Environmental Engineering and Management Journal *April 2019, Vol. 18, No. 4, 865-872*
http://www.eemj.icpm.tuiasi.ro/; http://www.eemj.eu

"Gheorghe Asachi" Technical University of Iasi, Romania

MODELLING THE PISTON EFFECT IN SUBWAY TUNNELS USING FIRE DYNAMICS SIMULATOR

Omar Lanchava[1,2*], Nicolae Ilias[3], Giorgi Nozadze[1], Sorin Radu[3], Roland Moraru[3], Zaza Khokerashvili[2], Nino Arudashvili[2]

[1]Gr.Tsulukidze Mining Institute, 0186, No. 7, Mindeli Street, Tbilisi, Georgia
[2]Georgian Technical University, 0177, No. 77, Kostava Street, Tbilisi, Georgia
[3]University of Petrosani, No. 20, Universitaria, Petrosani, Romania

Abstract

The influence of the piston effect in subway tunnels depends on a train speed, the geometry of a tunnel and a train, the types of air flow caused by mechanical ventilation and other variable characteristics. Tables and graphs of changes in air flows generated by the effect of the piston are presented depending on the speed of a train and the degree of fill rate of a tunnel. It is noted that the piston effect is characterized by two phases. At the first stage, the piston effect and the processes of changing physical fields are non-stationary whereas at the second stage, the processes become stable. The speed of the circulation flow created by the piston effect, in accordance with the fill factor of a tunnel, is characterised by a linear relationship; the degree of its growth is directly proportional to the speed of a train. Based on the results from the present paper it is possible to calculate the velocity and consumption of an air flow in an underground space. The maximum value of air flow carried out by the piston effect does not exceed 90-100 m^3/s. It corresponds to the stationary phase of motion, when the tunnel filling factor $\alpha = 0.35$ and train speed is in the range of 40-45 km/h. Based on the obtained numerical simulation results, technological parameters for metro ventilation systems can be calculated more accurately.

Key words: air consumption, circulation flow, computer modelling, oncoming flow, piston effect

Received: September, 2018; Revised final: January, 2019; Accepted: April, 2019; Published in final edited form: April, 2019

[*] Author to whom all correspondence should be addressed: e-mail: o.lanchava@yahoo.com