E N E R G Y

SCIENTIFIC AND TECHNICAL JOURNAL

1(49)/2009

Tbilisi

SUMMARIES

GEORGIAN MAIN PRIORITIES OF ENERGY DEVELOPMENT. *A.Khetaguri, A.Nikolaishvili.* "Energy". Tbilisi. 2009. №1(49). p. 3-12. geo. sum. geo. engl. rus.

The article discusses the opportunities of utilizing renewable energy sources in Georgia and priorities of their development.

Given the efficiency of using renewable energy sources, water, wind, sun and geothermal water energy have been compared in the article. Among natural wealth of Georgia, hydro power resources with annual potential capacity of 15000 megawatts and average annual power generation equaling 50 billion kilowatt/hour take the first place.

Given the peculiarity of Georgian rivers, which are characterized by clearly defined seasonality, it is possible to redistribute these resources by constructing ecologically acceptable seasonal power plants. Besides, modernization of the power units of Tbilisi Power Plant on the basis of contemporary energy efficient steam power technologies and introduction of cogeneration in towns need special focus. This will provide combined generation of electric and heat power in low and medium capacity gas-turbine units - heat and power plants.

The article provides analysis of the potential to construct hydro power stations in Georgia in future. Layouts of the infrastructure necessary for transferring and distributing power have been drafted too. Ill. 2, bibl.3.

MODERNIZATION OF POWER UNITS OF TBILISI POWER PLANT USING TRADITIONAL METHODS. *A.Khetaguri, G.Chitashvili.* "Energy". Tbilisi. 2009. №1(49). p. 13-16. geo. sum. geo. engl. rus.

The article discusses several methods of modernization of 150 megawatt Tbilisi power plant units. It is underlined, that first of all, regeneration system of turbosets need an upgrade by replacing low pressure surface heater section with mixer heaters. They are cheaper, run by zero underheating and provide an increased power unit efficiency factor of up to ~ 1%.

Second modernization method of functioning steam-turbine power units involves their conversion into the so called extended efficiency units. In such case, an additional so called turbine economizer, increasing the unit efficiency factor by 1,5-2%, should be installed in steam boiler gas pipes of each unit. At the same time, the capacity of each turbine will increase by 5-7% i.e. by 8-10 megawatt due to limiting regeneration in high pressure heaters, which will be achieved without consuming any additional fuel.

The article reviews many other possible methods of modernization of the power units of Tbilisi Power Plant envisaging various constructive improvements and an increase of working body parameters such as an increase of initial steam temperature and reheat temperature by 10^0C (above nominal), which taking into the account current technical condition of Tbilisi Power Plant will not be reasonable, as problems may arise in boiler and with regard to elongation of the turbine rotor. Given this, we think it rational to modernize the power units of Tbilisi Power Plant by using mixer type low pressure heaters and installing turbine economizers. Ill.2, bibl. 12.

METROLOGICAL PROVISION OF JSC TELASI. *M.Kobalia, D.Kandelaki, B.Tsopurashvili, G.Nemsitsveridze, I.Chichua.* "Energy". Tbilisi. 2009. №1(49). p. 17-21. geo. sum. geo. engl. rus.

The article reviews a complex of activities relating to metrological provision of Telasi. It is shown, that under the requirements of normative documents envisaging the supply of appropriate quality power, there have been laboratories for certifying new informative and metering equipment and running physical and chemical analysis of transformer oil founded and introduced at Telasi. It is also shown, that the laboratories are upgraded and modernized to test electric units and certify electric metering units.

A simplified diagram showing which laboratories, equipment and tasks are used for the fulfillment of the issues relating to the metrological provision of Telasi is provided in the article. Some normative requirements applicable under current state standard are given in table.

It has been determined, that the results associated with the quality of power production correspond to the normative requirements given in presented table. Diagram 1, bibl. 10.

ABOUT PROCESS FLOWSHEET OF TKIBULI SHAORI FIELD DEVELOPMENT. *I.Rekhviashvili, T.Pirtskhalava.* "Energy". Tbilisi. 2009. №1(49). p. 22-26. geo. sum. geo. engl. rus.

