Economic assessment of cured concrete by organic coating materials and double wall corrugated HDPE pipes in sewer networks

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Resistance to deteriorations (especially corrosion) and initial price are important features in selecting the proper pipe materials for sewers. Among different types of pipe material used in Malaysia sewers, concrete and double wall corrugated high-density polyethylene (DWC-HDPE) pipes are more common. Laboratory tests were conducted using cylindrical concrete samples coated by polyurethane and epoxy materials to investigate their ability to protect concrete pipe against corrosion. Secondly, the cured concrete pipe price was compared to sewer construction costs. Economic analyses were carried out to compare the prices of cured concrete and DWC-HDPE pipe in various diameters. The results revealed that the coatings act as a barrier against the aggressive environment. Besides, their ability was proved to prolong concrete service life. In addition, the results showed that using the coatings to prevent or delay concrete networks’ deterioration (against corrosion) was at least 2 times more economical compared to sewer reconstruction. Furthermore, it was concluded that DWC-HDPE pipe larger than 600 mm is not economical to be used for sewers due to well performance of designed coatings on extending the concrete pipe service life. Finally, mathematical models were developed to assist engineers or designers to accurately select the proper pipe based on desired variables.

Key words: Corrosion, cost analyses, service life, sewer pipe, surface treatment.

INTRODUCTION

Varieties of pipe materials (e.g. concrete, asbestos, iron and plastic) are being used for sewer networks. Among all, concrete is the most widely used construction material in sewers, treatment plants, and open channels due to its compatibility with environment, huge material resources, cost effectiveness, far more resistance and strength, and ease of make. Unfortunately, the rapid degradation of concrete structures is reported in wastewater facilities due to the acidic environments mostly generated by bacterial activities (Yamanaka et al., 2002).

The more the pipe resists problems (e.g. corrosion), the longer the service life of network will be. Durability for long life, an abrasion-resistant interior to withstand scouring action of wastewater carrying gritty materials, impervious walls to prevent leakage, and adequate strength to resist failure or deformation under loads (Figure 1) are physical characteristics essential for sewer pipes. In addition, resistance of pipe material to chemical attacks which could lead to corrosion, dissolution, etc. is important enough to be considered in selecting the proper pipe material.

Corrosion deterioration (e.g. in concrete sewer networks) has significant impacts on economy, environment, and society (Zhang et al., 2008; US EPA, 1998). Hence, economical and effective techniques are required to prevent or control corrosion deteriorations in particular areas of sewers (e.g. low-slope pipelines, drops, where \( \text{H}_2\text{S} \) generation is common, etc.). Corrosion process mostly occurs by hydrogen sulfide generation in sewage networks (Vollertsen et al., 2008; Okabe et al., 2007; Roberts et al., 2002). Overtime (usually, about 5 to 30 years), dissolved sulfates in water penetrates hardened