

Plastic Deformation Characteristics of Liners for the Production of Cladding Tube in Sodium-cooled Fast Reactor

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Abstract

A typical method for ensuring stability in SFR(sodium-cooled fast reactor) is to stabilize the metallic fuel. Metallic fuel and cladding can cause a eutectic reaction, which can easily damage the fuel rods. To solve this problem, a lined barrier cladding that does not react with metallic fuel inside the cladding is needed [1]. Liner materials require high specific strength, high corrosion resistance and stable mechanical properties at high temperatures. In addition, when the interface between liner and cladding is continuous, the characteristics of the composite material can be expected.

In this study, Zircaloy-4 and Titanium grade 2 with HCP structure were selected for liner material. For precision tube manufacturing of materials with HCP structure, the pilgering process is used [2]. The effect of the cold pilgering process on the plastic deformation behavior of liner and cladding tube was investigated. During the cold pilgering processing, the percentage reduction of cross-sectional area increased with decreasing turn angle and increasing roll pass, and the mechanical properties were changed according to number of pilgering passes and annealing process. It was confirmed that the conditions of number of pilgering passes and annealing affected the plastic deformation of the material. This is a variable element of the manufacturing process that reduces the thickness of the liner. By applying this process, we were able to produce a cladding with Zircaloy-4 lined 9Cr-2W-NbVB steel tube.

Keywords: Plastic deformation, Pilgering process, Cold working, Cladding tube, Liner

References

- [1] Chandrasekhar, B., et al. Manufacture of double clad tube. Proceedings of international conference on peaceful uses of atomic energy-2009. V. 1. 2009.
- [2] Pocięcha, D., et al. Analysis of tube deformation process in a new pilger cold rolling process. Archives of Civil and Mechanical Engineering 14.3 (2014): 376-382.

Biography

Minsu Lee received his M.Sc. degree in Material Science and Engineering at Hanyang University, Republic of Korea, in 2012, respectively. He is currently a researcher of Surface R&D Group at Korea Institute of Industrial Technology (KITECH). His main research interests are electroforming and electroplating simulation.