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ENVIRONMENTAL AIR QUALITY MONITORING SYSTEM AS A SUPPORT FOR PRECISION AGRICULTURE

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Abstract: *In order to make better decisions in the precision agriculture the measurement of air pollution parameters such as PM10, NOx, SO2, CO, O3 and agriculture parameters such as air temperature, humidity, soil moisture and leaf wetness are of crucial importance. Making analysis using different AI technics based on these parameters can bring better yield and quality in the food production process. In this paper, we present our approach in building an environmental air quality monitoring system as a support for precision agriculture by using Arduino [5] open-source electronics platform.*

Keywords: AIR POLLUTION, ARDUINO OPEN-SOURCE ELECTRONICS PLATFORM, WSN, IoT

1. Introduction

Rapid development of IoT technologies made an impact in production of more accurate and cost effective sensors. Application of wireless sensor networks (WSN) yields a great benefit in agriculture and the food production process. Farmers and companies are able to make more precise decisions based on measurements taken from the wireless sensor network. On the other hand pollution data are very important for quality food production, but sensors for environmental measurement have to be very accurate but not very expensive.

For agriculture parameters we designed a wireless sensor network that is cost effective, easy to scale and has efficient power consumption management [1]. Sensor node, which is the smallest structural and functional unit of our wireless sensor network, is equipped with multiple sensors for measuring important environmental parameters in the field of agriculture. Environmental air quality monitoring system as a support for precision agriculture is equipped with multiple sensors for measuring pollution parameters and also is cost effective.

This paper is organized as follows. Section 2 gives an overview of the monitoring system with wireless sensor network, while in section 3 we present architecture of WSN sensor node structure for agriculture upgraded with pollution sensors by using Arduino open-source electronics platform. In section 4 we present our cloud services for data collection and visualization for further analysis. Section 5 concludes the paper and presents the future work.

2. Overview of the monitoring system for agriculture

The wireless sensor network for agriculture is constructed from sensor nodes (A1, A2, A3…An) and base stations (Fig.1). It uses a star-of-stars network topology, where every sensor node sends its data directly to the base station. Long range communication protocol (LoRaWAN) [2] [4] that we use for data transmission, dictates this kind of topology. This gives us the benefit of easy and inexpensive network scalability, while maintaining the possibility of placing our sensor nodes at a great distance from the base station. Packets that are received from the base stations are then send via the TTN (The Things Network) IoT platform to our cloud services. The wireless sensor network for pollution monitoring system is constructed from sensor nodes for pollution parameters (P1,P2,P3..Pn) and base stations. Communication protocol is constructed with SIMCOM 800I.

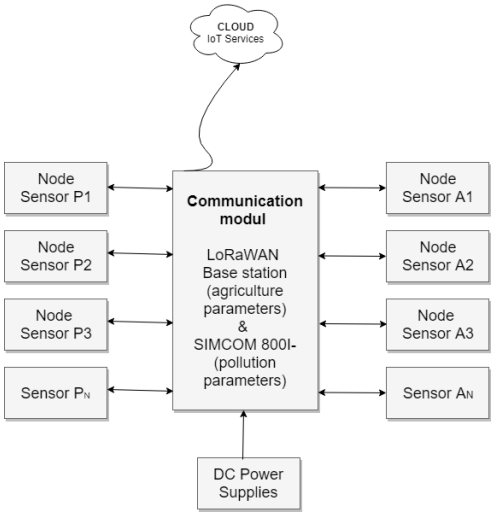


Fig. 1. *Wireless sensor network topology diagram*

On the other hand the wireless sensor network for pollution monitoring system is constructed from sensor nodes for pollution parameters. We have two options:

1. Cost effective sensor nodes with PMS5003- PM Sensor - PLANTOWER(R) (for PPM concentrations) and

2. Alphasense(R) 4-electrode sensors with low power, validated technology for use in high volume applications and evolving markets such as Air Quality monitoring. This type of sensors are specifically designed for low gas concentration detection: parts per billion (PPB). (Fig.2)



Fig. 2. *Alphasense 4-electrode sensors*

3.Architecture of upgraded wireless sensor network for agriculture

The sensor node is the smallest structural and functional unit of our WSN. Every sensor node should be equipped with all necessary sensors, processing unit for collecting, processing and encoding the data from the sensors, as well as communication module for sending the data to the backend service for further analysis. Every solution to this problem has its trade-offs in terms of cost and efficiency. Nevertheless every solution must fulfill certain requirements i.e. collection of accurate data, efficient power consumption, easy and economical network scalability and reasonable overall system construction and implementation cost.