The article gives brief review of the process flowsheet used at Tkibuli Shaori field. It is shown, that the process flowsheet used at Tkibuli Shaori field complies with the conditions of low rate mines equipped with primitive technologies which are on state subsidy.

The article suggests the process flowsheet which involves opening of total field reserves with tilting boreholes with conveyance, splitting the mine field into separate compartments with posts exceeding 1500m,

using effective mechanized complexes when the number of mining face does not exceed 4 (with the daily load exceeding 3000t).

The process flowsheet enables to maximally increase concentration of production and provide reasonable conditions for intensive field development as a result of which unprofitable coal industry will turn into a profitable one. It is necessary to increase state control on the fulfillment of license terms and conditions. It is also necessary to give priority to the preparation of State Target Program for Rehabilitation of Georgian Coal Industry. Tabl. 1, bibl. 10.

INNOVATION PHOTOVOLTAGE BLOCK WITH PHOTOELECTRIC CELLS LOCATED ON ONE AXIS IN LINEAR FOCUS OF OPTICAL CONCENTRATORS. *J.Avaliani, T.Khachidze*. "Energy". Tbilisi. 2009. №1(49). p. 27-29. geo. sum. geo. engl. rus.

The article is about the investigation of new photovoltage block consisting of gallium arsenide photoelectric cells and optical concentrators of solar radiation. Gallium arsenide photoelectric cells were made in Germany, at Fraunhoper Institute of Solar Power Systems (Freiburg) and were kindly presented by Dr. Bett to the article authors. Photoelectric cells were of round shape and their diameter was 5mm. Solar energy concentrators were estimated and made from optically transparent material – ПММА (polymethylmethacrylate) in Georgia (Institute Optica).

Main novelty of this study is that the photoelectric cells (6 photocells) are for the first time located on one axis in a linear lens focus. Such a scheme, due to decrease of the concentrator amount, enabled us to make it simpler and cheaper. Concentration of solar radiation during tests was 17. Experiments proved the potential of our method, especially for large capacity photovoltage blocks. Ill.2, tabl.1, bibl. 3.

PROBLEM RELATING TO ELIMINATION OF EMERGENCY CAPACITY DEFICIT IN ENERGY SYSTEM. *M.Rukhvadze, A.Kokhtashvili.* "Energy". Tbilisi. 2009. №1(49). p. 30-33. geo. sum. geo. engl. rus.

Transit from Azerbaijan to Turkey via the territory of Georgia can be done by 500 kV high voltage line called Mukhrani and 330 kV high voltage line called Gardabani. Line capacity of the latter does not exceed 350 megawatts, and in case of Mukhrani cutout, it is expected that it will be overloaded and switched off. Such circumstances will result in significant capacity deficit of Georgian energy system and failure of the system stability.

It is necessary to work out such an algorithm of systemic automatics in the transit of 500-1000 megawatts from Azerbaijan to Turkey, which will enable to provide both the supply of the above capacity to Turkey and cutout of minimum load of Georgian energy system, thus maintaining its stability.

For different performances and for different generator compositions, by modeling Mukhrani cutout, it has been determined, that when there is large capacity deficit in the system, in order to maintain the system stability and switch off as minimum amount of consumers as possible, it is necessary to immediately cut out certain amount of load in the system. The article presents the method of estimation of such load. Ill.1, tabl.3.bibl. 2.

ANALYSIS OF LIGHTNING PROTECTOR OF 500 KV AIR-LINE. *Z.Babunashvili, N.Gvaramadze, M.Makharadze, G.Arziani.* "Energy". Tbilisi. 2009. №1(49). p. 34-37. geo. sum. geo. engl. rus.

Reason for generating impulsive wave on power transfer line is an atmospheric discharge. The latter may occur on a high voltage air line or close to it, for instance on a phase structure, lightning protector or on the ground close to the line.

Lightning protection of 500 kV air line - Kartli-2 has been evaluated in a new way and rating software called ATPDraw was used in order to solve the task. Presentation of the elements being part of its electrical system is done by their mathematical model. The air line has been modeled by three-phase line parameters presented in a matrix form.

Overvoltage limiter is switched on at the end of the line. Its operating discharge voltage is 110 kV corresponding to testing impulsive voltage of 500 kV voltage line insulation.

