



Look For A Better Way

If you always do,
what you've always done,
you'll always get,
what you've always gotten.

PECO

Goals For Improvement

How do you improve winter time unloading of coal?

Coal freezes like the rings on a tree. The outside surfaces are the first to show the impact of cold weather. Treating the sides of the rail car has the most impact on the unloading of the car. The problems with existing side release formulas include:



- runoff through car bottom after treatment
- dilution by water/moisture at the car metal surface
- freeze point effectiveness vs corrosion vs raw material used

Improved Adherence

Formulation changes were made to improve product adherence. Testing showed that showed **14 times** as much material adhered to the metal surface.



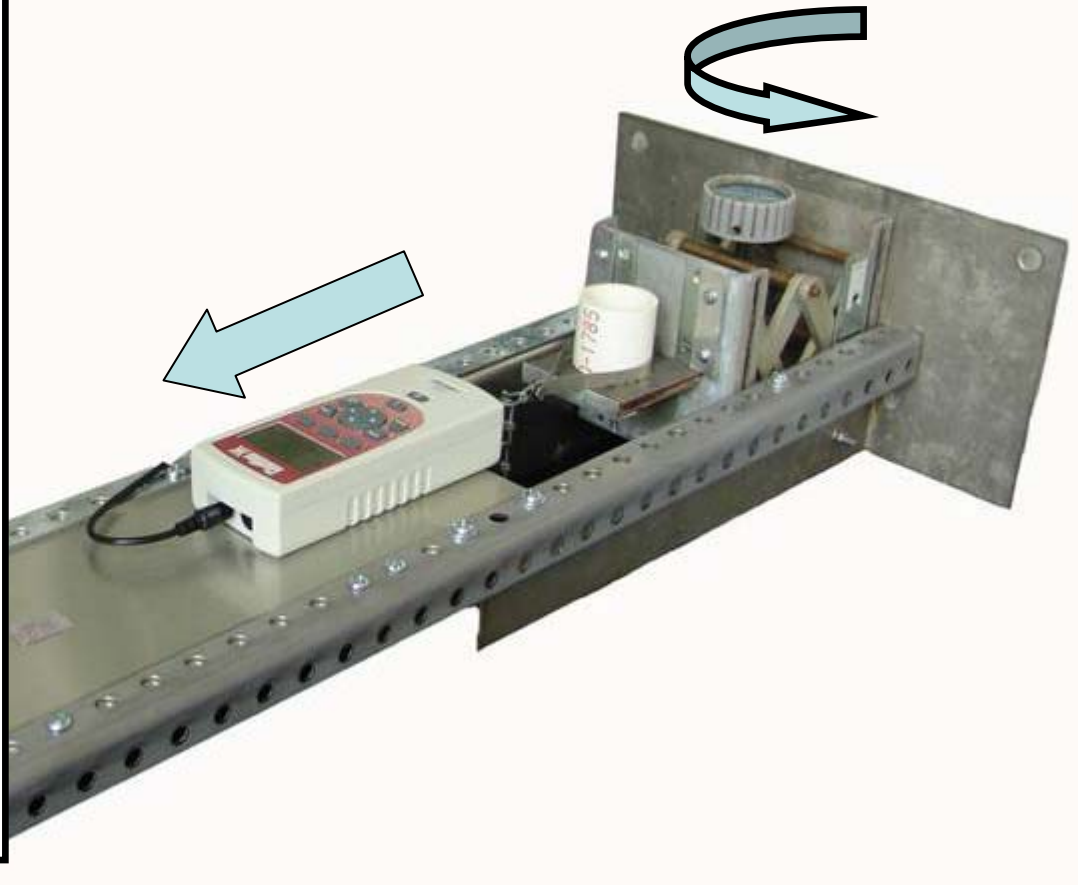
Coal Contacts Coupons

Samples of coal were ground to 10 mesh, taken to a moisture of 20%, and then packed into into a small cross section of PVC pipe that is placed on a treated or untreated steel plate—creating intimate contact between the coal and the steel surface. Samples were then placed in a freezer and maintained at a temperature of 5 degrees Fahrenheit.



Shear Force Applied

A test was developed to measure the amount of shear force required to break the frozen bond between the coal and steel surface. The test used the shear force measurement device seen here. Turning the knob moves the stage and applies force to the PVC section. Increasing the force on the pipe section eventually leads to its release from the steel surface. The digital device measures the tensile force required to break the sample free.





