1-10 Toward Innovative MOX Fuel Production by Simplified Process –Developing a Unified Process Combining De-Nitration by Microwave Heating with Granulation–

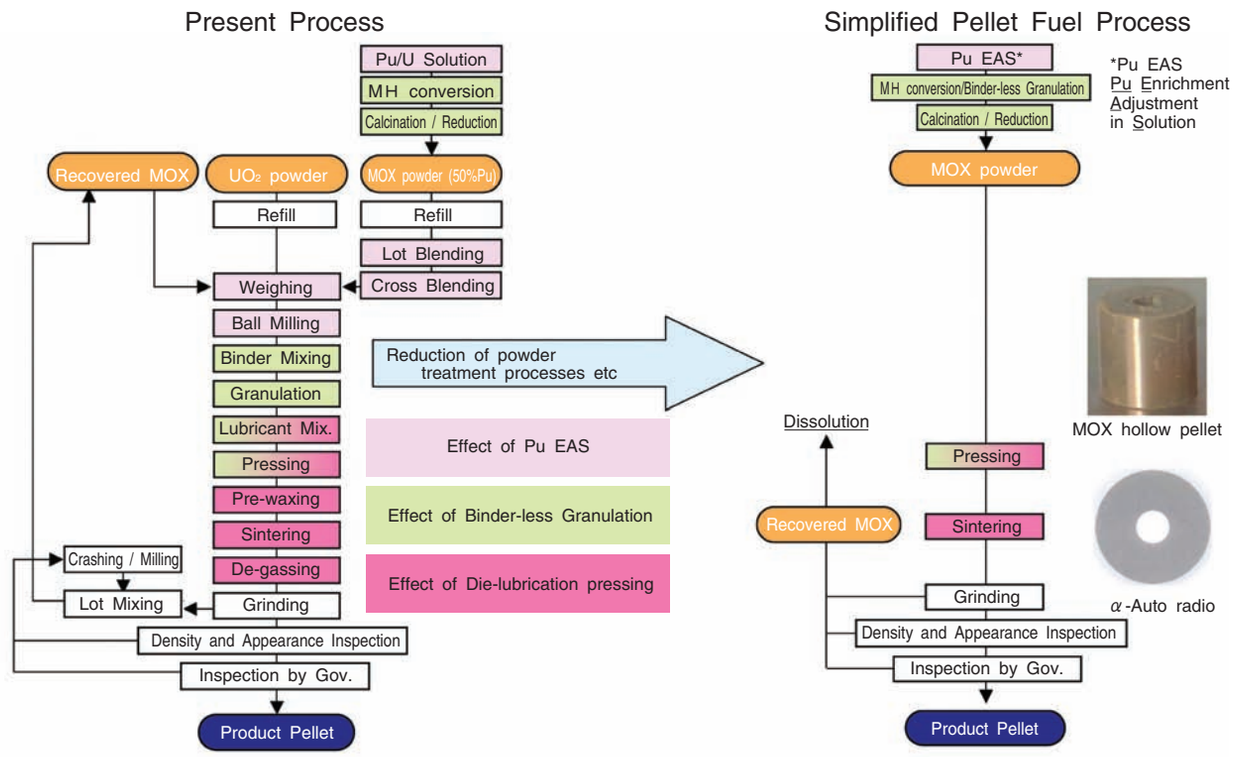

Fig.1-30 Simplified pellet fuel production process
Simplified pellet fuel making process (right) compared with present process (left)

The key for the industrial production of MOX fuel to be burned in the FBR is the reduction of its manufacturing cost. The most promising method for meeting this requirement is the simplified technology shown in Fig.1-30. The key ideas behind this method are (1) adjustment of mixing rate of PuO_2/UO_2 in the liquid state, (2) combining de-nitration with granulation, and (3) fabricating a hollow-pellet with a lubricated die. The details are as follows.

Apart from its simplicity, the distinctive characteristic of the simplified technology is its accuracy in adjustment of mixing rate of PuO_2/UO_2, since the job is carried out in the liquid state. By this means, complicated powder mixing processes needed in the conventional solid state mechanical mixing system were greatly improved. In simulation experiments employing a mockup system and typical liquids, a mixing accuracy of ±2.5% was attained. The overflow type fixed quantity service cylinder and an air lift separator which supplies air free liquid into the service cylinder played important roles in this success. In laboratory experiments employing real fuel liquids (Pu/U=3/7), we observed the mixing state of the powder products which were de-nitrated by microwave heating, and confirmed that non uniform distribution of Pu was not appeared in the hollow-pellet. The results clearly show that the uniformity of MOX powder products obtained by the liquid phase mixing method is better than that by the conventional method.

Another distinctive characteristic of the simplified technology is the granulation done in process of adjusting the U/Pu mixing rate. In this method, high speed agitation with rotating blades is efficiently employed, and not an organic binder but rather water is sprayed, resulting in slippery particles. Thus, the flowability of particles is improved (over 60 in Carr coefficient), a great benefit. The density of MOX hollow-pellets, which were filled with these particles and compressed by the usual press in a die, reached over 95% TD after sintering.

Further, a hollow-pellet was fabricated utilizing the same MOX particles as above, and compressed in a die which was lubricated. These results demonstrated the feasibility of this simplified technology for MOX fuel production on the laboratory scale.

Hereafter, we would like to carry out larger scale experiments to attain the target production rate by 2010 when the adoption of innovative technology will be made. The improvement of production efficiency is the key for this innovative technology, we believe.

Reference

Suzuki, M. et al., Development of FR Fuel Cycle in Japan(3) -Current State on Unified Technology of Denitration Conversion and Granulation for Simplified Pellet Fuel Fabrication Based on Microwave Heating- , Proceedings of 2008 International Congress on Advances in Nuclear Power Plants (ICAPP '08), Anaheim, CA, USA, 2008, p.2036-2045, in CD-ROM.