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DEVELOPMENT OF VERTICAL ELECTROPOLISHING FACILITY FOR Nb 9-CELL CAVITY (2)

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Abstract

In IPAC18 (Vancouver, Canada), we reported our first step of development of niobium 9-cell cavity vertical electropolishing (VEP) facility. In this article, we will report the method, system for uniform polishing for niobium 9-cell cavities and the current situation of our 9-cell cavity VEP facility (the result of polishing uniformity, vertical test will be presented in other posters of this conference). In addition, we will show the movie of experiments of VEP-3 with Ninja cathode. This facility aims not only for test VEP but also for mass production and long-time operation.

INTRODUCTION

In May 2018, at the IPAC-18, we made our first historical report regarding our last 5 years of continuous R&D work on vertical electropolishing (VEP). In the last few months, further improvement has been made targeting good VEP results, system automation, and cost-effective mass production. This second report shows these improvements of the VEP facility. The detailed experimental VEP results are reported by Mr. Nii in TUPO067 [1], and Dr. Chouhan in TUPO068 [2].

DEVELOPMENT OF NINJA-VERTICAL EP SYSTEM

VEP system was designed to use it with our unique Ninja cathode. The system includes acid tank, auto-controlled valves, lower chamber for acid flow bifurcation, Ninja rotary system etc. Figure 1 shows the VEP system photos.

Figure 1: Photos of Ninja-vertical EP system.

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ADVANCED ACID TANK

The acid tank is made of clear PVC material and has a 70L capacity. In order to do EP with the least amount of EP solution, the solution is changed every one or two times of VEP process. Make sure the deterioration of the solution doesn't affect the EP finish. The tank is equipped with a niobium heat exchanger for liquid temperature control. The tank also has mesh filters and an ultrasonic oscillator used to remove hydrogen gas bubbles remaining in EP solution. Figure 2 shows the photos of the acid tank.

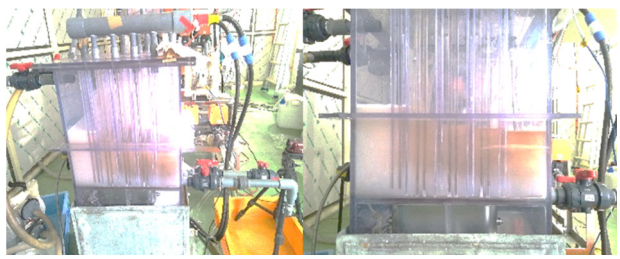

Figure 2: Photos of the acid tank.

AUTOMATIC CONTROLLED VALVES FOR EP SOLUTION CONTROL

For automatic control of EP solution path and direction, electric switching auto valves are used. The operation of valves are controlled with programmed sequences. This allows to select the acid and water flow from bottom to top and vice-versa. The acid and water flow rate can also be remotely controlled with a touch panel screen. Figure 3 shows the touch panel screen and auto valves.

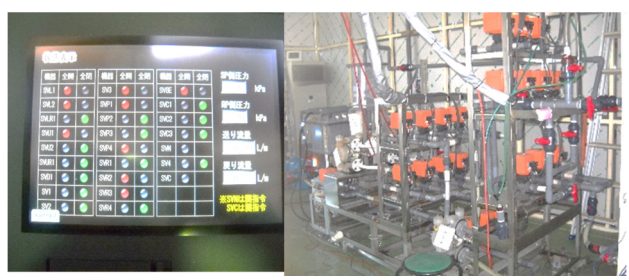

Figure 3: Photos of the touch panel screen and auto valves.

NINJA-VEP SYSTEM

EP solution is inflowed from the lower chamber, and the Ninja cathode is spun. A unique characteristics of the lower chamber is that it can bifurcate the EP solution and allow separate flows in the cathode housing and cavity. This

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process removes hydrogen gas bubbles quickly from the cathode and cavity. Figure 4 shows the schematic view and the photo of this system.

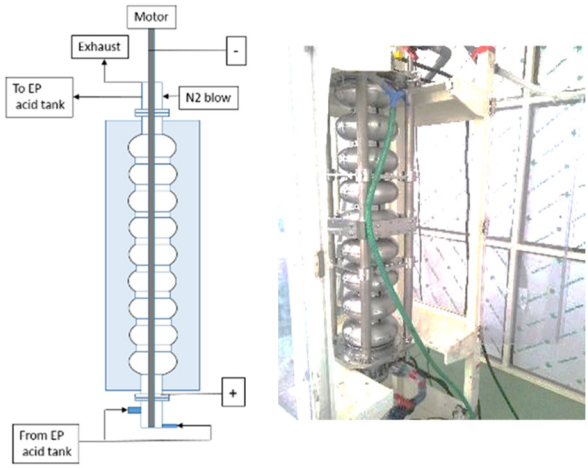

Figure 4: The schematic view and the photo of this system.

POST-EP PROCESS

After EP, the EP solution is drained from the cavity and the interior surface of the cavity is rinsed with pure water. The cavity is then goes to the high pressure water rinsing process. Figure 5 shows ultrasonic rinsing process.

Figure 5: A photo of ultrasonic rinsing process.

SUMMARY

In May 2018 at the IPAC-18 in Vancouver, we made our first report. Following that, we announced our improved version in our second report. The Ninja-type VEP version using manual valves is the basic system, and we are aiming for mass production system that will use auto valves, shorten the VEP time, improve process capacity, achieve uniform polishing, and improve the overall system performance. For the 9C up to the previous process, the inspection is complete, and approved parts are accepted.

REFERENCES

[1] K. Nii *et al.*, "Study on New Removal Thickness Distribution Improvement Methods for Niobium 9-cell Cavity Vertical Electropolishing with Ninja Cathode", presented at LINAC'18, Beijing, China, Sep. 2018, paper TUPO067, this conference.

[2] V. Chouhan *et al.*, "Vertical Electropolishing of 1.3 GHz Niobium Nine-Cell SRF Cavity: Bulk Removal and RF Performance", presented at LINAC'18, Beijing, China, Sep. 2018, paper TUPO068, this conference.

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