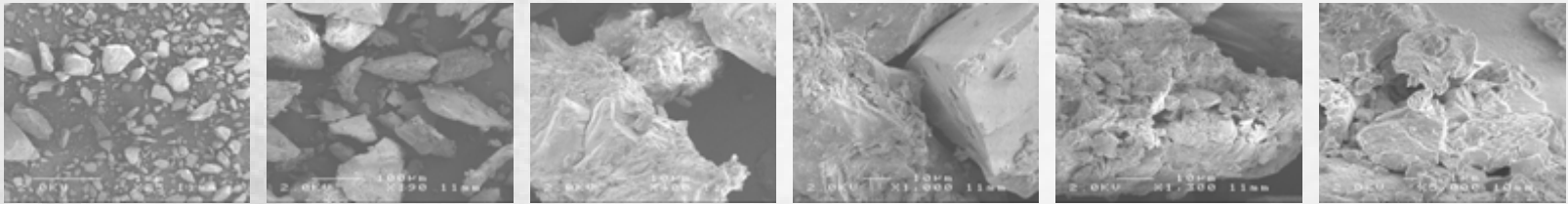
Best Products For SRA

Formulation Viscosities

Product Applied	Average Shear Force	cPs @ 22 Degrees C	cPs @ -20 Degrees C
CACL2/Proprietary Additive	5,180	255	Gel
CACL2/DEG/Proprietary Additive	1,897	228	580
CACL2/Polysaccharide/Proprietary Additive	4,110	173	552
DEG/Proprietary Additive	1,230	280	625
Propylene Glycol/Proprietary Additive	316	440	2,016
Glycerin/Proprietary Additive	230	90	616
Potassium Acetate/Proprietary Additive	615	315	712

Based on performance, research showed that the Glycerin/Proprietary Additive and Potassium Acetate/Proprietary Additive products were both effective in providing release of high moisture coal from the steel surface and had viscosities low enough to be applied in winter time conditions.

