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Study on Concrete Activation Reduction

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PETtrace cyclotron is one the medical cyclotrons in Korea which is used to generate 18F by impinging 16.5 MeV protons (60 μA) on a water target with enriched 18O via 18O(p, n)18F reaction. The secondary neutrons can activate the surrounding materials that result in radiological hazards. A huge amount of radioactive waste will be generated which is one the main issues due to high cost of radioactive waste management. It is important to decrease the activation level of the concrete.

PHITS-3.02 Monte Carlo code was used to simulate a simplified PETtrace cyclotron target and enclosure. In this work, neutron absorbing materials such as Gd2O3, B4C, polyethylene (PE) and borated (wt.5%) polyethylene (BPE) were considered to reduce the thermal neutrons at 20 cm depth in concrete.

Results showed that 23 cm of Gd2O3, 7 cm B4C, 14 cm of PE and 12 cm of BPE (wt.5%) would be effective to decrease the activation level of concrete at depth of 20 cm by a factor of three. B4C and Gd2O3 would be costly to cover whole walls. On the other hand, PE and BPE (wt.5%) showed an acceptable ability of reducing thermal neutrons. These materials are much more cost-effective as well.

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