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Preparation of TBq Activity 7Be from SINQ Cooling Water

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7Be is an important radionuclide for investigations of several astrophysical processes and phenomena. The study of the destruction of 7Be during the first 10-15 minutes of Big Bang Nucleosynthesis (BBN) via the 7Be(n,alpha)alpha reaction could help to understand the longstanding problem in BBN theory - the disagreement of the predicted abundance of primordial 7Li with the observed one. Another application of 7Be is the study of key reactions concerning the solar neutrino flux, in particular the reaction 7Be(p, γ)8B.
10Be and its daughter products have been used to examine soil erosion, soil formation from regolith, as well as variations in solar activity and the age of ice cores. One of the "hot topics" is the half-life of 10Be, where the literature values differ from 1.34 to 1.51 My. Two very recent measurements support rather the lower value: 1.388 My and 1.386 My [1, 2]. Additional measurements are, therefore, urgently needed. One possibility is the use of LSC for the determination of the activity and ICP-MS for measuring the number of atoms. The mass-bias calibration of the ICP-MS requires at least 2 mass points in known amounts and since Be has only one stable isotope (9Be), 7Be can serve as the second marker.
Another application area of this interesting and rare isotope is the development of new construction materials, requiring sensitive methods for studying their wear resistance. Implantation of 7Be and follow up the changes of its activity can determine wear-out less than a micrometer.
7Be is produced in considerable amounts in the cooling water (D2O) of the Spallation Induced Neutron Source (SINQ) facility at PSI by spallation reactions on 16O with the generated fast neutrons. By-products can be nearly neglected, so that this cooling water establishes an ideal source for highly active 7Be-samples.
A shielded ion-exchange filter containing 100 ml of the mixed-bed ion exchanger LEWATIT was installed as a by-pass for the cooling water into the cooling circle of SINQ for 6 weeks. The collected activity of 7Be was in the range of several hundreds GBq. Further the 7Be was separated and purified in a hot-cell installed, remote-controlled separation system. The facility is capable for production of 7Be with activities up to 1 TBq per year.
1. G. Korschinek et al., doi:10.1016//j.nimb.2009.09020
2. J. Chmeleff et al., doi:10.1016/j.nimb.2009.09012

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