Proceedings of the Canadian Society for Mechanical Engineering International Congress 2022
CSME Congress 2022
June 5-8, 2022, Edmonton, AB, Canada

POLYMER PIPES FOR THERMALLY ASSISTED WELLS — PERFORMANCE UNDER TENSILE LOADS

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ABSTRACT

In wells where viscosity of the crude is very high, steam injection is used to increase the mobility of the heavy oil. Large quantities of water are required at the steam generation plant. In cases where the water-bearing sandstone is fragmented, steel sand screens are employed for sand control. However, corrosion is a serious issue, leading to trial runs with non-metallic pipe materials such as high strength PVC. Some 15% wells have reported failure worldwide due to screen collapse in PVC pipes. In collaboration with a regional petroleum development company, the applied research unit at our university was tasked with the design and construction of a test facility for performance assessment of large-diameter hard PVC pipes under tensile, compressive, and collapse loads.

Structurally, pipe sections were of three types: plain pipes, built-up pipes (with a threaded connection in the middle), and slotted pipes (used as sand screens). To imitate actual field conditions, PVC pipes were subjected to a 2-3 month ageing process in saline water. Using appropriate jigs and fixtures, pipes were tested under tension on a heavy-duty universal testing machine with a capacity of 2000 kN. Appropriate gripping of the pipes was a major challenge. Pipe diameter (200 mm) was too large to fit the standard gripping system of the machine; PVC surface was too smooth to provide requisite friction for good grip; and too much load in the grip region could force the PVC material to fracture near the grip rather than in the main pipe section. Many gripping designs were tried out. Single-grout, double-grout, and extended-length grout designs used a gluing agent known as grout. This is a chemical resin mixed with water, and is used in the construction industry to deliver high strength reinforcement in concrete structures. This grout design was successful in the case of slotted PVC pipes, but failed in the case of plain and built-up pipes. Another grip mechanism used a threaded contact between the PVC pipe and the inner support ring. Three pipes were tested in each case to confirm repeatability, reporting average values. Stress-strain graphs were plotted from tensile test data. Values of fracture strength, total deformation, and Poisson's ratio were evaluated. Strain gage sets were used to record dynamic behavior in axial and hoop directions. Apart from the scientific contribution, findings from this work can serve as prequalification of PVC pipes for appropriate fields, and result in major savings in cost and time.