Patol Limited

Rectory Road
Pardworth Common
Berkshire
RG7 4JD
Tel: (0118) 9 701701
Fax: (0118) 9 701700 / 9 701300

APPLICATION NOTE

CONVEYOR SYSTEM FIRE PROTECTION OVERVIEW

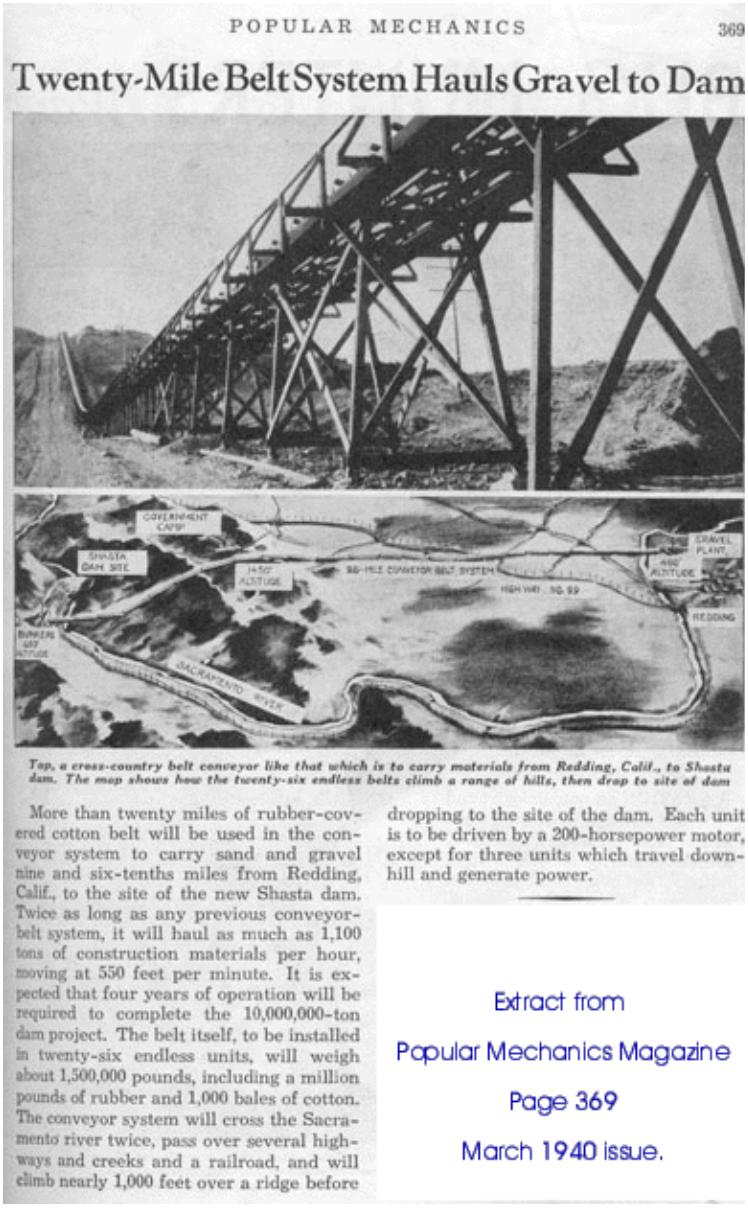
Conveyors:-
Coal
Peat
Sugar
Sulphur
Grain
Wood
Nitrates
Ore
Food Stuff - Etc.

Conveyor systems are not new, as the extract (right) from a magazine published in 1940 shows.

The fire protection of conveyors, however, has not stayed in line with the advances in belt transfer technology over the years.

Measures such as " Thermocouple Hoods" have been proved to be ineffectual.

Patol Limited can now provide an effective fire detection & protection system for conveyors of all forms.



