Sludge and Solid Waste analysis according to the Council Decision 2003/33/EC

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Historically, in ancient cities, wastes were thrown onto unpaved streets and roadways, where they were left to accumulate. It was not until 320 BCE in Athens that the first known law forbidding this practice was established. At that time a system for waste removal began to evolve in Greece and in the Greek-dominated cities of the eastern Mediterranean. Since then, proper waste management is an essential part of society's public and environmental health. European legislation specifies a series of analyses that must be conducted in order to determine indicators on waste generation, treatment and disposal, as well as to ensure that the latter takes place in ways that ensure the protection of human health and environment.

Specifically, the criteria and procedures for the acceptance of waste at landfills were established according to Council Decision of 19 December 2002. This 2003/33/EC specifies the limit values of inert waste, non-hazardous and hazardous waste that are permitted to be disposed in landfills by using the Leaching test procedure calculated at liquid to solid ratios (L/S) of 2 l/kg and 10 l/kg and the Up-flow percolation test procedure expressed in mg/l (the first eluate of percolation test at L/S = 0,1 l/kg). The Standard ISO methods for these procedures are ISO 21268-1-2-3:2019 (Part 1 to Part 3) and need to be performed in accredited laboratories such as Eurofins Athens Analysis Laboratories. The analyses that are performed in these wastes are shown in Table 1.

Table 1. Parameters for waste acceptable at landfills

Arsenic-As	Barium-Ba	Cadmium-Cd	Chromium-Cr total	Copper-Cu
Mercury-Hg	Molybdenum-Mo	Nickel-Ni	Lead-Pb	Antimony-Sb
Selenium-Se	Zinc-Zn	Chloride	Fluoride	Sulphate
Phenol Index	DOC	TDS	BTEX	PCBs
Mineral Oil	PAHs	pH	ANC	TOC

Our laboratory receives a variety of solid waste samples such as municipal solid waste streams, Sewage Treatment Plant (STP) and industrial sludges, polluted sediments and excavated soils, sludges from sand traps and scrappers and provide complete and reliable results for the characterization of the samples according to the European legislation.

When the samples (Picture 1 & 2) arrive in the laboratory, there is a specific procedure that must be followed. The samples must be homogenized and sieved to a particle size less than or equal to 2 mm (Picture 3). Oversized material of natural origin in the sample shall be separated and discarded. If the laboratory sample cannot be homogenized or sieved because of its water content, it will be dried in a temperature that shall not exceed 30 °C. For the Leaching test procedures, the percentage of the water content and dry matter will be determined in order to prepare the portion of the sample and the volume of the leachant. The sample will be attached in the agitation device (Picture 4) for 24 ± 0,5 hours. After the agitation, the sample must be centrifuged, and the eluent filtered.

Picture 1, 2, 3. Dewatered STP Sludge, Sediment samples, Sieving procedure



For the Up-flow percolation test procedure, the dried sample will be used to fill the column with an internal diameter of 5 cm to 10 cm and a filling height of about (30 ± 5) cm (Picture 5) fitted with filters in the bottom and

top sections made of appropriate materials ensuring minimum interference with the substances of interest. In the top and bottom of the column, a filter plate or a thin layer of fine-grained non-reactive material (e.g. fine quartz sand) is applied to ensure proper water flow over the width of the column and as a support for the pre-filter. When the column is filled with the sample, the net weight of the sample is determined to calculate the right amount of eluent that will be received. It is crucial that no open space (dead volume) is left between the particles or above the material. Then the column gets saturated with water either by using a pump or by hydrostatic pressure and then rests for a period of at least 16 to 72 h, in order to equilibrate the system. After the equilibration period, the outlet hose connects to an eluate collection bottle of appropriate size the flow rate sets for a specific eluate fraction calculated from the dry mass and volume of the sample.

Picture 4,5. Agitation device, Up-flow percolation columns

In both procedures, the filtered eluent will be analyzed for elemental analysis using ICP MS/MS (Picture 6) and for spectrophotometry (Picture 7) and organic analyses (Picture 8) according the 2003/33/EC, as shown in the table 1.

Picture 6,7,8. ICP MS/MS, Discrete Analyzer, DOC Analyzer

The results of the different samples of sludge, solid waste and polluted soil that arrive in our laboratories show how important these waste streams are, and how aggravating they are for the environment and the human health. The proper waste characterization and analysis is an integral part of waste management in all its stages in order to ensure the smooth function of treatment facilities and the safeguarding human health and quality of the environment.

References

- 2003/33/EC: Council Decision of 19 December 2002 establishing criteria and procedures for the acceptance of waste at landfills pursuant to Article 16 of and Annex II to Directive 1999/31/EC.
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