AECL-10477
COG-92-162

ATOMIC ENERGY OF CANADA LIMITED

ÉNERGIE ATOMIQUE DU CANADA LIMITÉE

ASSESSMENT OF MATERIALS FOR CONTAINMENT OF NUCLEAR FUEL WASTE: ENVIRONMENT-SENSITIVE FRACTURE OF TITANIUM

ÉVALUATION DES MATÉRIAUX DE CONFINEMENT DES DÉCHETS DE COMBUSTIBLE NUCLÉAIRE: FRACTURE SENSIBLE AU MILIEU DU TITANE

C. F. Clarke, D. Hardie, B. M. Ikeda

Whiteshell Laboratories | Laboratoires de Whiteshell
Pinawa, Manitoba R0E 1L0

August 1992 août

main legacy - n.d

ASSESSMENT OF MATERIALS FOR CONTAINMENT OF NUCLEAR FUEL WASTE: ENVIRONMENT-SENSITIVE FRACTURE OF TITANIUM

by

C.F. Clarke, D. Hardie and B.M. Ikeda

ABSTRACT

As part of the assessment program for container materials for the long-term disposal of nuclear fuel waste, a test involving slow tensile straining at 10^{-5} mm/s has been developed to study the effect of hydrogen on the fracture behaviour of titanium. Compact tension specimens of Grade-2 and Grade-12 material have been precracked in fatigue before charging with hydrogen at various concentrations up to 3000 wppm and then straining to failure.

At low hydrogen concentrations, propagation of a slow crack may be followed at higher stress intensities by fast brittle failure, whereas at high concentrations the majority of materials suffer only fast brittle failure at stress intensity factors that decrease with increasing hydrogen content. The resistance of both Grade-2 and Grade-12 titanium to embrittlement by hydrogen is more dependent upon microstructure, and particularly the distribution of β-phase, than upon the concentration of basal poles lying perpendicular to the principal fracture plane.

