

Long-term test for oxidation in a drying cabinet - Direct Comparison of Nitrogen and Dry Storage

Introduction

Humidity in the air is the strongest negative influence on the surface oxidation of metals. Due to oxidation, components are rendered more difficult to wet and cause more soldering defects, which can lead to failure of the entire assembly. In a dry atmosphere, there is virtually no metal corrosion since two conditions must be met for this to occur. An oxidizing agent must be present, which is available through the oxygen O_2 in the air. The second prerequisite is an aqueous solution that acts as an electrolyte. The electrolyte forms above an air humidity of 10%rh in the form of a thin, invisible water film on the metal surface.

Objective of Experiment

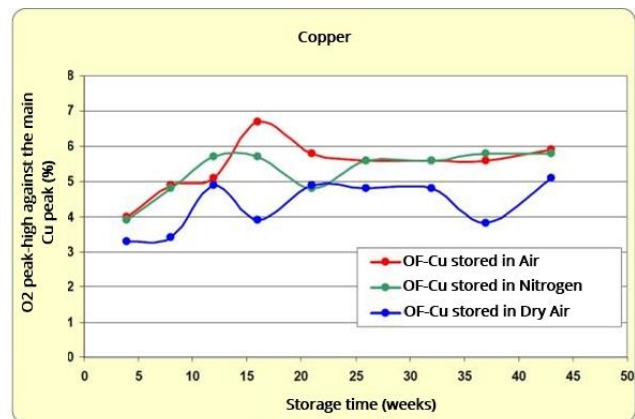
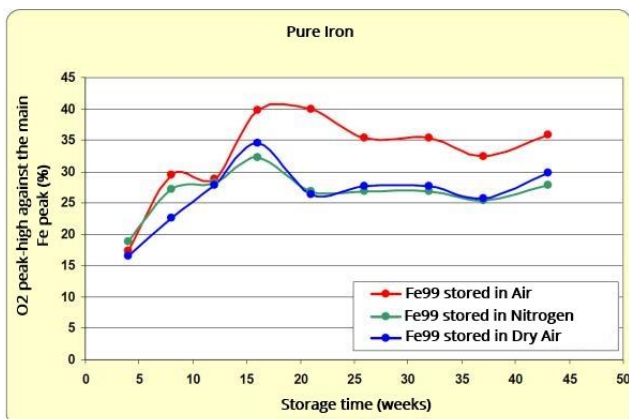
A Drying storage cabinet and N_2 cabinet each remove one component of the oxidation reaction and should thus stop the corrosion. But what is the more effective protection against oxidation? How good is a nitrogen chamber in direct comparison with a drying cabinet?

