paper that they monitored the air for H2S, however the sheet mistakenly said H2G. MSHA's interviews revealed that no one knew what H2G was and were not aware it was supposed to be H2S, including Gilmore and Dunn. The employees stated that the only training they received was that they were to stick the monitor in the railcar and write down what it recorded and that no one ever told them what potential hazards could be associated with the gases they were to monitor. MSHA issued a noncontributory 104(g)(1) Order. Four miners were withdrawn until the required training was provided. The lack of this task training directly contributed to the accident.

ROOT CAUSE ANALYSIS

A root cause analysis was conducted and the following root cause was identified:

Root Cause: The mine operator failed to have proper policies and procedures, including training, for miners working in the confined space of the rail car.

Corrective Action: Management established procedures and controls to assure safe rail car entry. A procedure was developed to include life line and attendants, rescue capability, ventilation, and atmospheric monitoring. All miners will be provided adequate task training in the health and safety aspects of this task before performing rail car entry.

CONCLUSION

The accident occurred because management policies and procedures failed to address all health and safety hazards associated with cleaning railcars. All hazards were not identified to ensure that persons could safely perform the task. Because of the inadequate policies and procedures, proper task training on the health and safety aspects of the car washing job was not given. Rail tank cars were not treated as a confined space. The air quality inside the tank cars was not properly monitored and an attendant manning a lifeline was not used.

ENFORCEMENT ACTIONS

Issued to Theile Kaolin Company

Order No. 8821378 -- issued on July 15, 2015, under the provisions of Section 103(j) of the Mine Act:

A fatal accident occurred at this operation on 15 July 2015, when a miner was found unresponsive in a slurry tank car on the #2 rail track adjacent to #1 and #2 product silos. Doniece Schlick verbally issued a 103J order at approximately 1300 over the phone to Trey Turner to assure the safety of all persons at this operation. The order prohibits all activity on and around #2 rail track. This order is now reduced to writing at 1530 on today 15 July 2015.

The order was terminated on November 12, 2015, after conditions that contributed to the accident no longer existed.

Citation No. 8816519 -- issued under the provisions of Section 104d1 of the Mine Act for a violation of 30 CFR 46.7a:

On July 15, 2015 a fatal accident occurred at this operation when a miner entered a rail tank car to wash out the residual material from inside. He was later found unresponsive inside the car. The victim was not properly trained to identify or correct hazards that they would likely encounter as they performed the task of washing railcars. Policies and procedures failed to address the health and safety aspects of this task.
Management engaged in aggravated conduct, constituting more than ordinary negligence by not ensuring contract miners were properly task trained. This violation is an unwarrantable failure to comply with a mandatory standard.

Order No. 8816520 -- issued under the provisions of Section 104d1 of the Mine Act for a violation of 30 CFR 56.16002c:

On July 15, 2015 a fatal accident occurred at this operation when a miner entered a rail tank car to wash out the residual material from inside. He was later found unresponsive inside the car. The victim was wearing a fall protection harness; however, he was not attached to a lifeline and a second person was not there similarly equipped to attend the lifeline.
Management engaged in aggravated conduct constituting more than ordinary negligence by allowing miners to enter tank cars without a lifeline and attendant. This violation is an unwarrantable failure to comply with a mandatory standard.

Order No. 8816521 -- issued under the provisions of Section 104d1 of the Mine Act for a violation of 30 CFR 56.5002:

On July 15, 2015 a fatal accident occurred at this operation when a miner entered a rail tank car to wash out the residual material from inside. He was later found unresponsive inside the car. The operator failed to have procedures in place to ensure that frequent testing of dust, gas, mist and fumes were surveyed prior to and during exposure to oxygen deficient areas. The victim did not monitor for conditions inside the tank car before entering to determine the adequacy of passively ventilating the rail tank car prior to the victim's entry into the oxygen deficient atmosphere.
Management engaged in aggravated conduct, constituting more than ordinary negligence by not having any policy and procedures in place for monitoring the atmospheric condition prior to entering the rail tank cars. This violation is an unwarrantable failure to comply with a mandatory standard.

Order No. 8816522 -- issued under the provisions of Section 104d1 of the Mine Act for a violation of 30 CFR 56.5005c:

On July 15, 2015 a fatal accident occurred at this operation when a miner entered a rail tank car to wash out the residual material from inside. He was later found unresponsive inside the car. The victim was using respiratory protection when he entered the tank car. At least one other person was not present outside the tank car opening with backup equipment and rescue capability when the victim's respiratory equipment was inadequate to provide oxygen.
Management engaged in aggravated conduct, constituting more than ordinary negligence by not having any policy and procedures in place for providing an attended and immediate rescue capability. This violation is an unwarrantable failure to comply with a mandatory standard.

Order No. 8816523 -- issued under the provisions of Section 104d1 of the Mine Act for a violation of 30 CFR 56.5001a/.5005:

On July 15, 2015 a fatal accident occurred at this operation when a miner entered a rail tank car to wash out the residual material from inside. He was later found unresponsive inside the car. The victim entered the tank car and succumbed to asphyxiation because the available oxygen was below the minimal oxygen content of 18%, as incorporated by reference, Threshold Limit Values for Chemical Substances in Workroom Air Adopted by ACGIH® for 1973.
Management engaged in aggravated conduct, constituting more than ordinary negligence by not having any policy and procedures in place to provide forced air ventilation in order to maintain a minimum acceptable oxygen concentration. This violation is an unwarrantable failure to comply with a mandatory standard.

