Horizontal High Pressure Water Rinsing for KEKB Superconducting Cavity

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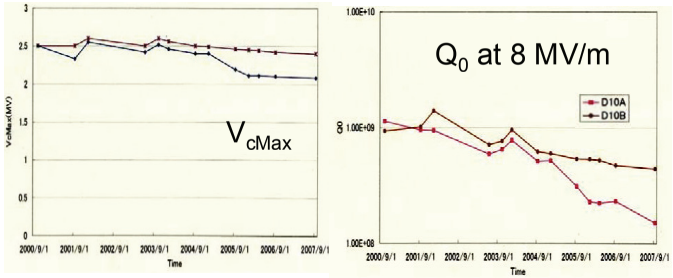
Summary
Usually, high pressure water rinsing of superconducting cavity is performed at vertical position to vent water and dusts smoothly. In KEKB cavities, there is a possibility that the cavities are contaminated with dust particles. To remove those contaminants at online tunnel, although the baking should be avoided because of indium joints, horizontal high pressure water rinsing (HHPR) would be useful. We have tested HHPR using KEKB proto type niobium SC cavity with 60 bar ultra pure water and an aspirator pumping system. Even without any baking, the cavity cleaned with HHPR achieved an accelerating field of 10 MV/m in a vertical cold test. The performance was similar to one before HHPR.

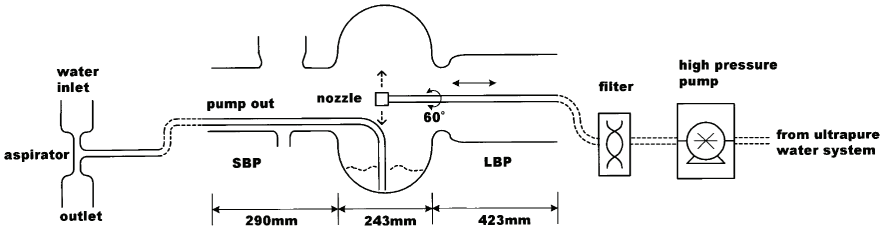
Degradation of V_{cMax} & Q value of KEKB cavities



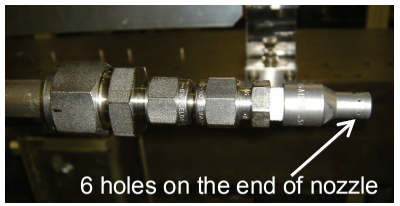
KEKB has been operated about ten years since 1999 with eight superconducting cavities for the high energy ring (HER). In the operation of KEKB HER, the maximum current is 1.4 A and the maximum HOM power is 13 kW. These values are higher than the designed parameters. Therefore the coupling constant of high power coupler for the cavities has been changed several times to correspond to the higher current and power. At that time, the degradation of the performances of cavity such as E_{acc} and Q values occurred possibly due to particle contaminations. In the current operating conditions of KEKB, those degradations of performances are acceptable. In the future project of super-KEKB (SKEKB) which is planned to operate with further higher beam current more than 2 A, the degradation will have to be removed in order to operate with those cavities.

Horizontal High Pressure Rinsing (HHPR) System

The trial of HHPR was carried out in the KEKB clean room for KEKB prototype Nb cavity.

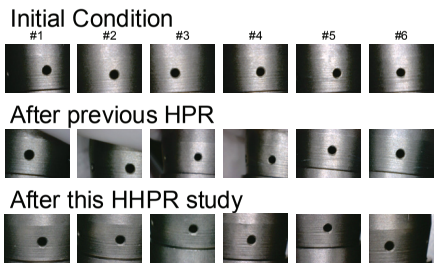


Cavity was electro polished and baked.
Ultra-pure water pressure : 60 bar
Holes : 6 holes, ϕ0.54mm
Driving speed : 10mm /15sec for LBP & SBP
5mm /15sec for Cell
Rotation speed : 60deg. / 5sec
Total time : 20 min.
Nozzle was manipulated manually.



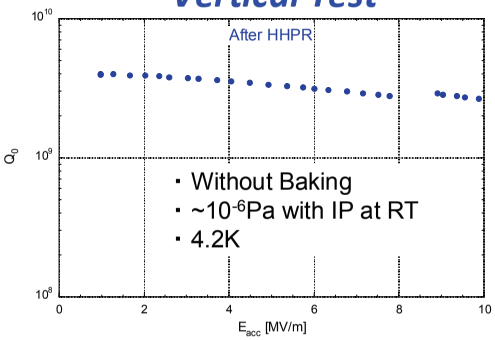
The nozzle was made of SUS 410.

Shape of Holes



Neither crack nor deformation was found.

Vertical Test



The cavity after HHPR was evacuated with oil free scroll type pump for long time to pump out remained water. Then TMP and IP were used. The pressure of cavity without baking was of the order of 10^{-6} Pa at room temperature. Vertical test of the cavity was carried out without any baking before cooling down. The maximum field reached 10 MV/m almost same as the previous experiment. This is encouraging results for our HHPR.

Conclusion

KEKB prototype Nb cavity which was baked once after the electro polishing was cleaned with HHPR as a trial. The maximum electric field of the cavity reached 10 MV/m without baking. We are planning further experiment fully assembled cavity with a high power coupler and indium joints. This type of HHPR system might be useful for SRF cavities of Super KEKB, and also for many same type cavities of synchrotron light sources.