Innovative – Agitator Sonar Discharging System

Redpath Australia Pty Limited

The Problem or Initiative

Personnel and equipment interaction continues to be a significant risk in the mining industry and especially in the underground mining environment where equipment and personnel work in close proximity to each other to complete a number of tasks in an underground mining cycle. Of particular concern to Redpath, has been the personnel and equipment interaction risks associated with the set up and discharge process during the supply of shotcrete from the underground agitator trucks to the underground shotcrete spray rigs working at the face.

In a typical scenario the shotcrete spray rig is set up in an underground working face *(typical 5.5 x 5.5 mtr)* in preparation to apply shotcrete to the newly blasted excavation. When the Agitator truck arrives at its designated location it is required to reverse back on to the spray rig aligning its discharge chute with the spray rigs hopper in preparation to discharge the load.

This process requires the spray rig operator to guide the reversing agitator back into position over the hopper of the spray rig, potentially putting him/herself in the line of fire between the two pieces of equipment and then once in position the agitator operator is then required to operate/manage the discharge of shotcrete from the rear controls of the agitator putting him/herself in the potential interactive zone.

Picture 1 - Interaction Zone between Agitator and Shotcrete

Picture 2 - Interaction Zone between Agitator and Shotcrete

The Solution

The Redpath Cannington project team along with Remote Control Technologies (RCT) investigated options whereby we could eliminate the need for personnel to be positioned in the interaction zone between the Agitator and the Spray Rig during the supply and application of the shotcrete cycle.

The solution needed to be a simple process that operators would fully endorse and that would not require major structural changes to equipment and processes. It also needed to be robust enough to sustain the harsh environmental conditions of the underground environment.

The concept of the Sonar Discharging system was born from a number of alternate systems used in the mining industry. The Sonar Discharging system utilises a bullet camera, sonar sensor and alarm, sonar backing plate, cabin monitor and proximity alert.

The concept was installed and trialled in the surface workshop over a period of three months and was then tested in the underground environment where it was trialled for a further month. At this time only a few minor adjustments and modifications were made and the sonar system became our preferred method and eliminated the interaction zone between the agitator and the spray rig during the supply and application of the shotcrete cycle.

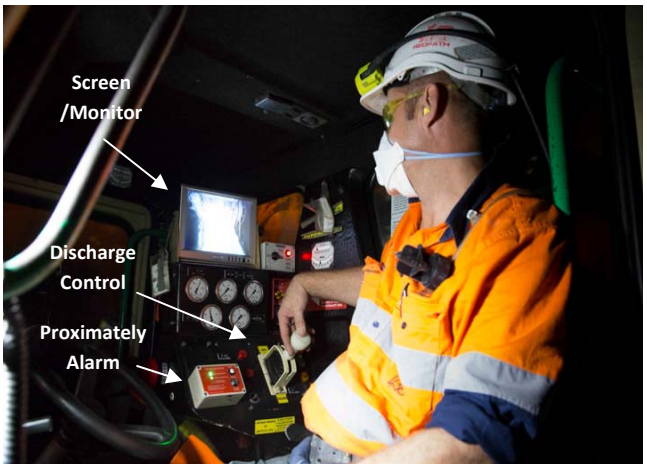
The operation of the system is user friendly and takes no extra time, when the agitator operator arrives at the access to the work area he stops and raises the discharge chute up to its maximum height and locks it in the central position prior to reversing into the work area to be sprayed

The operator then turns on the sonar system and reverses slowly back towards the spray rig, when the operator is within 2 metres of the spray rig, the red LED proximity light illuminates notifying the operator. At all times, a clear view of the rear of the agitator is maintained using the image from the bullet camera displayed on the cab monitor.

The operator continues to back up until the chute is located over the hopper grate of the shotcrete rig, indicated by the 1.5 metres sonar pulse alarm inside the cabin. The operator then applies park brake and installs wheel chocks. The operator can then return to the cabin to discharge the load of fibrecrete, from within the cabin with a full view from the cab monitor.

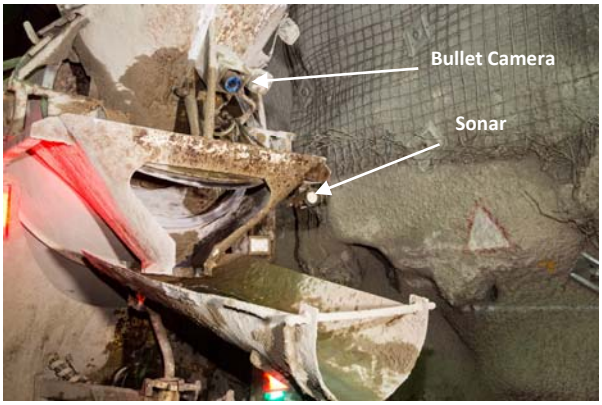
This process eliminates the requirement of personnel to direct the agitator onto the hopper of the spray rig and to operate/manage the discharge of shotcrete from the rear controls of the agitator, thus removing people from potential crush zone and elliminating the risk of pedestrian and vehicle interaction.

Picture 3 - Operator in cab of agitator discharging shotcrete.



Picture 4 - Close up view of high resolution monitor showing shotcrete discharge into hopper.

Picture 5 - Bullet Camera and Sonar fixed to rear of agitator.



Picture 6 - Sonar backing plate fixed to spray rig.

Benefits/Effects

The agitator sonar discharging system offers several benefits to the safety of employees and are as follows:

- No personnel are required to direct the agitator onto hopper of the spray rig, thus removing people from potential crush zone/eliminate pedestrian vehicle interaction risk.
- In cab discharging allows the agitator operator to discharge the shotcrete load from within the cabin removing him/her from the potential crush zone/ eliminate pedestrian vehicle interaction risk.
- Controls and lowers DPM exposure to operators by minimising operators from the outside environment.
- Helps to maintain positive communication between the sprayer and the agitator operator via two way radio, as both operators are inside the cabins.
- The agi operator has more control of the agitator because he/she is now sitting in the cab at the controls. Eliminating the potential for any uncontrolled movement of the agitator.

Transferability

This system has the capability to be used across multiple industries, where ever there is a requirement for one piece of equipment to reverse up to another and especially the shotcrete industry world wide including civil applications.

Innovation

The innovation came from the need to exclude personnel from potential interaction zones mitigating the potential for crush injuries from the uncontrolled movement of agitators during the shotcreting set up and discharging operations in the underground environment. Several ideas were looked at consisting of soft and hard barriers. The option of reversing sensors were eliminated due to the harsh

environment with dust, mud and corrosive water. The final solution was a combination of systems, the sonar alarm is a converted haul truck tub alarm, which is suitable for this harsh operating conditions, the camera is a high resolution bullet camera designed for underground operation with a large high resolution monitor inside the cab for the operator providing a clear view of the area. The “in cab” discharging controls are a part of the OEM specifications.

The Cost

The approximate cost to design, develop and manufacture the Agitator Sonar dispatching system was $15,000 per Agi/Spray rig fully installed.