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Subject: Cast Zn-4Al fines versus Zn cut-wire fines
Review and evaluation of EMSL Analytical test results

Executive Summary

Transmet Corporation produces a cast zinc-4% aluminum alloy metal shot product that offers superior performance in metal cleaning (shot blasting) applications compared with conventional zinc cut-wire blast media. Because of the well-known hazards of handling pure aluminum dust or fine particulate, some concerns were raised whether fine Zn-4Al dust generated as the cast shot deteriorates presents a greater flammability or explosibility hazard than zinc cut-wire blast media.

Consequently, Transmet submitted samples of cast Zn-4Al shot fines and Zn cut-wire fines to EMSL Analytical, Inc. for flammability and explosibility testing. EMSL Analytical (EMSL), located in Cinnaminson, NJ is fully accredited and an industry leader in the field of environmental and material testing services. A copy of EMSL's laboratory test report^[1] is attached to the Appendix of this report.

Transmet contracted Material Technology Innovations, LLC (MTI) to perform an independent review and assessment of EMSL's test results. MTI determined that EMSL performed the testing in accordance with industry/Government accepted practices.

MTI's review of EMSL's test results shows that the cast Zn-4Al fines and Zn cut-wire fines have nearly identical reactivity. Actually, the average values for the cast shot sample were slightly lower than those for the cut-wire fines, but are considered the same within the experimental test tolerances.

MTI compared the test results with previous work on "Explosibility of Metal Dusts" from the U.S. Bureau of Mines (Jacobson et al.)^[2]. The average maximum pressure rise P_{max} of the cast Zn-4Al fines was slightly lower and the P_{max} for Zn cut-wire fines slightly higher than the results reported in the Bureau of Mines work for zinc fines

The Bureau of Mines work rated zinc fines as having only a "weak explosibility index" relative to many other fine particulates. Therefore, the EMSL test results indicate that both the cast shot fines and cut-wire fines, although rated combustible, are relatively weak in their reactive with oxygen.

MTI concludes that Transmet's Zn-4Al cast shot does not pose a greater risk for fires or explosions from generated fines than zinc cut-wire shot blast media.

Discussion of EMSL Analytical Test Results

Testing of each sample was performed in a Siwek chamber in accordance with ASTM-E1226 and OSHA ID201SG Directive CPL 03-00-008^[1].

Table 1 below shows the test results, with the pressure units (bar) reported by EMSL converted to psig for each of comparison to previous work by the U.S. Bureau of Mines.

Table 1. Test results from EMSL Analytical compared to U.S. Bureau of Mines testing of zinc dusts.

| Sample | Maximum Pressure | Maximum Rate of Pressure Rise | Deflagration Index |
|--|---------------------|-------------------------------|--------------------|
| | P_{max} psi (avg) | dP/dt_{max} psi (avg) | K_{St} |
| Cast Zn-4Al | 39.2 | 3,829.0 | 72 |
| Cut-Wire Zn | 69.6 | 4,017.5 | 75 |
| Bureau of Mines Zn Fines ^[2] | 48 | 1,800.0 | nr** |
| * The deflagration index K_{St} is the maximum rate of pressure rise normalized to a volume of one cubic meter. | | | |
| ** Not reported in Bureau of Mines work; however an Index of Explosivity for zinc is reported as <0.1 "weakly explosive" on a scale of 0 to 10, relative to coal dust (explosivity index =1) and (aluminum = 10) | | | |

EMSL's test results show that Transmet's cast Zn-4Al fines and Zn cut-wire fines have nearly identical reactivity in terms of all test parameters, including: average maximum pressure rise P_{max} , average maximum rate of pressure rise $(dP/dt)_{max}$, and deflagration Index, K_{St} . In fact, the average values for the cast shot sample were slightly lower than those for the cut-wire fines, but are considered the same within the experimental test tolerances.

MTI compared the test results with the classical work on Explosibility of Metal Dusts from the U.S. Bureau of Mines (Jacobson et al.)^[2]. The EMSL test units were converted from bar to psig for comparison purposes.

The average maximum pressure rise P_{max} of the cast Zn-4Al fines was slightly lower and the P_{max} for Zn cut-wire fines slightly higher than the results reported in the Bureau of Mines work for zinc fines. The average maximum rate of pressure rise for both samples was higher than the value reported for the Bureau of Mines work. The reason for the discrepancy is unknown, but may be related to differences in the test chamber volume.

The Bureau of Mines work rated zinc fines as having only a "weak explosibility index." Therefore, the EMSL test results indicate that both the cast shot fines and cut-wire fines, although rated combustible, are only weakly reactive with oxygen.

These results indicate that Transmet's Zn-4Al cast shot does not pose a greater risk for fires or explosions from generated fines than zinc cut-wire shot blast media.

Conclusions

- EMSL Analytical, Inc. performed the testing of cast Zn-4Al fines and Zn cut-wire fines in accordance with accepted industry/Government equipment and specifications.
- The cast Zn-4Al fines and Zn cut-wire fines have nearly identical flammability and explosibility characteristics. The average values for the cast shot sample were slightly lower than those for the cut-wire fines, but are considered the same within the experimental test tolerances.
- The test results were reasonably consistent with previous test work on zinc fines by the U.S. Bureau of Mines.
- MTI concludes that Transmet's Zn-4Al cast shot does not pose a greater risk for fires or explosions from generated fines than zinc cut-wire shot blast media.

References

1. Laboratory Report, EMSL Analytical, Inc., No. 361202070 to Transmet Corporation, dated July 25, 2012.
2. "Explosibility of Metal Powders, M. Jacobson, A. Cooper, and J. Nagy, U.S. Bureau of Mines, Report of Investigations 6516, 1964.

Sincerely,



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