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Ore Pass Level and Blockage Locator Device

Objective

Develop a means of determining both the fill level of material in an ore pass or bin and the location of bridging material causing a blockage.

Background

Bridging of material in ore passes causes blockages in the flow of material. These blockages can be hazardous and must be removed before production can continue. Sensors are available that can determine fill level from the top of an ore pass, but there are presently no sensors that can determine both fill level and the position of a blockage. If information can be obtained regarding the location of a blockage, the depth of the material above the blockage and the distance from the outlet can be determined. This information is needed to determine the safest and most effective method for removing the blockage.

Approach

Because an ore pass is constructed in solid rock, there is no access to the outside of it, which presents significant challenges in designing a means of determining depth of the material. A second challenge is that any system internal to an ore pass must be rugged enough to withstand direct impacts from rock or other materials flowing through it.

An inexpensive level-sensing system was designed to monitor the presence of material inside an entire ore pass. The sensor consists of simple steel strapping instrumented with strain gages that can detect the presence of material at discrete points along the length of the strapping. The steel strap can be attached to the interior of an ore pass or bin and can conform to the shape of an irregular opening. It can be from 3 to 30 m (10 to 100 ft) long as designed. Longer distances may be possible. Tests of a prototype in a 6-m- (20-ft-) tall bin have shown that the sensor works with various sizes of rock.

How It Works

The prototype consists of steel strapping 4.6 m long, 10 cm wide, and 3 mm thick (15 ft by 4 in by 1/8 in). Weldable strain gages are attached at equal intervals along the strap. Bolts with standoffs are inserted between each strain gage, and the steel strapping is bolted to the wall of the bin with the strain gages toward the wall. A slotted rubber hose protects the back of the strap from impacts and/or filling with material.

As material fills the bin, hoop stresses cause a slight deflection in the steel strapping between the bolts. This deflection is measured by the strain gages. Where material is present, strain is indicated. In this way, the location of material can be resolved to within 0.6 m (2 ft). A microprocessor multiplexes and analyzes the data from the strain gages and outputs data to a user interface that indicates the presence or absence of material at each gage. While the sensor was originally developed for ore passes, it can also be used in bins and hoppers that might require a more rugged level sensor than currently exists.

Patent Status

A patent has been applied for under the name "Ore Pass Level and Blockage Locator Device," application number 60/086,929. The patent will be available for licensing, and a cooperating mine is being sought at which to conduct full-scale tests.

U.S. Department of Health and Human Services

Public Health Service
Centers for Disease Control and Prevention
National Institute for Occupational Safety and Health

For More Information

Additional information can be obtained by contacting Todd Ruff at (509) 354-8053, e-mail ter5@cdc.gov, Spokane Research Laboratory, E. 315 Montgomery Ave., Spokane, WA 99207.

To receive additional information about occupational safety and health problems, call 1-800-35-NIOSH (1-800-356-4674), or visit the NIOSH Web site at www.cdc.gov/niosh

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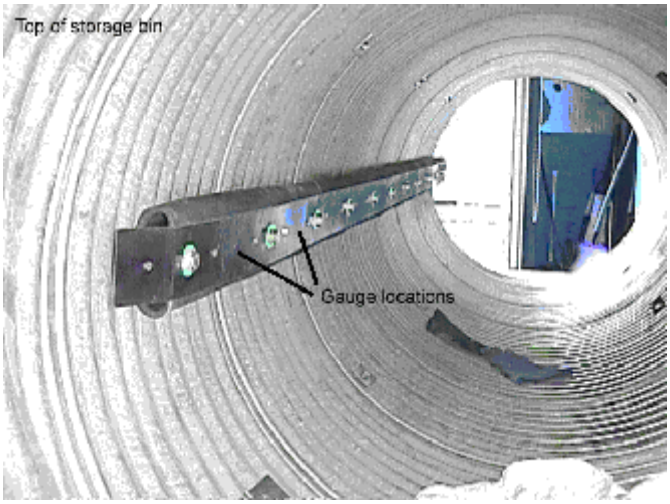

Figure 2.—Device installed in bin.

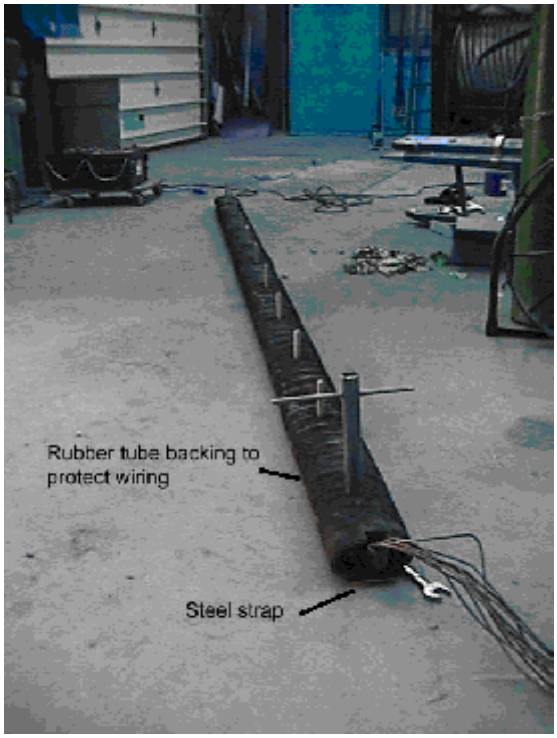

Figure 1.—Ore pass level and blockage locator device prior to installation in bin.

Figure 3.—Level indicator with LED's showing presence or absence of material at each gage.