



Clearing the Line

WATER VS. AIR AND THE SAFETY RISKS OF CLEANING SHOTCRETE DELIVERY HOSES

By Derek Pay

At the end of a shotcrete placement day, the work is not finished when the last material is placed. One of the most important tasks — and potentially most dangerous — still remains: Clearing the shotcrete delivery hose.

For many crews, cleaning the line is so routine that it can become almost automatic. The crew has spent hours shotcreting, everyone is tired, the concrete truck is waiting to leave, equipment needs to be cleaned, and people are ready to go home. Unfortunately, this is exactly when complacency can turn a routine procedure into a serious incident.

There are two common methods used to clear a shotcrete delivery system: Compressed air and water. Both can move material through a hose, but they do not present the same hazards. The fundamental difference comes down to one simple fact: Air is compressible, while water is essentially incompressible. That difference matters tremendously when energy is introduced into a delivery hose filled with concrete.

THE HIDDEN ENERGY OF COMPRESSED AIR

When compressed air is used to clear a shotcrete hose, energy can accumulate behind the concrete remaining in the line. If the material moves freely and the system remains unobstructed, the line may clear without incident. However, if a blockage, restriction, kink, hardened section of material, or other obstruction develops, compressed air can continue storing energy behind it. The danger comes when that obstruction suddenly breaks free.

At that moment, the stored compressed air can rapidly expand, accelerating concrete, cleaning balls, plugs, aggregate, sand, and other debris through and out the end of the hose. The discharge can occur with tremendous force and little warning.

The hose itself can also become a serious hazard. A sudden pressure release or rapid movement of material can cause violent hose kicking or whipping. Anyone standing near the discharge end, near an unsecured hose, or within the potential line of fire may be exposed to severe injury.

The greater the volume of compressed air trapped in the system, the greater the potential stored energy. This is why clearing long delivery lines with compressed air deserves particular caution. A long hose or pipeline can

contain a significant volume of compressed air, and if that stored energy is suddenly released, the results can be violent and unpredictable.

Compressed air also does not necessarily give the crew a clear indication of exactly what is happening inside the hose. Pressure may be building even though nothing appears to be moving at the discharge end. That silence should never be mistaken for safety.

LESSONS FROM THE FIELD: PERSONAL EXPERIENCE AT OCEANSIDE CONSTRUCTION

Over the years, I have personally witnessed numerous incidents and near-misses associated with using compressed air to clear shotcrete delivery systems. These are not theoretical risks or hazards that exist only in a safety manual: They are real events I have seen occur on active jobsites.

I have seen shotcrete violently discharged over houses, vehicles, concrete trucks, equipment, and surrounding work areas, costing hundreds of thousands in insurance claims. I have witnessed personal injuries caused by the sudden and unpredictable release of stored energy within a delivery system. In one incident, two workers were violently thrown into each other. In others, hoses have lifted workers off the ground and slammed them back down, while uncontrolled hoses have kicked and whipped workers in the face and other parts of the body.

One of the more severe hazards I have witnessed occurs after the majority of the concrete has left the line. Workers may assume the danger has passed, but residual sand, small aggregate, cement paste, and other debris can remain inside the hose. When compressed air finally breaks through, that material can be violently expelled at high velocity.

I have personally seen a worker struck directly in the face by this residual material. The violent spray of sand, small aggregate, and cementitious debris left the worker with extensive concrete burns and severe skin irritation across the face, not to mention a laceration to the face as well. Incidents like this demonstrate that the danger does not end when the main mass of concrete exits the hose. In fact, the final moments of clearing a line can be among the most unpredictable.

These experiences have shaped the way we approach hose clearing at Oceanside Construction. When you've witnessed hoses lifting people off their feet, workers slamming into one another, uncontrolled hoses whipping violently, and residual material blasting personnel in the face, the hazards of compressed air become impossible to dismiss as simply part of the job.

The issue is not whether compressed air can successfully clear a shotcrete delivery system — it can. The issue is the amount of stored energy involved, and what can happen when that energy is suddenly and unpredictably released.

This is one of the primary reasons I believe water, when practical and compatible with the equipment and project conditions, offers a significant safety advantage over compressed air.

WHY WATER CAN REDUCE THE RISK

Water behaves differently because it is incompressible. When water is used to push material through the hose, it does not store large amounts of compressed energy in the same way that compressed air does. This is the primary safety advantage of water.

If material stops moving while clearing with water, the system does not have the same large, pressurized reservoir of compressed air waiting to rapidly expand when the obstruction releases. Pressure can still exist — and a pressurized water system must still be treated seriously — but the potential for explosive expansion is substantially reduced compared with compressed air.

In practical terms, water provides a more controlled pushing force through the delivery line. The operator can monitor the flow and movement of material without relying on a large volume of compressed air behind the concrete.

This does not mean water makes hose clearing risk-free. A blocked hose under hydraulic pressure can still release suddenly. Fittings can fail. Hoses can move. Concrete and debris can still be expelled with significant force. No one should ever stand directly in front of the discharge end of a hose, regardless of the cleaning method being used.

