Current status and Future Plan of Low Activation Steel R & D in Japan

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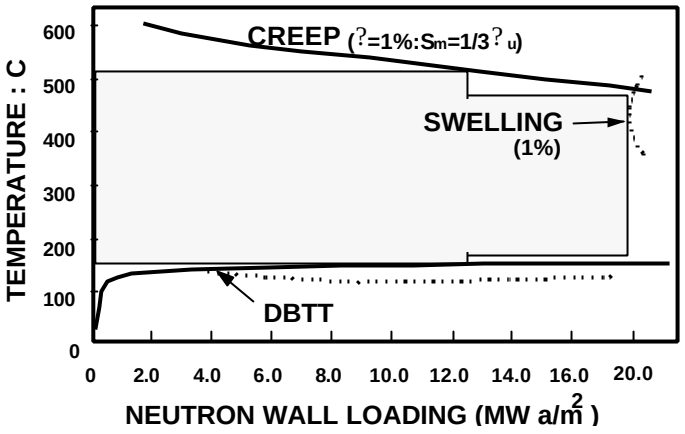
Research and development (R & D) of low-activation materials is one of the most important challenges in fusion technology for making fusion energy systems acceptable and feasible energy options for the 21st century. Presently, low activation ferritic steels (LAFs), vanadium alloys and SiC/SiC composite materials are considered promising candidates. Among them, the LAFs R&D is placed at the highest priority in the Japanese and the European programs.

To accelerate the development of LAFs, a working group under the Annex-II of the International Energy Agency (IEA) implementing agreement on a program of research and development on fusion materials has been formed to coordinate a collaborative program between the European Union (EU), USA and Japan. The steels for the IEA test program have been provided from the two Japanese research sectors: the Monbusho universities program and the STA JAERI program. Two large heats (1 and 1.5metric tons) of JLF-1 steel (a 9Cr-2W steel) and two 5metric ton heats of F82H steel (an 8Cr-2W steel) were produced. Plates with thicknesses from 7 to 25 mm and plates of these thicknesses with EB or narrow gap TIG welded joints have been distributed to the participants of IEA working group and those of Japan/US collaboration program of fusion materials, JUPITER Program. Together with the materials R & D activities, many conceptual design studies using LAFs are in progress. As the representing design studies, Steady State Tokamak Reactor (SSTR) and Forced Free Helical Reactor (FFHR) are introduced with the emphasis on “how LAFs are applied in the reactor systems, especially for blankets”. It is also the objective of this paper to describe in some details the status and future perspectives of the LAFs development program.

Although the chemical composition of the JLF-1 used for the IEA round robin test is the same from the pre-IEA heats, that of the F82H has been slightly modified. However, the physical and mechanical properties of the IEA heat alloys are almost the same as those of the

pre-IEA heat alloys. Thus, in this paper, the baseline properties of F82H and the irradiation data of JLF-1 are mainly introduced. Based on the current database on JLF-1, Figure 1 is obtained and is discussed .



As Conclusions, the followings are provided.

(1) The large heat productions of JLF-1 and F82H have been successfully accomplished and the data obtained up to now are quite straight forward to continue the efforts of low activation ferritic steel development toward DEMO and Power Reactors.

(2) The Japanese domestic and the IEA low-activation ferritic steel working group activities has been and is effective in planning and coordinating the international and domestic R & D programs on LAFs.

(3) Preliminary data on LAFs and the current individual efforts are quite promising, but further coordination efforts and support are required to accomplish the R & D programs of LAFs.

(4) To qualify and finally validate the application of 8-9CrWVTa steel, a sufficient design database must be accumulated, including code approval aspects. A continuous use of mixed neutron spectra irradiation facilities (HFR, Phenix,.) is needed; however, for final validation of alloy performance under irradiation more relevant to fusion, the high-energy neutron source IFMIF should be available soon.

(5) As an important milestone for the development of a blanket test module in ITER, a preliminary set of material design data is required by about 1999. For further verification and qualification, significant efforts are needed for a next milestone about 2005.

REFERENCES

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