

Moisture Analysis of Metal Powder Samples by Karl Fischer Titration

Why measure the moisture content of metal powder for Additive Manufacturing applications?

Metal powders can be sensitive to many factors that will influence the way they behave in the Additive Manufacturing (AM) process. In general, powder flow will decrease with an increase in the moisture content, and a material that does not flow reproducibly could leave voids in the build envelope resulting in porosity, crack initiation sites, and poor mechanical properties in the final product.

Moisture content can affect the reproducibility of optimised parameters, potentially introducing variability into the build process. It can lead to gas entrapment within the built part, and the dissociation of water can potentially release extra oxygen and hydrogen into the AM process.

In the event of a build issue, understanding the powder's moisture content through repeated builds can help to inform whether the problem is attributable to the powder, the environment, or the process, adding confidence in the integrity of the components and reducing overall build down time.



Why choose Karl Fischer Titration?

Karl Fischer Titration is a fast, precise test that can determine 0.001 to 100% moisture (water) content in solids, liquids and gases, all of which may be present in metal powders. It is accurate to within 1% of the moisture detected in the sample, and is suitable for all metal powders and alloys.

In contrast to the 'loss of mass on drying' technique which will detect the loss of any volatile substance, Karl Fischer Titration is selective for water. Furthermore, lower levels of moisture can be detected than for any alternative technique. There are two methods of Karl Fischer Titration, coulometric and volumetric, LPW uses the coulometric method which can measure the lowest levels of water.

Karl Fischer Titration Methodology

The test is undertaken in a laboratory environment using specialised equipment which is stabilised before each analysis is run. Three 5g samples of the metal powder are required to run the analysis in triplicate, delivering confidence in the results. The powder samples are weighed at site then sent to LPW's laboratory in hermetically sealed vials, the packaging and vials are supplied by LPW.

Three additional vials are provided to collect blank reference samples, ensuring that local ambient moisture levels can be measured and accounted for in the results.

As the powder samples are heated, water is released and transferred via an inert carrier gas to a titrator cell where an electrochemical reaction occurs, yielding the moisture content, reported in ppm (parts per million). It is this electrochemical reaction which results in the specificity of the test for water. Analysis reports are returned electronically via LPW's secure, encrypted system and treated in the strictest of confidence.

Additional Metal Powder and Additive Manufacturing Testing Services

LPW's PowderLab offers a full suite of tests for enhanced characterisation of powders, fully optimised for specific applications. With our 3D printing industry expertise, we can also test AM components in validation studies and root cause analysis of failed builds.

Chemical Analysis

Full Chemical Analysis is available including residual elements and interstitials using various techniques as appropriate, undertaken by ISO17025/Nadcap Approved Lab

- Oxygen, Nitrogen, and Hydrogen Analysis by Inert Gas Fusion
- Elemental Analysis/Contamination Screening (EDX)
- Moisture Analysis by Karl Fischer titration

Physical Analysis

A range of physical tests is available including:

- Apparent/Bulk Density (measurement according to ASTM B212)
- Tap Density (ASTM B527)
- Hall Flow (ASTM B213)
- Angle of Repose (LPW standardised internal procedure)
- Sieve Analysis (ASTM B214)
- Particle Size Distribution by Laser Size Diffraction (ASTM B822)
- Powder Imaging (SEM)
- Powder Cross-Section/Porosity Imaging (SEM)
- Metallographic sample preparation & examination (SEM)
- Rheometry and Shear Cell Analysis
- True Density by Helium Gas Pycnometry (ASTM B923)
- Quantitative Shape Analysis (Optical & SEM)

All our testing is undertaken to ASTM as standard with ISO available on request, adding consistency and confidence to your process.

For further information on any of our analytical testing services, please contact your local LPW office at www.lpwtechnology.com/contact-us/