A CURSORY OVERVIEW OF THE RESEARCH PROJECTS ACCOMPLISHED IN RECENT PAST and ONGOING

1. Understanding the Mechanisms and Microscopic Mechanisms Governing the Quasi-Static, Cyclic Fatigue and Fracture Behavior of Monolithic Alloys, Intermetallics and Metal-Matrix Composites.

A preponderance of scientifically tailored experimental studies with the purpose of enhancing the existing knowledge base on potential crack initiation mechanisms, during quasi-static and cyclic deformation, in: (a) metals spanning the alloys of aluminum, copper and magnesium, (b) selected intermetallics, i.e. titanium aluminide, niobium aluminide and nickel-aluminide, (c) magnesium-base alloys, and (d) composites based on metal matrices and discontinuously-reinforced with ceramic particulates.

Sponsors:
- ***Aluminum Company of America,***
- ***Alloy Technology International,***
- ***DURALCAN USA,***
- ***DWA Composite Specialties,***
- ***General Electric Co.***
- ***SCM Metal Products***
- ***Air Force Materials Laboratory***

2. Processing Influences on Microstructural Development, Cyclic Fatigue Response and Fracture Behavior of Advanced Materials

Established an understanding of innovative processing techniques on microstructural development, Mechanical Response and Failure-damage analysis (Fracture) of Monolithic Metals, Intermetallics and metal-matrix composites so as to establish the viability of using advanced materials to replace the traditional counterparts used in a spectrum of structures in aerospace engineering, civil (structural) engineering, mechanical engineering and materials engineering

Sponsors:
- **General Electric Aircraft Engines**
- **US Air Force: Air Force Materials Laboratory**

3. The Fatigue Behavior of Butt Welded Steel Pipes

Rationalize the bending fatigue resistance of butt-welded steel pipes. The effects of pipe size and field welds on fatigue strength of the butt-welded pipes were examined. Specimens of the butt-welded pipe were mechanically deformed in bending using four-point bending test fixtures designed and fabricated exclusively for this study. All mechanical testing was performed under constant cyclic alternating displacement amplitudes about a zero mean value. Strain amplitudes were measured to provide the variation of strain with fatigue life for the butt-welded pipes. The failure characteristics were established and rationalized in light of the conjoint influences of microstructure, weld quality and state of stress.

Sponsor: • **SAUDI ARAMCO**
[ARAMCO Oil Company (Houston (USA) and Saudi Arabia)]

4. The Bending Fatigue Resistance and Fracture Behavior of HDPE (High Density Polyethylene Pipes)

The influence of joining on the bending fatigue and fracture behavior of high-density polyethylene pipe was evaluated and their performance compared with the plain unwelded counterpart. High-density polyethylene pipes were joined using electro-fusion and butt-fusion techniques. Stiffness and strength of the electro-fusion joined pipe was far inferior to the butt-fusion and the plain unwelded pipe. Bending fatigue resistance, quantified in terms of life to failure, of the pressurized pipe was superior to that of the unpressurized pipe. The fatigue resistance of the butt-fusion joined specimen was observed to be superior to that of the electro-fusion joined pipe specimen. The unwelded plain polyethylene pipe had bending fatigue resistance superior to that of the butt-fusion joined counterpart. Rational for the observed differences in bending fatigue life were established and intrinsic differences in failure characteristics documented.

Sponsor: • **Pressure Vessel Research Council**
Welding Research Council.

5. The Fatigue Deformation and Failure Behavior of High Strength Steel Wires used in Radial Tires

Use of high carbon steel wires as a reinforcement in radial tires used in the automotive and transportation industries has necessitated the need for a careful design of microstructures to ensure high strength, damage tolerance and durability. This has created an inescapable need to comprehensively characterize the mechanical response and deformation characteristics of the wire under monotonic loading conditions. The kinetics governing stress-strain response and quasi-static fracture have been established in light of intrinsic microstructural effects and test temperature. Temperature influences on the stress amplitude-controlled high-cycle fatigue resistance and the fracture behavior of high carbon steel wires have been established. The cyclic fatigue life and mechanisms governing cyclic fracture was established in light of test temperature, stress amplitude and intrinsic microstructural effects. The optimum microstructure for the achievement of enhanced cyclic fatigue resistance and fracture durability was established.

Sponsor: • Goodyear Tire and Rubber Company

6. The Mechanical Behavior of Steel Wire Reinforced Radial Tires.

High carbon-containing steel wires have shown much promise as potentially viable, attractive and cost-effective reinforcements for radial tires. In this carefully engineered experimental study, the influence of wire configuration on cyclic compression response characteristics (fatigue life) of steel-wire reinforced polymer cords was investigated. The wires, in two different configurations, referred to as wrapped and unwrapped, were cyclically deformed under total deflection-control. The influence of wire configuration and deflection on cyclic fatigue life was established.

Sponsor: • **Goodyear Tire and Rubber Company**

7. Understanding the Influence of Processing Variables on Microstructural Development and Mechanical Properties of Nanostructured Materials

Sponsor: • **National Science Foundation**

8. Understanding the Mechanisms Governing the Dispersion of Nanopowders in Solidifying Molten Metals

Sponsor: • **National Science Foundation**

9. An Investigation of the Influence of Tire on Stress, load-Deflection Response and overall Mechanical Response of Automobile rims

Sponsor: • **Goodyear Tire and Rubber Company**.

10. The Tensile Deformation, Cyclic Fatigue and Fracture Behavior of Aluminum Alloy Synthesized by Plasma Pressure Compaction

Sponsor: • **Materials Modification Inc**.

11. Influence of Processing Variables on Microstructural Development and Hardness of Tungsten Carbide, Boron Carbide and Hafnium Boride Ceramics

Sponsor: • Materials Modification Inc., through US Department of Energy

12. The Quasi Static, Cyclic Fatigue and Fracture Behavior of Friction Stir Welded Aluminum Alloy 2024

Sponsor: • BOEING Company

13. The Intrinsic Mechanisms Governing the Quasi-Static and Cyclic Fatigue Behavior of Aluminum Alloy 2219-T62: Influence of Anodized Coating

Sponsor: • BOEING Company

14. The Quasi Static, High Cycle Fatigue and Fracture Behavior of High Strength Titanium Alloys

Sponsor: • ATI WAH CHANG