

# 1 Introduction

## 1.1 Research Importance

The final disposal of the PET bottles represent a difficult problem to deal with, because it is a product that needs larger spaces to be storage and also takes almost half a century to decompose. In Brazil the consumption of PET bottles are raising yearly and in 2016, with the Olympic Games in the city of Rio de Janeiro, the consumption is estimated to be around 840 kilo tons, but just half of this quantity is expected to be recycled. According to the Health Surveillance Secretariat of the Ministry of Health, the recycled PET cannot be used in contact with beverages, medicines, food, toys and hospital material, limiting its uses. Thus, finding out an alternative use for this residue is one of the main concerns of the modern society.

Nowadays, the concern about the wrong disposal of the solid urban waste, is leading the environmental organism to create laws that might reduce this problem. So, mayors of many cities in Brazil are required to prepare integrated management plans of waste as well as laws and policies regarding the recycling and disposal of these materials. When handled wrongly, the waste can cause a lot of environmental impacts from the site of generation to final disposition. The inclusion of alternative materials in geotechnical works helps to reduce the costs of the works, encouraging investment in this type of infrastructure and in researches.

In order to give another alternative to the PET residue, it is extremely important that the mechanical behavior of the mixture are studied, as well as the physic, environmental and chemical characteristics. The knowledge of the reinforcement mechanism will assist on a better understanding of the mechanical behavior of mixture soil-PET. This material could work as soil reinforcement and be applied in geotechnical works, such as, slope stabilization, landfill and embankments on soft soils.

This research aims to study the viability of the use of PET residue as soil reinforcement through laboratory tests. The use of this residue as alternative material can contribute to minimize environmental problems, adding value to the waste and prevent green problems such as air pollution and the silting up of the rivers and lakes, eliminating current problems of waste disposal in dumps and landfills.

## **1.2 Objective of the Research**

The main objective of this research is to evaluate the influence of the insertion of PET waste as reinforcement in three different soils. In order to reach this objective, it was conducted physical characterization, chemical and mechanical behavior analysis of pure soil and mixtures, establishing parameters that might help to understand the influence of this material on the soil.

According to the main propose previously described, it was set up the following specific objective:

- Perform physical characterization and chemical tests, through standardized laboratory tests, on the three different soils and on the mixtures involved in the research;
- Evaluate the mechanical behavior of pure soil and mixtures with different contents of PET residue, through compaction, triaxial consolidated isotropically drained (CID) and direct shear tests, in order to obtain shear strength parameters;
- Analyze the influence of fine crushed PET and PET flakes, in different contents, inserted in mixtures with three types of soil: sand, clayey soil and bentonite.

## **1.3 Research Organization**

This work is divided into five chapters, beginning with this introductory chapter (Chapter 1), followed by Chapter 2, which presents a literature review on PET, its composition, environmental impact and existing recycling technologies. It will be also discussed, summarized, the soil reinforcement with other types of

materials and previous research have used the PET waste in geotechnical researches.

In Chapter 3 is described in detail the experimental program followed in this research. It also describes the materials, equipment and testing procedures.

Chapter 4 presents the results of the physical and mechanical characterization tests performed in the pure soils and mixtures. These results are analyzed in order to observe whether there is a change in the behavior of soils caused by the addition of the PET waste.

Finally, in Chapter 5, the final considerations are presented based on the discussion of the results and the recommendations for futures researches.