False Security

By Trevor Bray and Oscar Duckworth

This article is a true account of an accident that resulted in an injury to a worker. The experiences described should be shared with others in the construction industry to improve the safety of all crew members and the general public exposed to the shotcrete industry.

Our story begins on a typical hot Texas day in August, with a temperature over 100°F (38°C). A shotcrete crew had started their first job of the day applying vertical wet-mix shotcrete on a highway project as part of a temporary shoring system. The crew consisted of a pump operator, a nozzleman, and a helper. The job was going well and the pump operator was tending to the concrete truck as it was finishing delivery of its load. The nozzleman and helper were applying the shotcrete when a blockage in the line occurred. Both the nozzleman and the helper signaled and yelled at the pump operator to stop the pump. However, the operator was focused on the concrete truck and lost visual contact with the crew. In the seconds to follow, the nozzleman braced for the hose whip that was sure to follow if the blockage cleared the line. Unfortunately, the force generated behind the blockage as it cleared was too great for the nozzleman to control. As a result, the nozzleman was struck in the leg by the hose, causing a contusion. The incident could have easily resulted in a more serious injury.

When a blockage in the system occurs, many crews rely on yelling or hand signals to stop the pump. In most cases, this process works and no incident or accident occurs. It is so common that even the crews develop a false sense of security. Unfortunately, for the few times this process does not work, a worker can suffer a serious injury that could result in death or a permanent disability. Was this accident predictable? If so, was it preventable? A deeper look into this unfortunate event reveals an often overlooked lesson.

Fig. 1: Modern multi-function encoded devices are compact, durable, and easy to maintain

Never operate pressurized placement equipment that cannot be immediately stopped in the event of an emergency.

This common-sense warning is critical to the safe operation of nearly every type of concrete placement equipment ever produced. Its meaning is clear; however, its implementation can vary widely. Typically, wet-mix shotcrete crews may station a full-time pump operator at the pump. The operator may use visual signals, audible signals, or two-way radio communication to keep connected to the nozzleman and placement crew. Some pumps are also equipped with hard-wired controllers or radio transmitters that can remotely control equipment directly from the point of placement. This equipment configuration provides greater safety because, aside from typical packing of concrete within the reducers, potential pressure-related risks are greatest at the point of discharge. Downstream components such as sweeps may pack, hoses can become accidentally kinked, and nozzles occasionally plug.

The Nozzleman Is the First to Know

Typically, it is the nozzleman who is the first to notice the imminent signs of trouble. Nozzlemen must continually anticipate and counter the rhythmic thrust of shotcrete flowing through the nozzle. The balance to accommodate the thrust becomes a subconscious effort for skilled nozzlemen as they work. Thus, experienced nozzlemen immediately feel unexpected fluctuations in the stroke, chatter, or momentary flow interruptions. These are the initial indications of a blockage. Within moments, internal line pressures can quickly reach hazardous levels. The hapless nozzleman's only course of action is to brace for impact, aim the nozzle in a safe direction, and signal to stop the pump and relieve pressure. **In**

this situation, any delay in stopping the pump can generate destructive force within the placement system. A lucky nozzleman can remain in a braced position while pressure is relieved within the line. Unfortunately, if pressure builds excessively, a highly pressurized system can burst or unexpectedly clear, putting the nozzleman and crew at risk of serious injury.

A System That Is Safer by Design

Occasional blockage within the placement system is not unusual in shotcrete placement. It must be expected and can occur at any time. When a blockage does occur, placement crews using a system controlled at the point of placement that can be quickly stopped is safer than crews using equipment that requires more communication and, therefore, more time to stop. This accident demonstrates that urgent communication through various crew members at critical moments can fail or require additional time, ultimately causing an injury. In this instance, a hardwired or radio remote controller was not used by the nozzleman. After evaluation of this incident, we are currently taking steps to require a wireless controller for the nozzleman and/or helper on all projects.

The nozzleman is the first person to know when a problem exists with the smooth flow of material through the placement system. At that instant, action can be taken to prevent a potential serious hazard by activating the emergency shutoff on the remote pump controller. Our company learned an important lesson. We are now safer because of it. Hopefully, by sharing the lesson learned from this unfortunate accident, we can help others in our industry be safer.

Note from Oscar Duckworth: This story mirrors a similar unfortunate incident that happened to me nearly 20 years ago. Since then, the mandatory use of a belt-operated wireless remote is an essential component of my personal safety program.

Fig. 2: Multi-function wireless remote worn by nozzleman

Fig. 3: Duckworth's remote transmitter has provided over 15 years of reliable service, requiring only minor repairs

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