

Development for Low-Activation Concrete Design Reducing Radioactive Waste

Ken-ichi Kimura^{*1}, Masaharu Kinno², and Akira Hasegawa³

¹Fujita Corporation, Technical Development Division

2025-1, Ono, Atsugi, 243-125 Kanagawa, Japan

²Fujita Corporation, ³Tohoku University

Abstract

Concrete is very valuable and inexpensive material, however it can be changed to be expensive and hard to deal with in use of a nuclear plant after long operation. One of the counter plans for the above is to use low-activation concrete instead of the ordinary concrete, that will reduce radioactive waste and could be even below clearance level in decommissioning and that is very useful in term of life cycle cost. Radioactive analysis showed that Co and Eu were the major target elements which decide the radioactivity level of reinforced concrete in decommissioning stage, and a several material were selected as a low-activation raw material from wide survey of raw materials for concrete (typically aggregates and cements). With the candidate of raw materials, several low-activation concrete were proposed for various portion of light water reactor plant, which reduction ratio were 1/10 to 1/30 which were mainly consist of limestone and low heat cement or white cement, and 1/100 to 1/300 which were mainly consist of alumina aggregate or quartz and high alumina cement, comparing to the ordinary concrete in $\Sigma Di/Ci$ unit, where “Di” indicates concentration of each residual radioisotope, Ci defined by IAEA as a clearance level, and suffition of “i” indicates each radioisotope.

National funded project for development of low-activation design method for reduction of radioactive waste below clearance level were started from 2005 with aiming (1) development of a database on the content of target elements, which transform radioactive nuclides, in raw materials of reinforced concrete, (2) development of calculation tools for estimation of residual radioactivity of plant components, and (3) development of low-activation materials for concrete such as cements and reinforcing steel bars for structural components. For the optimized design for applying low-activation concrete to the reactor portion, effective evaluation of neutron spectrum in the certain portion including activation cross section library and accurate estimation of major target elements in various raw materials for the concrete with width of uncertainty are necessary. So, development for low-activation concrete design reducing radioactive waste have been conducted in the project mentioned above.

Detail survey of the selected aggregates and cements for the low-activation concrete are carried out and uncertain of the materials are obtained. Tons of execution experimental works for several types of low-activation concrete are conducted to categorize as conventional, high performance and boron added, with reduction rate of radioactivity to the ordinary concrete from 1/10 to 10000. Low-activation material development system and activation mapping system could calculate required quantities of target elements in certain area and boundary of the radioactivity level for sheilding wall in decommissioning. These results contribute to optimaize the design of low-activation concrete fo reduceing radioactive waste.

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KEYWORDS: *Low-activation concrete, Clearance level, Radioactive waste, Reactor plant, activation*

* Presenting author, E-mail: kkimura@fujita.co.jp