Calculation results are given in form of curves. Ill. 6, bibl. 2.

ANALYSIS OF DYNAMIC STABILITY OF SYNCHRONOUS MOTORS OF RUSTAVI CHEMICAL CENTER – JSC ENERGY INVEST. *Z.Babunashvili, M.Rukhvadze, D.Dgebuadze.* "Energy". Tbilisi. 2009. №1(49). p. 38-41. geo. sum. geo. engl. rus.

Analysis of dynamic stability of synchronous motors of Rustavi Chemical Center has been run. An algorithm and technology of systemic automation the implementation of which, at the authors estimates, will enable to avoid the cases of failure of motor stability have been developed.

Analysis have been run based on mathematic modelling of 500, 220 and 110 kV network of Georgian power system. For this, the authors used software complex PSS/E. The case, when Rustavi chemical centre is fed from just Gardabani substation and at the same time, both power units of Gardabani airturbine power

station of JSC Energy Invest are running has been considered here. Modelling has been done for three different cases. Ill. 4, bibl. 3.

FOR ECOLOGICAL EVALUATION OF IMPACT OF NONIONIZING ELECTROMAGNETIC RADIATION ON HEALTH OF TBILISI POPULATION. *M.Kndaria, L.Urushadze*. "Energy". Tbilisi. 2009. №1(49). p. 42-48. geo. sum. geo. engl. rus.

The article reviews ecological problems arisen in Tbilisi power supply. First of all, this is about nonionizing electromagnetic radiation (man-made field) arisen during receiving, transferring and utilizing power. Since the second half of the 20th century, the scientists from all over the world have been working hard to thoroughly study negative impact of man-made fields both on environment and creatures living within such field. This very ecological factor associated with the exploitation of power supply lines was not properly taken into the account in designing and constructing the power supply system of both Tbilisi and Georgia. Besides, there have been no technical protection measures worked out either. This is why, there are power facilities located in some of densely populated areas and light voltage power transferring lines - on the roadways. The article presents recommendations about the compliance of power supply network with environmental safety of Tbilisi.

For the purposes to determine ecological norms corresponding with natural conditions of Georgia, it is recommended to establish eco-monitoring system. Such eco-monitoring system should be introduced and first of all be based on epidemiological investigation of the population living close to power facilities. It is also recommended to systematically monitor the degree of environmental pollution with nonionizing electromagnetic radiation in Tbilisi. Bibl. 5.

OPTIMIZING AND MODELLING THE DEVELOPMENT OF FUEL AND ENERGY COMPLEX OF THE REGION. *M.Razmadze, K.Vezirishvili.* "Energy". Tbilisi. 2009. №1(49). p. 49-53. geo. sum. geo. engl. rus.

The article reviews the issues relating to optimization and modelling of the development of fuel and energy complex of the region. Regional energy planning is aimed at the development of production forces and fuel and energy base in an optimal and mutually agreed way. The development of fuel and energy complex of the region should become a determinal factor for Georgian energy policy. The article also presents the methodology to run financial and economic analysis in order to increase power usage efficiency. Mathematical models have been worked out to optimize the development of both fuel and energy complex as a whole and separate (compartments) structures, which based on available information provide the solution of optimization tasks at different stages of planning.

The article demonstrates the formulas with which it is possible to calculate balanced interconnection of the consumption and supply of energy and fuel for energy industries and fuel and energy complex of the region, which is so important for normal functioning of Georgian energy and for establishing optimum national economy. Ill. 2, bibl. 2.

ANALYSIS OF STRESS-STRAIN STATE OF AN AAR-AFFECTED EXISTING CONCRETE GRAVITY DAM. *A.Motsonelidze, V.Abuladze, V.Lomidze.* "Energy". Tbilisi. 2009. №1(49). p. 54-58. engl. sum. geo. engl. rus.

