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Study of reliability index for high-density polyethylene based on pipestandard dimension ratio and fracture toughness limits

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Abstract: The reliability of high-density polyethylene (HDPE) pipes remains a central issue for gas transportation and distribution net-works. The objective of this study is to investigate the estimation of reliability index (?) for a plastic pipe using the critical stressintensity factor (KIC) as the maximum limit for safe operating conditions. Simulations are performed as a function of operatingpressure, crack length, and standard dimension ratio (SDR) for three fracture toughness levels (low, moderate, and high). Inaddition, the study compares results from three hoop stress calculations methods (thin, thick, and ISO plastic pipe equation).Based on design recommendation for reliability index, it is found that both operating pressure and crack length show comparablebehaviors. However, the thick wall pipe results overestimate (?) for every KIClevel. In all cases, it is found that the higher thecritical stress intensity factor, the better the reliability index. Results obtained with the standard ISO pipe formula are morerealistic, as they are usually around the design recommendation, i.e., SDR basis indicates that it is a true conservative designapproach incorporating both upper and lower thickness limits. The importance of all variables (thickness, diameter, crack length,pressure, and fracture toughness) is also discussed

Keywords : HDPE pipe . Critical stress intensity factor . Standard dimension ratio (SDR) . Crack length . Reliability index . Importance of variables