Journal of Powder Metallurgy & Mining

Mini Review Open Access

Coal Mining and Combustion's Contribution to Total Soil Copper Concentrations in China Could Be Measured Using Copper

Mirkarimi P B*

Lawrence Livermore National Laboratory, Livermore, CA 94550, United States

Abstract

High explosive materials, and in particular insensitive high explosive (IHE) materials, are of significant interest. TATB-based LX-17 and PBX 9502 are two IHE's and mechanical properties are an important metric of performance. In this work we present, for the first time, a study of fracture as a function of temperature and displacement rate and starter crack length on billet pressed IHE materials using a standard three point bend technique [1-15]. We demonstrated that the technique can yield consistent results over time by measuring samples from the same lots 4 years later and observed that the fracture toughness of LX-17 and PBX 9502 are similar. We also determined the temperature dependence for different starter crack lengths and found that the fracture toughness generally decreases with larger starter crack sizes and temperatures. For the LX-17, where a wide temperature range of −60 C to 50 C was investigated, the impact of temperature on fracture toughness between −20 C and 23 C was less than expected.

Introduction

For the PBX 9502 we observed the difference in fracture toughness values between −20 C and 23 C did depend on the particular lot, and also there was a tendency of the fracture toughness to scale with the tensile strength. We also investigated the effect of a lower displacement rate and observed that while the impact on the fracture toughness was relatively small, the samples surprisingly did not break (fail) after exceeding the peak load. We took advantage of this to perform x-ray computed tomography (CT) of the samples to image crack propagation in the intact samples. We observed that cracks were generally straight and unaffected by the microstructure in the LX-17, in contrast to the PBX 9502 where the direction of the cracks would frequently change and were likely influenced by the underlying microstructure.

High explosive materials, particularly insensitive high explosive (IHE) materials, are a hot topic. Mechanical qualities are a crucial parameter of performance for the TATB-based LX-17 and PBX 9502 IHEs. For the first time, we use a typical three point bend approach to investigate fracture as a function of temperature, displacement rate, and beginning crack length on billet pressed IHE materials. By evaluating samples from the same lots 4 years later, we were able to show that the technique can produce consistent findings across time, and we discovered that the fracture toughness of LX-17 and PBX 9502 are identical.

Subjective Heading

We also looked at the temperature dependence of different initial crack lengths and discovered that when the starter crack size and temperature increase, the fracture toughness falls. The impact of temperature on fracture toughness between 20 C and 23 C was less than expected for the LX-17, which was tested throughout a wide temperature range of 60 C to 50 C. For the PBX 9502, we found that the difference in fracture toughness values between 20 C and 23 C varied according on the lot, and that fracture toughness tended to scale with tensile strength.

The TATB molecule in LX-17–1 is wet-aminated, while the one in PBX 9502 is dry-aminated .Also, the proportion of polymeric binder varies slightly, with LX-17 having 7.5 percent binder and 92.5 percent TATB and PBX 9502 having 5% binder and 95 percent TATB For the sake of convenience, we shall refer to this study as "LX-17," however we should stress that we are actually referring to LX-17–1 (which uses wet aminated TATB). Kel-F 800 or FK-800, a more recent and nearly similar form of this, is frequently used as the explosive polymeric binder. The TATB molecules are made up of small particles that are combined with a polymeric binder during the formulation process.

Discussion

Demonstrate fracture toughness as a function of temperature for two distinct notch depths, 1 mm and 3 mm, respectively. shows data collected across a wide temperature range of 60 to 75 degrees Celsius, while Figure 5b shows data collected between 60 and 50 degrees Celsius. While a reasonable linear fit can be obtained for both data sets, a third order polynomial provides the best fit for both data sets. This is likely due to the fact that fracture toughness does not change as much in the range of 20 C to 23 C as it does when the temperature is significantly below or above that range.

We also looked at the effect of a lower displacement rate of 5 106 in/sec, and found that while the difference in fracture toughness was minor, the samples did not break (fail) after exceeding the peak stress. We took advantage of this by imaging the samples with x-ray CT to see how cracks propagated in the intact samples. In the LX-17, we noticed that cracks were often linear and unaffected by microstructure; it flowed right through the remaining prills evident in the image.

The peak load is the maximum the force that the sample sustains during 3-point bend testing. The peak load and the physical parameters of the samples can be used to calculate/estimate the fracture toughness

***Corresponding author:** Mirkarimi P B, Lawrence Livermore National Laboratory, Livermore, CA 94550, United States,Email:mirrgj@gmail.com

Received: 04-Jun-2022, Manuscript No: jpmm-22-58569, **Editor assigned:** 06-Jun-2022, PreQC No: jpmm-22-58569 (PQ), **Reviewed:** 20-Jun-2022, QC No: jpmm-22-58569, **Revised:** 22-Jun-2022, Manuscript No: jpmm-22-58569 (R), **Published:** 28-Jun-2022, DOI: 10.4172/2168-9806.1000310

Citation: Mirkarimi PB (2022) Coal Mining and Combustion's Contribution to Total Soil Copper Concentrations in China Could Be Measured Using Copper. J Powder Metall Min 6: 310.

a schematic of the physical parameters of interest to are shown in below. We note that a fracture toughness cannot be computed for the no notch (0 nm notch depth) samples we tested in this study and so that data is shown on other plots such as the peak load vs notch depth.

