A Test of the High Voltage System of 1.7 MV Tandem Accelerator at KOMAC

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1. Introduction

The 1.7 MV pelletron-type tandem accelerator (NEC 5SDH-2) has been operating at KOMAC (Korea Multi-purpose Accelerator Complex), Gyeongju. The low energy beam implantation service is currently operating for user and Ion beam analysis service, PIXE and RBS will be start. So, terminal high voltage stabilization and beam quality must be good to provide stable service. Therefore, introduce the study on terminal voltage stabilization by adjusting corona probe position of 1.7 MV pelletron tandem accelerator.

2. System Description

The 1.7 MV tandem accelerator can accelerate a variety of ion species for use in PIXE, Implantation, RBS and nuclear physics experiments. Negative ion beams produced in a negative ion source are a little accelerated to 30 keV before being injected into the tank (5SDH-2). The negative ions are taken to the positively charged high voltage terminal and they are stripped of two or more electrons and converted into positive ions in stripping system. Positive ions are repelled by the voltage terminal and ions are accelerated once again[1]. The method of applying high voltage up to 1.7 MV in KOMAC uses the principle of van de Graaff accelerator. However, KOMAC tandem accelerator is pelletron-type. It is more efficient than the original type because it can charge in double. The precise regulation of the high voltage terminal of tandem particle accelerators has three models of Terminal Potential Stabilizer (TPS) systems. These systems use two simultaneous control elements, together two feedback systems, to maintain a consistent terminal voltage[2]. 1.7 MV Tandem accelerator use the GVM (Generating Voltmeter) mode. As a result, the terminal voltage stabilization is improved only when the charging system is well maintained by comparing the measured column current with the theoretical value, also comparing the balance between chains current and measuring the difference charging and discharging current. Finally, based on data will find the ideal corona probe position.

3. Results and Discussion

3.1 Column current

The column is a composite structure that provides mechanical support to the terminal and the tubes as well as electrical insulation and potential distribution between the terminal and ground. A series of resistors, 555 Mohm, are mounted in the acceleration tubes. So the terminal voltage can be inferred by measuring the column current.

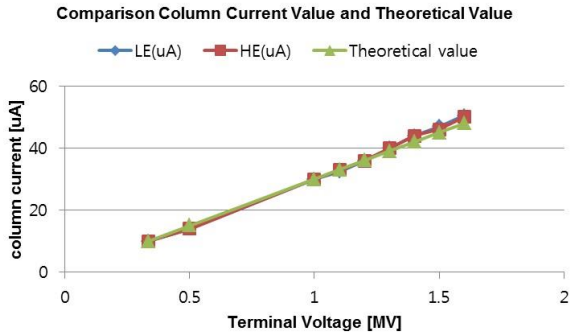

Fig.1. Compared column HE/LE current with theoretical value.

The terminal voltage can be calculated from two column currents. Comparing to the Terminal voltage value measured by GVM, it is consistent.

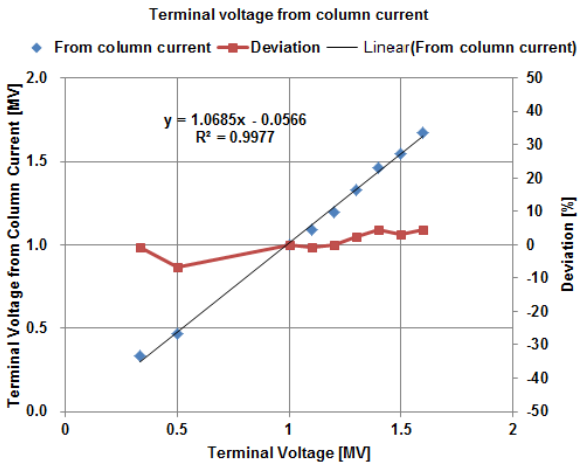

Fig.2. Relationship between terminal voltage measured by GVM and terminal voltage inferred by column currents.

3.2 Corona probe current

Terminal voltage in the 5SDH-2 is stabilized by corona current drain between the terminal and a needle of the corona probe located at the tank wall[1]. To permit control over a wide range of terminal voltage, the

needle need to move to the correct position. The corona probe properly adjusted it should draw about 20 μA with 7 – 10 V on the grid. So by the conditions mentioned above, the tandem accelerator in the KOMAC is measuring the corona probe position.

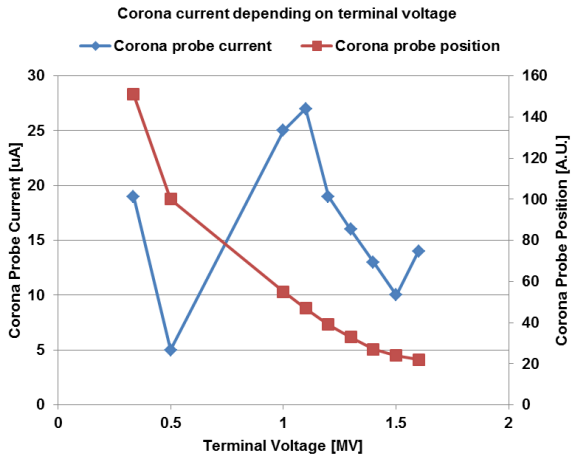

Fig.3. Corona probe position according to terminal voltage.

3.3 Chain current

The 5SDH-2 Pelletron Charging system consists of two chains. The balance between two chain currents was within 5% and the balance between charging and discharging current was also less than 5%, which showed that the high voltage system is well maintained[3].

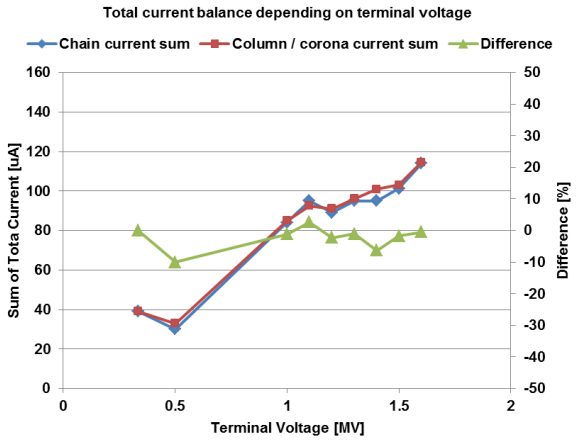

Fig.3. Total current balance depending on terminal voltage

4. Conclusions

Because of study on stabilization of 1.7 MV Pelletron Tandem Accelerator have been able to drive the high terminal voltage operation to nearly limit. However, there is a problem in that the corona probe current should be similar to the bias current setting. This problem will be improved to find the proper corona probe position for stable 1.7 MV Tandem Accelerator operation.

REFERENCES

[1] NEC(National Electrostatics Corporation), Instruction Manual for Operation and Service of 5SDH-2 Pelletron Accelerator , 1986.
[2] NEC(National Electrostatics Corporation), Terminal Potential Stabilizers, 2017.
[3] Hyeok-Jung Kwon, Operation of the 1.7 MV Tandem Accelerator for User Service, Transactions of the Korean Nuclear Society Autumn Meeting, Goyang, Korea, October 24-25, 2019.