The computation algorithm of AAR-affected existing concrete gravity dam involves a complex approach, which takes into account a) A Hypoelastic (Nonlinear-Elastic Fracture) constitutive model for concrete in the Plane Strain condition; b) Analysis of creep strain by means of modified Boltzmann-Volterra Theory of linear hereditary creep and using modified Hypoelastic constitutive model for dam concrete using calculated creep strain; c) Cyclic-induced degradation of stiffness and strength for concrete (Fatigue of Concrete); d) Aging-induced change of stiffness and strength for concrete (Aging of Concrete); and e) Alkali-Aggregate Reaction within the body of a concrete gravity dam. The mentioned approach and proposed model are described in cited [1] source of the paper. Ill. 5, bibl. 3.

INVESTIGATION OF THE PROCESSES OF ELECTRICAL DISCHARGE BETWEEN ELECTRODES ROTATING IN AIR SPACE. *P.Merabishvili, G.Tskhomelidze.* "Energy". Tbilisi. 2009. №1(49). p.59-63. engl. sum. geo. engl. rus.

Process of electric discharge between the electrodes rotating in low pressure air space has been studied. It is shown, that the relation of discharge voltage to air pressure (Pashen curve) does not depend on geometrical parameters of the electrodes (while the distribution of the electric field is monotonous). It is determined, that the discharge voltage significantly depends on the electrode movement rate. The higher the electrode movement rate, the lower the air discharge voltage. It is also determined, that in case of the electrode rotation, an ignition potential also depends on the polarity of applied voltage. Formula for estimating electroconductivity of the air considering the fact, that gas current in a low pressure is predominantly conditioned by the electrons, has been received. Theoretical explanation of the obtained experimental results are provided in the article as well. Ill. 3, bibl. 6.

DEVELOPMENT OF ECOLOGICALLY PROTECTED TECHNOLOGY TO PRODUCE RARE-EARTH METAL CONTAINING ALLOY FROM METALLURGIC AND CHEMICAL INDUSTRY WASTE PRODUCTS. ***B.Gogichaishvili, T.Tsertsvadze.*** **"Energy". Tbilisi. 2009. №1(49). p. 64-66. rus. sum. geo. engl. rus.**

The article presents the technology of complex alloy production using metallurgic and chemical industry waste products, such as rare-earth metal production residues, aluminum chip shifting, electrolytic manganese dioxide production residues and concentrate of Chiatura carbonate manganese mineral. Proposed technology provides the production of high quality complex alloy. Composition of the waste gas has been studied; Ecological monitoring has been run throughout the entire process. Two-stage gas cleaning system has been worked out to reduce atmosphere air pollution.

It has been experimentally determined, that it is possible to produce rare-earth metal containing alloy from metallurgical and chemical industry waste products. Suggested complex alloy is used for deoxidation and modification of steel. Tabl. 3, bibl. 4.

TREATMENT OF LIQUID STEEL WITH EXOTHERMAL SLAG-FORMING MIXTURE AND SELECTION OF METHOD TO CLEAN EXIT GAS. ***B.Gogichaishvili, Z.Svanidze.*** **"Energy". Tbilisi. 2009. №1(49). p.67-70. geo. sum. geo. engl. rus.**

Contemporary technologies of steel production include many such ways of treating liquid steel without oven as degassing in ladle, injection of chemicals into ladle, steel treatment with exothermal slag-forming mixtures, etc. For the treatment of liquid steel without oven, we have developed the exothermal slag-forming admixture consisting of high aluminic complex alloy, fresh fired lime and calcium fluoride.

Treatment of liquid steel with slag-forming mixture has been run under different mixture consumptions. Desulfurization and deacidification degree of the slag-forming mixture is given too. High performance of mixture has been determined experimentally. It should be noted, that in treating steel with the suggested mixture, the amount of nonmetallics decrease and this provides the improvement of steel quality. Composition of exit gas in treating liquid steel with slag-forming mixture has been studied as well.

Efficiency of gas cleaner system has been justified. Tabl. 3, bibl. 6.

COMPARATIVE DATA OF SOUND LEVEL IN POWDER METAL SPRAYING USING TURBULENT AND LAMINAR FLUX OF PLASMA. ***M.Khutsishvili, L.Kikvadze, G.Khutsishvili.*** **"Energy". Tbilisi. 2009. №1(49). p. 71-73. rus. sum. geo. engl. rus.**

An accurate impulsive sound level metering unit PSA-202 with any time dependence was used for metering sound level. The unit provides frequency regulated sound level and impulsive sound level measurements.

