



Effect of the presence of water vapour on the high temperature oxidation of a Co-10Ni-30Cr alloy. Part 2: Kinetic results in oxidation in wet air and comparison with dry air

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Thierry Schweitzer, Lionel Aranda, Pascal Villeger, Patrice Berthod, Elodie Conrath. Effect of the presence of water vapour on the high temperature oxidation of a Co-10Ni-30Cr alloy. Part 2: Kinetic results in oxidation in wet air and comparison with dry air. Eurocorr 2015, Sep 2015, Graz, Austria. hal-03377268

HAL Id: hal-03377268

<https://hal.science/hal-03377268>

Submitted on 14 Oct 2021

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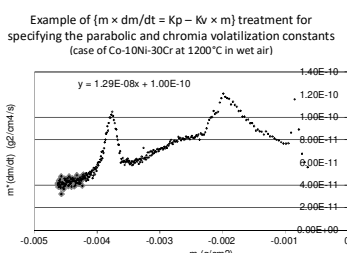
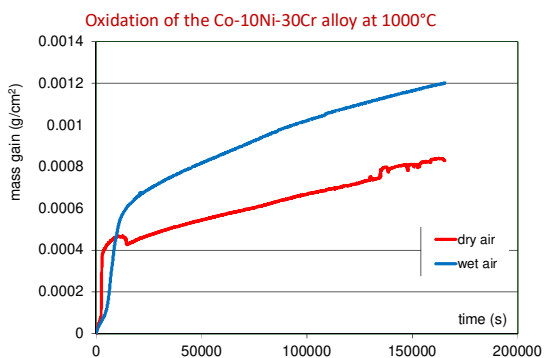
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Water vapour is known to influence the general behaviour of superalloys in oxidation at high temperature [1], in terms of isothermal oxidation rate, volatilization of the protective scale formed (alumina, chromia or silica), and of oxide scale spallation in thermal cycling. After having studied the double kinetic of both mass gain of oxidation and mass loss by chromia volatilization in the case of chromia-forming nickel-based alloys [2,3], it was wished here to characterize the effect on oxidation of water vapour in the case of cobalt alloys, with thermogravimetry recording followed, here too by using the $\{m \times dm/dt = K_p - K_v \times m\}$ method [4] for the isothermal part, and by examining their heating and cooling parts.

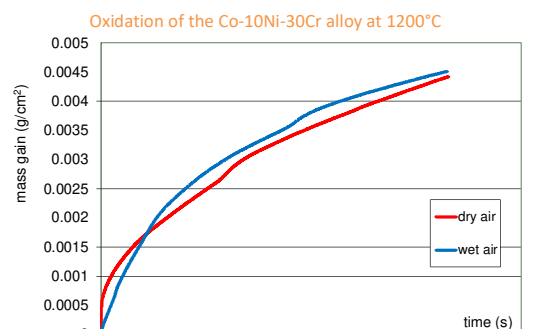
Cobalt-based superalloys are generally rich in chromium (several tens weight percents) and are strengthened by carbides [5]. Many of them additionally contain several weight percents in nickel to stabilize the FCC network of the matrix. These were the reasons why a simple model alloy was considered in this work: a carbide-free Co-10Ni-30Cr ternary alloy (study of the specific behaviour of the matrix). This cast alloy was subjected to oxidation in humidified air inside a thermobalance. The results of the analysis of the three parts (heating, isothermal oxidation, cooling) of the mass gain files were compared to the corresponding ones obtained in dry air last year [6] for the same alloy. The results of the metallographic characterization of the oxidized samples will be presented next year [7].

The Co-10Ni-30Cr alloy (wt.%) was elaborated by high frequency induction melting from pure elements, in inert gas. Parallelepiped samples were prepared and subjected to thermogravimetry runs carried out in humidified air (temperatures of test: synthetic air 80%N₂ – 20%O₂ with addition of 180mbars H₂O (air with 90% of relative humidity at 60°C), temperatures: 1000 and 1200°C, duration: 46 hours.

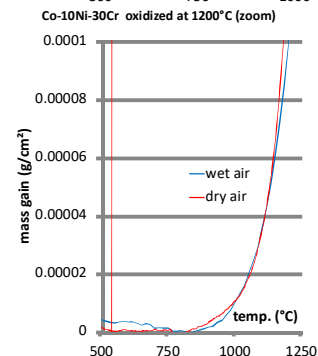
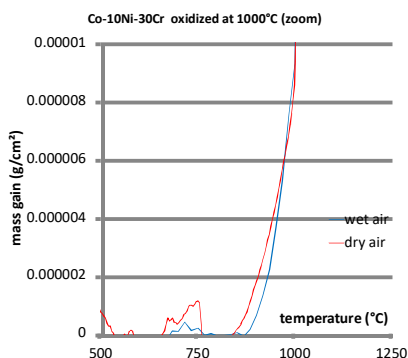
Isothermal mass gain kinetic



$10^{-12} \times K_p$ (g² cm⁻⁴ s⁻¹)	1000°C	1200°C	$10^{-10} \times K_v$ (g cm⁻² s⁻¹)	1000°C	1200°C
dry	1.71	76.9	dry	/	45.9
wet	8.97	100.0	wet	52.0	129

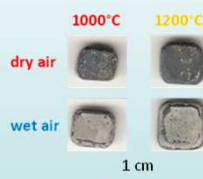


Oxidation at heating



T _{oxid start} (°C)	1000°C	1200°C
dry	844	825
wet	851	851

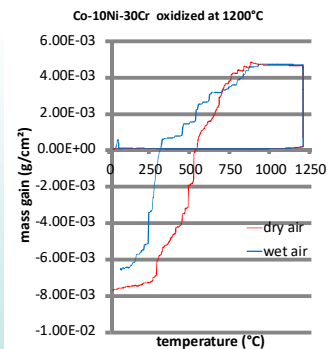
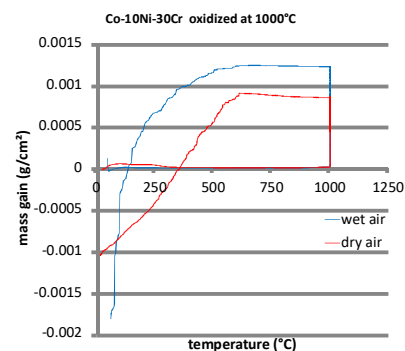
Mass gain at heating (μg/cm²)	1000°C	1200°C
dry	9.36	150.6
wet	13.00	113.1



T _{spall start} (°C)	1000°C	1200°C
dry	652	907
wet	650	975

Final mass variation (mg/cm²)	1000°C	1200°C
dry	-1.03	-7.68
wet	-1.80	-6.52

Scale behaviour at cooling



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