Approved: Samuel K. Pierce Date 4/5/16
Samuel K. Pierce
Southeast District Manager

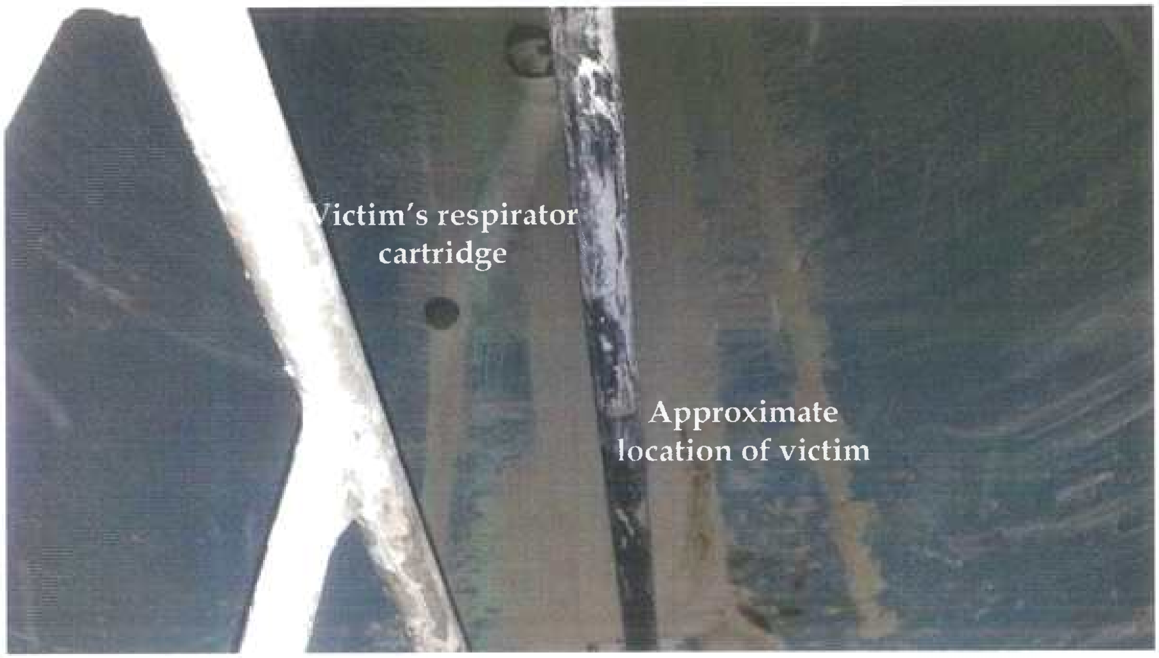
APPENDIX A
PHOTOS

Figure A1. Victim's Railcar

Figure A2. Railcar Manway and Access Ladder

Figure A3. Inside View of Victim's Railcar

Figure A4. Inside View of Victim's Railcar


Victim's respirator cartridge
