Optimum Angle of Cutting Roller of 2-Row Blades Slitter for Rod-cuts

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1. Introduction

Mechanical head-end processing of SF disassembly, extraction of the rods, and the shearing of the extracted rods shall be performed in advance as the head-end process of the pyro electro-reduction process. Also, in the head-end process, for oxidation treatment of the spent fuel, a 2-row blades slitter for decladding the cut rods is necessary. Major requirements were based on KSFA type (16x16) rods. For the 2-row blades slitter performance evaluation, the simulated rods of zircaloy (Zry-4) were used to carry out the 2-row blades slitter performance test, and in the 2-row blades slitter method, the enhancement plan for horizontal device was derived. Also, for the slitting test, prototype 2-row blades slitter was made, the device is driven with hydraulic pressure, and it is composed of driving part, step input part, slitting part, and fuel supply part. As a result, the enhancements were derived. Also, the optimal angle of the cutter angle that can process multiple types of nuclear fuel rods was obtained, and the enhancements after the test were reflected for the enhanced design of the 2-row blades slitter.

2. Two-row blades slitter Test

2.1 Decision of the optimal angle of the roller

As in Fig. 1, to split multi type of PWR assembly rods, the optimal angle of the roller is obtained. If the contacting surface of the roller and the rods is a round shape, it can only handle 1 type of the rods. Therefore, we made the roller contact surface as a straight line to process various rods.

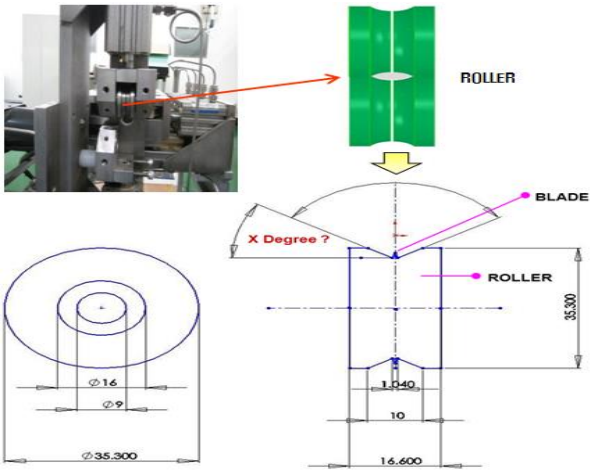


Fig. 1. Two-row blades slitter roller.

As in Fig. 2, to decide the optimal angle, the outer diameter and inner diameter averages of the domestic PWR assembly rods were obtained, and the optimal angle of 32.7° was assumed. Also, Solid works was used to match the cutter roller and each rod for the verification. As a result, each rod was within the cutting boundary.

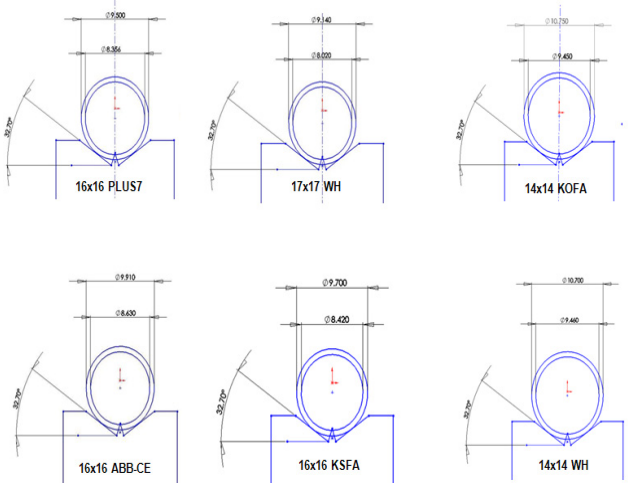
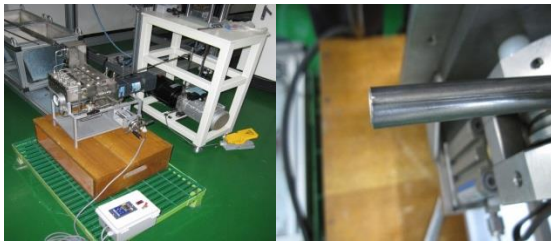


Fig. 2. Roller optimal angle for slitting (32.7°).

2.2 Two-row blades slitter enhancements

Zircaloy rods were used to carry out the 2-row blades slitter performance test (Fig. 3-(a)). As in Fig.

3-(b), rods were not split by the leveled force of step input part and slitting part with the hydraulic driving. Therefore, independent hydraulic system enhancement is required for each part. Also, the problem in the progress of the following rods and the remaining sheared rods processing problem shall be enhanced.



(a) Test (b) result

Fig. 3. Capacity test of horizontal 2-row blades slitter.

As in Fig. 4, the enhancements for 2-row blades slitter were derived by the horizontal device performance test. To reinforce the friction of the step input part roller, knurling was reflected in the roller guide surface, and in the double driven hydraulic system shall be changed to single driven type with elastic recovery power. Also, in the hydraulic driving system, it shall be driven with the driving part composed of 2 hydraulic utilities, the slitting part roller enhancement is required, and it was composed of 2 level structure roller slitting parts. The above enhancements were reflected in the enhanced design of the 2-row blades slitter. In the future, using the enhanced device, the performance comparison against the slant slitting device will be carried out through the simulated rods slitting test.

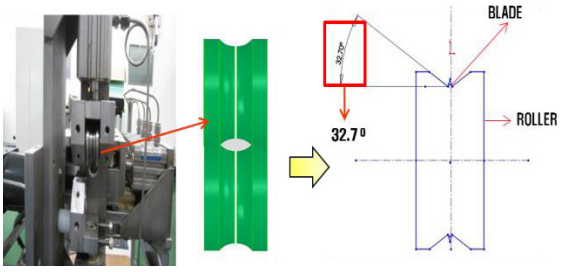


Fig. 4. Improvement item of 2-row blades slitter.

3. Conclusion

Simulated nuclear fuel rods were used to carry out the 2-row blades slitter performance evaluation. Also, Solid works was used for modeling of multi types of the rods, and as a result of matching and verifying the cutter roller and various rods, the optimal angle of the cutter roller for multi types of PWR assembly rods slitting was derived as 32.7°, and as a result of using zircaloy rods for the 2-row blades slitter performance test, the 2-row blades slitter enhancements for hydraulic system, rods step input part, and cutter roller output part, etc. were derived and the design data were obtained.

ACKNOWLEDGEMENTS

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