But from the standpoint of stored energy, the difference is significant: Compressed air stores energy through compression; water does not store energy in the same way.

THE PROJECTILE HAZARD

One of the greatest concerns when clearing any concrete delivery line is the possibility of turning material or cleaning equipment into a projectile. With compressed air, a cleaning ball or plug can potentially accelerate to high velocity. The same is true of chunks of concrete, aggregate, or other debris inside the hose. If the end of the hose is pointed toward a person, vehicle, structure, window, or piece of equipment, the consequences can be severe.

This is why the discharge area must always be controlled. No employee should stand directly in front of the hose outlet (and yes, this does bear repeating). The discharge end should be securely restrained and directed into an appropriate containment area. The entire crew should understand when clearing is about to begin, who is controlling the pressure source, and who has

authority to stop the process. Communication is not optional. The pump operator, shotcreter, and ground personnel must know exactly what is happening before pressure is introduced into the line. A simple misunderstanding — one worker believing the line is depressurized while another introduces air or water — can have catastrophic consequences.

NEVER OPEN A PRESSURIZED LINE

What is perhaps the most important rule in hose clearing is also a simple one: Never disconnect, loosen, strike, or attempt to open a delivery line until positive verification has been made that all pressure has been

relieved. A hose that appears inactive may still contain trapped pressure.

If a blockage occurs, the crew must not assume that shutting off the air compressor, pump, or water source automatically means the pressure is gone. Trapped compressed air energy may remain behind the obstruction.

Before opening any coupling or connection, the system must be isolated, the pressure source shut down, and stored pressure safely relieved and verified according to the equipment manufacturer's procedures and the contractor's established safety program.

No one should ever place their face or body over a coupling while loosening it. No one should attempt to physically manipulate a pressurized hose to force a blockage through. The pressure must be removed first.

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FATIGUE AND THE END-OF-DAY MENTALITY

One reason hose-clearing incidents deserve special attention is timing. This task usually happens at the end of a placement, when fatigue is highest. The crew may have been working for eight, ten, or twelve hours. Everyone wants to finish washing out, load the equipment, and head home. That creates an environment where shortcuts become tempting. This is precisely when discipline matters most.

The final twenty minutes of the job deserve the same attention as the first twenty minutes. A successful shotcrete placement is not complete until the line has been safely cleared, the equipment has been cleaned, and every member of the crew is accounted for and uninjured. Production pressure should never dictate an unsafe clearing procedure.

THE JOB IS NOT OVER UNTIL THE LINE IS CLEAR

Experienced shotcrete crews understand that some of the most dangerous moments on a jobsite happen during tasks that have been performed hundreds of times before. Familiarity can create confidence, but it can also create complacency.

Clearing a shotcrete hose is not just cleanup. It is a pressurized operation involving heavy equipment, concrete, hoses, couplings, and potentially significant stored energy. It deserves a defined procedure, trained personnel, clear communication, and complete respect for the forces involved.

Whether clearing with water or compressed air, the principles remain the same: Control the energy, secure the discharge area, keep people out of the line of fire, never open a pressurized system, and never allow the desire to finish quickly to override safe procedure.

The last material out of the hose should never be the most dangerous part of the job.

WATER VS. AIR: WHICH IS SAFER?

From a stored-energy standpoint, water offers a significant safety advantage because it is incompressible and does not accumulate expandable energy in the same way that compressed air does.

Compressed air can be used successfully when proper equipment, procedures, pressure limitations, containment, training, and communication are in place. However, the potential energy stored in compressed gas creates an additional hazard that should never be underestimated.

Where water cleaning is practical and compatible with the equipment, project, environmental requirements, and manufacturer's recommendations, it can provide a more controlled method of clearing a delivery line and reduce the risks associated with the sudden expansion of compressed gas.

After more than 20 years working in the shotcrete industry and witnessing both successful operations and

serious failures, my conclusion is simple: The safest cleaning method is the one that minimizes stored energy, controls the discharge, and reduces the possibility of an unpredictable, violent release. In my experience, water provides a clear advantage in accomplishing that goal.

Establishing a Safe Hose-Clearing Procedure

- Confirm a written, job-specific hose-clearing procedure is in place and understood by all crew members
- Assign and verify who is authorized to control the air, water, or pressure source
- Establish clear communication between pump operator, shotcrete, and ground crew before starting
- Secure and properly position the discharge end into a designated containment area
- Clear all personnel from the line of fire and maintain exclusion zones
- Verify equipment limits and do not exceed maximum allowable pressures
- Begin clearing using the approved method (water or air) while monitoring flow and hose behavior
- If material stops moving, stop the operation and follow the defined blockage procedure — do not improvise
- Maintain continuous communication throughout the clearing process
- Shut down and isolate the pressure source once clearing is complete or if an issue arises
- Relieve and positively verify all pressure is removed before loosening or opening any coupling
- Ensure all required personal protective equipment is worn at all times
- Exercise stop-work authority immediately if unsafe conditions are observed



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