The article presents drawing of plasmatron the anode-jets of which were used for spraying with high enthalpy laminar flux of plasma.

It is experimentally justified, that in case of spraying with laminar plasma flux, the sound level drops down by 20% for one and the same arc power.

Figure 1 presents a diagram showing the dependence of sound amount on the arc power.

Powder with 40-70 mcm grain size and NPA-80 grade was used during spraying (component content Ni 80 and Al 20%).

Argon was used as plasma generating gas. Consumption ranged within 2-4 m^3/hour. 6mm jets were used for turbulent plasma and 7mm jets – for laminar plasma.

Figure 2 shows axonometric view of anode-jets. Ill. 2, bibl. 5.

ANALYSES OF METHODS OF DESIGNING PERMANENT TUNNEL LINE IN CONSTRUCTING TUNNEL USING NEW AUSTRIAN METHOD. ***T.Tchuradze, G.Meparishvili, N.Kvatchadze, N.Maisuradze.*** **"Energy". Tbilisi. 2009. №1(49). p. 74-79. geo. sum. geo. engl. rus.**

Many different design methods have been proposed for such cases when tunneling is performed with New Austrian method. The article presents the characteristics of some of them.

According to Austrian Professor L. Rabtsevich, in driving round tunnels, the surrounding soil starts collapsing in form of stripes. According to Linder, the only thing necessary to know during designing is the value of tunnel line resistance, or in other words the value of the radial direction under which the line starts to collapse. According to Fenner, line resistance value can be determined in just analytic way.

The article discusses the possibilities of using finite elements in designing tunnel line. Among methods considering the usage of simulation digital model, first of all the software "FINAL" proposed by Prof. Svoboda (Austria) should be noted together with softwares "RUPS" and "LIRA" developed At ЦНИИС tunnel laboratories (Moscow) and Institute of Architecture and Construction (Kiev).

Department of Bridges and Tunnels of Tbilisi Technical University developed fundamentally new model enabling to consider particular features for designing the tunnel line in tunnelling with New Austrian method. Ill. 1, tabl. 1, bibl. 11.

WATER – VITALLY IMPORTANT AND INDUSTRIAL PRODUCT. ***A.Nadiradze, A.Lezava.*** **"Energy". Tbilisi. 2009. №1(49). p. 80-82. geo. sum. geo. engl. rus.**

The tables present water reserves on earth, main requirements to water quality, chemical composition of water and harmful substance content. Except that water is the first vital product for a human being, it is also the main component for preparing construction materials and products. It is an active basic component in the preparation of solutions and concrete. Except for drinking water which is mainly used here, water from river and water storages with hydrogen value of PH<4, mineral salt content – not exceeding 5000 mgr/l including sulfates of no more than 2700 mgr/l (recalculating on SO_4^{-2}) may be utilized as well.

Water appropriateness may be determined by tests. For this, the test samples of industrial and drinking water should be tested when they are 28 days old. Water can be considered appropriate, if the strength of the samples made on it does not yield to the strength of the concrete samples made on pure drinking water. Tabl. 4.

TESTING AND CALIBRATION OF EQUIPMENT AND MACHINERY USED ON ON-SHORE TERMINAL. ***D.Nadiradze.*** **"Energy". Tbilisi. №1(49). p.83-85. geo. sum. geo.engl. rus.**

The present work considers necessity of testing and calibration for equipment and machinery installed on "Western Road Export Pipeline" according to the international standards and regulations.

We tested and carried out the calibration on the following equipments and machinery: Motorized Operating Valves, Turbines and the meters thereof, Pressure Transmitter, Temperature Meter, Densitometer, Viscometer, Water Percentage Meter, Prover Loop, Flow Computer configuration and etc.

All above provides perfect and prompt exploitation of the objects. Bibl. 7.

THERMOINSULATION AND EFFECTIVENESS OF CONTAINING WALLS OF MULTIFUNCTIONAL MUSEUM AND HOTEL COMPLEXES BEING CONSTRUCTED IN TBILISI. ***G.Tsintsadze, M.Amkoladze.*** **"Energy". Tbilisi. №1(49). p. 86-91. geo. sum. geo.engl. rus.**

Effective utilization of power and protection of the environment are main concerns for the entire civilized world.

