

Effects of Dust Suppression on Conveyor Belting

► 1.0 Dust Suppression Overview

Coal dust originates primarily when coal is broken by impact on crushing, grading, milling etc. These “fugitive releases” can occur at numerous stages in the subsequent loading and conveying. The amount of dust generated depends upon the methodology employed, but typical coal dust is normally found in the range of 1 to 100 microns. Excessive dust provides environmental, housekeeping, and health/safety concerns for the plant operations and its staff.

Chemical dust suppression systems have become prominent in various coal-handling industries (e.g., power generation, etc.) in an obvious attempt to reduce such unwanted emissions. Available dust suppressant materials contain a relatively complex chemical cocktail of additives, which are marketed under a number of proprietary brand names. These additives appear to work by changing the surface chemistry of the coal, rendering it capable of adsorbing water to the surface.

Some systems also use oils to suppress dusting. However, their harmful affect on conveyor belting is well understood owing to their ability to swell/soften non-oil resistant rubber grades.

The chemistry behind most of the reagents is the modification of the surface tension of water to increase the “wettability” of the coal... which is generally accepted as being hydrophobic in nature (water resistant). These additives often have the dual function of being antifreeze agents. To be effective, these surfactants must also create an increase in the adhesion of dust particles, and then maintain the binding of the particles to prevent regeneration of dusting.

Overall, *chemical* dust-suppression systems can be classified as follows:

1) Surfactant / Water Spray... This method (discussed on the previous page) will sometimes use a foaming agent to assist the coal-wetting process.

2) Polymer Modification... As an addition to the surfactant system, some polymeric additives are also used to retard the loss of moisture by the coal dust.

Humectants may also be found. These are materials that have an affinity for water, and have a stabilizing action on the water content of the coal during changes in humidity, or its

movement and transportation.

3) Emulsions...

Emulsions can be oil or latex-based, and are used to help suspend immiscible binders. Latex can sometimes be used to seal coal when either piled on the ground, or as transported in railcars. These are often found in conjunction with the surfactants described above.

Oils, a common additive to coal to improve its thermal properties, are (as mentioned earlier) also used to assist its dust suppression. There are some oil soluble surfactants that can be used in conjunction with the oils.

The products on the market today may include a blend of all of the above attributes. Certain blends may even have a synergistic effect when used together.



Photos courtesy Fenner Dunlop Conveyor Belting Americas.

► 2.0 Influences on Conveyor Belting

The complex nature of the dust-suppression chemistry, and the range of products available, makes it almost impossible for the belting manufacturer to know the exact composition of the agents employed... or their affect on the rubber belting compounds in contact with them.

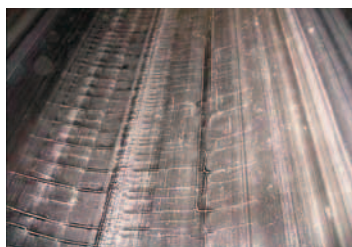
However, we have observed a propensity for deleterious effects on the rubber compounds normally employed in *coal-handling*... both in fire retardant and non-fire retardant RMA Grade 2 styles. Here are the more prominent of those observations:

2.1 Cover Hardening

Conveyor belts handling dust-suppressed coal have been prone to an increased rate of cover hardening. The typical durometer of a conveyor belt cover in this market is 65 degrees Shore A.

This hardness level has been seen to increase to above 80 degrees, after only 15 months of service, in some coal-handling applications.

When the durometer increases above 80 degrees, the cover becomes less flexible... and prone to cracking through repeated flex-cycling. The hardening reduces haulage capabilities on incline conveyors, while the cracking creates housekeeping problems for the operator. Both, effectively, tend to contribute to a much shorter belt life! (The adjacent photo shows cover cracking due to such durometer increases.)



2.2 Belt Cupping or Curl

This conveyor belt application topic is well-documented in the Fenner Dunlop bulletin on *Conveyor Belt Curl* by George Frank.

All belts with an imbalance of cover gages already have a *shrinkage disparity* that results in some *degree* of “curl.” When in contact with certain de-dusting reagents, the carry cover rubber will often “harden”... a process that results from the volume loss (and

shrinkage) of that contacted cover material. This “additional shrinkage” of the heavier top cover further aggravates any *already inherent* propensity within the belt to cup or curl.