Why would the LX-17 respond differently than PBX 9502 to crack propagation? There are two notable differences between the two HE's. The first is that LX-17 has about 7.5% binder vs 5% for PBX 9502. If the cracks preferentially propagate in the binder rich areas of PBX 9502 (i.e. at prill boundaries) then since LX-17 has even more binder, one might expect that the cracks might also prefer to propagate in the binder rich areas of LX-17, which is not what is observed. The second notable difference is that LX-17 uses wet-aminated TATB and PBX 9502 uses dry-aminated TATB. We are unaware of any mechanical property studies looking at wet-aminated vs dry-aminated TATB (with the binder % held constant) but this work suggests that cracks may have a greater tendency to penetrate wet aminated TATB than dry aminated TATB. We note that the fracture toughness values for the LX-17 and PBX 9502 are similar so the greater deflection of the cracks in the PBX 9502 microstructure did not manifest itself significantly in the fracture toughness; likely compensating factors arising from the differences between the two materials (different lots, binder %, etc) come into play.

In this work we present, for the first time, a study of fracture as a function of temperature and displacement rate and starter crack length on billet pressed IHE materials using a standard three point bend technique. We demonstrated that the technique can yield consistent results over time by measuring samples from the same lots 4 years later. We observed that the fracture toughness of LX-17 and PBX 9502 are similar; for example at 23 C and a 10^{-4} in/s displacement rate we observed 0.427 MPa$(m)^{0.5}$ and 0.337–0.432 MPa$(m)^{0.5}$ for LX-17 (single lot) and PBX 9502 (3 different lots) respectively. We also determined the temperature dependence for different starter crack lengths (notch depths) and found that the fracture toughness generally decreases with larger starter crack sizes and temperatures. For the LX-17, where a wide temperature range of −60 C to 50 C was investigated, the impact of temperature on fracture toughness between −20 C and 23 C was less than expected. For the PBX 9502 we observed the difference in fracture toughness values between −20 C and 23 C did depend on the lot. We had tensile test data on the three lots and the data suggested a general trend of increasing tensile strength with increasing fracture toughness.

Conclusion

he billet is machined into rectangularly formed three point bend specimens with dimensions of 1.0 cm broad, 1.0 cm thick, and 10.0 cm long. Precision calipers and micrometers were used to measure the dimensions of each sample. We also looked at the effect of a decreased displacement rate, and found that while it had a minor effect on fracture toughness, the samples surprisingly did not break (fail) after exceeding the peak load. We used this to image crack propagation in intact samples using X-ray computed tomography In the LX-17, we found that cracks were generally straight and unaffected by the microstructure, in contrast to the PBX 9502, where the direction of the cracks would frequently alter and be affected by the microstructure.

Acknowledgement

I would like to thank my Professor for his support and encouragement.

Conflict of Interest

The authors declare that they are no conflict of interest.

References

1. Ramani RV (2012) Surface mining technology: progress and prospects. Procedia Eng 46: 9-21
2. Nasarwanji MF, Dempsey PG, Pollard J, Whitson A, Kocher L (2021) A taxonomy of surface mining slip, trip, and fall hazards as a guide to research and practice. Appl Ergon 97: 103542.
3. Bergerson JA, Kofoworola O, Charpentier AD, Sleep S, MacLean HL (2012) Life cycle greenhouse gas emissions of current oil sands technologies: surface mining and in situ applications. Environ Sci Technol 46: 7865-7874.
4. Eisler R, Wiemeyer SN (2004) Cyanide hazards to plants and animals from gold mining and related water issues. Rev Environ Contam Toxicol 21-54.
5. Lin C, Tong X, Lu W, Yan L, Wu Y, et al. (2005) Environmental impacts of surface mining on mined lands, affected streams and agricultural lands in the Dabaoshan mine region, southern China. Land Degrad Dev 16: 463-474.
6. Qin J, Li R, Raes J(2010) A human gut microbial gene catalogue established by metagenomic sequencingNature.464: 59-65.
7. Abubucker S, Segata N, Goll J (2012) Metabolic reconstruction for metagenomic data and its application to the human microbiome. PLoS Comput Biol 8.
8. Hosokawa T, Kikuchi Y, Nikoh N (2006) Strict host-symbiont cospeciation and reductive genome evolution in insect gut bacteria. PLoS Biol 4.
9. Canfora EE, Jocken JW, Black EE (2015) Short-chain fatty acids in control of body weight and insulin sensitivity. Nat Rev Endocrinal 11: 577-591.
10. Lynch SV, Pedersen (2016) The human intestinal microbiome in health and disease. N Engl J Med 375: 2369-2379.
11. Leonard S, Hommais F (2017) Plant-phytopathogen interactions: bacterial responses to environmental and plant stimuli. Environ Microbiol 19: 1689-1716
12. Brader G, Compant S, Vescio K (2017) Ecology and genomic insights into plant-pathogenic and plant-nonpathogenic endophytes. Annu Rev Phytopathol 55: 61-83, 10.1146.
13. Vurukonda S, Giovanardi D (2019) Plant growth promoting and biocontrol activity of *Streptomyces*. spp. as endophytes.Int J Mol Sci.
14. Vacheron J, Desbrosses G (2019) Prigent-CombaretPlant growth-promoting rhizobacteria and root system functioning. Front Plant Sci 4: 356 10.3389.
15. Graf T, Felser C (2011) Simple rules for the understanding of Heusler compound sprog. Solid State Chem 39: 1-50.