HISPANSION

Technical Data Sheet: TLM-0

TDS-TLM-0-v1.2

1. Overview:

Figure 1: TLM-0 Close-up View

- **Type:** Low-Ti Mare
- **Series:** TerraLun™- Core
- **Composition:**
  - Basalt
  - Anorthosite
  - Altered Peridotite
- **Mean NASA FoM Score:** 81.8 %
- **100 % European** Sourced & Manufactured.
- **Uses:** High-fidelity general simulant suitable for geotechnical and mobility testing, excavation and construction trials, large-scale testbeds, ISRU process development, dust and environmental studies, filtration and sealing validation, scientific research, and technology demonstration.

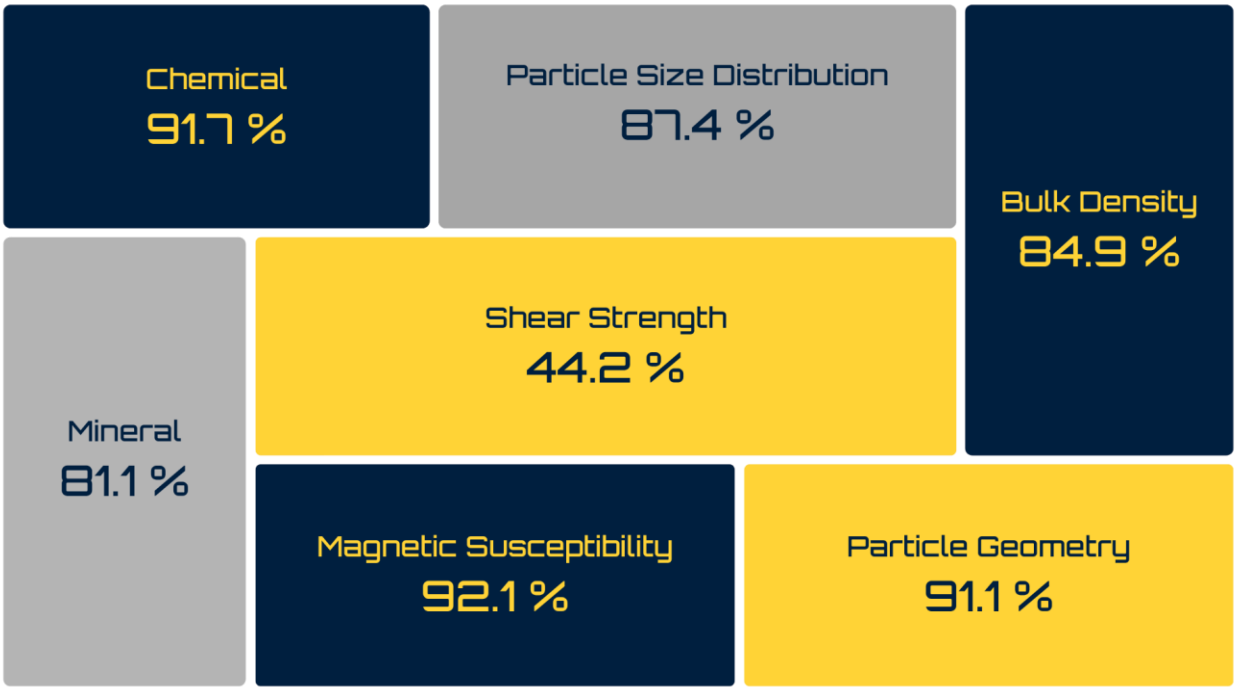


Figure 2: NASA Figures of Merit Results for TLM-0

2. Product Characterization

2.1 Chemical Composition

Chemical composition obtained through X-ray fluorescence analysis (XRF) performed by UPV/EHU with a Bruker M4 TORNADO.

SiO_2	TiO_2	Al_2O_3	FeO	MgO	CaO	Na_2O	K_2O	SrO	MnO	Cr_2O_3	NiO	ZnO
47.33	1.72	14.38	12.44	12.38	8.38	0.00*	1.28	0.25	0.14	0.11	0.01	0.19

Table 1: Chemical Composition of TLM-0

*Na2O is expected to be present according to the mineral composition, but it might be below the identification and quantification limit of this machine.

2.2 Mineral Composition

Mineral composition and quantification of glass/amorphous fraction through X-Ray Diffraction analysis (XRD) performed at UCLM by Jacinto Alonso-Azcarate with a PANalytical Xpert PRO machine. Supplemented by a Raman Spectroscopy performed at UPV/EHU with a Raman Renishaw InVia micro spectrometer.

Anorthite	Augite	Enstatite	Fosterite	Lizardite	Analcime	Smectite	Illite	Quartz	Hornblende	Amorphous/ Glass
35.2	17.2	1.9	2.1	5.7	3.8	1.2	0.6	0.6	0.3	31.4

Table 2: Mineral Composition of TLM-0

Pyroxene	Plagioclase Feldspar	Olivine	Ilmenite	Glass
19.1	35.2	2.1	0	31.4

Table 3: Mineral Group Classification of TLM-0

2.3 Bulk Density

Minimum, maximum and mean density measured in-house.