Belt curl creates its own set of operational problems for the end user... problems that include tracking issues, belt (edge) and structural damage, and increased load-zone spillage and skirt wear.

► 3.0 De-dusting Agents on Cover Compounds – Test Evaluations

The influence of some of the common de-dusting agents on Fenner Dunlop rubber compounds have been investigated by our laboratories. In the test trials that follow, it was necessary to confirm and reproduce the observations from the field.

Test #1 (see Figure #1 below)... This experiment involved samples of Grade 2 conveyor belting. Samples “Belt Run A” and “Belt Run B”

% Acetone/Methanol Extractions of Rubber cover

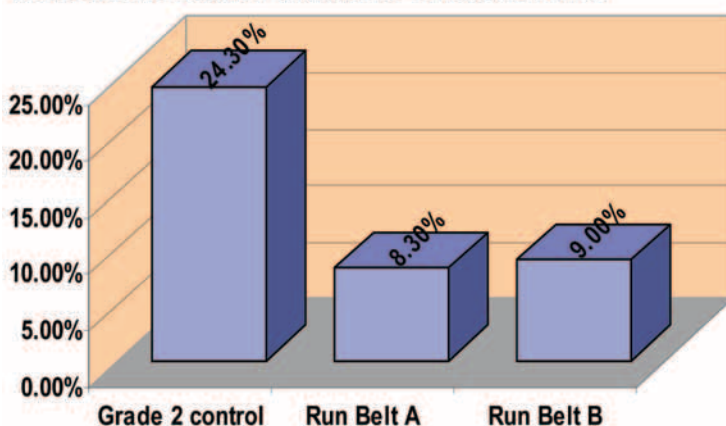


Figure 1.

were returned from a coal-generating power plant after 15 months of service. In the field, this belt had seen a *rapid increase* in durometer... after what was considered only 25% of its normal operating life. By extracting the residual plasticizer oils from the top covers of these “field” samples, and similarly comparing to a laboratory “control” sample (typical Grade 2 recipe), the effect on the rubber formulation could be observed.

In this test, all three rubber samples were exposed to a solvent mixture of acetone and methanol *under a Soxlet Reflux condensation technique*. This specific process removes the oils from the rubber. After which, the oil concentration of the two *field* compounds can then be compared to the original *control* sample.

The results confirmed that the *field* compounds had lost two-thirds of its original oil level (roughly 24% by mass down to 9%)... something not normally observed in service until *after many years* of operation.

Tests #2 and #3 (see the two figures that follow)... These two tests looked at the influence of prolonged exposure of the de-dusting agents on two Fenner Dunlop rubber compounds. The test compared the standard FDA “Grade 2” compound to Fenner Dunlop “PowerGuard”... a new generation compound, designed to *retard* the effects of de-dusting agents.



Photos and graphs courtesy Fenner Dunlop Conveyor Belting Americas.

Durometer Change 720 hrs @ 100 Deg F

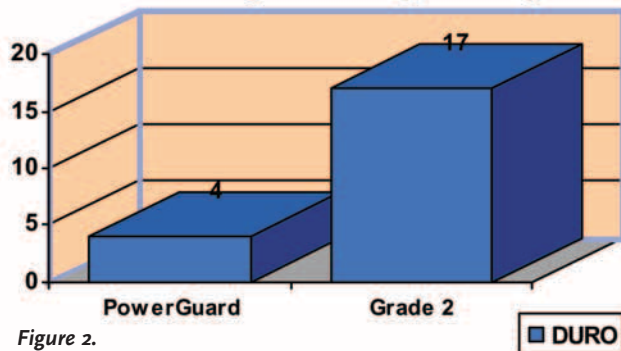


Figure 2.

The testing was carried out to a total of 720 hours of exposure. To accelerate the test, slightly elevated temperatures and 100% concentration of the surfactants were used.

The samples were then evaluated for both *durometer and volume change* in the compound. Figure #2 (above) shows the increase in durometer noted after the test duration. It can clearly be observed that the effects on the Grade 2 compound are very significant. The loss of plasticizer causes a loss of volume, and a corresponding increase in durometer... 17 degrees (Shore A) in the Grade 2 compound, as compared to *just 4 degrees* in the PowerGuard compound.

Figure #3 (below) reveals the change in mass due to oil extraction/absorption of the agents (again noted after exposure to the de-dusting agent *through* 720 hours).