Approximate location of victim

APPENDIX B
iBRID™ OXYGEN SENSOR DATA

Figure B1. Railcar GATX 29235 Atmosphere with iBRID SN 001 – 7/21/15

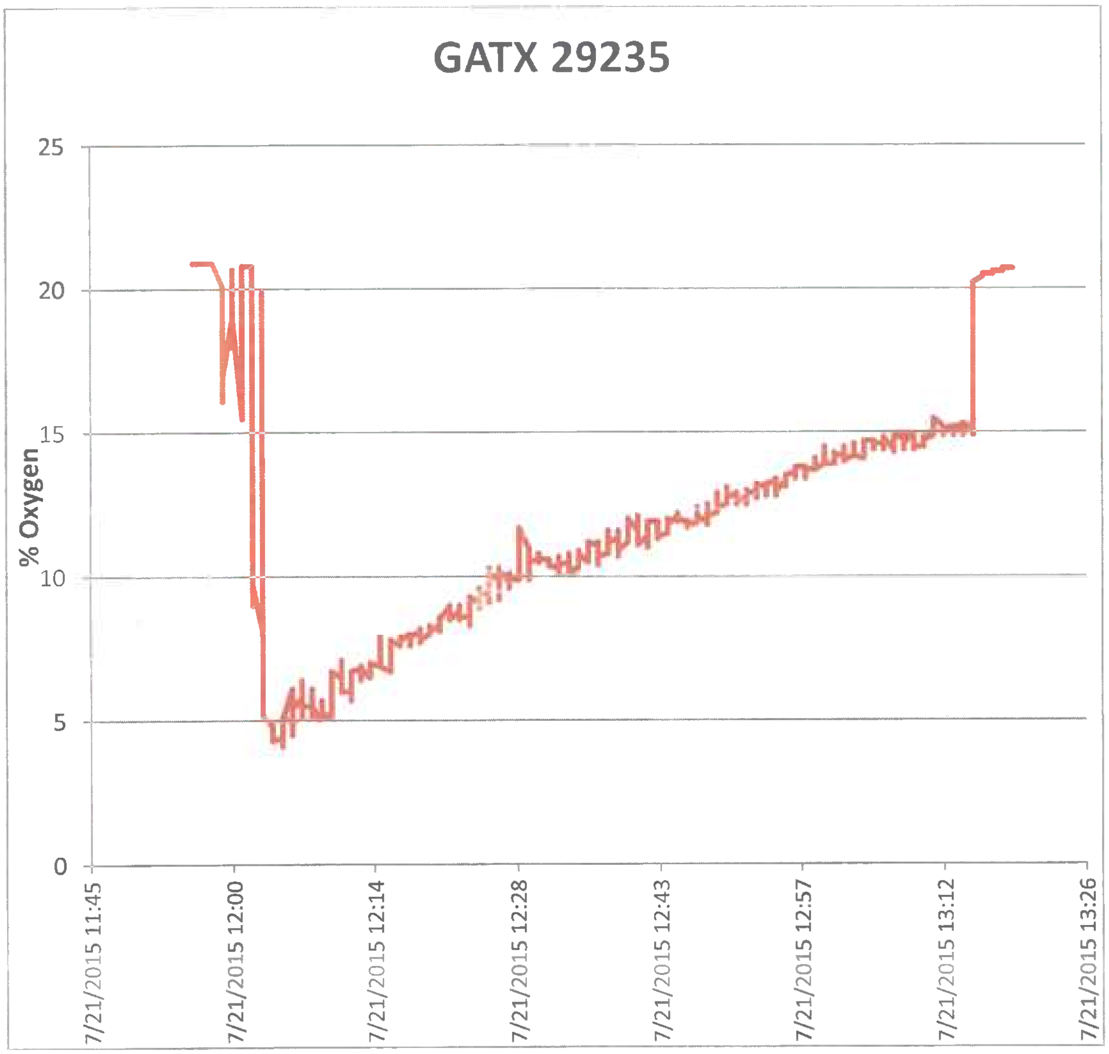


Figure B2. Railcar ACFX 79198 Atmosphere with iBRID SN 096 – 7/24/15

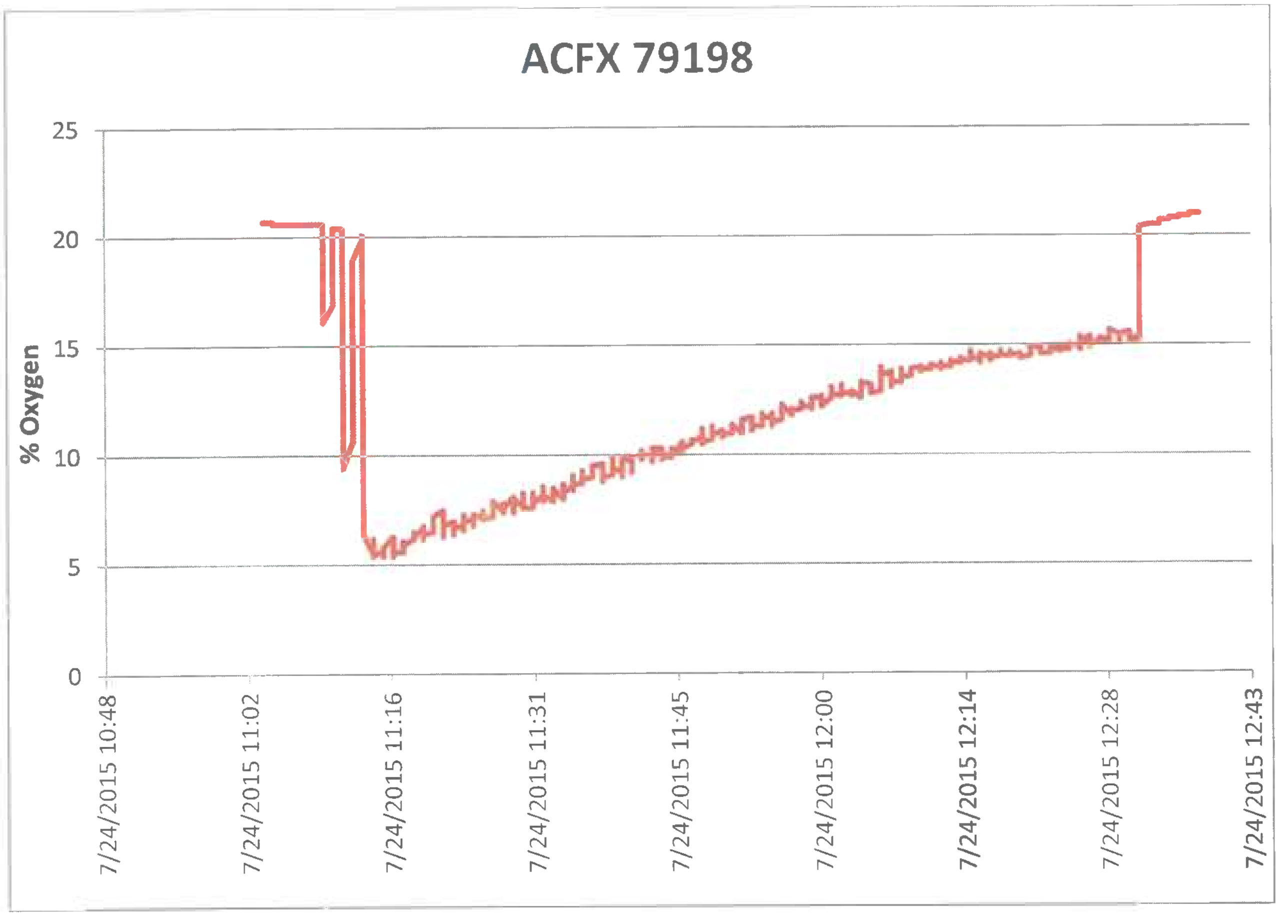


Figure B3. Railcar ACFX 79198 Atmosphere with iBRID SN 001 – 7/24/15