Minimum Density: 1.27 g/cm^3

Maximum Density: 1.76g/cm^3

Mean Density: 1.52 g/cm^3

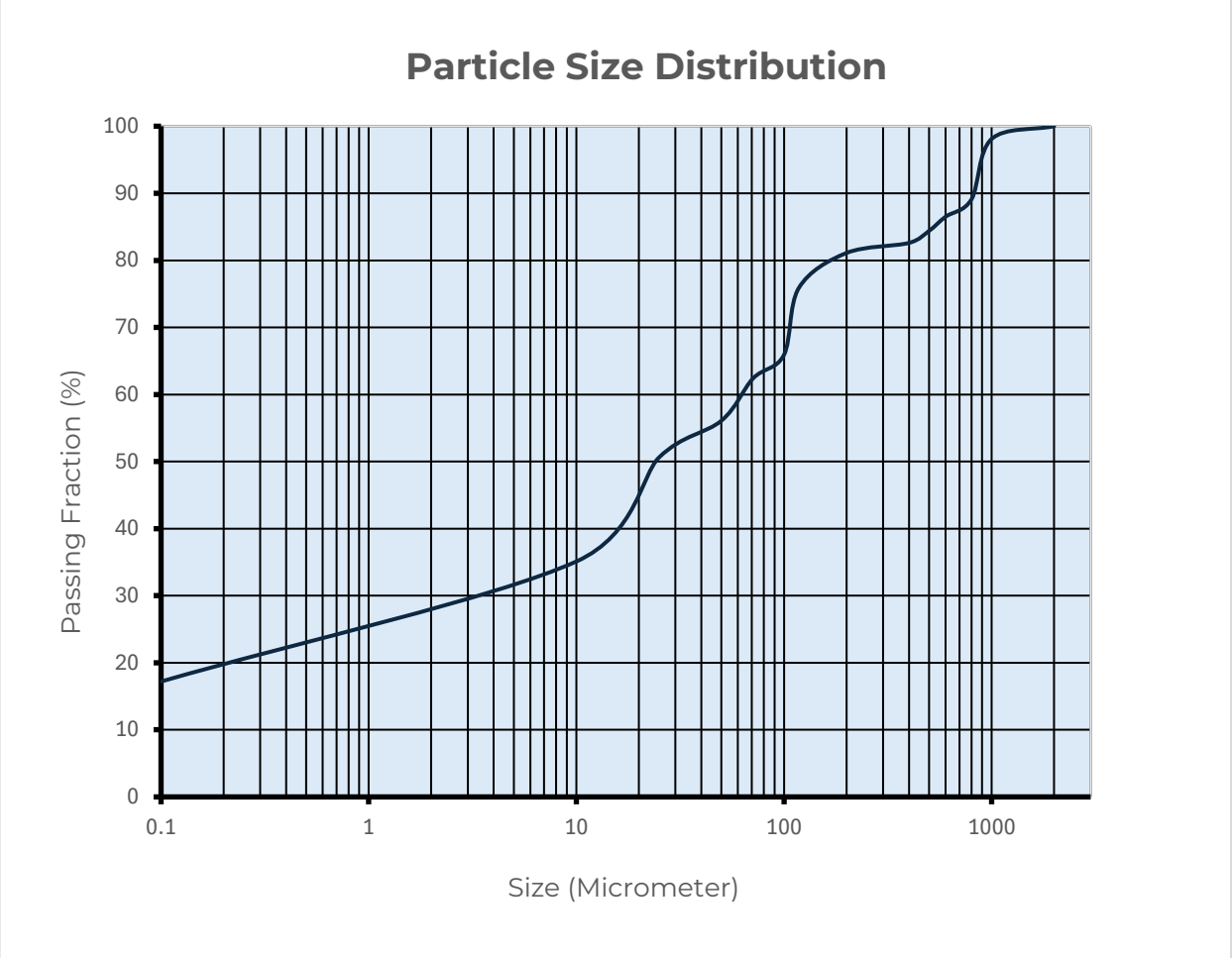
2.4 Particle Size Distribution

Particle size distribution (PSD) measured through Dynamic Image Analysis performed by a third-party entity with a CAMSIZER X2.

Range: 0.03-3000 µm

Median: 48.4 µm

Mean: 291.67µm



2.5 Particle Geometry

Particle geometry measured through Dynamic Image Analysis performed by a third-party entity with a CAMSIZER X2.

Aspect ratio: 0.71469

Root Form Factor/Circularity: 0.87628

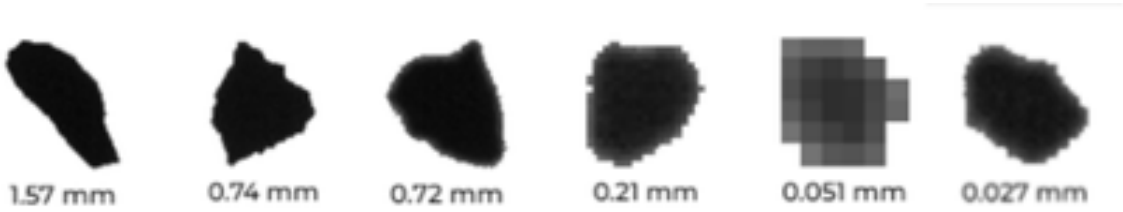


Figure 3: Particle Shape Example at Different Sizes

2.6 Shear Stress - Cohesion (c) and Angle of Internal Friction (φ⁰)

Cohesion and Internal Angle of Friction measured through Direct shear test Performed at UPM-ETSIME by the Space Mining Group with a Mecánica Científica S.A. - Direct Shear Cut Machine. Measurements were performed at ~25 kPa and ~50 kPa. The range of normal stress applied in the direct shear tests will be expanded by incorporating lower stress levels, allowing a more complete characterization of the simulant's shear behavior across a broader range of loading conditions.

Internal Angle of Friction (φ⁰): 34.617 °

Cohesion (c): 13.299 kPa

2.7 Magnetic Susceptibility

The massive magnetic susceptibility was obtained through a magnetic susceptibility analysis performed by UGR-CIC with a PPMS DynaCool Magnetometer with an ACMS II Module.

χ_m = 7536.7 x10^{-9} m^3/kg

3. Other Information

- Safety data sheet available on request.
- **Revision date**: December 4th 2025.