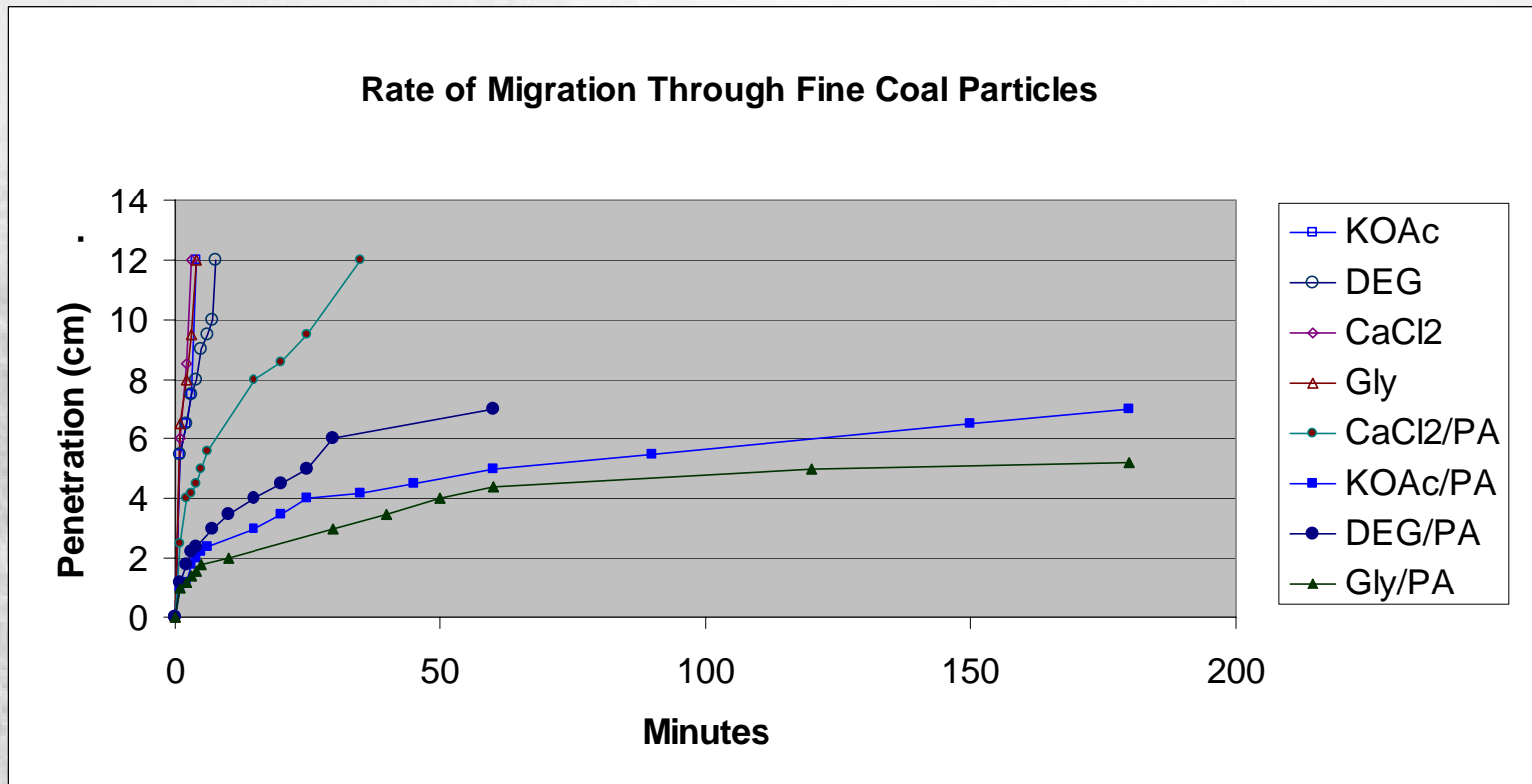
Coupons Appearance



During the shear testing it was noted that formulations not utilizing the new AKJ additive left the steel coupon surfaces dry underneath the coal samples. Coupons treated with the new AKJ additive were still obviously wetted. The logical question was why? To determine to this question, samples were analyzed via an electronic microscope.

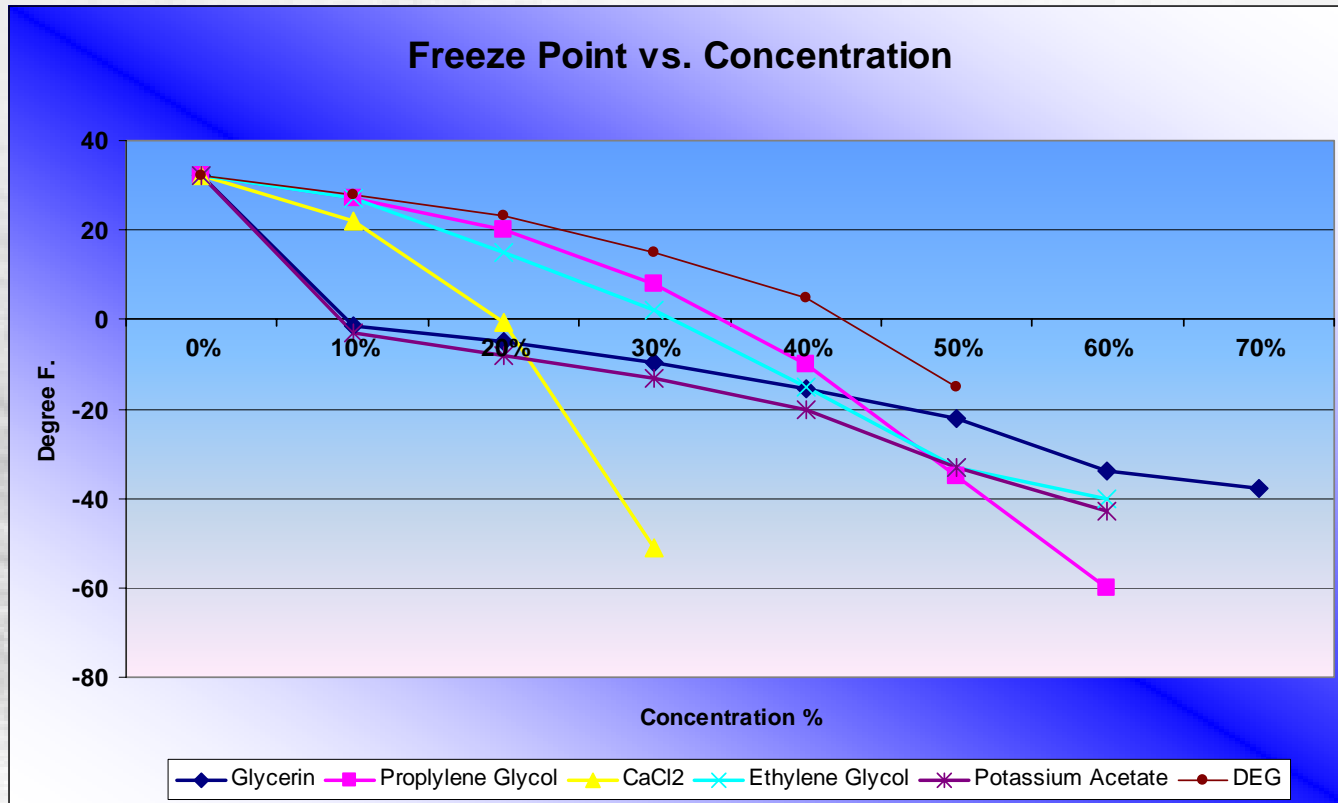
The pictures above range from 25X to 5,000X magnification and show the porous nature of coal. The physical characteristic of the coal allows liquid to “wick” into the internal crevices and pockets. AKJ’s research and development effort discovered that organic products, with the proprietary additives, resist “wicking” into the surfaces of the coal more so than their inorganic counterparts.

