

## **ABSTRACT**

Power plants efficiency improvement by increasing operating temperature and pressure allows the reduction of fossil fuel consumption and CO<sub>2</sub> emissions but requires the development of new materials capable of supporting more extreme conditions.

In the present work, new steels have been studied with the aim of being used in high efficiency and low CO<sub>2</sub> emissions power plants components fabrication. They have been classified into two groups, Group I: 14 % Cr steels designed for applications up to 650 °C and Group II: 2.25 % Cr steels designed for applications up to 600 °C.

Different alloys were obtained by casting and they were rolled at 900 °C. Subsequently, materials were subjected to a heat treatment of normalizing and tempering in order to obtain a microstructure composed by tempered martensite reinforced with fine and homogeneously distributed second phase particles.

Mechanical characterization was performed between 540 and 650 °C by means of strain-rate-change tests in compression and creep tests. For phase identification and analysis of microstructural changes suffered during high temperature exposure, alloys were studied both before and after mechanical testing by X-ray diffraction, Vickers hardness, optical microscopy, scanning and transmission electronic microscopy (SEM and TEM) and electron backscatter diffraction (EBSD).

It was detected a change in the mechanical behavior between high and low stress regions and a resistance loss associated to de microstructural degradation suffered during high temperature exposure. In spite of that, some alloys reach a 100.000 hours creep rupture strength of 100 MPa due to the high interaction between dislocations and reinforcing particles.