A new SRF cavity polishing facility which covers the needs for present projects like the HL-LHC and its CRAB4 cavities as well as ongoing and future activities in the frame of the FCC study was commissioned at CERN in 2019. This facility can handle chemical and electrochemical polishing baths, starting at 400 MHz up to 1.3 GHz for elliptical type of cavities and more complex shapes as defined by the DQW and RFD CRAB design. The main subassemblies of this facility are presented. Some important design details and materials choices of the facility will be briefly discussed together with the range of operational substrates and geometries are discussed. First results on different substrates and geometries are presented. New results on surface finishing and polishing rate uniformly.

Introduction

CERN new facility for polishing SRF cavities was assembled and commissioned in 2019 with the purpose of covering the treatment of three main subassemblies. The facility is composed of three main subassemblies. Two independent chemical plants and one handling equipment. In the following paragraphs, this facility will be presented together with the range of operational substrates and geometries. First results on different substrates and geometries are presented. Results on surface finishing and polishing rate uniformly. First results on different substrates and geometries are presented. New results on surface finishing and polishing rate uniformly.

Facility description

The facility is composed of three main subassemblies. A first chemical plant to handle copper electropolishing bath (HPO4 55% v/v + r-45% v/v), a second chemical plant to handle niobium Buffered Chemical Polishing (BCP): HPO4 50% v/v + HNO3 25 % v/v + HF 25% v/v) or electrochemical (H2SO4 90% v/v, HF 10% v/v) polishing baths, and a cavity handling device, which has a useful working example of a bath volume of 1000 mm in diameter by 1500 mm in length and can handle charges up to 300 kg.

Chemical Plants: Each plant was assembled as an independent unit and the safety of the installation as it hinders any accidental mixtures of different baths in case of a leak or mishandling. This facility provides more flexibility for future modifications and improves the safety of the installation. Each plant is designed to enable the leak tightness of the whole facility.

Cavity Handling Device: A 3 D view of the cavity handling device is shown in Fig. 5 without the safety frame. The plant is designed in 316L stainless steel and the parts in contact with the chemicals are made of PVDF, PTFE or PFA. This device respects European machine safety regulations and is CE marked. As such, the device is partially enclosed in Fig. 5, and it is only accessible when it has stopped, has its own control unit, which is autonomous in terms of machine safety parameters allowing to stop the process whenever they are breached.

In Fig. 9a, the data from wall thickness removal distribution in the former facility, without rotation are compared to those of the new facility, with rotation. Furthermore, the resulting surface was homogenous in morphology, stain free and in line with what is expected from BCP processing, see Fig. 9b.

The second cavity type to be processed were two RFD CRAB niobium bulk cavities. Not all was perfect, and the processing was modified after the first RFD to avoid the formation of stains near some ports as shown in Fig. 10b. Mainly, the removal of the polishing bath remaining in the process lines and trapped within the cavity is ensured by a rinsing step. The second RFD cavity was processed with this new sequence allowing to achieve a homogenous morphology and stain free surfaces. The RF performance achieved on this cavity was extremely good (up to 6.9 MHz, Q0 = 6x109) and provided the proof that this facility can deliver performing surfaces on SRF structures [3].

Conclusions

The new facility has proved that it is capable of handling and processing successfully a variety of geometries and substrates as by design. Namely, RFD CRAB and 1.3 GHz elliptical niobium monolayer cavities were BCP processed, and 1.3 GHz elliptical copper monolayer cavities were electropolished. High flexibility has been demonstrated allowing a rapid swap from one geometry to another, as well as from niobium to copper processing and vice versa. As experience is building up, the time and effort needed for assembling and dissassembling are becoming remarkably low, which allows a high availability of the new facility.

REFERENCES