In our solution the sensor node for agriculture is an isolated unit i.e. it does not communicate or share data with other nodes. The sensor node gathers the measurements from its own sensors, process and encodes the data and transmits it to the data collection service. It consists of three different sensors, microcontroller as a processing unit and LoRaWAN communication module for data transmission. The sensor node is equipped with sensors for measuring air temperature, air humidity, leaf wetness and soil moisture. These parameters are very important for further data analysis and extraction of valuable knowledge that cannot be observed from the raw data that we collect. As we said earlier, that we need to maintain reasonable overall system cost, for measuring of air temperature and humidity we chose to implement DHT22 sensor in our sensor node. DHT22 in comparison to other sensors on the market has a great balance between the performance and accuracy of the sensor and its cost. For sensing the leaf wetness of the plants we used the standard "wired leaf wetness sensor". These sensors are inexpensive, but most of them need to be calibrated for accurate measurements before use (Fig.3). For measuring the soil moisture, we used the standard soil moisture sensor with two probes. This sensor measuring process is very similar to the leaf wetness sensor and for that reason it also needs calibration before use. The leaf wetness sensor and the soil moisture sensor need additional LM393 chip for analog to digital conversion of the sensed
measurements.

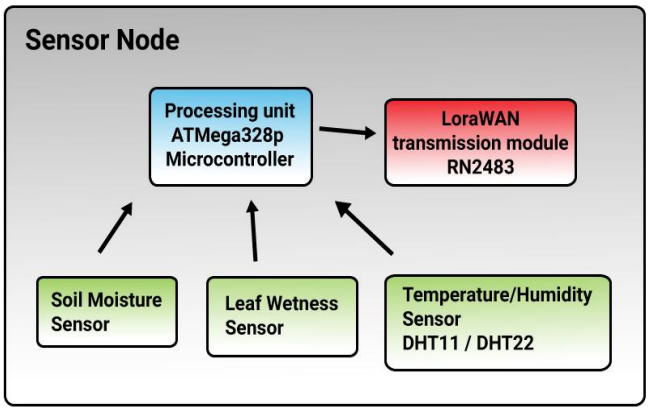


Fig. *3* Sensor node structure diagram for agriculture parameters

In our sensor node as a processing unit we use ATMega328p microcontroller [3]. This microcontroller is famous for its integration in the Arduino open-source electronics platform [5]. Because of its fame there are many libraries that help in easy integration with other modules and sensors. Its low cost and great performance in terms of power consumption and processing power, make this microcontroller acceptable for this application.

The purpose of the microcontroller is coordination of the sensor node i.e. to collect, transform and encode the data from the sensors, activate and connect the transmission module with the network base station and send the data to data collection service. Usage of this Wireless Sensor Network requires that the sensor nodes need to be placed in an open field without external power supply i.e. every sensor node must operate on battery power supply. Running on battery power supply adds a challenge on the overall sensor node inner workings design for power efficiency.

Parameters that we need to monitor with this system do not have real time constraint (e.g. air temperature and humidity cannot change in a second). For this reason we designed our system to work in cycles i.e. to take measurements every 18 minutes for 5 seconds runtime.

In our solution for Air quality monitoring system, the sensor node for pollution parameters is also constructed with Arduino open-source electronics platform (Fig.4). In this case is very important to know which pollution parameters we need to measure. If we have land near the roads and factories, then we have to measure NOx, PM, O3, CO and SO2 (in this case we will use Alphasense sensors, Fig. 2). On the other hand we will measure only PM parameters (cost effective).

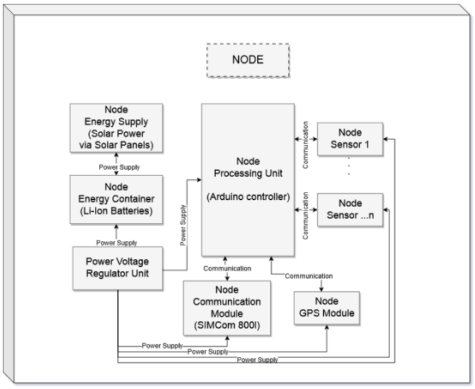


Fig. 4 *Sensor node structure diagram for pollution parameters*

4. Data acquisition and visualization services

We developed two services for the purpose of collection, storage, filtering and formatting of the data from the wireless sensor network. Main purpose of this service is to accept and store the incoming data from the TTN platform i.e. our sensor nodes. This application was developed using the Java EE technology. Collected data is then transferred to the data warehouse using ETL (extract, transform and load) software, to be utilized by our other services. Additionally in our data warehouse we store weather prediction data from our HPC weather prediction software for future comparison and data analysis. General purpose of the data visualization service is to supply the data from the data warehouse in a certain format so it can be easily adapted to a specific visualization type. The data can be visualized in many forms: charts, plots, maps and tables. To adapt the data for a certain format it needs to be filtered and formatted based on certain conditions and visualization types. Filtering conditions are based on certain property or properties (e.g. temperature, humidity, etc.) with specified marginal values, as well as the time period that needs to be observed. In addition to the data collection and visualization services, we developed a web interface for remote monitoring of the data from the wireless sensor network as well as overviewing the data in a different visualization types such as charts, plots, maps and tables. The web application was develop in AngularJS as a single page application (SPA) and D3 library for the different visualization types.

