

Ring Rail Line – Protection structures against aggressive fluids

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Summary

During the excavations of railway tunnel of Ring Rail Line ground water leakages containing adverse compounds were found under the airport area. The investigations showed that ground water at a minimum pH under 5 is acidic and contains antifreeze agents as ethylene and propylene glycols which have been used decades in aviation. In aerobic conditions the glycol based fluid forms alcohols and organic acids, most relevant of them acetic acid and propionic acid. The fluid is a nutrient for microbes and enables their growth in a tunnel. The microbe growth forms also distinctive odour, which is undesirable at underground railway used by passengers.

To isolate harmful aggressive leakages protection structures were designed for all tunnel sections and station areas where adverse substances were detected. Leakage has been found to be corrosive to steel structures and erode to cement-containing structures so polyethane membranes were designed to install around the railway tunnel structures and all materials which can be in contact with glycol based fluids were chosen for aggressive environments.

Keywords: protection structure, isolation, glycol, acids, membrane, microbe growth, concrete element, anchors.

1. Introduction

The Ring Rail Line is an important circular route of the Helsinki Metropolitan Area. It is an urban two-track passenger line for local traffic in Vantaa between Vantaankoski and Tikkurila and a rail link from Helsinki to Helsinki-Vantaa airport. The total length of the new line is 18 km, of which 8 km run in twin rail tunnels mainly under the Helsinki-Vantaa airport area.

Construction of the Ring Rail Line began in spring 2009. During excavation works under Helsinki-Vantaa airport area liquid fluid with distinctive odour was noticed leaking into the rail tunnel. The first observations of contaminants were made in summer 2010 and in autumn a comprehensive study of liquid and its origin begun.

Many water samples were taken to define liquid's contents and its impacts to indoor air and reinforcement structures of tunnel. The investigations showed that ground water is acidic and the fluid is nutrient for microbes and enables their growth in tunnel walls and bottom. In aerobic conditions it forms alcohols and organic acids, most relevant of them acetic acid and propionic acid. The microbe growth forms distinctive odour and showed to have a capability to block drainage