Contribution ID: **586** Contribution code: **SUSB011** Type: **Student Poster Presentation**

Design of 5 MeV SRF electron linac for wastewater purification

Sunday 25 August 2024 16:00 (2 hours)

Superconducting Radio Frequency (SRF) technology is a proven solution for generating high-power electron beams (EB), suitable for tasks like purifying wastewater from challenging impurities such as Per- and polyfluoroalkyl substances (PFAS). This paper elaborates on effectiveness of EB treatment and outlines design considerations for a 1.3 GHz SRF linac operating at 5 MeV with an average beam current of 10 mA. To get the high average beam current, attaining a high bunch repetition rate is important. The primary focus of the paper is on designing an injector which is able to generate high repetition beam with suitable short bunches for smooth acceleration to 5 MeV in a 1.3 GHz linac. Numerical analyses for accelerator system, ensuring that the beam reaches 5 MeV with the desired characteristics, lead to a compact beamline structure. This structure includes a 100 kV thermionic gridded gun, a 650 MHz buncher cavity, a 1.3 GHz 3-cell low beta booster cavity, and three 2-cell 1.3 GHz accelerator cavities, along with necessary focusing solenoids, all compactly fitting within approximately 4 meters. The results of the numerical studies conducted for all these components will be presented in this paper.

Footnotes

Funding Agency

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Session Classification: Student Poster Session

Track Classification: MC2: Electron Accelerators and Applications: MC2.5 Industrial and medical accelerators