5. Conclusion

In this paper we presented an overview of our environmental Air quality monitoring system as a support for Precision Agriculture. Also we present structure and topology of wireless sensor network. We presented its smallest structural and functional unit i.e., the sensor node. We presented the data transmission protocol that we used and its tradeoffs, as well as our data collection and visualization services that collect, store, filter and format the data from the wireless sensor network.

For the future work we intend to extend our cloud services i.e. to create two more services, one for the data analysis and the other one for decision support. Making analysis using different AI techniques based on these parameters can bring better yield and quality in the food production process. The data analysis service will use prediction models and data mining techniques for forecasting the emergence of a certain disease (infection), as well as presenting the marginal values for optimal quality of the product. The decision support service will help the user in the decision making process such as application of pesticides and irrigation.

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INNOVATIVE APPROACH TO CONTAMINATED SOIL PHYTOREMEDIATION: HEAVY METAL PHYTOEXTRACTION USING ENERGY CROPS

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Abstract: *Heavy metal accumulation potential in the biomass and different plant parts of the selected species of energy crops cultivated on contaminated soil was evaluated. Phytoextraction potential, biomass yield and qualitative parameters of bioenergy plants grown on heavy metal contaminated soil has been measured. Finally heavy metal influence on biomass utilization possibilities, energy recovery and further safe use of the rest products has been evaluated. Demonstrated possibilities to grow bioenergy plants on moderately contaminated soil could increase the use of marginal lands, decrease land use competition between food and liquid biofuels and provide options for a gentle and cost-effective remediation.*

Keywords: HEAVY METALS, SOIL CONTAMINATION, PHYTOEXTRACTION, ENERGY CROPS, BIOMASS

1. Introduction

Land contamination is now recognized as a problem capable to affect ecosystems and human health in a range of different ways. Perception of soil as a vital natural element as well as an essential resource for human survival and development raises public awareness of soil contamination as an important environmental issue worldwide. It is reported that more than 10 mln contaminated sites exist on our planet, with half of the sites contaminated with heavy metals *(Khalid et al., 2017)*. Every site identified as a potential contamination source has information about ongoing activities or the ones that were carried out in the past; loads and origins of the chemicals used during the activities; role and impact to the ecosystem and hazards to human health. Most of such activities were carried out before 1990. Historical pollution is very troublesome in Lithuania. In the absence of person, responsible for creating the pollution, expenses for remediation are paid from the state budget. Lithuanian Geological Survey states that every third identified pollution source pose risk to the environment, and every tenth source has a very high negative impact to the environment. The Survey says that area of the contaminated territory might be about 280 km^2. Main contaminants are oil products, but every fifth object is contaminated with pesticides, heavy metals and polycyclic aromatic hydrocarbons *(Ministry of Environment, 2012)*. Increased public awareness about health risks posed by heavy metals triggers pressure for the academic society to look for more efficient ways how to solve this problem. If most of organic contaminants are easily biodegradable, heavy metals (HM) are highly resistant to either biologically or chemically induced degradation. It is stated in the *Plan for the management of contaminated sites in 2013-2020*, that soil contaminated with heavy metals should be excavated and further treated *ex situ* or landfilled *(Ministry of Environment, 2012)*. Although, excavation being one of the cheapest options to "treat" heavy metal-contaminated soil so far, it is always very harsh for the soil micro- and macro-environment, it has low public acceptance and finally, the problem is not solved, but only transported elsewhere. Thus search for alternative cost-effective and environmentally friendly technologies and materials for clean-up of heavy metal contaminated sites is extremely important.

The EU countries agreed upon increasing the use of renewable energy, which strongly stimulates usage of biomass. Beneficial biomass ash on-land recycling or, alternatively, safe disposal of ashes will become more and more important in the future because of the increasing volume of the produced ashes worldwide. Removal of HM using phytoextraction followed by energy and/or HM recovery could be applied in the nearest future as an attracting closed cycle green technology.

