MAI-2005-07

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

REPORT OF INVESTIGATION

Surface of an Underground Nonmetal Mine (Limestone)

Fatal Machinery Accident

April 1, 2005

Kimballton Plant #1
Chemical Lime Company of VA, Inc
Ripplemead, Giles County, Virginia
Mine I.D. No. 44-00082

Investigators

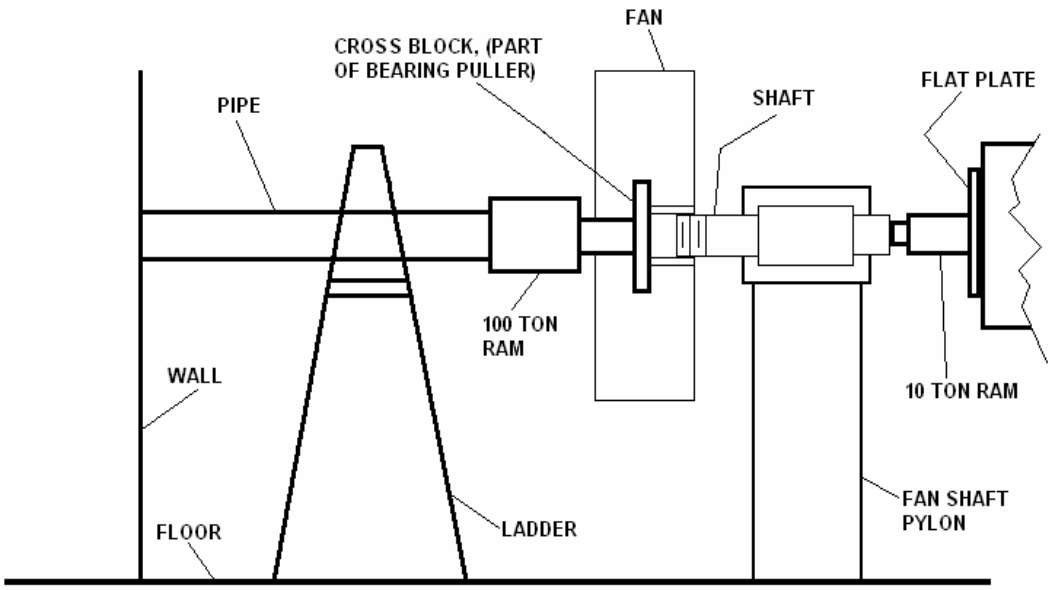
Thomas J. Shilling
Mine Safety and Health Inspector

