Hydraulic Analysis of Seawater Marine HDPE Pipeline

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ABSTRACT

Using marine pipelines to take and discharge water becomes the most popular way for seawater desalination plants, while marine HDPE pipelines are widely used in seawater intake and outfall pipelines due to their good flexibility, corrosion resistance, long service life and small water flow resistance. Based on the hydraulic analysis of seawater intake pipeline, describes steady and transient hydraulic analysis of marine HDPE pipelines, compares hydraulic theory and simulation, to provide an important technical reference for similar marine pipelines.

KEY WORDS: Marine HDPE Pipeline; Hydraulic Analysis; Steady; Transient.

INTRODUCTION

The mainstream technologies of seawater desalination incorporate Reverse Osmosis (RO), Multistage Flashing (MSF) and Low-Temperature Multi-Effect Distillation (LT-MED), where RO method depends on the advantages of shot construction period, mature workmanship, low investment and energy consumption, accounting for more than 60% of global seawater desalination market. As the increasing number of large RO desalination plants with a daily production of more than 100,000 cubic meters, marine intake pipeline becomes the most popular way due to its advantages of large water intake, great water quality and small impact on marine organisms and marine environment, and HDPE pipelines are widely used in marine intake and outfall pipelines because of its good flexibility, corrosion resistance, long service life, low water flow resistance and so on.

Roberts (2010) introduced the major design and construction issues for outfalls using HDPE pipelines. Arribas and Serina (2011) studied the marine pipeline along the seabed of the Mediterranean Sea, expecting the hydraulic performance of the pipeline by steady state and transient simulators. Qiang and Yong (2014) introduced the hydraulic and thermal analysis for pipelines of oil, oil-gas, gas, and water, including steady state temperature and pressure drop along the pipelines, temperature and pressure drop after the pipelines shut down, and the water hammer phenomena. Li and Fan (2015) studied the leakage from submarine pipeline, comparing the steady flow before leakage, transient flow during leakage and steady flow after leakage, and showed that the numerical results of the flowrate which are consistent with the theoretical solution under the condition of steady flow. Ma (2018) studied the hydraulic characteristics of pipelines with different materials, and obtained the relationship between the roughness and Reynolds number of different pipes. At present, the researches on marine HDPE pipelines mostly focus on the steady state theoretical analysis, and there is few researches on the steady and transient numerical analysis of marine HDPE pipelines.

Focused on marine HDPE intake pipelines, the research plans to study the hydraulic analysis of pipelines steady state and transient state. By comparing the results of theoretical analysis and numerical analysis, discusses the marine HDPE pipelines hydraulic of steady state and transient state.

STUDY SUBJECT

The Kingdom of Saudi Arabia (KSA) is developing a 103 square kilometers economic city, Saudi Aramco Refinery & Terminal facility, Integrated Gas Combined Cycle power generation facility and port facility in the Jazan Region in southwest Saudi Arabia, adjacent to the Red Sea Coast. The city will be located approximately 50 kilometers north of Jazan City (80 kilometers distance via existing roads) and 600 kilometers south of Jeddah and is master planned to include residential, commercial, and industrial zones that will provide business and employment opportunities for the Jazan region. The Kingdom has tasked Saudi Aramco to plan, design, construct, and commission the new infrastructure required to support Jazan Economic City and its commercial port facility.

Saudi Aramco is implementing the Jazan Port and City Infrastructure Project as part of the overall Jazan Economic City development located in the South-Western region of Saudi Arabia. The Jazan Commercial Port Offshore Package involves the design and construction of marine structures, facilities for ship berths to accommodate containerized and dry bulk loads through accommodation of large modern vessels.