AECL Research
Whiteshell Laboratories
Pinawa, Manitoba ROE 1LO
1992

AECL-10477
COG-92-162

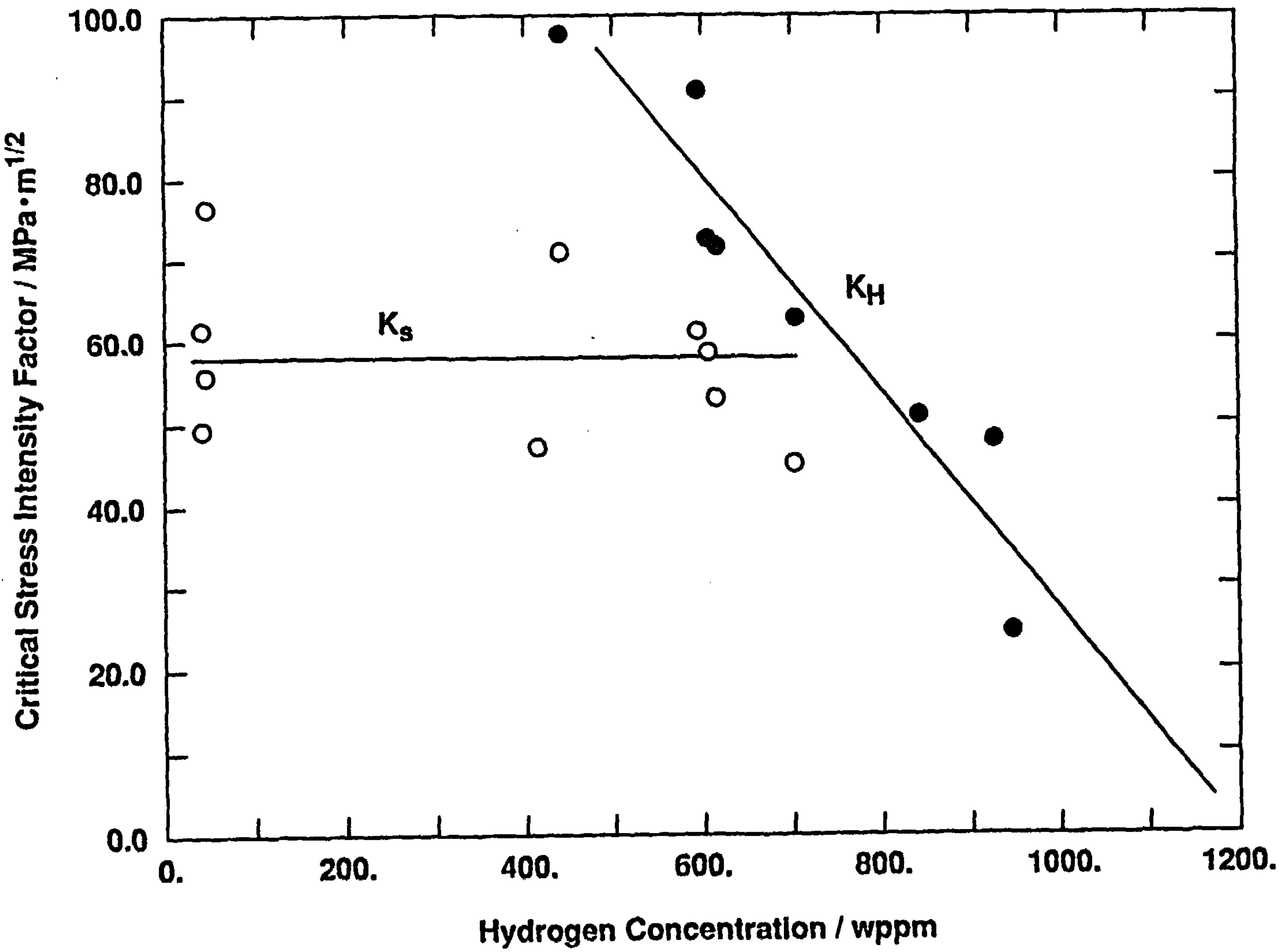

FIGURE 8: Variation of the Critical Stress Intensity Factors with Hydrogen Content in Grade-2 Titanium B: o for Slow Crack Growth (K_s) and ● for Fast Fracture (K_H)

