Study on Mobile 3.95 MeV X-band Electron Linac based Neutron Source

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Abstract

We have developed a mobile 3.95 MeV linac based beryllium neutron source. By use of the mobile linac based neutron source, 200g of water under the asphalt of thickness of 7cm was detected. As the future work, we will suppress neutron background noise by shielding the detector and optimize the beryllium neutron target in order to perform high signal-to-noise ratio water inspection.

Keywords: Neutron Source, Mobile Electron Linear Accelerator, Bridge Inspection, Water Detection

1 Introduction

The deterioration due to penetration of water of hollow floor panel type road, which is widely used in highway, is a severe problem. The hollow floor plate type bridges have a relatively thick concrete structure compared with other type of bridges, hence the use of neutron ray is necessary for water inspection. We have developed a mobile 3.95 MeV linac based neutron source for nondestructive moisture detection of concrete structure.

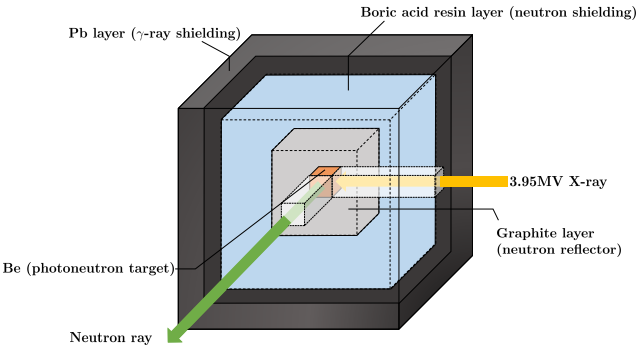

Fig. 1 Outline of the neutron target

2 Development of mobile electron linac based neutron source

We have combined the Be target with a graphite reflector, a boric acid resin layer for neutron shielding, a lead layer for γ-ray shielding, and a polyethylene layer as the neutron moderator (Fig.1). The Be target and 3.95 MV mobile X-ray source compose a mobile neutron source system. The optimization of Be thickness and neutron/γ-ray shielding simulation was done by using Monte-Carlo method.

3 Experiment of Water Detection in Concrete Sample

The experiment of water detection of concrete structure was conducted by use of the newly developed mobile linac based neutron source (Fig.2). 200g of water under the asphalt of thickness of 7cm was detected with 1σ of confidence level, and the significance level increased to 3σ by reducing the background noise.

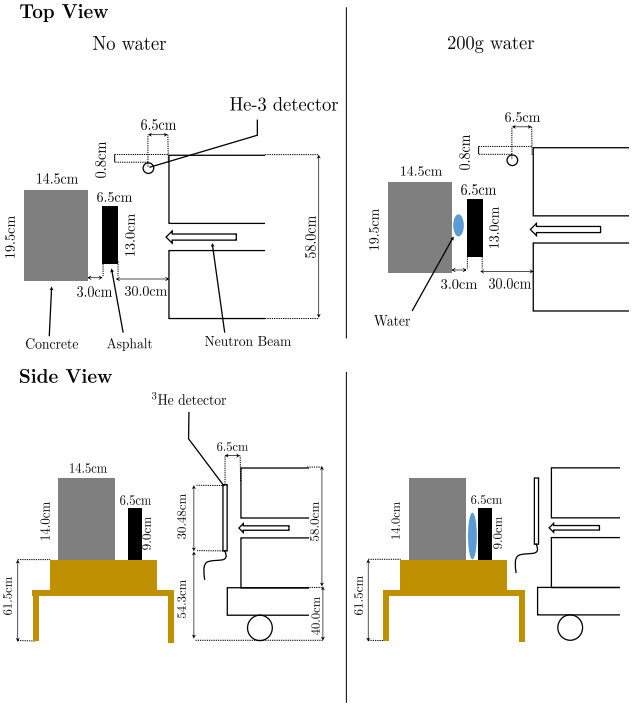

Fig. 2 Setup of the experiment of detection of water inside concrete structure

4 Conclusion

We have succeeded in developing Be photoneutron target for 3.95 MeV electron linac based X-ray source. We have also succeeded in water detection experiment of concrete structure, with 3σ of significance. As the future work, we will suppress neutron background noise by shielding the detector, in order to perform high signal-to-noise ratio water inspection. Moreover, we are going to optimize the Be neutron target by reducing the shielding materials, keeping enough radiation safety.

References

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