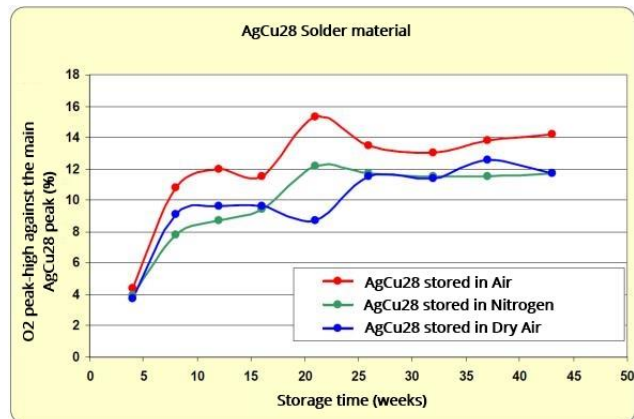
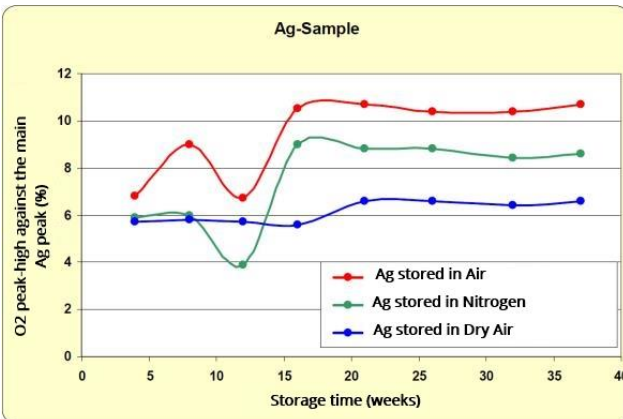
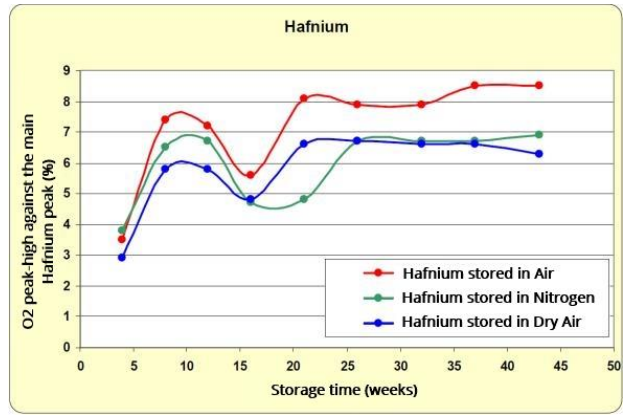
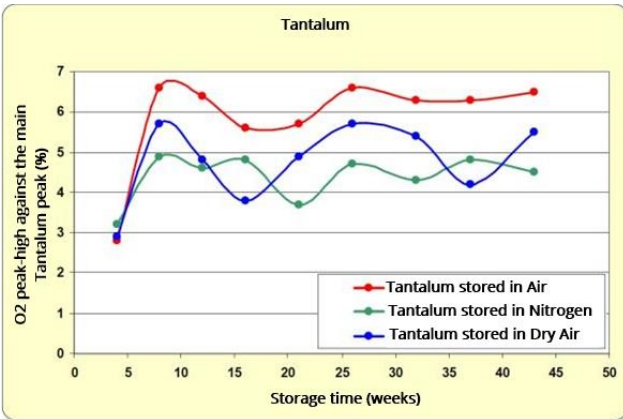
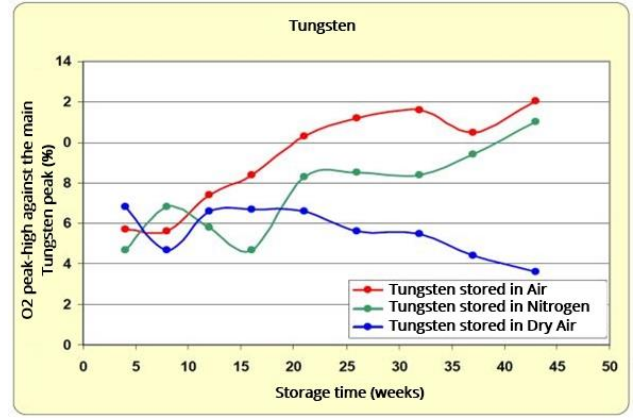
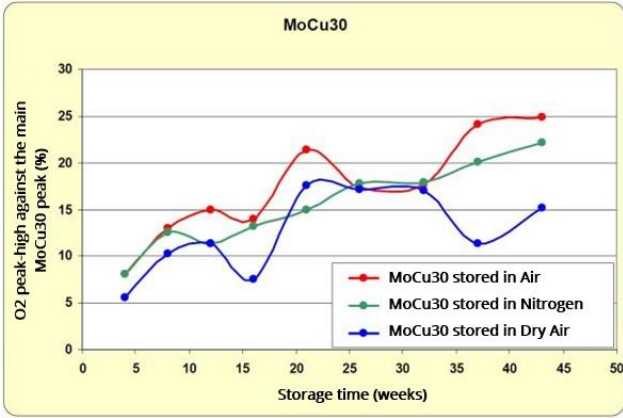
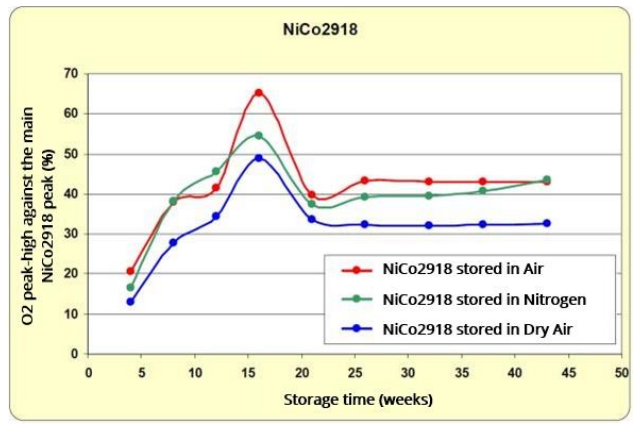
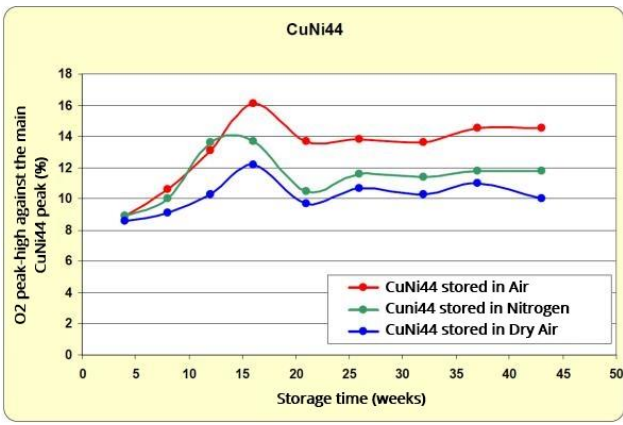
Direct Comparison of Nitrogen and Dry Storage

