

Hazard monitoring in the cement industry with Watchdog 'Elite' from 4B Braime

Conveying systems in the cement industry are exposed to difficult operational conditions. Cement is a heavy duty application where dust contamination and the heavy weight of the material and high temperatures puts strain on the system components and can lead to early wear-out and failures.

Although the potential risk of cement causing a dust explosion is low compared to other materials, the kiln which is at the heart of every cement plant has been the source of a number of explosions in the industry. The kiln is fired using either, powdered coal, oil, natural gas, or more recently waste materials, and reaches temperatures of around 1,600° Celsius. The areas at each end of the rotary kiln produce dust and hot fumes which must be cleared and made safe. Any conveying system used around the kiln or for the transportation of coal and cement should be carefully monitored for the risk of explosion hazards.

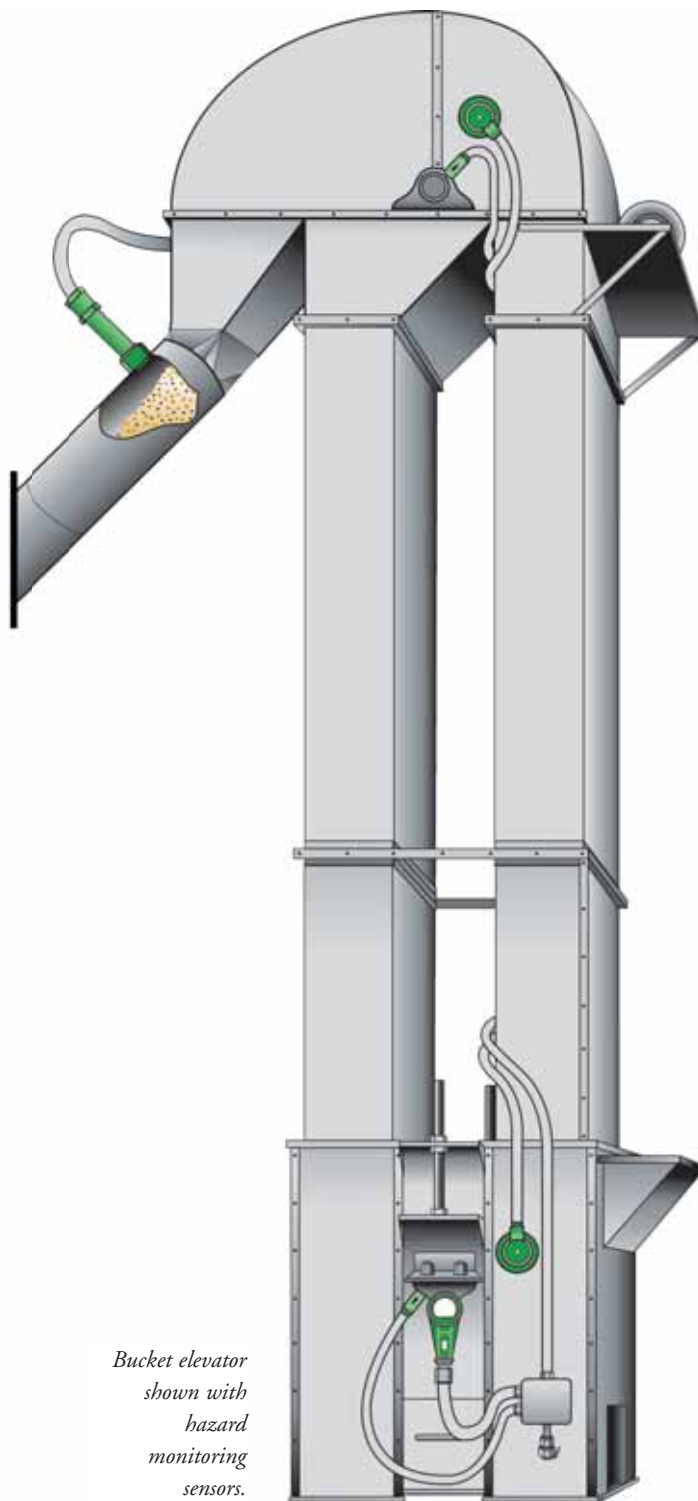
THE BUCKET ELEVATOR

Bucket elevators with high heat steel cord belts are increasingly being used (replacing less efficient chain elevators) to convey both coal and cement, often operating at temperatures of up to 160° Celsius. The bucket elevator is one of the most efficient methods for moving bulk granular materials, but it is also one of the most dangerous. The dust generated from the movement of materials within the elevator can be highly explosive, and mechanical failure or incorrect operation of the bucket elevator can have catastrophic consequences. The most common hazards are belt misalignment, belt slippage, blocked chutes, and bearing failures each of which should be monitored to reduce the risk of fires, explosions or breakdowns that result in costly downtime.