POPULAR MECHANICS 369

Twenty-Mile Belt System Hauls Gravel to Dam

Top, a cross-country belt conveyor like that which is to carry materials from Redding, Calif., to Shasta dam. The map shows how the twenty-six endless belts climb a range of hills, then drop to site of dam

More than twenty miles of rubber-covered cotton belt will be used in the conveyor system to carry sand and gravel nine and six-tenths miles from Redding, Calif., to the site of the new Shasta dam. Twice as long as any previous conveyor-belt system, it will haul as much as 1,100 tons of construction materials per hour, moving at 550 feet per minute. It is expected that four years of operation will be required to complete the 10,000,000-ton dam project. The belt itself, to be installed in twenty-six endless units, will weigh about 1,500,000 pounds, including a million pounds of rubber and 1,000 bales of cotton. The conveyor system will cross the Sacramento river twice, pass over several highways and creeks and a railroad, and will climb nearly 1,000 feet over a ridge before dropping to the site of the dam. Each unit is to be driven by a 200-horsepower motor, except for three units which travel downhill and generate power.

Extract from
Popular Mechanics Magazine
Page 369
March 1940 issue.

1.0 INTRODUCTION

A fire condition within a conveyor system may be considered to be :-

- **A "static" fire on the conveyor belt, or within the conveyor mechanism.**
- **An "imported" fire on a moving conveyor belt.**

It has been established by Patol Limited, that each of the above requires a different form of fire detection to provide a reliable, fast response and trouble free system.

It is the object of this data sheet to indicate general solutions, however it should be emphasized that any specific installation/site/plant must be addressed individually in order to obtain the correctly engineered system.

2.0 STATIC FIRE ON THE CONVEYOR

In the conveyor structure, material (such as coal) which falls from the moving belt, or an accumulation of settled dust from the transported substance, provides a ready source of combustible matter.

A mechanical fault in the bearing of a roller, or friction caused by the build up of coal around a roller, or a friction fault on the belt itself, may result in a heat source sufficient to initiate combustion (fire).

Tests have shown that coal is not readily ignited by hot objects such as metal falling from welding or cutting operations. It is also evident from tests that even a mass of several kilograms of red hot metal when placed on top of or into coal dust or 'fines' will not impart sufficient energy to cause smouldering (smouldering is considered to be the increase in temperature of a slowly increasing volume of coal over a long period). Many kilowatts of energy are required to raise the temperature of coal to the point where smouldering occurs leading to gases being generated which subsequently ignite. It is evident that the source of energy to raise the temperature of coal is a mechanical fault in the bearing of a roller or friction caused by the build up of coal around a roller or the belt itself.

However, coal is not the only substance to be transported by conveyor and the ignition criteria for each material must be considered.

Many different types of fire detector have been tried for material conveyors over the years including--

(i) Collective reflectors (thermo-couple hoods)
(ii) Ionisation & optical point smoke detectors
(iii) Point Heat Detectors
(iv) Point Flame Detectors
(v) Obscuration detectors employing infra-red beams
(vi) Pneumatic detectors with fusible bulbs

In every case, experience has shown that these devices are either unsuited to the environment producing unwanted alarms due to dust or fog, or are so insensitive that a fire can propagate and cover many metres of the length of the conveyor before they are operated.

Patol Limited's solution to the above is Linear Heat Detecting Cable - **L.H.D.C.**

Tests have been carried out to check the response time of Linear Heat Detecting Cable - **L.H.D.C.** in a number of different locations within the conveyor housing.

As a minimum, a detection "run" should be installed above the centre of the belt at a height 1.0 to 1.5 metres. Duplexing of this "run" , especially with sideways separation, enhances both responsivity and coverage and is recommended. Ideally detection "runs" should also be sited immediately above the return roller on each side (beneath the bottom plate on most conveyor systems), however, experience has shown that rigorous cleaning regimes, especially on coal conveyors, can cause damage to the **L.H.D.C.** when installed in this location.
If the conveyor housing has a pitched roof and contains more than one conveyor it is recommended that a detection "run" is installed close to, but not directly in, the apex.

The above arrangements have been employed on a number of large Power Station installations and have been found to be trouble free.

The zoning of the conveyor is dependent upon whether the system is for detection only or is used in association with an "electrically actuated" waterspray system.