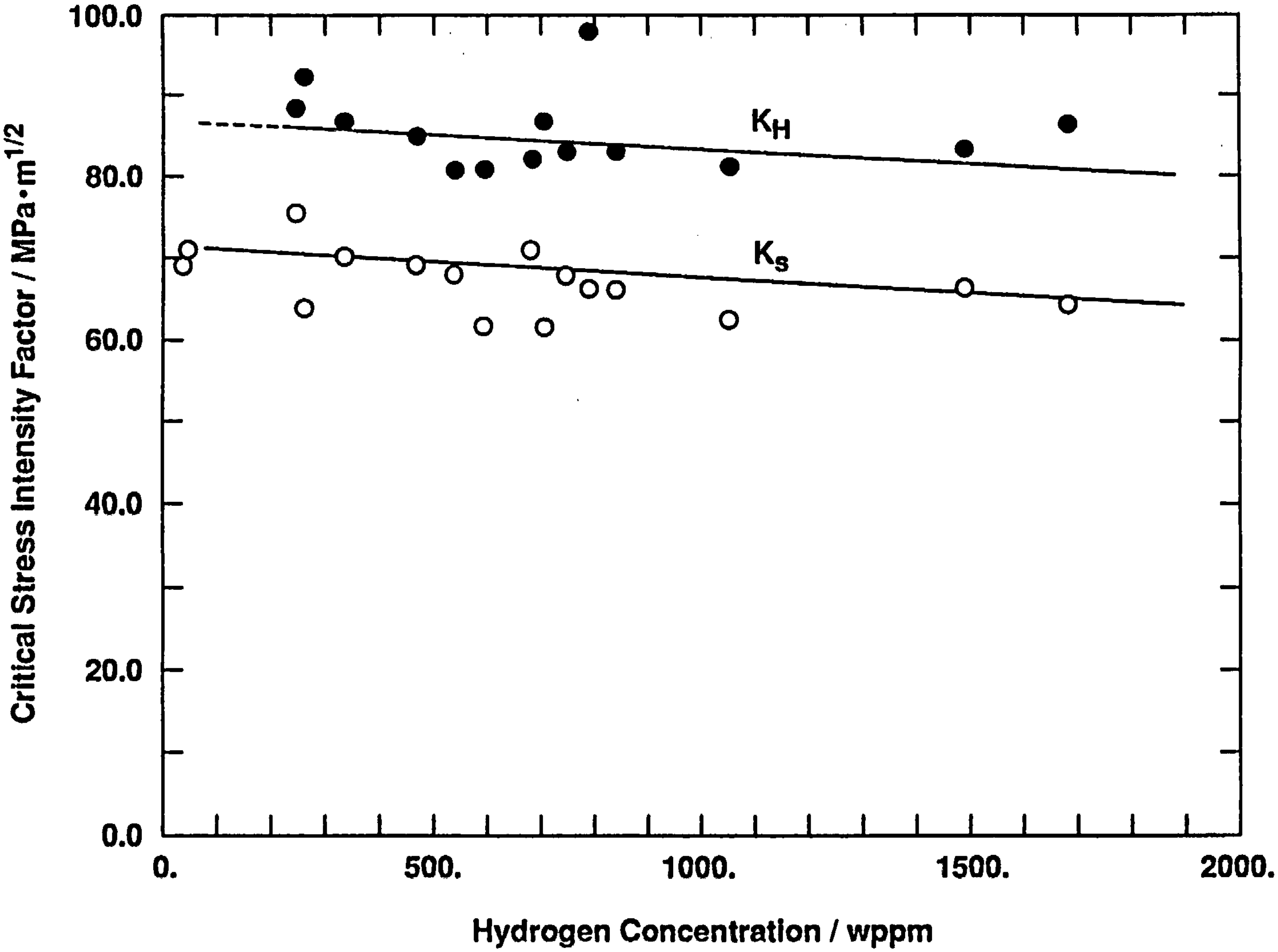

FIGURE 10: Variation of the Critical Stress Intensity Factors with Hydrogen Content in Grade-12 Titanium C - for Specimens with the T-L Orientation: o for Slow Crack Growth (K_s) and • for Fast Fracture (K_H)