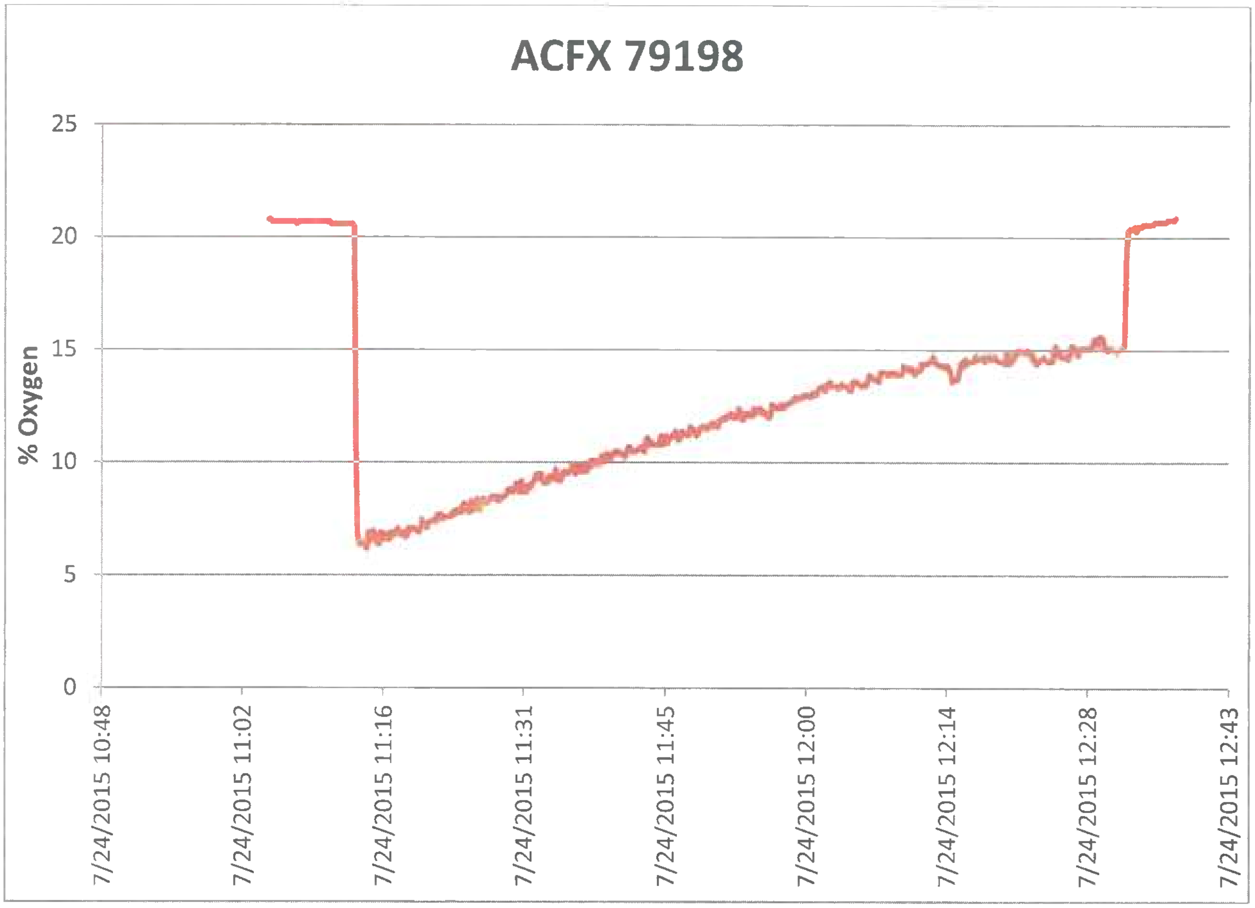


Figure B4. Railcar UTLX 300466 Atmosphere with iBRID SN 001 – 7/29/15

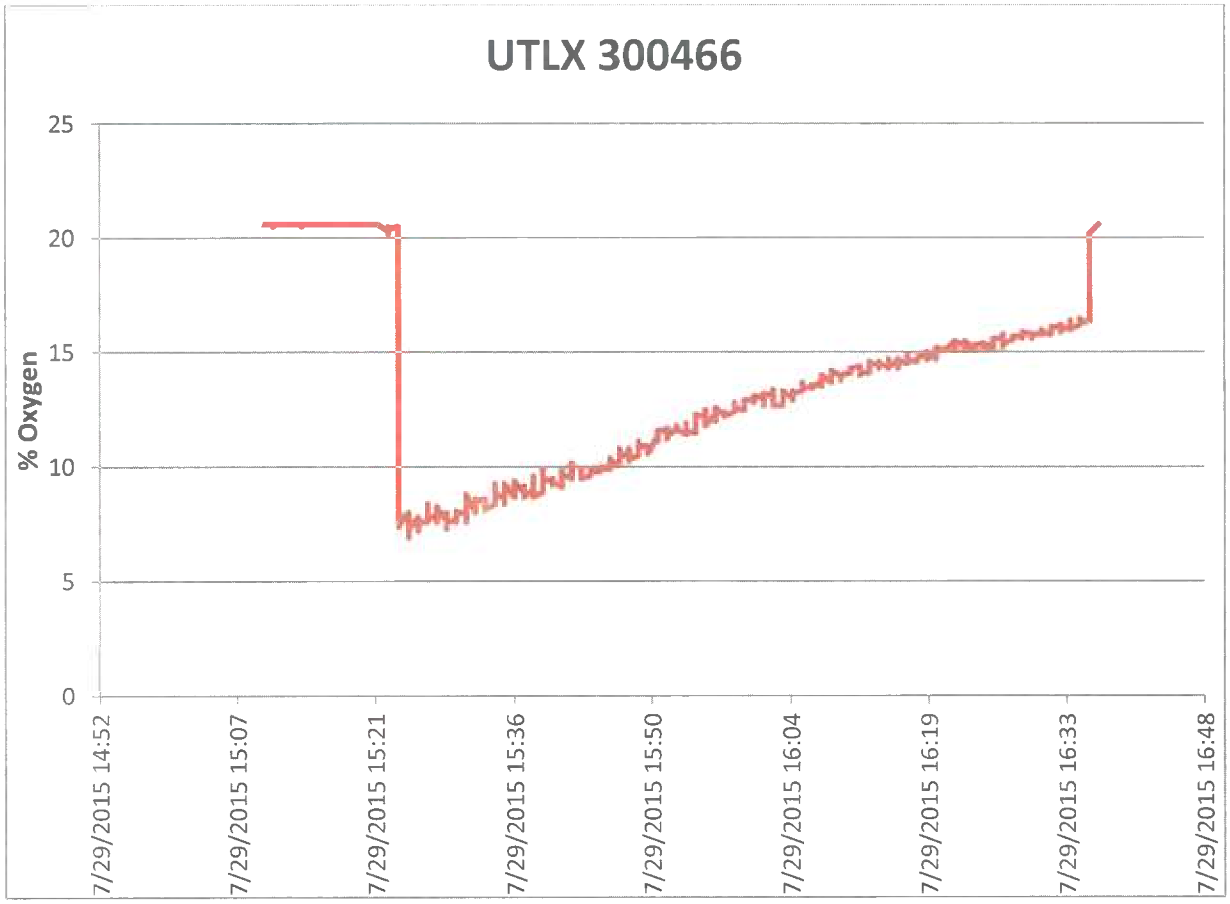


Figure B5. Railcar UTLX 300466 Atmosphere with iBRID SN 017 – 7/29/15

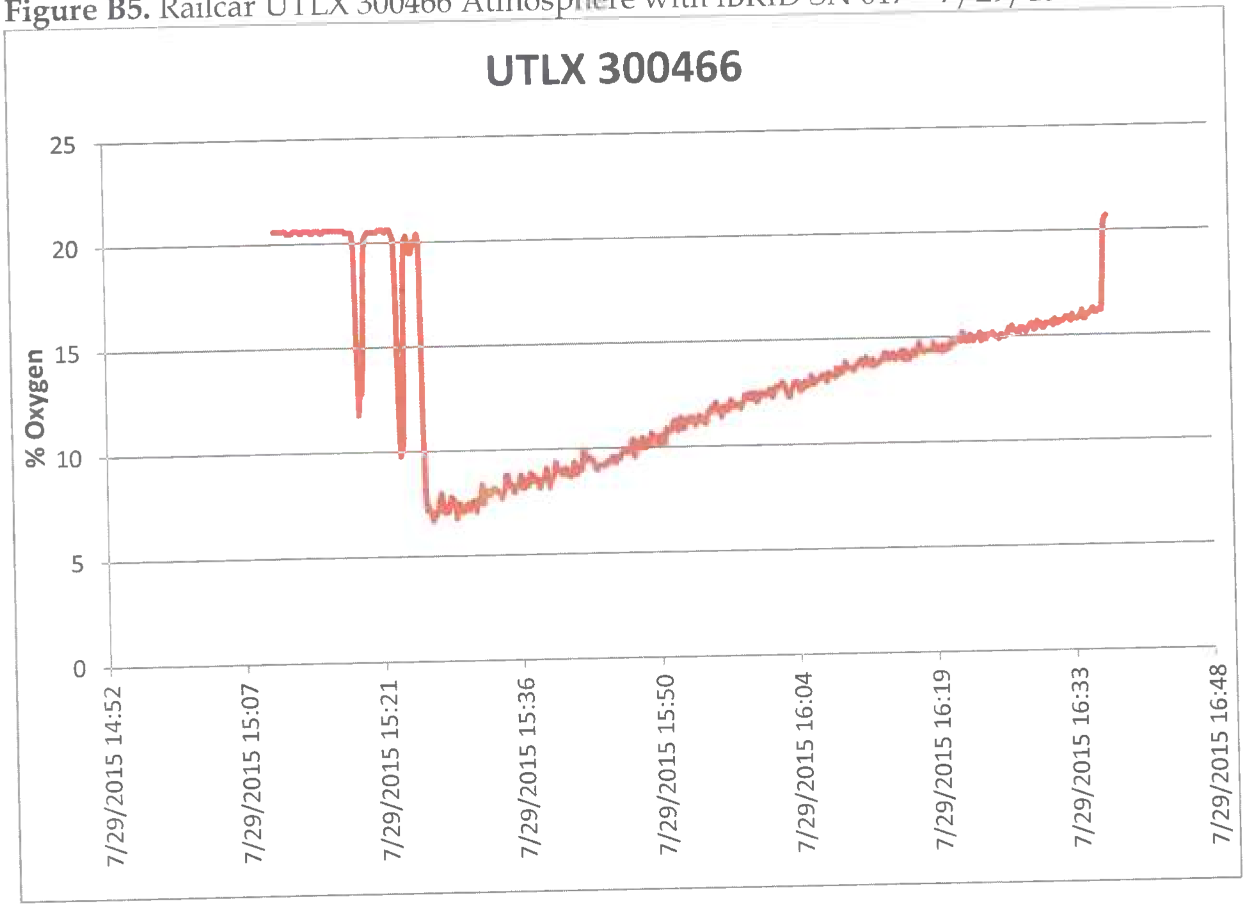


Figure B6. Railcar UTLX 300467 Atmosphere with iBRID SN 001– 7/30/15

