

# CHAPTER I

## INTRODUCTION

The problem of non-equilibrium and/or preferential flow and transport has received much attention in the soil and agricultural sciences because of its implications in accelerating the movement of agricultural contaminants (fertilizers, pesticides, pathogenic microorganisms and toxic trace elements) through the unsaturated zone (vadose zone) to underlying groundwater.

Non-equilibrium flow and transport are probably the most difficult processes in terms of restrain accurate predictions of contaminant transport in soils and fractured rocks. Non-equilibrium or/and preferential flow, as opposed to uniform flow, results in irregular wetting of the soil profile as a direct consequence of water moving faster in certain parts of the soil profile than in others.

There is good confirmation by many investigators that water flow and solute transport processes in soil often cannot be described using classical models that assume uniform flow and transport. Many experiments (laboratory or field experiments) have illustrated the presence of non-equilibrium flow and transport conditions in soil. Attempts to describe non-equilibrium transport have traditionally developed along two lines: physical and chemical non-equilibrium models. Physical non-equilibrium models assume that non-equilibrium flow or transport is caused by physical factors such as soil heterogeneity. Chemical non-equilibrium models assume that chemical factors are the cause of non-equilibrium transport. Few researchers have been combined the physical and chemical non-equilibrium approaches to account both possible causes of non-equilibrium, thus we can improve the description of water flow and solute transport in soil. Over the years, several numerical models have been developed to consider number of options for simulating non-equilibrium water flow and solute transport processes.

The most common model is HYDRUS-1D software package (**Šimůnek *et al.*, 2005, 2008**), it is wide range approaches that can be selected for simulating non-equilibrium processes. The HYDRUS software packages are among the most widely used models simulating water flow and solute transport in soils. Traditionally, the HYDRUS software, as well as many other models simulating variably saturated water flow and solute transport. The objectives of the present work were to evaluate and compare the physical and chemical non-equilibrium processes of potassium transport under the present experimental conditions using the last version of HYDRUD-1D (**Šimůnek *et al.*, 2008**).