INTRODUCTION

In 2013 a new horizontal Electropolishing facility was developed and implemented by Ettore Zanon SpA.

More than 300 cavities have been treated by electropolishing for the preparation of cavities for EXFEL series production at EZ. Electro polishing was in use there for two major applications: bulk removal during series production and recovering of cavities with surface defects. For the LCLS II project the EP system will be updated.

EP TREATMENT

BPC flash production scheme for EXFEL:

140 µm EP as first cleaning + 10 µm BCP after He tank integration

Main Parameters for EXFEL:

- Voltage : 17 V
- Average current value: ≈ 270 A
- Average acid temperature value: ≈ 32 °C
- Acid flowrate: 10 l/min
- Automatic current and temperature control
- Automatic movements and rotation
- Sensors for: temperature, pressure, flowrate, acid level
- Personnel and explosion safety → H2 and HF control
- Removal rate: ≈ 0.4 µm/min
- Main EP completed in 6 hours

The facility can perform five bulk treatments per week (140 µm each) over a long period.

A one/two days maintenance every month is necessary to assure stable quality.

A typical EP treatment. The oscillating value is caused by the cooling system, that works as ON/OFF. Data taken each minute.

Here a test with the new wireless thermocouples that can be installed directly on cavity surface, at equators or irises. Almost instantaneous local temperature!

Average removal can be estimated from cavity weighing and from current integration:

\[ \text{µm} = \sum_{i=0}^{n} \left(1.484 \times 10^{-3} \times i \times \Delta t \right) \]

Data are in good agreement.

Comparison between material removal from weight vs current measurement.

Comparison between material removal by EP and cavities performances.

The material removed by EP causes a frequency variation in the cavity. Correlation depends on:

- differential removal iris/equator
- EP facility and parameters
- Data are quite scattered, but:
  - mean value used for cavity composition: 1 µm = 6 kHz
  - specification requirements fulfilled.

According to Desy request, several cavities did a longer EP to verify if a higher surface removal could improve Eacc performances. Data collected from 300 cavities show no correlation.

RESULTS AND CONCLUSIONS

Correlation between material removal and frequency variation.

Linear regression

\[ y = 5.8x - 15.4 \]

The completion of EXFEL production has shown that the facility is reliable.

- More investigation may be interesting to understand frequency variation behavior.
- As long as the minimum 140 µm removal is guaranteed, cavities electropolished with this facility perform well during vertical test, above requested goal (23 MV/m).
- Facing the new production of cavities for the upgrading of LCLS II, the process will be modified and verified according to specification of Jefferson Lab.