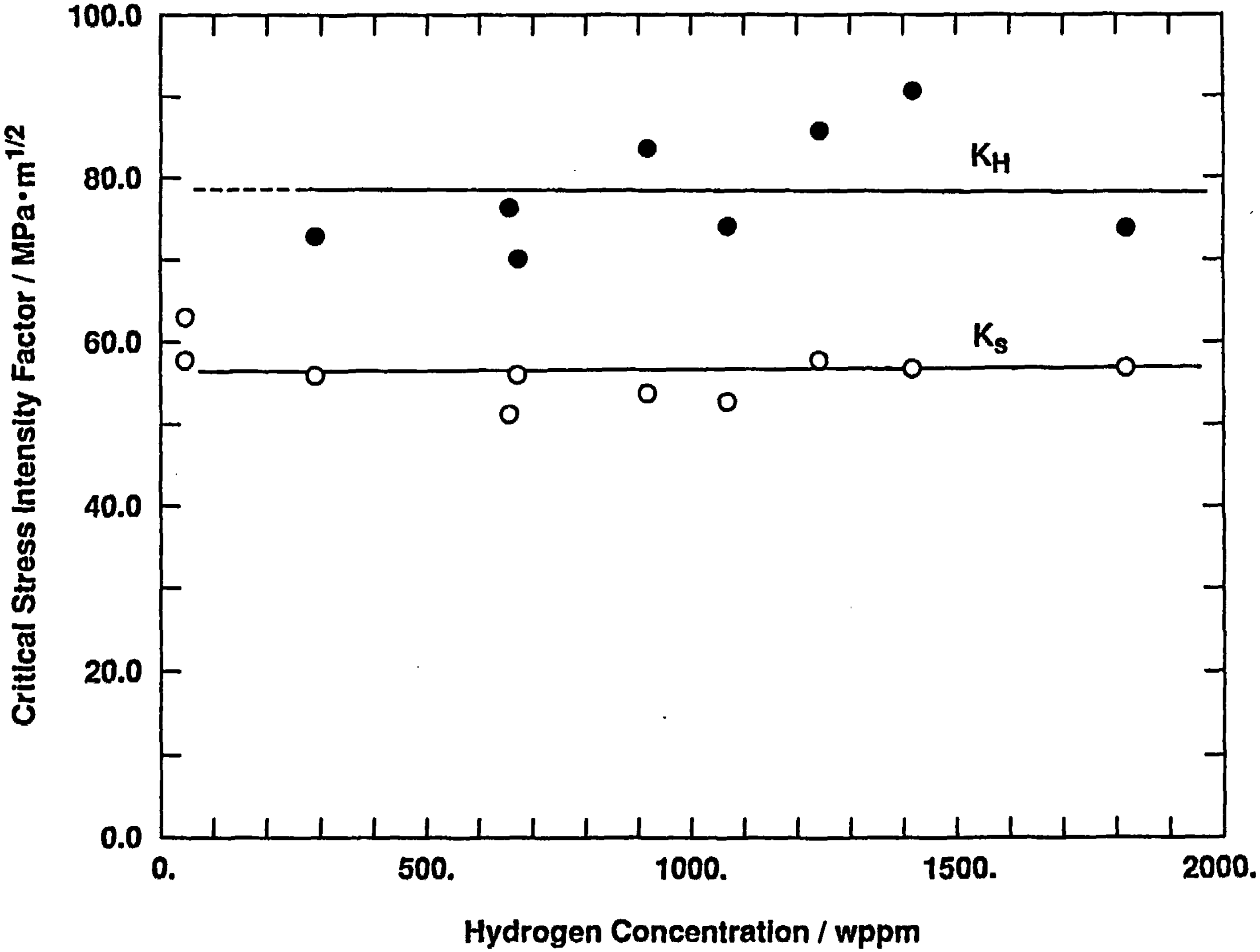

FIGURE 11: Variation of the Critical Stress Intensity Factors with Hydrogen Content in Grade-12 Titanium C - for Specimens with the L-T Orientation: o for Slow Crack Growth (K_s) and • for Fast Fracture (K_H)

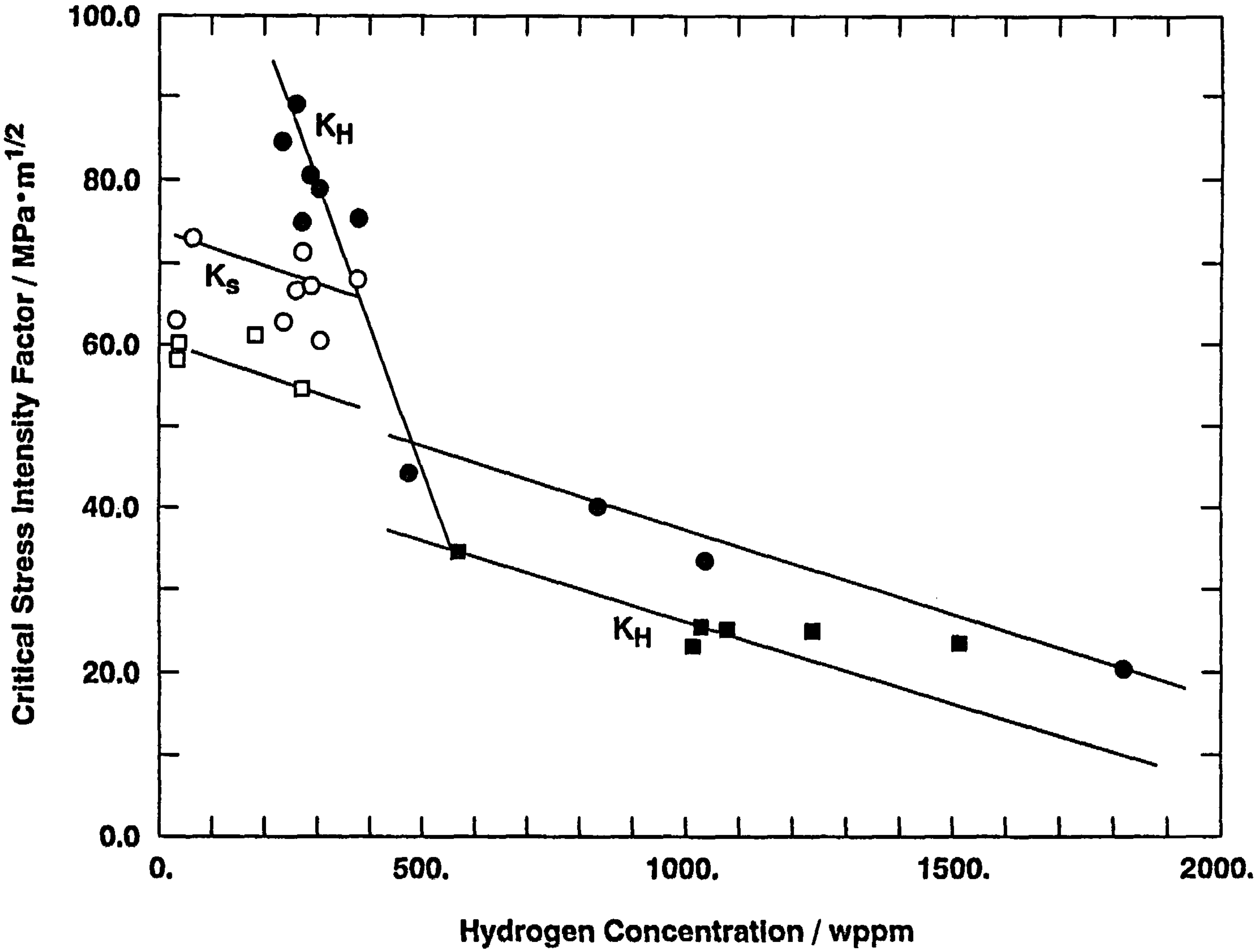

FIGURE 13: Variation of the Critical Stress Intensity Factors with Hydrogen Content in Grade-12 Titanium E - for Specimens with S-L o● and S-T □■ Orientations: o□ for Slow Crack Growth (K_s) and ●■ for Fast Fracture (K_H)