Daryl E. Porter
Mine Safety and Health Inspector

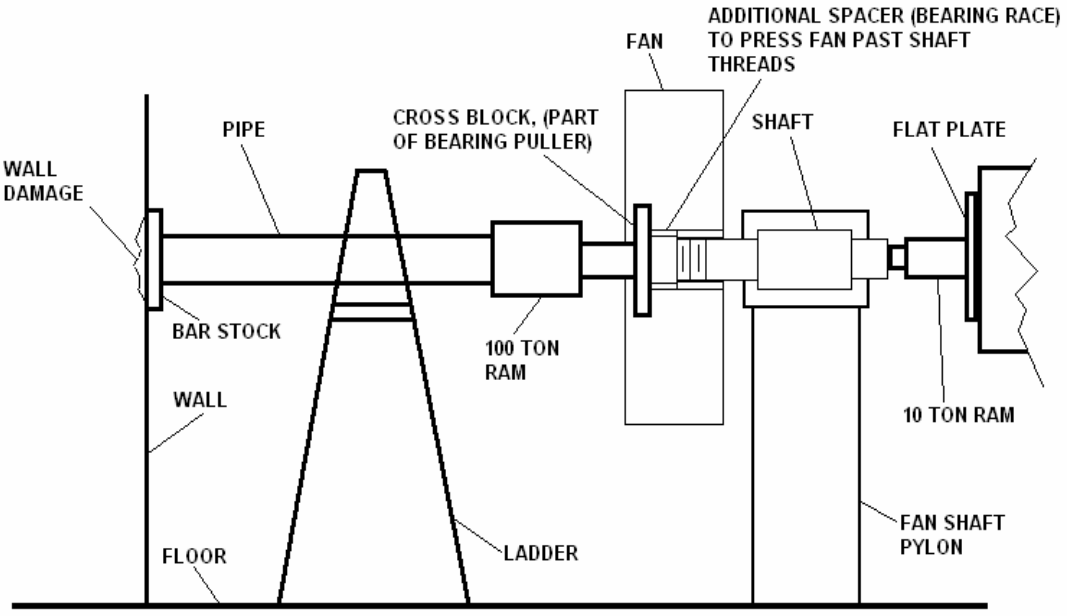
Phillip L. McCabe
Mechanical Engineer

Originating Office
Mine Safety and Health Administration
Northeast District
Thorn Hill Industrial Park
547 Keystone Drive, Suite 400
Warrendale, Pennsylvania 15086-7573
James R. Petrie, District Manager

First Press Setup of Fan



Second Press Setup of Fan



OVERVIEW

On April 1, 2005, Robert L. Burton, mechanic, age 50, was fatally injured when he was struck by a steel pipe while attempting to install a fan housing on a coal mill. Burton and five co-workers had positioned the pipe against a concrete wall to support an electrically-powered hydraulic ram that was used to push the fan into position onto the shaft. During the process, the pipe became dislodged and struck the victim.

The accident was caused by the failure to evaluate the work procedures, identify all possible hazards, and establish safe procedures to install the fan housing. The steel pipe was used beyond the designed capacity intended because the force applied bent the pipe, causing it to kick out.

GENERAL INFORMATION

Kimballton Plant #1, an underground limestone operation, owned and operated by Chemical Lime Company of VA Inc, was located at 2093 Big Stoney Creek Road, Ripplemead, Giles County, Virginia. The principal operating official was Richard Werner, plant manager. The mine operated three 8-hour shifts per day, 7 days a week. Total employment was 106 persons.

Limestone was mined from the underground mine and transported to the surface by truck and conveyor where it was crushed, sized, dried, and stockpiled in silos. The finished product was used in the construction and agricultural industries.

The last regular inspection at this operation was completed on January 24, 2005.

DESCRIPTION OF ACCIDENT

On the day of the accident, Robert Burton (victim) reported for work at 5:00 a.m., his normal starting time on Fridays. At 11:15 a.m., it was reported that the exhaust fan shaft, of the No. 3 Raymond Coal Mill, had faulty bearings. Burton and Ray Sessor, maintenance supervisor, traveled to the No. 3 Coal Mill to assess the situation and determine what tools and equipment would be needed to complete the job. Burton traveled to the maintenance shop and cut a section of schedule-80 steel pipe to use in conjunction with an electric Porta-Power unit and a Power Team hydraulic ram.

An exhaust fan was removed from the shaft and a new shaft, with the bearings pressed in place, was installed. To install the fan onto the shaft, a porta-power was used to power the hydraulic ram to apply force to the fan for installation onto the shaft. The steel pipe was placed against the south concrete wall and used in conjunction with several metal spacers. At least three attempts were made to push the fan onto the shaft prior to the accident.

About 7:42 p.m., it was discovered that an additional ⅛ inch was needed to complete the job. Burton informed Steven Baker, environmental engineer, who was operating the porta-power, that he needed one more push. As the power was being supplied to the hydraulic ram, the pipe kicked out, striking Burton. Delbert Collins, maintenance worker, positioned on the west side of the fan immediately behind Burton, received minor injuries. Co-workers immediately attended to Burton; however, they were unable to detect any vital signs. Emergency medical personnel were summoned and Burton was pronounced dead at the scene. Death was attributed to blunt force trauma to the head.

INVESTIGATION OF THE ACCIDENT

MSHA was notified of the accident at 8:50 p.m. on April 1, 2005, by a telephone call from Bonnie Davis, regional safety manager, to James Petrie, northeast district manager. An investigation was started the same day. An order was issued under the provisions of Section 103(k) of the Mine Act to ensure the safety of the miners.