MULTI-HAZARD MONITORING SYSTEMS

Over the years, many different types of monitoring systems have been designed and implemented. All use either electronic, mechanical, or electro-mechanical transducers mounted on the bucket elevator or the conveyor. These transducers pass signals to a control device, which usually provides visual/audible warnings and automatic shutdown of the bucket elevator or conveyor when dangerous or improper operating conditions are

identified. Designers attempt to engineer these systems to operate in fail-safe modes, which can assure correct operation of the monitoring system when a dangerous condition occurs or a failure is



Bucket elevator shown with hazard monitoring sensors.



Watchdog Elite hazard monitoring system.

imminent. They are a great tool for plant maintenance engineers as they give an instant overview of the different areas monitored through one central control unit.

4B's Watchdog 'Elite' is a multifunctional hazard monitoring system for bucket elevators and conveyors that monitors belt speed, belt and pulley alignment, bearing temperature, and plug condition. The Watchdog 'Elite' features the latest solid state electronics and fail-safe design principles to ensure the most, accurate and reliable monitoring all the time.

Belt speed and belt alignment monitoring utilizes extended range magnetic proximity sensors to detect either steel elevator bucket bolts or steel elevator buckets. These sensors have an

adjustable sensing range of 0-100mm, and are not affected by any amount of dust or material build-up. A high temperature version is available for temperatures up to 180° Celsius.

BELT SPEED

The sensors provide a single digital pulse for each target (bolt or bucket) passing through the sensing field. These digital pulse signals correspond to the speed of the elevator belt and are translated and averaged by the Watchdog control unit.

BELT ALIGNMENT

Two sensors are arranged so that during normal belt alignment both sensors detect the passing targets and during belt misalignment only one sensor detects the passing targets. This arrangement is simply achieved by installing the sensors on the outer edge of the steel bolt heads or on the sides of the steel buckets. When the control unit is receiving two signals the belt is aligned correctly. When the control unit receives only one signal the belt is misaligned.

Normal belt 'wander' is allowed for by adjustment of the sensing range and the position of the sensors from the targets during system installation and commissioning.

The benefits of using this type of non-contacting continual sensing system are two fold.

Firstly, there is no contact with the components being monitored; therefore, no parts to wear out and no dangerous

WDA3 sensor.



contact with the belt. Secondly, the system is actively processing signals during normal operation, ensuring fail-safe operation as no signal indicates an unsafe condition.

CONTROL UNIT

Using the latest available technology, the Watchdog 'Elite' control unit processes the signals received from the speed and alignment sensors through dual PIC microprocessors. A menu system displayed on the liquid crystal display (LCD) allows for easy parameter adjustments, which are accessed via a password and three panel mounted push buttons. Calibration and set-up parameters are retained in a non-volatile EPROM memory chip.

DISPLAYS

The bright light emitting diode (LED) display provides continuous indication of belt speed, and the LCD screen provides operators with clear and concise messages on the status of the monitoring system and the operation of the bucket elevator or conveyor.

PARAMETERS & TEST

Underspeed and misalignment alarm and shutdown trip points are adjustable within industry regulations via the password protected set-up menu.

The Watchdog system and all associated external wiring, warning and shutdown controls can be fully tested through the menu system.

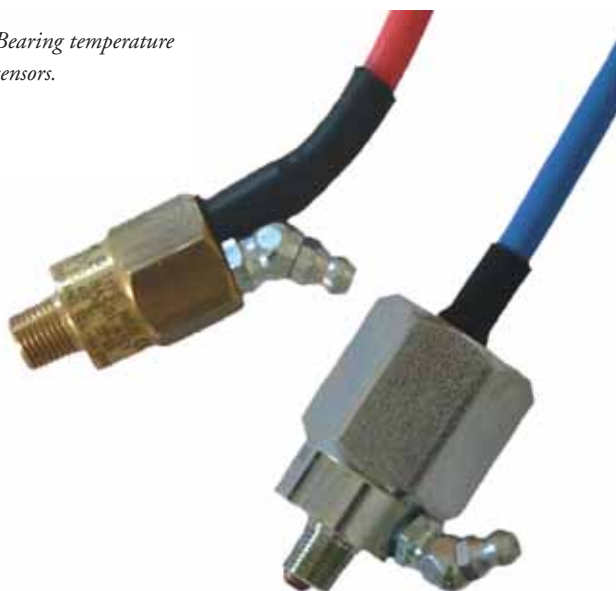
OUTPUTS

The control unit provides three standard outputs for control of external equipment;

WDA3 high-temperature sensor.