Additive Impact



Testing showed that while the addition of the proprietary additive impacted the migration of solution into small coal voids, this benefit was most apparent with organic solutions such as Glycerin, Potassium Acetate and Glycol.

Freeze Point vs %



All freeze conditioning agents are not the same! As the product concentration drops (based on dilution from coal moisture), products with a flatter freeze curve offer superior protection.



Application Rates

Application Rates							
Freeze Conditioning and Side Release Agents							
Temperature (Degrees F)	Side Release Gallons/Car	CaCL ₂	CaCL ₂ /PA	CaCL ₂ /DEG	DEG/PA	Glycerin/PA	Potassium Acetate/PA
30 to 32	3 to 5	--	--	--	--	--	--
25 to 30	3 to 5	2.00	1.75	2.00	2.00	1.50	1.50
15 to 25	3 to 5	3.00	2.25	2.50	2.50	2.00	2.00
5 to 15	3 to 5	4.00	3.00	3.25	3.00	2.50	2.50
0 to 5	3 to 5	5.00	3.75	4.00	3.50	3.00	3.00
<0	3 to 5	6.00	4.50	5.00	4.00	3.50	3.50

The impact of AKJ's proprietary additive on application rates (listed in pints per ton for treating the coal or gallons per car for side release) is illustrated in the chart above. As you can see, the Proprietary Additive allows for a reduction in application rates which reduces the net cost per treated ton.



Reduced Corrosion

Tests were run by an independent lab that showed the additive, developed by AKJ Industries, used in the CaCl₂ product reduced corrosion levels by more than 70%. The Potassium Acetate product and the Glycerin product with the additive were non-corrosive.



Rail Road Approvals

AKJ has worked hard to ensure that our freeze conditioning products are on the approved list for CSX and Norfolk Southern:

- AKJ-10
- AKJ-11
- AKJ-11SR
- FC-149
- FC-149SR
- FC-284
- FC-284SR
- FC-285
- FC-285SR
- FC-503
- FC-503SR
- FC-504
- FC-504SR
- FC-505

Carry Back Is Very Costly

What kind of impact can an effective freeze program have?

The cost of carry-back is significant and far reaching...

Mine Weights

Each ton of carry-back results in a loss to the buyer equivalent to the delivered cost of the coal.

Destination Weights

Each ton of carry-back results in a loss to the producer equivalent to the selling price of the coal.

Each ton of carry-back results in a loss to the railroad equivalent to the freight rate for the coal.

Overloads Are Costly

What kind of impact can an effective freeze program have?

The cost of carry-back is significant and far reaching...

Overloads

The railcar weight limit is a gross weight of 286,000 pounds. If a car exceeds this weight based on railroad scales it must be unloaded to within the 286,000 pound limit. Costs to the producer are;

- loss of coal – cost/ton**
- contractor expense - \$100**
- railroad fee - \$100**

A hidden cost is reduced loading rates based on conservative estimates of the amount of coal that can be put on top of carry-back coal and still be below the 286,000 pound threshold.



Product Pricing vs Cost

Product pricing is one of many factors when determining a freeze conditioning program's true cost. Program cost factors include:

- Product Cost
- Effective Service to Assure Proper Application Rates
- Application Rates
- Cost of Carry Back
- Cost of Coal Overloads
- Operations of Shakers and Thaw Sheds
- Overtime for Coal Unloading
- Rail Car Corrosion
- Rail Car Maintenance

***All freeze conditioning programs are not created equal!
The new technology developed by AKJ Industries offers
Mines, railroads, and end users the best cost performance
available to the industry!***