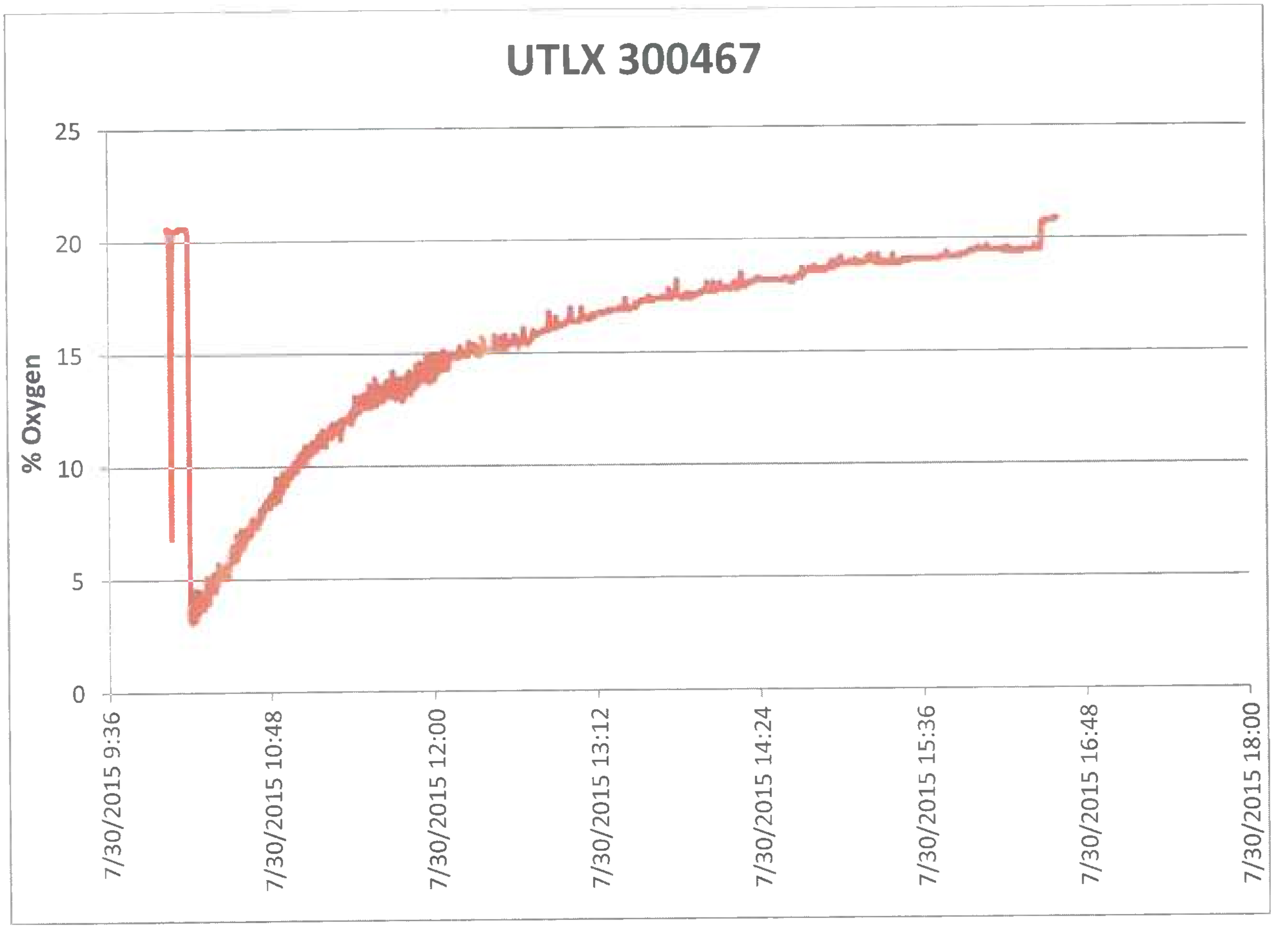
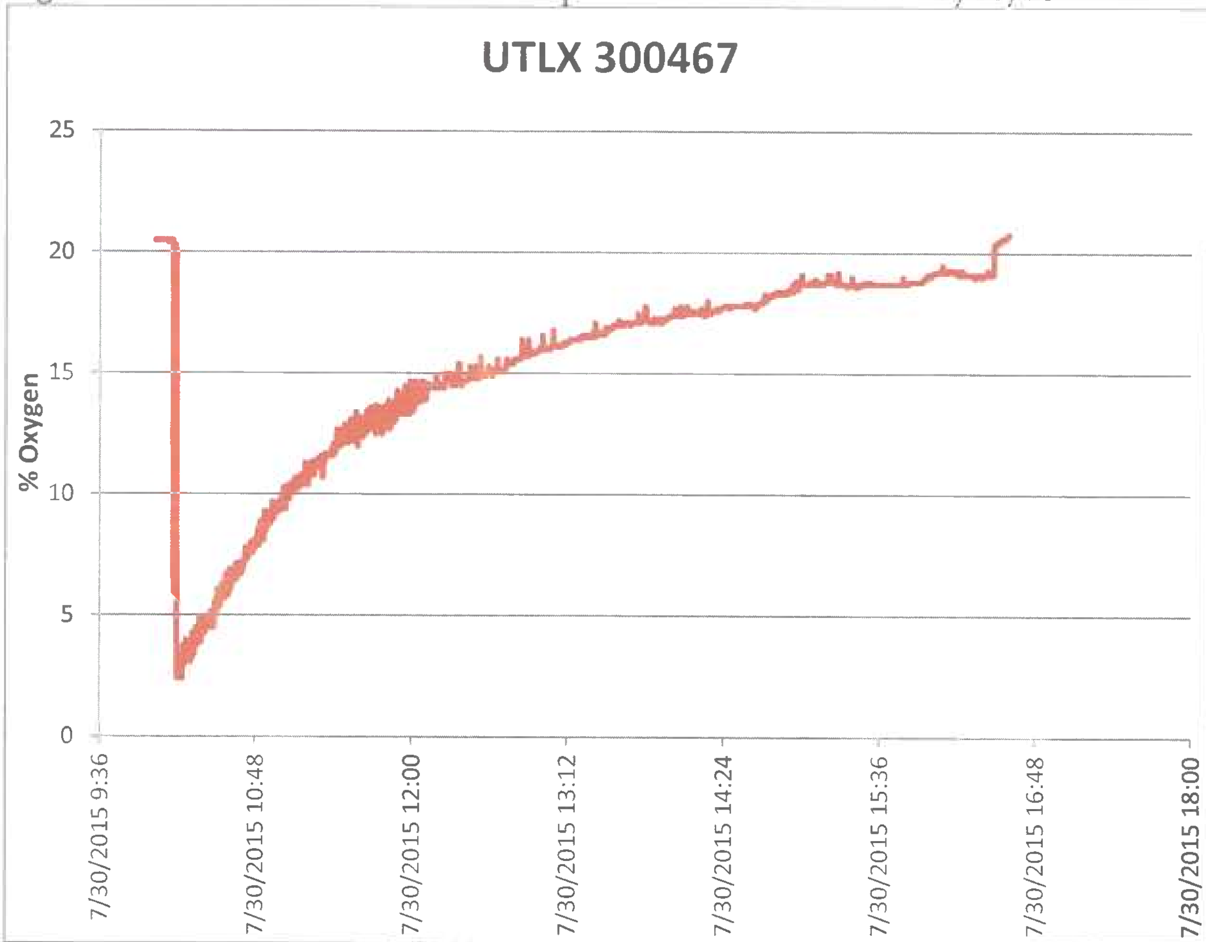


Figure B7. Railcar UTLX 300467 Atmosphere with iBRID SN 017- 7/30/15



APPENDIX C
RKI GX-2009 DATA ANALYSIS

An RKI GX-2009 Portable Gas Monitor (SN 358010919) was recovered from the victim. Following removal of the victim from the railcar, a different GX-2009 monitor (SN 4X9062162) was used by a rescuer to test the atmosphere at the railcar's manway. The data files recorded on these monitors were downloaded and analyzed. Data files were also downloaded and analyzed on three additional RKI GX-2009 monitors obtained during the investigation from Thiele's Track Wash Crew.