%Mass Change at 100 Deg F

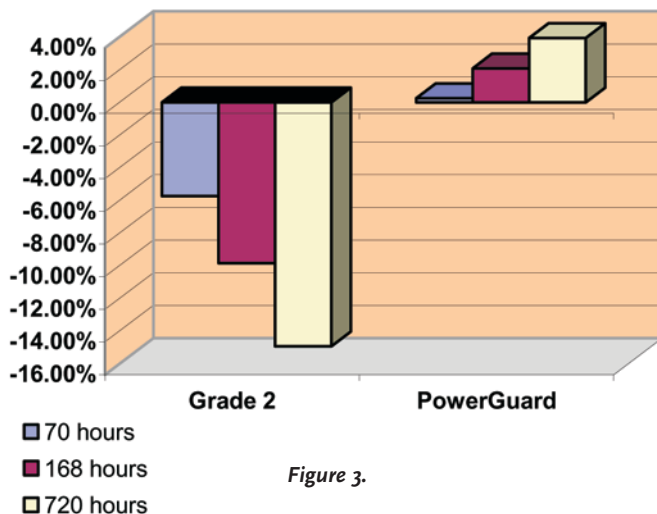


Figure 3.

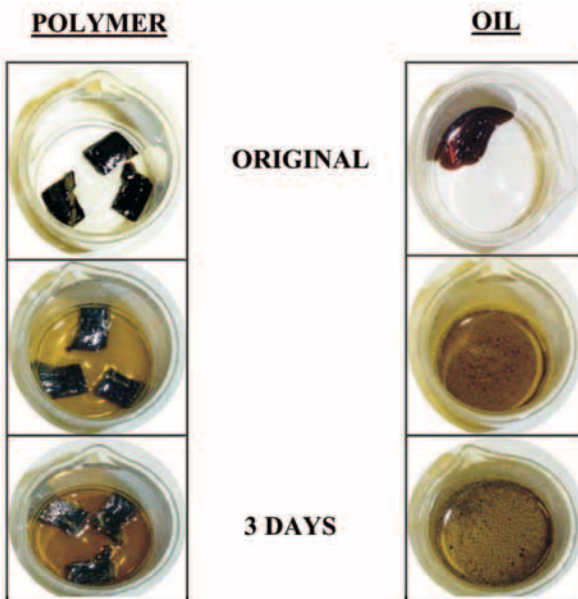
The mass change denoted reflects the equilibrium set up between *extraction* of plasticizer oils within the Grade 2 compound (causing a corresponding volume reduction)... and the *absorption* of the de-dusting agent with the PowerGuard sample.

The "Litmus Test"... SBR Polymers used in the rubber industry may be purchased as an oil-extended grade. This means that a certain level of plasticizer oil is already combined. Additional oils can be added during the mixing process.

To check the miscibility of these oils with a de-dusting agent,

samples were placed in a beaker containing a small quantity of the oil extended SBR rubber and in another beaker a sample of 100% process oil (plasticizer).

After 3 days... one can observe that the plasticizer oils are miscible with the de-dusting agent, and the process oil can also be extracted from the polymer.



Photos and graphs courtesy Fenner Dunlop Conveyor Belting Americas.

► 4.0 Conclusions

From field observations of our conveyor belting products, and through extensive laboratory experiments, we can conclude that the dust suppressing agents used in the industry today can have a deleterious effect on standard conveyor belting compounds. Their prime mode of attack is their ability to extract plasticizers from the rubber compounds... which, in turn, creates other nondesirable changes in belt performance.

Such "extraction" results in a mass/volume reduction within the affected rubber... which causes the cover to harden, and possibly crack. In addition, this onset extraction/shrinkage process can also worsen an already existing curl/cup situation with the belt!

The use of Fenner Dunlop PowerGuard® compounds, in either MSHA or Grade 2 styles, retards the effect of such de-dusting agents that may come in contact with either compound. The end user can therefore combine the benefits of the dust suppressant, and still enjoy longer belt life, by merely selecting either of these two "low extraction" PowerGuard® offerings. ★



Written by Geoff "Small G" Normanton, Corporate Director of Technology, and edited by George "Big G" Frank, Manager, Application Engineering, Fenner Dunlop, December 2005.