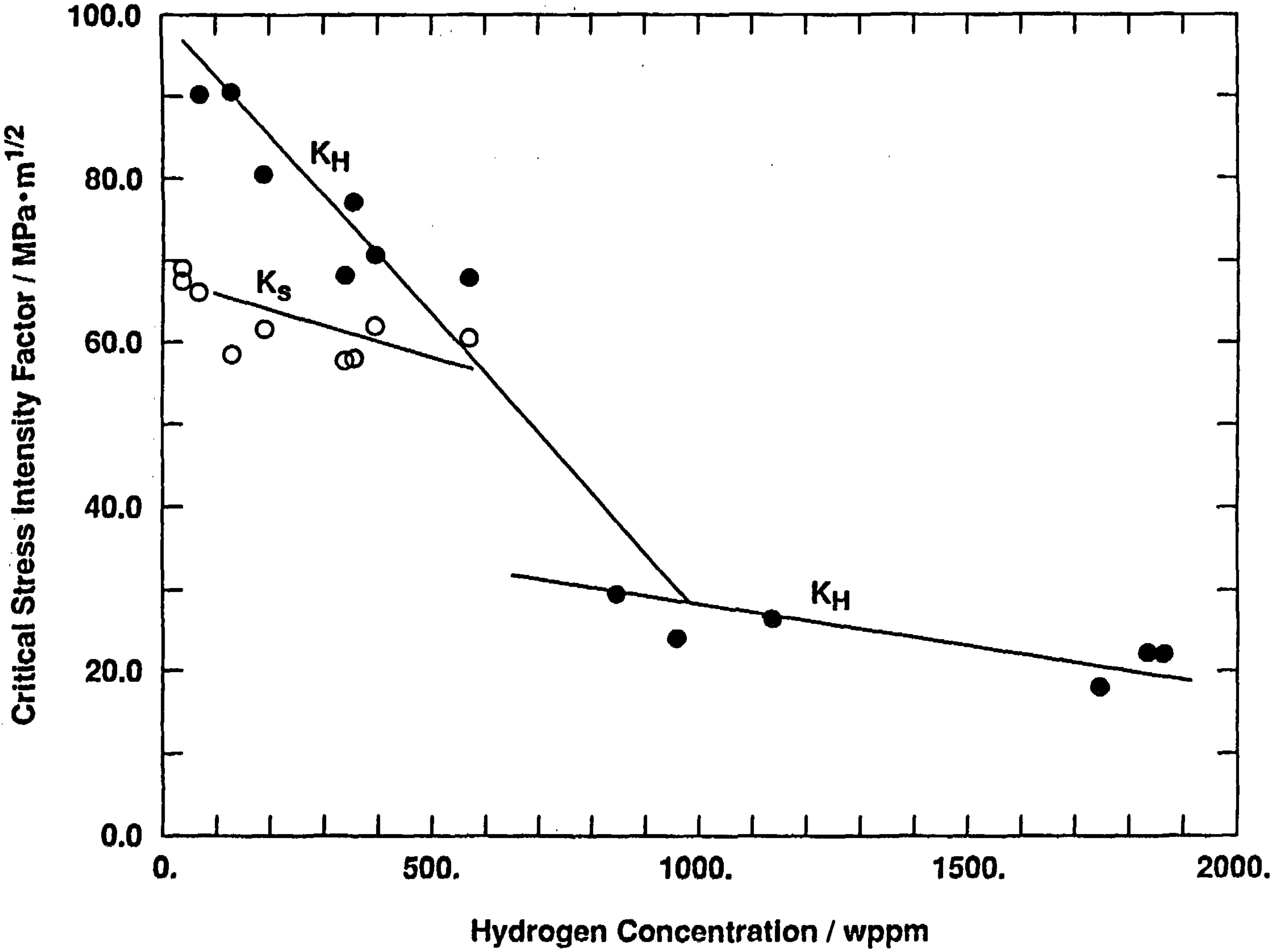

FIGURE 14: Variation of the Critical Stress Intensity Factors with Hydrogen Content in Grade-12 Titanium E - for Specimens with T-L Orientation: o for Slow Crack Growth (K_s) and • for Fast Fracture (K_H)