The GX-2009 monitors were equipped with O_2, CO, H_2S, and methane/lower explosive limit (LEL) sensors and were configured to record the average interval concentration every five minutes. An analysis was conducted on each of the five monitors' trouble event(s), alarm event(s), and calibration history. Trouble events are defined as sensor and battery failures. A summary of the total number of trouble events recorded on each monitor, as well as the total number of successful and unsuccessful of calibrations, is provided in Table C1.

Table C1. RKI GX-2009 Trouble/Calibration Alarm Events and Calibration History

Instrument SN	Date Range	No. Battery Failures	No. O_2 Sensor Failures	No. CO Sensor Failures	No. H_2S Sensor Failures	No. Successful Calibrations	No. Unsuccessful Calibrations
358010919 (Victim's Monitor)	8/15/13-7/21/15	13	18	4	18	9	13
449011823	5/15/14-7/23/15	24	11	0	0	8	2
449011820	5/15/14-7/22/15	3	0	0	0	6	0
367122939	8/14/13-7/21/15	4	7	2	0	8	1

4X9062162 (Rescuer's Monitor)	12/16/14-7/23/15	0	0	0	0	4	0

The victim's monitor (SN 358010919) experienced 13 battery failures, 18 O_2 sensor failures, four CO sensor failures, and 18 H_2S sensor failures from 8/15/13 to 7/21/15. The monitor was infrequently calibrated and the sensors failed calibration on several attempts. The monitor's calibration history recorded calibration attempts approximately every three months. However, larger gaps in the calibration history were observed. For example, the monitor was successfully calibrated on 7/17/13, but not successfully calibrated again until 2/19/14. The monitor was successfully calibrated on 2/19/14, following two unsuccessful calibration attempts on 2/19/2014 and three unsuccessful calibration attempts on 12/18/13. The monitor was last successfully calibrated on 5/28/15, following six unsuccessful calibration attempts on that day. There was no indication or evidence that the monitor was bump tested between calibrations.

The rescuer's monitor (SN 4X9062162) appeared to be the newest monitor in use based on the timeframe of the data files. The monitor's data file history did not log any sensor or battery failures or unsuccessful calibrations. The monitor was calibrated a total of four times from 12/16/14 to 5/29/15. There was no indication or evidence that the monitor was bump tested between calibrations.

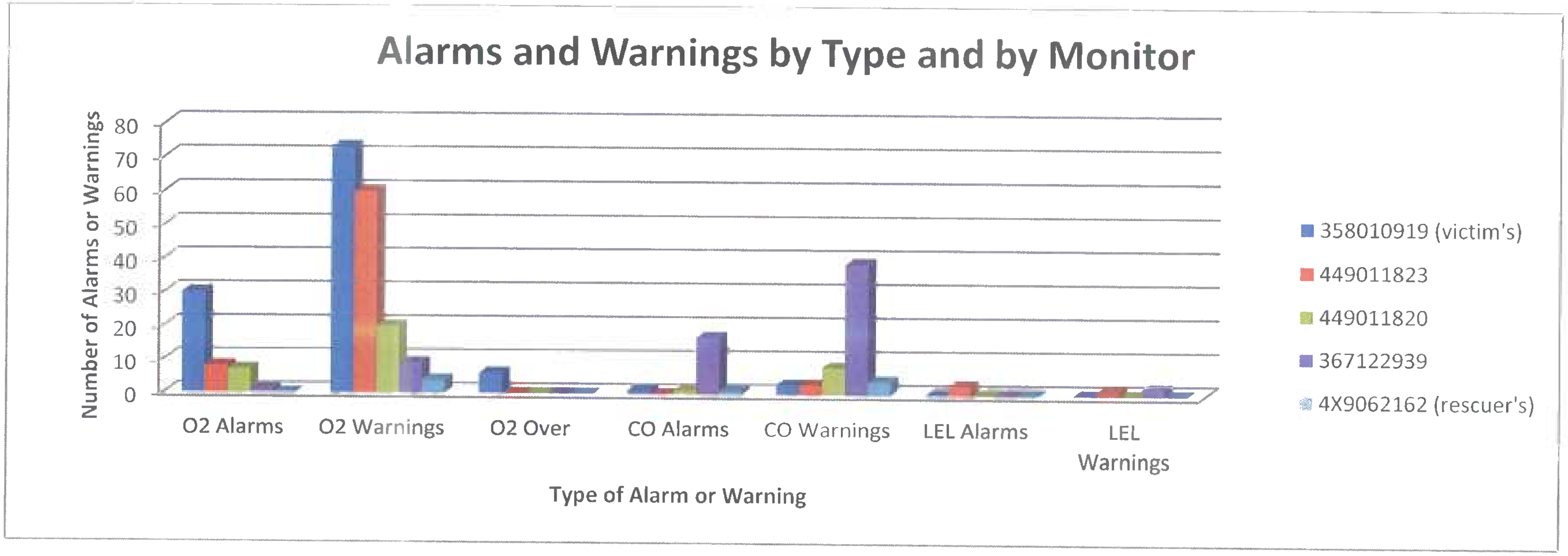
Monitor 367122939 experienced four battery failures, seven O_2 sensor failures, and two CO sensor failures from 8/14/13 to 7/21/15. The data logs indicate that the monitor was infrequently used in 2015. The monitor was last calibrated on 5/29/15, with only one gap between calibrations greater than six months. There was no indication or evidence that the monitor was bump tested between calibrations.

Monitor 449011820 experienced three battery failures from 5/15/14 to 7/22/15. The monitor was last calibrated on 5/28/15, and there were no significant gaps in the calibration history of the monitor. There was no indication or evidence that the monitor was bump tested between calibrations.

Monitor 449011823 experienced 24 battery failures and 11 O_2 sensor failures from 5/15/14 to 7/23/15. The monitor was last calibrated on 5/28/15, following one unsuccessful calibration attempt. A second unsuccessful calibration attempt occurred on 3/3/15. There were no large gaps observed in the monitor's calibration history. There was no indication or evidence that the monitor was bump tested between calibrations.

