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MEMORANDUM FOR PRS (In-House Publication)

FROM: PROI (TI) (STINFO) 10 Aug 2000

Liu, C.T., “Strain Rate Effect on Crack Opening and Growth in a Particulate Composite Material at Low Temperature”

3rd Conference on Mechanics of Time Dependent Materials (Statement A)
(Erlangen, Germany, 18-20 Sep 00) (Submission Deadline: 28 Aug 00)

1. This request has been reviewed by the Foreign Disclosure Office for: a.) appropriateness of distribution statement, b.) military/national critical technology, c.) export controls or distribution restrictions, d.) appropriateness for release to a foreign nation, and e.) technical sensitivity and/or economic sensitivity.
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APPROVED/APPROVED AS AMENDED/DISAPPROVED

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Strain Rate Effect on Crack Opening and Growth in a Particulate Composite Material at Low Temperature

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Distribution A: Approved for Public Release
Objective

- Investigate the Effects of specimen thickness (2.54 mm and 12.7 mm) and Displacement Rate (2.54 mm/min and 12.7 mm/min) on Crack Opening Displacement, Failure process Zone, Local Strain Fields, and Crack Growth Behavior at Low Temperature.
Aluminum grips cemented to specimen
Specimen thickness: 2.5 mm
\[ a_0 = 23 \text{mm} \]
Load / Thickness vs. Global Extension

- High Rate: 12.7mm/min
- Low Rate: 2.54mm/min
- Thin Specimen: 2.54mm
- Thick Specimen: 12.7mm
- Low Temperature: -65°F
TKLRLT - COD vs. Time
TKLRLT - Failure Process Zone vs. Time
TKLRLT - COA vs. Time
TKHRLT - COD vs. Time
TKHRLT - COA vs. Time
Crack Growth Rate vs. Mode I Stress Intensity Factor

Specimen Thickness = 2.54 mm

- Crosshead Rate 2.54 mm/min
- Crosshead Rate 12.7 mm/min
Crack Growth Rate vs. Mode I Stress Intensity Factor

Specimen Thickness = 12.7 mm

- Crosshead Rate 2.54 mm/min
- Crosshead Rate 12.7 mm/min

Log da/dt, cm/rec

Log $K_I$, Kpa $\sqrt{\text{mm}}$
Iso - Intensity Strain Contours
(thickness = 0.1 in.)

Crosshead Rate = 12.7 mm/min
Global Strain = 0.83%

Crosshead Rate = 2.54 mm/min
Global Strain = 0.83%
Iso - Intensity Strain Contours (thickness = 0.5 in.)

Crosshead Rate = 2.54 mm/min  
Global Strain = 3.3%

Crosshead Rate = 12.7 mm/min  
Global Strain = 3.3%
Conclusions

- For the thin specimen and the thick specimen tested at 2.54 mm/min, the basic crack growth behavior consists of a blunt – growth – blunt phenomenon.

- For the thick specimen tested at 12.7 mm/min displacement rate, a classical brittle fracture occurs.

- The increase in displacement rate alters the local strain fields but the iso-strain contours are of the same general form.

- A power law relationship exists between the Mode I stress intensity factor and the crack growth rate.