The article discusses the issues of thermoinsulation of containing walls on the example of public multifunctional buildings being constructed in Tbilisi a draft of which has been prepared by the article authors.

The article also touches the issues relating to the economy of thermoinsulation works, cost of heat losses before thermoinsulation, cost of thermoinsulation works, term of thermoinsulation cost payback as well as justification of profitability of such activities for both constructing buildings and old buildings. Ill. 2, bibl. 3.

UTILIZATION OF MTKVARI RIVER ENERGY WITHIN TBILISI CONSIDERING URBANIZATION PROBLEMS. ***T. Lortkipanidze, G. Gigiberia, V. Jamarjashvili.*** **"Energy". Tbilisi. №1(49). p.92-94. geo. sum. geo.engl. rus.**

Kura river is canalized in the city center and submerged at particular length. In other areas, during shallow water period that lasts 8-9 months a year, the river-bed gets bared and distorts the city view. In order to prevent this and give the city more contemporary urban shape, a proposal to construct several hydro power stations with collapsible platimun (analogy to Ortatchala hydro power station) has been prepared. By doing so, the Mtkvari river will be more full-flowing. There will be four hydro power stations with the total capacity of 43,5 megawatts (generating 217,5 mln kW/hour power) constructed in the city. Implementation of the proposal will substantially improve the overview of the city center.

The hydro power station parameters have been selected in such a manner that the quays in the city center will maintain their dimensions. Chart 1, tabl. 1, bibl. 2.

CONCRETE MECHANICAL CHARACTERISTICS AT TORSION WITH DIFFERENT DEFORMATION VELOCITIES. ***A.Sakvarelidze, N.Gudushauri, M.Giorgadze.*** **"Energy". Tbilisi. №1(49). p.95-96. geo. sum. geo.engl. rus.**

Influence of deformation velocity on mechanical characteristics (strenth, deformation, module of shear) of fine concrete at torsion is investigated.

Tests were conducted on universal testing machine "Instron-1115" at five levels of deformation velocity: $0{,}56x10^{-7}$; $0{,}56x10^{-6}$; $0{,}56x10^{-5}$; $0{,}56x10^{-4}$; $0{,}56x10^{-3}$ 1/sec. Practically all area of statical loading is examined.

There were tested specimen-cylinders (diameter d=17 mm and length l=610 mm) of concrete of different moisture containment, so called "humid" specimens with moisture containment w=4,7 (by mass) and "dry", dried up to permanent weight "humid" specimens. The moisture containment of dry specimens - W=0%.

There are conducted two series of experiments. In first series 36 "humid" specimens, and in second series 36 "dry" specimens were tested.

Carried out investigations have shown that for each age of specimens at increasing of deformation velocity on 4 degree the indexes of shear deformations are changed insignificantly. The indexes of modulus of share and strength are increased on 18,1 ("humid" concrete), 22,6 ("dry" concrete), 17,9 ("humid" concrete) and 14,3 ("dry" concrete) correspondingly.

The work is conducted by support of Georgian National Scientific Foundation (Grant N079). Tabl. 1, bibl. 2.

INFLUENCE OF MOISTURE CONTAINMENT ON GREEP OF CONCRETE AT TORSION. ***A.Sakvarelidze, N.Gudushauri, M.Turdzeladze.*** **"Energy". Tbilisi. №1(49). p. 97-100. geo. sum. geo.engl. rus.**

The issues of creep of concrete with different moisture containment in torsion are investigated.

In experiments on torsion the specimen-cylinders of age of 28 days (d=70 mm and l=610 mm) were tested. Before testing the "standard" specimens of age 28 days had humidity w=4,7% (by mass). According to demanda of experiment the part of "standard" specimens were dried up to given level of moisture containment. I.e. the specimens before testing had humidity 4,7; 2,7; 2,2 and 1% (by mass). Before testing the surfaces of specimens were isolated to prevent the moisture loss.

For moisture containment there were tested on creep 4 specimen-twins, in all 16 cylinders+6 on short-time strength.