The total number of alarm and warning events recorded on each monitor is shown in Figure C1. The highest number of alarms and warnings were recorded on the victim's monitor. The victim's monitor recorded 71 low oxygen warnings and 28 low oxygen alarms from 8/15/13 to 7/21/15. Additionally, five high oxygen alarms above 23.5% were recorded. The victim's monitor was not turned on the day of the accident. The monitor was last operated on 7/6/15, at which time an oxygen sensor failure occurred. There was no log found in the monitor's history indicating that the oxygen sensor had been replaced following this event.

Figure C1. Total Number of Alarms and Warnings by Monitor Serial Number and Sensor Type



The rescuer's monitor (4X9062162) did not record an unexpected number of sensor alarms and warnings. Note: the time programmed on this monitor was three hours behind. On the day of the accident, the monitor registered an oxygen warning condition between 8:36:38 a.m. to 8:38:33 a.m. (actually 11:36:38 a.m. to 11:38:33 a.m.). The average oxygen concentrations recorded during this time ranged from 15.0% to 20.9%. The monitor recorded a fresh air zero event at 8:37:36 a.m. (11:37:36 a.m.). The monitor recorded oxygen concentrations in the 15% range before and after the fresh air zero event. These data events support the low oxygen concentration (16.7%) that was reported at the manway following removal of the victim.

Monitor 367122939 was turned on the day of the accident, but no data was recorded. On 7/21/15, the monitor recorded a minimum oxygen concentration of 16.4%. The monitor was zeroed in fresh air and the data recorded after that event show that the oxygen concentration was 21.0% or greater. This indicates that the instrument may have been improperly zeroed in a contaminated atmosphere containing less than 20.9% oxygen.

Monitor 449011820 alarmed at 17.3% oxygen at 10:40:35 a.m. on 7/15/15. On 7/18/15, the monitor experienced a number of low and high oxygen sensor alarms. The data indicate that the instrument was zeroed in fresh air; however, the oxygen concentration recorded after that event is 21.0% or greater. This indicates that the instrument may have been improperly zeroed in a contaminated atmosphere containing less than 20.9% oxygen. On 3/21/15, a similar event was logged at 7:40 a.m., at which time the CO warning alarmed.

Monitor 449011823 recorded low oxygen concentrations on 7/3/15 at 7:15 a.m. (17.7%) and 8:22 a.m. (0%). The monitor was zeroed and the data recorded following that event show that the oxygen concentration reached a peak of 25.6% at 7:30 a.m., at which time the monitor was zeroed again. It appears that the oxygen sensor was failing and the monitor was shut off at 8:22 a.m. On 7/6/15, the oxygen sensor failed. A total of 86 data points of oxygen concentrations below 19.5% were logged on the monitor. On 3/2/15, an average oxygen concentration of 19.8% was logged over a five hour period.

The GX-2009 Operator's Manual recommends a Breath Test to test the oxygen sensor's audible, visual, and vibratory alarms for proper operation. This test is performed by cupping one's hands over the oxygen sensor opening and gently exhaling over the sensor. The oxygen sensor output will drop below the alarm point of 19.5% and activate alarms. A slight response on the CO sensor may occur during a Breath Test. It cannot be determined how many oxygen sensor alarms and warnings can be attributed to the manufacturer's recommended Breath Test.

APPENDIX D

Persons Participating in the Investigation

Theile Kaolin, Inc.

Daryl Hutchings	Operations Manager
Jim Dunn	Track Supervisor
Sheryl Newsome	Safety Administrative Assistant

CVB Industrial Contracting

Trey Turner	EHS Manager

Washington County Coroner

E. K. May	Coroner

Sandersville Police Department

Jeff A. Pettit	Detective

EMS

Washington County EMS

GBI Crime Lab

Dr. Jacqueline Martin	Medical Examiner

Mine Safety and Health Administration

Jeffrey Phillips	Supervisory Mine Safety and Health Inspector
Larry D. Melton	Mine Safety and Health Inspector
Christina D, Stalnaker	Chief, Physical & Toxic Agents Division
Michael P. Valoski	Senior Industrial Hygienist
Brett Calzaretta	Mine Safety and Health Specialist (Training)

APPENDIX E
Victim Information

Accident Investigation Data - Victim Information

U.S. Department of Labor
Mine Safety and Health Administration

Event Number: 6 6 7 7 0 8 7

Victim Information: 1

1. Name of Injured/Ill Employee:	2. Sex	3. Victim's Age	4. Degree of Injury:
Travis Barnes	*M*	*25*	*01 Fatal*

5. Date(MM/DD/YY) and Time(24 Hr.) Of Death: *a. Date: 07/15/2015* *b.Time: 12:06*

6. Date and Time Started: *a. Date: 07/15/2015 b.Time: 6:00*

7. Regular Job Title: *113 Rail Tank Car Washer*

8. Work Activity when Injured: *098 Entered a confined space with low oxygen*

9. Was this work activity part of regular job? Yes X No

10. Experience

	Years	Weeks	Days
a. This Work Activity:	0	24	3
b. Regular Job Title:	0	24	3
c. This Mine:	0	24	3
d. Total Mining:	0	24	3

11. What Directly Inflicted Injury or Illness? *022 low Oxygen*

12. Nature of Injury or Illness: *110 Suffocation*

13. Training Deficiencies:
Hazard: [ ] New/Newly-Employed Experienced Miner: [ ] Annual: [ ] Task: [X]

14. Company of Employment: (If different from production operator) *CVB Industrial Contracting INC*
Independent Contractor ID: (if applicable) *5BR*

15. On-site Emergency Medical Treatment:
Not Applicable: [ ] First-Aid: [ ] CPR: [X] EMT: [X] Medical Professional: [ ] None: [ ]

16. Part 50 Document Control Number: (form 7000-1)

17. Union Affiliation of Victim: 9999 *None (No Union Affiliation)*