Dragline dangers: are you in the kill zone?

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High pressure, high volume | Slurry hose systems have their advantages along with hidden risks

GUELPH, Ont. — Dragline hose systems that feed slurry injection implements can carry 2,500 gallons per minute at 130 pounds per sq. inch, powered by 550 horsepower engines.

It's a potentially fatal combination, said Ben Puck of Puck Custom Enterprises in Iowa.

Each dragline setup has a main pump at the slurry source and up to a half-dozen booster pumps to ensure the liquid is delivered at the correct volume and pressure to the injection equipment working in the field.

The hoses must be purged of fluid and bled of air pressure when it's time to trouble shoot a problem, change the setup or move to a different farm, he told the annual North American Manure Expo.

"Cleaning lines, you're using a high volume of high pressure air to shoot the pig (cleaning plug) down the line," said Puck, who stressed that people are mistaken if they believe they can manipulate a highly pressurized hose without tragic repercussions.

"The end of the hose weighs only six or seven pounds, but the zone it whips around in is a 50 foot radius. People in this business call it the kill zone. If you're within that 50 foot radius when the hose goes wild, it can run you down and kill you. Yes, it happens."

Suddenly, the seemingly simple task of incorporating liquid livestock manure into a farm field took on a serious tone. The chatter went silent in the tent at the Guelph exhibition grounds.

Puck told the 400 farmers that the danger is obvious, but people can't seem to comprehend the gravity of it. He said an excessive pressure buildup while cleaning even a short hose

means a potentially fatal situation is developing, caused by a buildup of sand or debris in front of the pig. The pressure can get out of hand before the operator notices it.

“Pressure buildup means the pig is jammed,” he said.

“Do not add more pressure. You should bleed off all the pressure at the pit pump very slowly. But remember that in doing this, you’ve put yourself in another potentially fatal situation. You often get a slurry buildup behind the pig, on the pump side of the pig. While you’re bleeding off pressure at the pump, you’ll see slurry flowing back into the pit. Your reaction is to think that’s a good thing. But that scenario can be a killer. It tricks you into thinking there’s no air left in the line. Not true. Once that heavy liquid flows out, you get an abrupt acceleration of the captive air. The hose gets to be very, very violent, whipping around that kill zone, smashing anything it can touch.”

Puck said there are three things the operator can do: know the boundaries of the kill zone at all times and stay out of the zone when high pressure situations develop or things start to go wrong.

“Third, you can safely run the whole system by remote control wireless that lets you monitor everything and make adjustments from a safe distance.”

Puck sells a remote system called the MobileStar Wireless Pump Control, which lets the farmer or custom slurry injection manager monitor every motor, pump, hydraulic cylinder and gate in each setup.

On small setups, it means the operator in the tractor might be the only person needed to keep things flowing. On larger setups, it lets the person in charge do a better job of directing hired help.

The in-cab monitor provides live numbers on all engine-pump units, including r.p.m., p.s.i. and g.p.m. The information helps operators fine tune the speed of each engine and flow of each pump for greater system efficiency. They can also open and close gates as needed and start or stop engines.

More importantly, the operator can spot potential hazards before they become problems.

“Before, we needed one person to be present at each and every pump, just watching the gauges and checking things. Now, the operator can do all that from the cab,” he said.

“It’s made this business a lot more efficient. As things evolve, we need that better efficiency because we cover more fields and we’re constantly further from the slurry source.”

The MobileStar system sends and receives internet signals and requires a data plan from a wireless carrier.

Violent explosions can be caused by pump cavitation, another potentially fatal scenario also caused by careless operation of the equipment or by incorrectly sizing components.

Cavitation occurs with the sudden formation and collapse of low-pressure bubbles.

“When you get a cavitation explosion, it’s immediately followed by a tremendous implosion,” Puck said.

The implosion pulls such a strong vacuum that it literally sucks the metal off the backside on the pump. It’s all a matter of physics. If you break the laws of physics, bad things happen.

Despite what people think, water is not a very stable compound, and that’s why it’s dangerous. Water wants to exist in pressure that’s very close to normal atmospheric pressure to remain fluid. In a vacuum, it wants to boil and separate into two hydrogen molecules and one oxygen molecule.

The same thing happens if you create a vacuum on the inlet side of your pump.

Puck said allowing liquid slurry to drop much below 14.7 p.s.i. 34 feet of mercury or one bar is messing with the laws of physics.

A slurry pump pulling liquid from a pit can create a strong vacuum, especially if there’s 550 horsepower pulling that vacuum.

As pressure within the inlet side drops, water in the slurry starts to boil and vaporize, or separate into hydrogen and oxygen particles.

“Here’s your initial explosion,” he said.

“Water vaporizes and expands at a ratio of 1,400:1. So one cubic foot of water suddenly requires 1,400 cubic feet of space. But of course, that space isn’t available within the confines of the inlet of your pump. What happens next is pure physics. The slurry expands and blows a hose or some other component in the system. And it’s a very violent explosion. Next comes the implosion. The very moment that the explosion brings the vapours back to 14.7 p.s.i., they

contract back into liquid at the same 1,400:1 ratio. That's when you experience such a force that it really does cause the metal to sheer off from the surfaces inside the pump."

Puck said there's a high risk of a hard left-right knockout explosion-implosion if the inlet side in the liquid pit lacks the capacity to keep up with the pump.

He said this is why the manufacturers' recommendations should always be followed when sizing components and setting up systems.

"It's all been designed and tested by engineers so it won't boil the slurry," he said.

"It's all in the guidelines from the manufacturers, so there's no reason to risk an accident because you installed the wrong pump or components. Everybody in this tent has had the experience of pulling apart a faulty pump and seeing that metal is actually missing from the inside. The first reaction is always to blame the manufacturer. But when you see that metal has been pulled off and blown away down the line, that tells you you've been close to a big mishap."

For more information, contact Puck at 712-653-3045 or visit www.puckenterprises.com.