As an indication of relative performance, **L.H.D.C.** located on a conveyor, as detailed above, responded within two minutes to a small coal fire with a surface area of approx. 0. 1 sq metres, where a conventional sprinkler bulb took over 12 minutes to respond to a timber fire of surface area of approx. 1.5 sq metres.

There have been situations where conventional sprinkler heads have failed to prevent the spread of a belt fire in a Power Station conveyor system due to the delay in operation.

The use of **L.H.D.C.** has become an established industry standard and is of particular import in harsh environments where other types of detectors would be constantly raising unwanted alarms. When combined with "electrically actuated" sprinklers **L.H.D.C.** provides the ultimate in reliability with rapid response of the protection system.

It must be appreciated that **L.H.D.C.** is only recommended for a static fire either on a conveyor belt or in the conveyor housing. Due to the rapid movement of conveyor belts (up to 4 metres per second) **L.H.D.C.** does not provide an adequate form of detection for a moving belt fire. **(SEE FOLLOWING)**

3.0 IMPORTED FIRES ON MOVING BELTS

A number of years ago research was conducted such as to find the ideal "moving" belt fire detector. This being undertaken when it became obvious that existing systems employing thermocouples and heat detectors in hoods were unable to detect anything other than a very large fire.

It was clear that the reason why Linear Heat Detectors and thermocouple hoods were not able to detect small fires moving at speeds of up to 4 metres per second was that they relied upon convected and radiated heat. Even the very low thermal mass of the thermocouples used in the hoods (working on the differential between hot and cold junctions) cannot produce reliable results.

In order to gain sufficient sensitivity it was clear that a radiation detector which operates on an emissions principal, as opposed to thermal effect, would be the only reliable device with sufficient sensitivity. The result was the development of an infra-red pyrometer based system which has been employed in a series of trials.

The device developed is a quantum infra-red detector designed with parameters that incorporate the principals laid down by both Wien's & Stefan's laws of physics. Simplistically, the device is tuned for wavelengths which enable it to detect required black body emissions yet is virtually blind to direct and reflected radiation from the sun. Conventional flame detectors have proven to be unsuitable as they only monitor diffusion flames within predetermined flicker frequencies and are "blind" to the black body radiation from smouldering fires.

The Patol Limited 5000 Series Infra-red Detector is mounted above the conveyor at a height between 1.0 and 1, 5 metres such that its optical system can cover the full width of the belt. The response of the detector depends upon the size and surface temperature of the object. Typically the alarm can be given if an object of 250mm by 250mm at a temperature of 100 degrees centigrade passes beneath the detector at a speed of up to 4 metres per second. The system can also detect hot coals as little as 25mm (1inch) in diameter.

The detector will respond to a hot spot beneath the surface, as well as a flaming fire, provided that the temperature/heat at the surface is within the alarm level.

The infrared detector should be mounted at sufficient distance back from the discharge end of the conveyor such that on detecting a fire the belt would be stopped.

A . Before the conveyor can discharge the fire to a hopper etc.

B. Where the fire would be beneath a protection system such as a "water curtain" (commonly employed at intervals along and at the ends of conveyors).

The 5000 Series Infra-red Detector would be used to raise an alarm and stop the conveyor.

At this stage, the **L.H.D.C.** run above the belt would then be able to detect the fire, confirm the alarm and where necessary actuate the waterspray system.

Where the environment in the location of the infrared detector is particularly prone to airborne dust then it is recommended that the air purging accessory is fitted to the detector in order to keep the optical system clean. Tests have shown that the detector can still raise an alarm when a relatively small fire moving at 4 metres per second is viewed through a cloud of coal dust.

Applicable Data Sheets

Linear Heat Detection Cable
Patol Zone Control Module LDM-519 / SEN
Patol Zone Control Module LDM-519 / ACT
Patol Zone Control Module LDM-519 / LP (line powered)
Patol LDM-519 Eurocard Module
LHDC Fixings
Patol Series 5000 Infra-red Fire & Heat Detectors