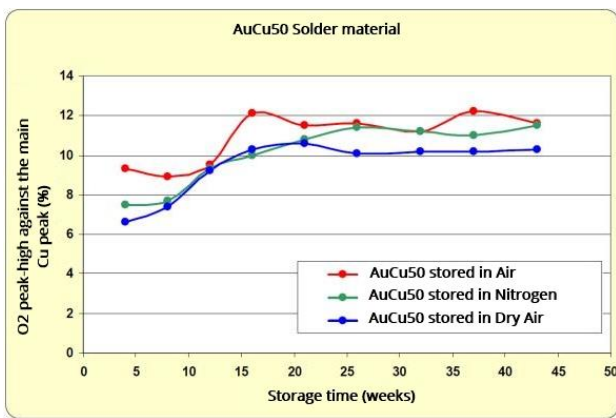
To determine the oxidation rate under the two storage conditions, a long-term test (over nine months) was carried out. At regular intervals (every four weeks) the samples were examined for oxidation by EDX analysis. In parallel, the same materials were stored as a reference under ambient air.

For each material, there is a diagram showing the development of the percentage oxygen peak height compared to the respective main peak as a function of the storage time. This comparison is permissible insofar as all EDX spectra were recorded under the same measuring conditions (high voltage, the running time of the analysis, the aperture setting, and the sample distance to the detector).

Measurement results







Evaluation of the results:

As expected, the highest O₂ peaks and thus also the highest surface oxidation could be measured on the samples stored under air. The samples stored in N₂ show a significantly lower oxidation. The samples stored in the drying cabinet had the lowest O₂ peaks and thus the lowest surface oxidation, though the differences to the samples stored in N₂ are not significantly large. The results of this long-term test prove that drying storage cabinets can be classified as very suitable for storage due to their optimum oxidation protection. It was even possible to achieve a slight improvement compared to storage in N₂.

From an energy point of view, [drying cabinets](#) have a significantly lower energy consumption than a nitrogen oven and are therefore not only more energy-efficient but also, with only approx. 1.7 % of the N₂ costs, considerably cheaper to maintain.

References:

- 1st Karl Müller, Lehrbuch der Metallkorrosion (Lehrbuchreihe Galvanotechnik), page 32-33 2nd
- M.Roggenbuck, M.Haubner, qualification drying storage cabinets, Thales Electron Devices GmbH 3rd
- G.Kurpiela, Totech GmbH, cost comparison N₂ with Totech drying storage cabinet, 6/2016