

Reliability Index of HDPE Pipe Based on Fracture Toughness

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Abstract: This work presents a contribution to evaluate the reliability of a high density polyethylene (HDPE) pipe using the PHIMECA Software. The critical stress intensity factor (KIC) is adopted as a criterion to the maximum limit of a numerically calculated KI. The reliability index β is obtained using failure probability and a mechanical model. It is found that at lower KIC, no safe domain for actual service pressures existed while for moderate and higher values of KIC (above 3.5 MPa $\cdot\sqrt{m}$); the β design index is reached and even exceeded. In terms of increasing crack length, β decreased systematically for all toughness cases supporting the idea that reliability and fracture toughness designate similar properties for service life or material resistance to cracking. For a KIC=5 MPa $\cdot\sqrt{m}$, the pipe is considered safe when crack length is below 370 μ m. Finally, it is shown that SDR basis is a reasonable and conservative design approach for plastic pipes.

Keywords : HDPE pipe, critical stress intensity factor, crack length, SDR, reliability index, PHIMECA software