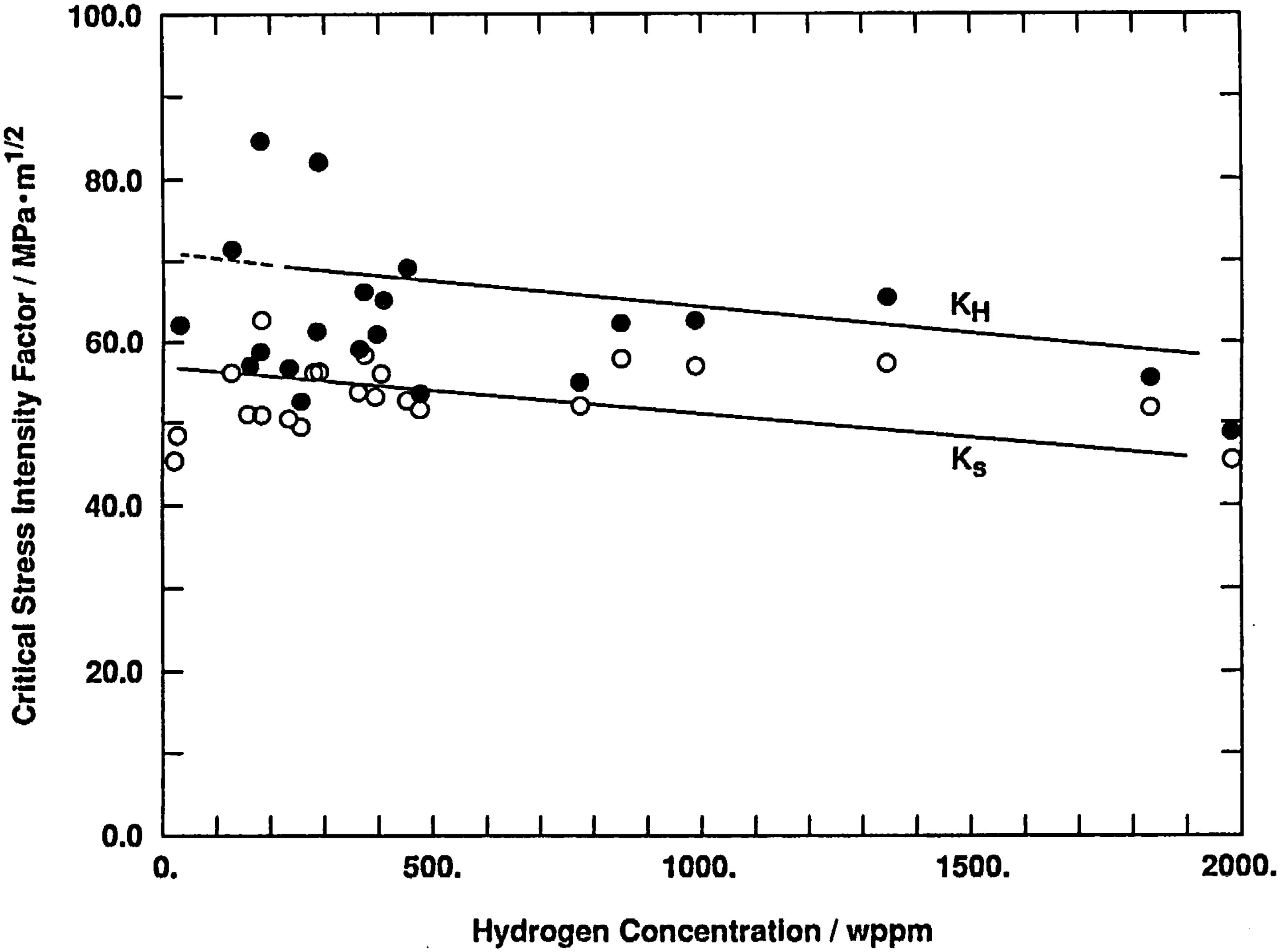

FIGURE 15: Variation of the Critical Stress Intensity Factors with Hydrogen Content in Grade-12 Titanium E - for Specimens with L-T Orientation: o for Slow Crack Growth (K_s) and • for Fast Fracture (K_H)