**Yeditepe University Civil Engineering Department**

**CE 492 Engineering Project**

**Proposal Form**

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| **Supervisors Name/s** | Professor M. Murat Monkul  Assoc. Prof. Hakkı O. Özhan |
| **Project Title** | *Determination of Atterberg Limits of Microplastic-added Bentonite with Fall Cone Tests for the Design of Liner Systems in Landfills* |
| **Project Reference No\*** |  |
| **Relevant course/s for the project** | CE 341: Soil Mechanics |

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| **Project Summary:** |
| Plastics cover a significant amount of the solid wastes and these wastes are either released to the natural environment or stored in landfills. The plastic wastes that are stored in the landfills may undergo both physical and biochemical changes due to many factors including biodegradation, temperature change and CO2 generation. As a result of these changes, the plastic wastes can be fragmented into smaller pieces that are classified as microplastics. Microplastics are referred to small plastic debris with particle size ranging from 0.0001 mm to 5 mm. The soil and the groundwater can be contaminated due to the possible transfer and migration of these microplastics from a landfill to the subsoil environment. The lack of sufficient liner systems in landfills might cause environmental problems.  Compacted clay liner (CCL) is considered as one of the most preferred barrier materials that can be naturally used as a liner in a landfill. In this project, fall cone tests will be performed on a selected bentonite (a specific clay type consisting mostly of montmorillonite) to find its Atterberg Limits. Later, the bentonite would be mixed with different amounts of microplastics and Atterberg limits of the microplastic-added bentonite will be determined. Different methods for manufacturing microplastics will be investigated and the most appropriate method will be chosen for this study. The microplastic-added bentonite will simulate a clay liner (the barrier at the bottom of a landfill) that is contaminated with microplastics migrated from the wastes in a landfill. Microplastics with various particle sizes will be mixed with the bentonite and the fall cone tests will be performed on the specimens in the laboratory. Afterwards, the correlations between Atterberg limits and hydraulic conductivity will be used in order to determine the design hydraulic conductivity of the liner system. |

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| **Project Achievements:**  *(Please explain how the proposed project helps to achieve the performance criteria listed below)* | |
| **Identifying specific design objectives based on project requirements:** | 1. Literature review about “ microplastics” and “soil contamination with microplastics” 2. Identifying the effects of microplastic addition to the bentonite by considering Atterberg limits 3. Literature review about the correlation between Atterberg limits and hydraulic conductivity 4. Geotechnical design of liner systems in landfills |
| **Gathering and using relevant information** | In this project knowledge obtained from all or some of the following courses shall be used by the student:  1) CE 341: Soil Mechanics (core) |
| **Analyzing alternatives using appropriate engineering knowledge** | The hydraulic performance of both natural and microplastic-added bentonite used in landfills will be analyzed. |

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| **Considering the relevant constraints in the design:**  *(Please explain how the proposed project considers one or more limitations listed below)* | |
| **Economy**  **Environmental Issues/Sustainability**  **Manufacturability** | 1. Manufacturability : The manufacturing process of the microplastics will be investigated and the most appropriate process for this study will be identified. 2. Economy: The results would be important from economical point of view as it would influence the liner system in terms of hydraulic conductivity due to the migration of microplastics from the wastes in the landfill to the bentonite component of the liner system. 3. Environmental Issues/Sustainability: Microplastics are substances that contaminate the environment. For this reason, the comparison of the hydraulic performance of the liner material in a landfill will be made by considering both the natural bentonite and the microplastic-added bentonite. |

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| **Definition of outcomes linked to the objectives of projects** | 1) ability of usage their knowledge in mathematics, science and engineering,  2) ability to identify and solve complex engineering problems,  3) design experience,  4) ability to use modern tools and employ needed information technologies,  5) ability to conduct experiments if needed, gather data and analyze results,  6) routine of combining their individual creativity with teamwork,  7) oral and written presentation experiences in foreign language,  8) ability to access information and recognition of the need for following developments in science and technology,  9) awareness of professional and ethical responsibility,  10) information about business life practices like project management and risk management,  11) awareness of effects of their engineering practices on health, environment, and safety,  12) awareness of project award mechanisms and tendering procedures,  13) awareness of the interaction of designers and constructors.  *(Minimum requirements are;*   * *project timeline,* * *abstract,* * *Türkçe özet,* * *the definition of the problem,* * *the scientific information and literature review,* * *different design alternatives and decision criteria,* * *selection of optimum alternative* * *economical, sustainability, ethical issues* * *engineering drawing and demonstration methods while presenting the solution*   *appendix including standards, patents, brochures etc.)* |