This work is focused on experimental Fe-9Cr ODS steels which offer the potential of adequate high temperature strength and ductility, isotropic microstructure and mechanical properties. Their development was promoted for application in blanket concepts at operating temperature in the range 550°C to about 650°C [1].

The matrix of these ODS alloys which exhibit the EUROFER 97 composition (Fe-9%CrWVTa) were strengthened by mechanical alloying with different fractions of Y$_2$O$_3$ particles (0.3% or 0.5% Y$_2$O$_3$) and consolidated by hot extrusion carried out at 1100°C using a pressure of 13000 bars. Two distinct extrusion dies geometry were used which allow to obtain bars with circular or rectangular cross-sections. Cold rolling trials were also carried out to convert rectangular cross-section into plates of different thickness (up to 1mm).

The consolidation of the mechanically alloyed ODS powders was mainly performed by hot isostatic pressing (HIP) [2, 3, 4]. The present work shows that compared to HIP, hot extrusion process results in a more homogeneous and finer microstructure without porosity. The tensile and impact tests confirm the interest of hot extrusion to improve the strength and to decrease the Ductile-Brittle Transition Temperature (DBTT) values. In addition, a severe plastic deformation can be successfully applied by cold rolling on the extruded bar. Thin plates of ODS steels with a very high cumulated cold work are obtained by this way without any damage. The results of tensile tests on these plates are presented in this paper.

For the same processing conditions, an increase of the yttria content from 0.3% at 0.5% leads to a refinement of the microstructure and an improvement of the tensile properties but appears to be detrimental on the impact behaviour (decrease of the upper-shelf energy).

The effect of forming processes (including thermal treatments) and Y$_2$O$_3$ content on the microstructure and the mechanical properties is also analysed in relation with the possible incidence on the ODS production at industrial scale.


Number of words in abstract: 365

Keywords:
Technical area: 31. Developing fusion materials Ferritic/martensitic and ODS steels
Special session: Not specified
Presentation: No preference
Special equipement: No special equipment