Bearing temperature sensors.



alarm relay, shutdown relay, and RS485 serial comms. The alarm relay provides an output to warn operators when a system fault has been detected. The shutdown relay provides an output to automatically stop the elevator or conveyor under a fault condition. Both of these outputs have user definable trip points and both operate in a fail-safe mode (relay energized during normal running conditions).

The third output is used for serial communication with a computer or PLC system. Using a four-wire RS485 network cable, this output provides information on elevator or conveyor operation and control unit status. Additional control units can be 'daisy-chained' on the network as the system is expanded.

In addition to the three standard outputs, an optional interface board provides isolated relay contacts for belt underspeed, belt misalignment and bearing temperature. This option is useful for simple integration to PLC's or computers when the RS485 network capability is not utilized.

OPTIONAL AUXILIARY SENSORS

Bearing temperature

The temperature of the elevator or conveyor bearings are

monitored using positive temperature coefficient (PTC) bearing temperature sensors. These zinc-plated steel sensors thread into the grease zerk location on the bearing housing, providing positive mounting. The sensor housing is grease-through and incorporates a standard grease nipple for bearing lubrication. The sensors wire back to the control unit, which provides a warning, followed by an automatic shutdown when an overheated bearing is detected.

The location of the failed bearing is displayed on the LCD screen to allow for rapid location and rectification. Negative Temperature Coefficient (NTC) bearing temperature sensors are available which display the temperature of the bearing.

Plug condition monitoring

When an elevator or conveyor discharge becomes plugged, material is forced down back into the machine, quickly filling up the casing of the elevator or (enclosed) conveyor, resulting in belt slip and possible severe damage to the machine. A capacitance-style 4B proximity sensor mounts in the discharge section or discharge spout of the elevator or conveyor and can provide early warning of plug conditions. In high temperature applications a Remote Autotest can be used which has remotely mounted electronics and probes suitable for temperatures up to 600°C.

A continuous signal from the sensor to the control unit indicates a normal plug-free condition, and an open signal occurs up on a plug condition. The control unit translates this signal and displays 'plug condition' on the LCD screen and can automatically shut down the elevator or conveyor.

Head pulley alignment- monitoring

Under certain mechanical fault conditions, the head pulley of an elevator can move over and rub against the elevator trunking, while the elevator belt remains normally aligned. This can lead to severe damage or explosion, and the head pulley alignment should be monitored at all times. The Watchdog system incorporates a head pulley alignment monitoring option, which uses solid state inductive proximity sensors to monitor head pulley position. The non-contacting sensors provide a signal to the control unit when the head pulley is running within normal operating parameters and deactivates the signal under a

Binswitch capacitance probe.





Autoset Remote probes.

misaligned condition. The control unit activates a warning device, displays 'head pulley misalignment', and after a delay period, can automatically shut down the elevator.

APPROVALS

The Watchdog 'Elite' system is ATEX approved for zones 21 and 22 and also carries CSA and IECEx approvals.

SUMMARY

The Watchdog 'Elite' system uses the latest solid state electronics and provides accurate and reliable safety monitoring for bucket elevators and conveyors. Some of the key features of the system are as follows:

- ❖ non contacting fail-safe belt speed monitoring
- ❖ non contacting fail-safe belt alignment monitoring
- ❖ solid-state electronic bearing temperature sensors
- ❖ solid-state electronic sensors for plug condition monitoring
- ❖ non contacting electronic head pulley alignment sensors
- ❖ acceleration monitoring during elevator start-up
- ❖ slack or broken chain detection
- ❖ user adjustable trip points and parameter customization
- ❖ simple password protected menu system with front panel push buttons for set-up and parameter adjustment
- ❖ large bright LED speed display
- ❖ LCD message/warning panel display
- ❖ display in English, French, Spanish, or German
- ❖ non volatile EPROM memory chip
- ❖ passive and active system test which verifies Watchdog

AutoSet remote control.



system function and correct working of all external wiring and associated equipment

- ❖ ATEX, CSA and IECEx approved

The Watchdog 'Elite' is essentially a 'Guardian' system, constantly monitoring for a change condition indicating a potential performance failure. An extremely user-friendly and reliable system, the Watchdog 'Elite' hazard monitoring system has established itself as the industry standard product for hazard monitoring in bucket elevators and conveyors.

The 4B group has been a pioneer in developing hazard monitoring systems for the bulk handling industry. 4B's electronics division specializes in level controls, intelligent sensors and safety control systems that prevent costly downtime and minimize the risk of explosion in hazardous areas.