MSHA's accident investigation team traveled to the mine, conducted a physical investigation of the accident site, interviewed employees, and reviewed documents and work procedures relevant to the accident. MSHA conducted the investigation with the assistance of mine management, employees, miner's representative, and the Virginia Division of Mineral Mining.

DISCUSSION

Location of the Accident

The accident occurred at the No. 3 Raymond Coal Mill. The exhaust fan was located in the corner of the lower level of the surface lime processing plant. The nearby concrete wall of the building was located perpendicular to the floor and parallel to the fan. The fan shaft and bearings were mounted in a cylindrical housing on top of a concrete pylon. The shaft was perpendicular to the concrete wall. The concrete wall was used as the primary support for the portable ram. The company reportedly used a similar ram arrangement in the past when installing the fan onto the shaft. Evidence of concrete chipping was present by the location of marks in the wall where the supports were previously used to push the fan onto the shaft.

Fan and Shaft design

The 80-inch diameter fan was designed to have a slight press fit to hold the fan tight on the shaft. A keyway, square key stock, and socket head setscrews were also used to secure the fan on the shaft. Once the fan was installed onto the shaft, a spanner nut was installed onto the threaded shaft end to complete the fan installation. This fan normally required the application of heat, along with the ram, when removing or installing the fan onto the shaft.

Hydraulic Ram

The hydraulic ram was a single acting hydraulic cylinder that used pressure to extend the cylinder and an internal spring to retract the cylinder. The body of the ram was fabricated from aluminum making for a lightweight and portable unit. The ram was rated for 100 tons with a 6 ¼ inch stroke.

A portable electrically driven hydraulic pump was used to supply oil pressure and flow to the hydraulic cylinder or ram. The pump unit had a flip lever to either supply oil pressure to extend the ram or to relieve pressure for the spring to retract the ram. An electrical pendent control on the end of a portable power cable connected to the pump could be used to remotely control the pump unit. A hydraulic pressure gauge was located on the pump unit to indicate the system ram pressure during use. A hydraulic hose was used to connect the pump to the ram.

Ram support components

Metal components, plates and pipes, were used to provide support for the ram during the installation of the fan. The limited ram stroke, fan location, and configuration of the fan shaft required the use of two different support arrangements to install the fan.

The arrangement of the supports of the first press attempts were a piece of steel bar stock placed against the concrete wall to provide a flat surface over the chipped area; a piece of saw cut, schedule 80 steel pipe, temporarily supported by a step ladder; the ram unit with the body against the pipe end, and a cross block from a bearing puller. A 10-ton ram, supported by a steel plate against the mill structure, was also used to support the shaft and bearings to help prevent the damage of the newly installed shaft bearings. The arrangement would only permit the fan to be installed to the point where the cross block would make contact with the end of the fan shaft.

The arrangement of the supports of the later press attempts was the same as the first attempts with the addition of an inner bearing race from a discarded bearing assembly.

The bar stock measured 8 inches long, 2 ⅝ inches wide and 1 inch thick; the steel pipe measured 64 inches long and 4½ inches in diameter, and the bearing puller measured 18 inches by 2½ inches.

After multiple attempts to install the fan completely, a maintenance worker noticed that the fan hub was not fully seated against the shoulder on the shaft. A final attempt to fully seat the fan using the second set-up resulted with the arrangement becoming dislodged.

Condition of pressing components

The conditions of the components used to install the fan were visually inspected. The bar stock used between the concrete wall and the pipe; the pipe, and the steel plate used to support the 10 ton ram, were all bent and deformed indicating that a large load was imposed during the fan installation attempts. Reportedly,

the three deformed components were relatively straight prior to the multiple fan installation attempts.

The portable electrically powered hydraulic pump units appeared intact with no physical damage. Both hydraulic rams appeared to be intact with no visible oil leaks or damage.

Based on design calculations performed according to the American Institute of Steel Construction, AISC Manual of Steel Construction, Load and Resistance Factor Design, the subject pipe involved in the accident has an approximate design compression strength limit of 60 tons. The 100-ton ram was capable of producing a force in excess of the 60 ton capacity of the subject pipe.

Training

Burton had a total of 30 years mining experience, 21 years as a mechanic. He had received training in accordance with 30 CFR, Part 48.

