Other Possible Material Limitations

It has been postulated that a maximum-tensile-stress fatigue criterion applies to the high-strength liner. Accordingly, fatigue data from uniaxial tension and rotating-beam bending tests were used to evaluate fatigue behavior of liners for high-pressure containers. However, the state of stress in an open-end hydrostatic extrusion container is biaxial and in a closed-end container a triaxial state of stress exists. (A triaxial state of stress may also occur in a shrink-fit open-end container where axial stresses may be produced by interface friction between shrink-fitted rings.) The effect of combined stresses on the fatigue strength of high-strength steels is unknown. It is pointed out, however, that the analyses performed in this study allow for arbitrary material behavior; i.e., the fatigue parameters, α_r and α_m, used in the analyses are left arbitrary in the equations and could be determined from combined-stress fatigue experiments.

It has also been postulated that a compressive mean stress may benefit material fatigue strength under cyclic fluid pressure. However, biaxial and triaxial fatigue behavior under compressive mean stress is unknown. Even fatigue data in the uniaxial case are lacking for conditions of compressive mean stress.

Also unknown is the possible fracture of high-strength steels under large compressive stresses. Pugh and Green[43] and Crossland and Dearden[44] found for cast iron that the fracture strain and ductility (and the maximum shear stress at fracture) are increased by superimposing hydrostatic pressure. Bridgman[45] found similiar but less conclusive results for steel. These are favorable results for the effect of true hydrostatic pressure, but the possibility of similiar behavior when only one principal stress (the radial stress in a container) is highly compressive is unknown and should be investigated. This is a particularly important factor because the difference between the hoop stress and the high compressive radial stress represents an extremely large shear stress.

The effect of a brittle-ductile transition in high-strength steels on the fatigue behavior near and above the transition temperature is another factor which may need to be considered.