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Correspondence on hard pushes
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From the desk of

Joseph A. DiMauro

JG

PLEASE DEFINE OUR PRACTISES FOR USING PUSHER CURRENT AS AN INDICATOR FOR HARD PUSHES & HOW WE CONTROL THE OPERNS TO MINIMIZE SUCH PUSHES.

ALSO, REVIEW & LET'S DISCUSS ASAP THIS LTR FROM M.A. KHAN. HAS AL CAMERON WRITTEN US ANYTHING ABOUT HARD PUSHES?

3-8
REV
ORIG

ACME METALS INCORPORATED

STEPHEN D. BENNETT
President and
Chief Operating Officer

3/5/94

JAD

Perhaps you already have seen this, too. In any case, the point here is that a number of operating and equipment factors can result in hard pushes, as well as purely coal blending issues.

Coal blends aside for the moment, how do we measure, record, and track our hard push / sticker experience at the coke ovens? It seems to me that we could use good, on-going data on pushing motor loads as a useful tool in developing charging + heating practices, and oven underfiring, + pusher maintenance scheduling. Maybe we already do this.

Let's discuss.

SDB

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3/4/94

Brian

There has been so much talk here at Acme about Hard pushes that I decided to ask a 3rd party opinion and explanation of what causes hard pushes. The attached is a report from M. M. KHAN who now works for Fording Coal.

In my mind, I'm trying to insure myself that we are addressing the right thing to solve this problem. Our operators keep saying the hard pushes are due to coal or coal blend. I'm not convinced yet that our coals are the problem.

I was wondering if I could get an opinion from you on Mohammed's report from his experiences with Hard Pushes/Stickers. So that I'm not overlooking something.

Thanks.

Dick

3/3/94
cc. RL Small

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March 3, 1994

Mr. Joe Johnson
Manager, Corporate Purchasing
Acme Metals Incorporated
13500 S. Perry Avenue
Riverdale, Illinois 60627-1182
U.S.A.

Dear Joe:

Re: Hard-Pushes/Stickers, Blend Contraction at S.H.O.

Further to our discussion a few weeks ago on the above subject, here are some of my comments and suggestions:

Hard-Pushes/Stickers: Causes and Effects:

- Hard pushes/stickers are serious operating problems, as they can damage the oven refractory ten times faster than the coking pressure. Hard pushes/stickers also result in coke quality deterioration (size) and production losses. The estimated cost of a sticker could be $7,000 - $9,000. Therefore, these type of operating problems need immediate attention.

- There are, however, several reasons for hard pushes/stickers occurring in a battery, other than coal or coal blend. They are:

    1. Over charging/under charging.
    2. Over heating/over soaking.
    3. Uneven charging with slumped end.
    4. Green/dark ends and top, incomplete/uneven heating.
    5. Δ T °C - too high at the end of cycle.
    6. Too often coking time changes.

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7. Insufficient vertical/lateral shrinkage of coal charge.
8. Small or highly fissured coke.
9. Too many door leaks.
10. Uneven oven floors or oven walls bulging.
11. Excessive carbon build-up on the oven walls.

- On the basis of my personal experience/opinion, more than 85% of the time hard pushing/stickers occur due to one or more of the above reasons and not because of coal or coal blend.
- The remaining 15% of the time can be coal/coal blend or related issues which include:

1. Contamination in coal/coal blend.
   (slag, iron ore pellet fines, sinter fines, etc.)
2. Low volatile too high (> 40%) in the blend.
3. Blend inerts too low (<15%).
4. Coal blend ash fusion temperatures below the oven refractory temperature (<1350 °C).
5. Coal blend moisture <6.0% increasing the oven B.D.
6. Too often blend changes.

Contraction Measurement in Sole-Heated Oven:

- The ASTM sole-heated oven is nothing but a large dilatometer, used by the cokemakers to ensure adequate volume change during the carbonization of an individual coal or a blend.
- An appropriate sample is placed on sole of a coking chamber approximately 11" x 11". A large piston is lowered on the sample and connected to a transducer. The piston exerts a constant pressure of 2.2 psi on the coal mass.
- The coal is then heated through a standard heating cycle and the final height of the coke mass noted in relation to the initial height of the coal charge.

- It is common practice to adjust the expansion or contraction to that expected if the coal had 2.0% moisture and 52.0 pound per cubic feet bulk density.

- The blend contraction results from this test are an indication to the cokemaker (considering all other heating and other practices are normal) of the safety of his coke oven during pushing. The 2.2 psi load on the coal is typical of a coke oven wall strength.

- The S.H.O. results are also used to differentiate various blends on the basis of their contracting behaviour, and to select blends which can be easily pushed out of ovens after the coking cycle. Blends with insufficient contraction do not leave sufficient space between the coke mass and the wall to ensure easy pushing.

- On the other extreme, the coke mass from blends which contract excessively can slump against the oven wall or collapse partly/entirely when touched by the pushing ram.

- It is generally accepted by the North American coke plants that safe contraction limits lie between 6% - 10%, depending on the condition of the battery. Newer or batteries with good walls and floor conditions will require less contraction (5% - 7%) than the aged batteries with uneven refractories.

- The expansion/contraction properties of coal are a reflection of the rank and petrographic composition.

- High volatile coals generally contract and low volatile coals generally expand. The medium volatile bituminous coals bridge the two.

- Cokemakers are more concerned with the blend contraction, rather than individual component, since it is not an additive property.

My Comments:

- If an operation has a practice that requires frequent blend changes, then the potential blends should be tested for linear contraction (S.H.O.) to categorize them on the basis of contracting behaviour.

- While selecting high volatile coals from U.S. Appalachian range, the coals can be grouped in high, mid, and low contracting types. Coals that indicate contraction (25% +) would be in "high contracting" category, 15 - 20% medium, and 10 - 15% would be in "low contracting" groups.

- ASTM defines the S.H.O. test capability to be ± 1.5% and the test reproducibility becomes poor at the higher contracting range.

- The above ranges are only good for U.S. coals, the Australian and Canadian coals, however do not respond to the test/test conditions, yet they provide sufficient volume changes in the blend for ease of pushing.

- Some of the Canadian/European cokemakers have found that Western Canadian/Australian coals provide better heat-transfer in the coal change (battery span temperatures are relatively more controllable) and therefore, provide relatively higher vertical/horizontal shrinkage in ovens.

- One very important point which should be understood is that hard pushes and or stickers due to heating or refractory problems cannot be resolved by the blend contraction.

Joe, I hope this provides you some understanding of pushing characteristics, sole heated oven test, and the common causes of hard pushes/stickers. Should you need further explanation of any of the comments or about the blending, feel free to call me.

Yours truly,

FORDING COAL LIMITED

M.A. Khan
Manager, Technical Services

MAK:drp