

Evaluation of mechanical properties of Zr cladding tubes for nuclear power plants

O. Srba, M. Zimina, P. Svrcula

Material and Mechanical Properties department, Research Center Rez
Czech Republic

Corresponding author: O. Srba <ondrej.srba@cvrez.cz>

1. Introduction

This work is focused on specimens and infrastructure preparation for successful tensile, creep and strength relaxation tests on Zr cladding tube irradiated in the Czech nuclear power plant during normal operation. The results of these tests will be used as a material database for calculations and better understanding of cladding behavior under normal operation conditions.

2. Processing

Specimens shape and dimension

Specimen designs were optimized according to the prediction models of their behavior during mechanical testing. Series of samples of various known materials were created to verify the behavior and accuracy of the results.

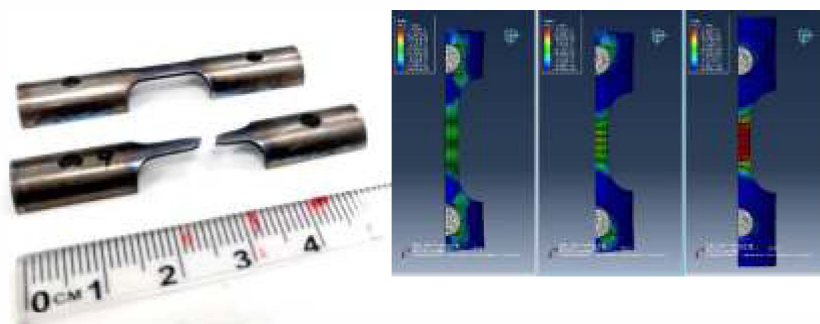


Figure 1. Final specimens shape and dimension (left), model (right)

Development of specimens holders'

Two types of specimen holder were designed for two shapes of cladding specimens for tensile and creep tests. First, 3D printing technique was used for a quick production of the prototype holder during the design process. After the final version was established and its prototype was tested, the steel holder was manufactured. This process allowed to significantly shorten the time for preparation of infrastructure for new type of test and specimen shapes. Although, an additional testing of the holder is necessary, the general manipulation issues within the testing machine located in the hot cell were solved.



Figure 2. The holder design evolution (left and middle), specimens before and after the test (right)

3 Cladding test

Over the past year, the entire testing process has been verified. It involved the design of the specimens, their machining from the cladding tube, dimension measuring, the manufacturing of the gripping mechanisms, and the subsequent measurement of the reference materials with declared properties. Lessons learned from the process will be presented during the Hotlab 2019 conference.



Figure 3. Creep machine inside the hotcell (left), specimen image from video/laser extensometer (right)