Measurement of Complex Dielectric Constant of Dry Soil of Rajasthan and Terrestrial Analogues of Lunar Soil at Temperatures Ranging from -196°Cto 200°C at Microwave Frequencies

CALLA O.P.N., SONI ANKUSH, RATHORE INDER SINGH
International Centre for Radio Science, Jodhpur-342003
opncalla@yahoo.co.in, soni_ankush4321@yahoo.com, ece.inder@gmail.com

The natural material is characterized by its physical and electrical parameters. The soil is a natural material characterized by electrical parameters like conductivity, permeability and permittivity or complex dielectric constant. The physical parameter is the texture, color, constituents and surface roughness. Here the Complex Dielectric constant of dry soil of the Rajasthan and terrestrial analogue of LUNAR soil at temperature varying from -196°C to +200°C has been measured at 2.5GHz and 6.6GHz using Wave Guide Cell Method. For accurate measurement, the measurement was repeated number of times at temperatures from -196°C to 200°C and the average value of complex dielectric constant of dry soil and terrestrial analogue of LUNAR soil obtained by waveguide cell method have been reported. The temperature on the Lunar Surface on the near side of the Moon is +130°C and on the far side which is not visible from earth, has -170°C and the poles of the Moon have -200°C. These temperatures were simulated and the dielectric constant was measured at these temperatures. The terrestrial analogue of LUNAR Soil has been procured from ORBITEC USA. The particle size is 1mm and lower these are used by NASA for studies for future LUNAR exploration. All the information including composition chemical and physical properties have been given by ORBITEC. This Terrestrial Analogues was used for measurement of dielectric constant. The storage factor $\in'$ as well as loss factor $\in''$ using waveguide cell method was measured. From the results, it is observed that at 2.5GHz the storage factor of terrestrial analogue of LUNAR soil is varying from increase 3.362287 to 4.041023 and the loss factor is varying from 0.187218 to 0.149298 decrease from temperature -196◦C to 200◦C. And for 6.6GHz the storage factor of terrestrial analogue of LUNAR soil is varying from 3.625316 to 3.929658 and the loss factor is varying from 0.046771 to 0.0421062 for temperature varying from -196◦C to 200◦C. At 2.5GHz the storage factor of dry soil is varying from 2.592975 to 3.111692 and the loss factor is varying from 0.099694 to 0.042207 from temperature -196◦C to 200◦C. And for 6.6GHz the storage factor of dry soil is varying from 2.576455 to 3.156764 and the loss factor is varying from 0.175581 to 0.054671 for temperature varying from -196◦C to 200◦C. The variation in ε' of dry soil is 0.518717 and 0.580309 at 2.5GHz and 6.6GHz respectively and variation in ε" is 0.057487 and 0.128734 at 2.5GHz and 6.6GHz respectively from temperature -196C to 200C. The variation in ε' of terrestrial analogue of LUNAR soil is 0.678736 and 0.304342 at 2.5GHz and 6.6GHz respectively and variation in ε" is 0.03792 and 0.004665 at 2.5GHz and 6.6GHz respectively from temperature - 196C to 200C. The real part of dielectric constant of dry soil and terrestrial analogue of LUNAR soil increases with temperatures where

as imaginary part of dielectric constant of dry soil and terrestrial analogue of LUNAR soil (ε") decreases with temperatures. The difference in ε' and ε'' of dry soil is higher at higher frequency and lower at lower frequency and the difference in ε' and ε'' of terrestrial analogue of LUNAR soil is higher at lower frequency and lower at higher frequency. The dielectric constant for dry soil is function of constituents. It is observed that ε' and ε" of the dry soil and terrestrial analogue of LUNAR soil, at lower temperatures is lower and at higher temperatures is higher, which means that the constituents are different at various temperatures. This means that it is likely that the constituents of the LUNAR Soil on the near side of the Moon are different than that of the soil of the far side of the Moon.