Abstract
The obligation of keeping a competitive edge against other means of transportation has increased the pressure on the railway industry to improve its efficiency and decrease the maintenance costs. In this paper, several innovative solutions are presented to improve the rail track foundations including optimum particle ballast grading and confining pressure as well as stabilising tracks overlying soft soils employing different techniques. A smart tool for predicting the performance of rail track substructure is also developed. This smart tool provides the user optimum construction parameters and required geotechnical properties according to various subgrade conditions, train loads and speeds.

Keywords: Rail track, ballast, smart tool, geosynthetics, track foundation.

1. INTRODUCTION

Rail track substructure, an essential component of the railway system, should be designed, built and maintained according to robust geotechnical principles and financially viable approaches. At present two types of rail tracks dominate railway systems: (1) slab track and (2) conventional ballasted track. Although conventionally ballasted track is the most common, some high speed railway systems have employed rigid concrete foundations. Recent studies [1, 2] indicate that slab tracks can be more cost-effective in some instances when life-cycle and maintenance costs are considered. Slab tracks are more suited to high velocity and high intensity traffic zones and especially where routine maintenance and traffic interruption are unfavourable or impracticable. The main advantages of a slab track design include, virtually free of maintenance, less traffic disruption, long service life, reduced dimensions and weight of substructure and no dust emission [1]. However, slab tracks have considerably higher initial construction and materials costs. Furthermore, slab tracks are required additional treatment and preparation for subgrade and in the case of structural damage or derailment it will be very costly and time consuming project [2]. The length of the rail network in many countries makes this option uneconomical. Hence, conventionally ballasted tracks keep on the most widely used option throughout the world; and its effective and efficient design remains a challenge for practicing engineers in rail industry.

Rail tracks founded on ballast (Figure 1) are relatively cost effective, have adequate drainage, and can easily be maintained. A conventional ballasted track is composed of differently graded layers of aggregates as shown in Figure 2. According to Selig and Waters [3] the ballast bed should undergo minimal plastic