The experiment has shown that creep of specimens is increased in proportion to moisture containment. The creep nucleus of specimens for all different humidity is determined. The theoretical dependence of shear nucleus of concrete, considering the material moisture containment at permanent age and temperature has been elaborated. Ill. 1, tabl. 3, bibl. 2.

STUDY OF MECHANICAL PROPERTIES OF HIGH-STRENGTH CONCRETE MADE ON GRANITE WASTE BASIS. ***B.Keshelava, G.Tatarishvili, L.Okujava, N.Gogokhia, L.Loladze, I.Giorgadze.*** **"Energy". Tbilisi. №1(49). p. 101-104. geo. sum. geo.engl. rus.**

Possibility to get high-strength (60 Mpa and more) concrete on the basis of granite wastes has been studied.

400 grade cement of Rustavi Cement plant was used in experimental studies. Composition of cement milling satisfied the requirements of the standard. An aggregate was of granite origin, sand belonged to coarse sand category. Additives were Sika FFN and Sika 300 grade plasticizers. Totally, there were 4 sample series that were tested in 28 days on ALFA-300 grade press.

Strength and strain characteristics of the concrete tested on pressure, expansion in bending and torsion have been studied too.

Study of the obtained data enables us recommend to the appropriate construction companies to use such wastes in producing high-strength concrete. Tabl. 6.

DOUBLE-FRAME TUNNEL ESTIMATION. ***T.Kikava.*** **"Energy". Tbilisi. №1(49). p. 105-108. geo. sum. geo.engl. rus.**

The article presents the method of estimating the underground construction – double-frame tunnel. Tunnel is regarded and estimated as double-framed reinforced concrete frame located on a linearly deformable foundation.

There are two options of estimation. First one involves splitting the cut frame into separate parts. Each of them are regarded separately. Lateral pressure of the ground is accepted in form of trapezium. Universal formula of flexible beam thread was taken for the estimations. Deflection of upper crossbar and rotation angle of the lower frame were found as a result of which it is possible to make distribution of ground reaction, transverse forces, moments of deflection and deflection of beam.

Second option envisages the closed frame cut in transverse direction. It is split into separate elements. Expressions obtained as a result of solving the first option are used in this case. Ground elasticity module in depth is accepted as a constant value. Appropriate distributions are estimated too. Ill. 1, bibl. 3.

EQUIPMENT REGISTERING FLOOD AND LANDSLIDE PHENOMENA. ***I.Gabrichidze, G.Kharabadze, V.Gabrichidze, I. Mosavlidze.*** **"Energy". Tbilisi. №1(49). p. 109-112. geo. sum. geo.engl. rus.**

The article presents new design equipment registering water level and landslide phenomenon. Such equipment enables to permanently observe disastrous phenomena and at the same moment, to immediately notify the checkpoint (guarding point) about them.

"Radio channel" method is suggested for transferring information from the registering equipment to the checkpoint. "Radio channel" set includes transmitter, receiver, scanner assembly, mobile connection and radio extender.

A unit serving as a sensor is suggested to register the relocation of the layers in case of observing the landslide phenomena. The suggested unit enables to get a true picture of ground movement and register the displacement of its particular layers. Ill. 3, bibl. 2.

MULTIFUNCTIONAL UTILIZATION OF WATER STORAGES AND BASINS AND FACILITIES. ***I.Gabrichidze, G.Tchumburidze, L.Mosavlidze, M.Kurdgelashvili.*** **"Energy". Tbilisi. №1(49). p. 113-116. geo. sum. geo.engl. rus.**

Several new options of effective utilization of functioning water storages and basins are proposed in the article. One of the options is an intake of surface warm water from the water storages and basins, run to the hydro power station units for power generation, supply to consumers and eventually supply the processed warm water to irrigation system canal.

All the above activities can be performed by special automatically run equipment.

The article also provides the second option, which is modified version of the first. According to this option, there may be no hydro power station in the lower pool, and this may be caused by such circumstances, when the hydro power station is mounted on a movable pontoon and hydro units operate on suction via float valves.

Positive values of the proposed engineering solution are given at the end of the article. Ill. 2, bibl. 3.