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C. T. Liu; M. Yen, "Investigating the Effects of Confining Pressure on Cumulative Damage and the Constitutive Behavior of a Particulate Composite Material"

International Conference on Mechanical Behavior of Materials
(Geneva, Switzerland, 25-29 May 2003) (Deadline: 14 May 2003) (Statement A)
Investigating the Effects of Confining Pressure on Cumulative Damage and the Constitutive Behavior of a Particulate Composite Material

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Objectives

- Investigate the Effects of Strain Rate and Confining Pressure on Cumulative Damage and the Constitutive Behavior of a Particulate Composite Material.

- Strain Rates: 0.73 cm/cm/min, 18.18 cm/cm/min, and 72.73 cm/cm/min

- Confining Pressures: Ambient and 1000 psi
Specimen Geometry

12.7 cm

7.6 cm

0.95 cm

1.27 cm
Fracture Surface Under Different Confining Pressures

Pressure = 1744 psi

Pressure = 72.7 psi
Applied Load Vs. Strain
(Confining Pressure=1000 psi)

Strain Rate
++ = 0.73 min⁻¹
+ = 72.73 min⁻¹
= 18.18 min⁻¹

Strain (%)

Applied Load (Lb)
Engineering Stress and Volume Dilatation Vs. Applied Strain
(Strain Rate=0.73 min⁻¹ and Ambient Pressure)
Volume Dilatation Vs. Confining Pressure

![Graph showing the relationship between volume dilatation and confining pressure. The graph includes curves for different pressures (0, 100, 250, 500, 800, 1000 psi) plotted against strain (in/in).]
Damage Parameter Vs Time, semi-log scale

- 18.18 min\(^{-1}\)
- 72.73 min\(^{-1}\)
- 0.722 min\(^{-1}\)

![Graph showing damage parameter vs time on a semi-log scale with data points and slopes indicated.](image-url)
Relative Change in Acoustic Attenuation Versus Strain

(constant strain rate loading)

Delta Relative Attenuation, $\Delta \alpha$

dB/cm

Strain

- • $\dot{\varepsilon} = 0.005 \text{ min}^{-1}$
- ○ $\dot{\varepsilon} = 0.05 \text{ min}^{-1}$
- △ $\dot{\varepsilon} = 0.5 \text{ min}^{-1}$
Relative Attenuation of Acoustic Energy Versus Volume Dilatation

(monotonic loading)

\[ \log Y = 1.385868 \log X + 0.274528 \quad R = 0.992702 \]
* The development of micro-cracks under multi-axial loading conditions results in a decrease in modulus.

* For a given number of defects (micro-cracks or micro-voids), the modulus (volume dilatation) is insensitive (sensitive) to the type of defects.
Conclusions

• For a given strain rate, confining pressure has significant effects on the maximum stress and the applied strain for the onset of dilatation.

• For a given strain rate, confining pressure has no effect on the Modulus and insignificant effect on the rupture strain.

• For a given time, the strain rate has a significant effect on the damage intensity.

• The critical damage intensity is insensitive to the strain rate.