Equipment and method of investigating and testing accumulator batteries for the telecommunications

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Abstract – **A piece of electronic equipment for the telecommunications has been developed, with computer control and management, for testing and investigating accumulator batteries by using autonomous electric supply. An accompanying methodology has also been developed that uses the electrical parameters of the accumulator batteries measured by the electronic equipment to calculate automatically the active internal resistance of all cells, whereby the defective ones are immediately shown in a graphic form.**

Keywords – **battery, impulse current, telecommunications.**

It is common knowledge for Bulgaria that many stationary accumulator batteries are supplied and installed, belonging to different electrochemical systems – lead-acid, nickel-cadmium, etc., for the needs of the telecommunications. One of the major applications of stationary accumulator batteries is the autonomous direct current electric supply for own needs in telephone exchanges, major stations of mobile telephone operators and Internet providers, etc., according to the requirements of the regulations in force.

Well known are the high requirements with respect to the electrical characteristics of accumulator batteries for the reliable and safe work on an autonomous direct current electric supply for own needs in telephone exchanges, major stations of mobile telephone operators and Internet providers, etc., according to the requirements of the regulations in force, in cases of failures of the alternate current supply.

One of the major requirements from the point of view of responsibility is, when using accumulator batteries in a mode of emergency for own needs for a period of 1-2 hours that the discharge current should not fall below a certain electric voltage, which guarantees the reliable and safe functioning of telephone exchanges, major stations of mobile telephone operators and Internet providers, etc. Many are the factors that influence this crucial electric indicator but most important among these are the average voltage in undercharge, the driving electrical voltage and the discharge electric voltage in an emergency discharge current of the cells or the monoblocks.

These electric indicators depend and are unequivocally determined by the active internal resistance of every element (a cell of 2,0 V, monoblock of 4,0 V, 6,0 V and 12 V), which guarantees an average electric voltage at an undercharge of lead-acid cells of 2,23 to 2,27 +/- 1,0 % V and a corresponding minimally admissible discharge voltage of accumulator batteries. This shows how crucial it is, during the periodic guarantee and post-guarantee testing of accumulator batteries for own needs in telephone exchanges, major stations of mobile telephone operators and Internet providers, etc., according to the requirements of the regulations in force, for the internal resistance of all cells to be determined.

On the basis of the above-mentioned critical requirements for the electrical characteristics of accumulator batteries, according to the Regulations, BDS, EN, BS, etc. it is necessary to carry out periodic measurements, tests, trials and investigations of accumulator batteries. During the periodic guarantee and post-guarantee testing and investigations of accumulator batteries it is necessary for many requirements to be met, which ensures the readiness of accumulator batteries for guaranteed autonomous direct current supply for own needs while not switching off the batteries, etc. We must stress that, unfortunately, a major deficiency of the producers and importers of accumulator batteries is that they do not offer, and are unable to offer, guarantee and post-guarantee servicing, because they do not have qualified personnel, methods and equipment in this crucial interdisciplinary field involving responsibility. Apart from that, there is a certain practice that does not guarantee the quality of the accumulator batteries that are imported. This practice is such that the importers of accumulator batteries offer this and the approval tests are "carried out" in the producer companies. We would immediately point out that the tests of a certain number of the accumulator cells that have been prepared by the company in advance do not guarantee the same electrical characteristics of those supplied later in tenfold quantities. This negative opinion of ours is confirmed in the current practice in Bulgaria of accumulator batteries imported by various Bulgarian companies and various European producer companies – we have established this from our periodic guarantee and post-guarantee measurements, tests, trials and investigations of accumulator batteries from various electrochemical systems and for various industrial applications.

Developed at the Electrotechnical Faculty of the Technical University of Sofia were: equipment and methodology for testing, investigations and trials of accumulator batteries for the telecommunications and other industrial applications.

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All the parameters for measurement, testing, investigations and trials of accumulator batteries (charging current, duration of the charging current, discharging current, duration of the discharging current, form of the charging or the discharging current, maximally admissible charging electrical voltage, minimally admissible discharging electrical voltage, etc.) are given in advance and during the testing they are managed, measured and recorded in tabular and graphic form by notebooks.

Some data of the equipment developed with computer control and management, microprocessor control and management with the particular technical characteristics and industrial applications are:

1. Programmable source of current with computer control, management and registration with nominal data:

- charge and discharge impulse current – 20 A.
- nominal voltage – up to 34 V.
- the electrotechnology is patented in Bulgaria and abroad (USA, Russia, Germany, England, etc.).