ROOT CAUSE ANALYSIS

A root cause analysis was conducted and the following causal factors were identified:

Causal Factor: Policies, standards, and controls were inadequate. The company had not developed safe work procedures to support the porta-power and hydraulic ram in conjunction with a steel pipe and combination of spacers. The task could not be performed safely because the pressure applied by the ram exceeded the designed capacity of the pipe.

Corrective Action: Conduct a thorough risk assessment before starting a task to ensure that all hazards are evaluated and eliminated. Management should develop and implement procedures that ensure repairs to the coal mill do not expose miners to hazards.

Causal Factor: None of the components were assembled or supported on a stable base. Miners were required to manually support the components during the installation process.

Corrective Action: Develop and implement a standard procedure that uses the safety features recommended by the manufacturer to ensure the equipment is properly blocked, secured, and utilized.

CONCLUSION

The accident was caused by the failure to evaluate the work procedures, identify all possible hazards, and establish safe procedures to install the fan housing. The steel pipe was used beyond the designed capacity intended because the force applied bent the pipe, causing it to kick out. The use of the pipe to support the amount of force the hydraulic ram exerted on it was not within the pipe's designed capacity.

ENFORCEMENT ACTION

Chemical Lime Company of Virginia, Inc.

Order No. 7739050 was issued on April 2, 2005, under the provisions of Section 103(k) of the Mine Act:

> A fatal accident occurred at this operation on April 1, 2005, when the mechanic was struck in the head while attempting to replace the fan on the No. 3 Raymond Coal Mill shaft. This order was issued to assure the safety of all persons at this operation. It prohibits all activity at the No. 3 Raymond Coal Mill until MSHA has determined it is safe to resume normal mining operations in the area. The mine operator shall obtain prior approval from an authorized representative for all actions to recover and restore operations in the affected area.

This order was terminated on April 4, 2005, after it was determined by MSHA that the affected area of the mine could resume normal operations.

Citation No. 6024349 was issued on April 25, 2005, under the provision of Section 104(a) of the Mine Act for a violation of 30 CFR 57.14205:

> A maintenance mechanic was fatally injured at this operation on April 1, 2005, when he was struck by a 5 feet, 4inch long, 4 ½ inch diameter section of pipe. The victim and co-worker were using a 100-ton (Power Team) hydraulic ram to push the exhaust fan blade assembly onto the shaft of the No. 3 Coal mill. The ram was placed in a horizontal position between the fan blade assembly and a pipe, and a piece of steel bar stock ultimately braced against a concrete wall. When the hydraulic ram was energized for the purpose of moving the exhaust fan, it also exerted force on the support pipe causing it to bend and then "kick out" with great force, and it struck the victim. The use of the pipe to support the amount of force the hydraulic ram exerted on it during reassembly of the exhaust fan was not within the pipe's design capacity.

This citation was terminated on April 25, 2005. The mine operator has submitted a plan to MSHA stating that a pipe will no longer be used as a spacer to push the fan assembly back onto the shaft and that a stable base will be used on all future applications when performing this task.

Approved by: _____ Date: _____
James R. Petrie
District Manager

APPENDIX A

Persons Participating in the Investigation:

Chemical Lime Company of Virginia, Inc

Darrell E. Haymore…....miner's representative
Richard L. Werner……plant manager
Bonnie B. Davis……regional safety manager
Quentin A. McGahey ……..maintenance manager
Keith N. Buchwald……director, maintenance engineering
Frank H. Johnson……engineering manager
Delbert D. Collins……maintenance/environmental technician
Marty A. Gautier…….....mechanic/supervisor
Roy M. Sessor……..maintenance supervisor
Donald D. Green…….....mechanic
Carroll W. Croy……mechanic
Steven W. Baker……..environmental engineer

State of Virginia Division of Mineral Mining

Gary E. Barney……supervisor
McDonald Hagy……..mine inspector

Mine Safety and Health Administration

Daryl E. Porter……. ……mine safety and health inspector
Thomas J. Shilling.....mine safety and health inspector
Phillip L. McCabe……mechanical engineer