ELV-Type (Rectifier) Accelerators and their Applications

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Electron accelerator of ELV-type was designed in Budker Institute of Nuclear Physics (Novosibirsk, Russia) and this accelerators have found wide application in industrial technological lines and in research laboratories.

First accelerator of ELV-type was designed in 1971 year and now more then 60 accelerators are operating in different countries and different application. Today we manufacture ELV-type accelerators, which cover energy range from 0.2 MeV up to 2.5 MeV with maximum power up to 100 kW and maximum beam current up to 100 mA. These accelerators can be supplied with different type of devices for extraction of electron beam into atmosphere such as "linear scanning", "two side scanning", "ring scanning" and "concentrated beam system". Different type of extraction system expand the areas of application of accelerators. The main areas of application of ELV-type accelerators is as following:

- radiation modification of cables and wires insulation for an operating temperature ranging from minus 60 to plus 100 degrees and up to 200 degrees in short usage;
- manufacturing of thermal shrikable items;
- extrusive rubber items;
- hardening the coating on various sublayers;
- disinsectization of grain;
- metal processing (hardening, facing, welding, ets);
- purification of sewage water of public, industrial and cattle compelexes;
- wrinkle free textile by draft polymerization.

All accelerators of ELV-type have control system on the base of computer. This control system provides the control and monitor for all systems of accelerator as well as parameters of electron beam. Graphical diagrams and menu system provide for operator personal friendly interface.

At present time we are testing new modification of ELV— type accelerator. We have designed and manufactured the new accelerator with maximum energy up to 1.0 MeV and maximum power of electron beam up to 500 kW. This accelerator was designed on the base of high voltage rectifier which essentialy different from standard one. High voltage rectifier with output voltage up to 1.0 MV and output power up to 500 kW has step-up secondary coil set and inside of this set we have primary winding with steel core. Accelerating tube is placed in additional high pressure vessel and this tube is connected to high valtage rectifier with gas feeder. Output voltage of high voltage rectifier is measured with electric field measuring device of rotor-type. This measuring device is placed in the vessel with accelerating tube. Power supply unit for electron gun is designed on the base of additianal generator and, therefore, beam current stabilising system is independent from output voltage of high voltage rectifier. Primary winding of high voltage rectifier is supplied 1000 Hz main. As the result of this designing we have high voltage rectifier with output power up to 500 kW and with small overall dimensions (1350 mm in diameter and 3740 mm in length).

Maximum value of beam current for this accelerator is equal to 0.5 A. Therefore, there is difficult to use "linear scanning" device for extracting of electron beam into atmosphere through the foil. In addition, the ripple of the output voltage of high voltage rectifier is not small, and, therefore, there is not possible to use "concentrated beam" device with system of lenses for extraction of electron beam into atmosphere. To solve this problem, we have designed new device for extracting of powerfull beam into atmosphere through small hole. We have used the effect of adiabatical decreasing of beam size in increasing longitudal magnetic field. In this case cathod of electron gun, accelerating tube and extraction device are placed in longitudal magnetic field. The value of magnetic field on cathode and output diaphragm is equal to 110 Gs and 9000 Gs respectively. Vacuum in accelerating tube and extraction device is provided with system of differential pumping with 6 steps. Accelerating tube in longitudal magnetic field was tested in requperation mode with the beam current up to 1 A at the energy up to 1 MeV.

At present time we have finished the testing of accelerating tube and extraction device with beam and have reached the beam current value 0.6 A at energy 0.6 MeV. The experience of operation with beam permits us to modificate some system of accelerator:

After the end of this modification we are planning to continue experiments with this accelerator to reach the energy up to 1.0 MeV.

The similar accelerator with the power in beam up to 200 kW will be instaled in pilot installation for electron beam processing of exhaust gases of powerfull electrostation Mironowskaja and we are planning to increase the power of this accelerator up to 400 kW in future.

REFERENCES

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