Application:

- charge with an impulse current of accumulator batteries.
- recycling with an impulse current of accumulator batteries.
- tests of hermetic and stationary (acid and alkaline) accumulator batteries.
- tests prior to approval in the import and export of accumulator batteries.

2. A stand for training and for investigations of systems for own needs with the following nominal data:

- charge impulse current – 20 A.
- discharge impulse current – 20 A.
- nominal charge and discharge voltage 200-300 V.
- the method and the electrotechnology are patented in Bulgaria and abroad (USA, Russia, Germany, England, etc.).

Application:

- charge with an impulse current of lead accumulator batteries.
- charge with an impulse current of alkaline accumulator batteries.
- discharge-charge cycles with an impulse current for restoring the electrical characteristics and for guaranteeing the operational life of accumulator batteries for energetics, the telecommunications, transport, etc.
- tests prior to approval of stationary and traction accumulator batteries for various industrial applications.
- servicing of stationary and traction accumulator batteries for various industrial applications.

3. A programmable discharge generator of current with microprocessor management and registration with nominal data:

- discharge current up to 300 A, according to the nominal capacity.
- discharge electrical voltage from 8 to 12 V.
- automatic printing of the results on paper:

Electric drive voltage of the accumulator battery.

Discharge current in testing.

Discharge voltage for the 1^{st}, 2^{nd}, 3^{rd}, 4^{th} and 5^{th} second

Information for every accumulator battery:

1. BATTERY OK
2. NOT EQUAL TO REQUIREMENT
3. TEST FAILED U < 8,00 V
4. Date / signature:…….

Application:

- automatic testing of various accumulator batteries under load for:

The degree of charge of the accumulator battery.

Short circuit in a cell.

A broken path in the accumulator battery, etc.

The electronic equipment is used to carry out tests, measurements and investigations of lead-acid and alkaline stationary accumulator batteries for various industrial applications.

As mentioned above, one of the electrical parameters of the accumulator cells is the low and equal internal resistance of the accumulator batteries, which guarantees a long operational life – over 15-20 years.

At the Electrotechnical Faculty of the Technical University in Sofia, a methodology and a software were developed for calculating the internal electrical resistance of all the cells of the accumulator batteries, during normal operation, without interrupting the guaranteed autonomous supply of electricity to the site. Using the methodology and the software, the internal resistance of all the cells is calculated, both during charging with a different current, and during discharging with different discharge current for own needs and at different ambient temperatures.

The methodology developed allows measuring and memorizing, using electronic equipment, of the concrete values of the current and the voltage of all cells during charging, discharging, without interrupting the normal operation of the accumulator batteries. The values of the current and the electrical voltage measured during charging, during charging with a different current, during discharging with different values of the discharge current, and the electric drive voltage of the electrochemical cells are transferred to the PC, according to the methodology and the software developed, where the internal resistance of all cells is automatically calculated during charging, during charging with a different current, during discharging with a different current and during charging according to different technologies and standards. The original and real results obtained for the active resistance of the accumulator cells in the various electrochemical processes are printed out in the form of tables and graphs. The tables and graphs immediately show the numbers of the accumulator cells that have significantly different internal resistance and do not, respectively, meet the requirements and do not guarantee a reliable and safe operation of the electrical substation.

The analysis made of the results obtained leads to the following major conclusions and recommendations:

1. An original methodology, the software and the equipment for testing, investigations and trials of accumulator batteries for industrial applications were developed.

2. All accumulator batteries for own needs must be subjected to guarantee and post-guarantee measurements and

tests for meeting the major electrical requirements, that would guarantee their reliable and safe functioning.

3. All accumulator batteries for own needs must be subjected to approval measurements, investigation and tests for guaranteeing the major electrical requirements according to the technical regulations – BDS, E N, etc., after their on site provision and installment that would guarantee their reliable and safe functioning.

4. It is necessary to carry out periodically recycling charge-discharge cycles with a computer-controlled impulse current, management and registration of the charge-discharge current, charge and discharge voltage, automatic calculation of the quantity of electricity and electric energy, the active internal resistance of all cells of accumulator batteries, that would lead to a decrease of the internal resistance of the cells, to lengthening and guaranteeing the operational life of the accumulator batteries and their reliable and safe functioning, respectively.

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