This study aimed at gaining better understanding on heavy metal accumulation in different plant parts, estimating biomass yield and utilization possibilities focusing on phytoextraction using bioenergy crops.

2. Bioenergy plants for phytoextraction

The main aim of *soil remediation* is to reduce risks posed to humans and environment. A need for remediation is based on various legislative and normative documents as well as assessment of existing risks. Such parameters as price, long-term stability, technological efficiency, applicably, public acceptance, etc. has to be well thought through when selecting possible remediation technique.

Selection of the remediation method is influenced by contaminant's speciation, concentration and distribution. Therefore, thorough characterization of the contaminated territory is always needed prior taking further steps. Depending on the remediation technology, contaminants can be immobilized in the soil or they can be mobilized and removed from soil. Thus, target establishment has a major impact on technology type.

Remediation techniques for the soil contaminated with HM can be categorized into three groups: 1) gentle *in situ* remediation; 2) rigorous tools that limit further contaminant's dispersion *in situ* and 3) rigorous tools that remove contaminant *in situ* or *ex situ (Wuana and Okieimen, 2011)*. Gentle remediation is applied when it is desired to restore soil functions and improve its quality. While rigorous tools are necessary to prevent humans and environment from direct hazard, especially in the case of heavy point-source contamination. United States Environmental Protection Agency (USEPA) classifies remediation technologies into two large groups: 1) contamination source control and 2) isolating measures to detain contaminants and prevent them from dispersion. Another classification is based on different technological principles: isolation, stabilization, mobility and toxicity reduction, physical separation and extraction. In order to reduce costs and achieve maximum results, various combinations of latter technologies are used in practice *(USEPA, 2008)*. However, it is widely acknowledged that many of the traditional remediation methods can cause adverse secondary impacts to the environment, e.g., heavy machinery powered by diesel fuel, emit large amounts of greenhouse gases. Furthermore, clean soil is required to replenish excavated site in case when a contaminated soil is treated *ex situ*. For excavation and transporting of soil, heavy machinery is used once again *(USEPA, 2008)*.

Phytoremediation is as an environmental clean-up biotechnology, incorporating selection of HM accumulating plant species. It can be seen as an alternative to the above mentioned process-based methods. Basic model of phytoextraction is not complicated. Metal tolerant plants that have a capability to accumulate high levels of HM are seeded or transplanted into a contaminated soil and are cultivated using relevant agricultural procedures. Plants absorb compounds containing HM through root system and transport them to the aboveground green parts for accumulation. When desired biomass is reached, vegetation of

plants is stopped by harvesting them as well as removing accumulated HM permanently *(Prasad et al., 2003)*.

Natural phytoextraction should be considered as a long-term technology for HM removal from vast contaminated territories. However, it can be applied only to the sites that contain low to moderate levels of pollution as vegetation cannot persist in highly contaminated media. Moreover, such sites should have suitable landscape for agricultural machinery and other equipment. Plants suitable for phytoextraction should ideally have the following characteristics: high growth rate, production of more aboveground biomass, widely distributed and highly branched root system, more accumulation of the target HM from soil, translocation of the accumulated HM from roots to shoots, tolerance to the toxic effects of the target HM, good adaptation to prevailing environmental and climatic conditions, resistance to pathogens and pests, easy cultivation and harvest, repulsion to herbivores to avoid food chain contamination *(Wuana and Okieimen, 2011)*. However, among all known plant families such ideal *hyperaccumulator* simply does not exist. Still there are reported about 400 species that can accumulate one HM or in very rare occasion several, and mainly they are slow growing and produce low biomass, thus metal accumulation is limited *(Lasat, 2000; Peer at al., 2004; Reeves et al., 2017)*.

Plant-based technologies are low-cost not only at establishment phase but also from a future maintenance perspective. Costs of growing plants are significantly lower in comparison to costs of physico-chemical technologies, like excavation (replacement), vitrification, soil washing, etc. Moreover, green biotechnologies such as phytoextraction always has a better public acceptance as it is less disruptive to ecosystems and therefore, it is easier to make ready a clean-up project.

The potential of a plant species for a phytoextraction is determined by two key factors: HM concentration in aboveground part and biomass yield. Comparatively less biomass is produced when growing HM hyperaccumulating plants on contaminated soil, but they tend to accumulate target HM to a greater extent. On the other hand, bioenergy plants grown on contaminated soil, accumulate target HM to a lesser extent, but produce more aboveground biomass, so that overall accumulation is comparable to that of hyperaccumulators due to the production of more biomass. Thus, hyperaccumulator will yield a HM-rich, low-volume biomass, which is economically easy to handle in case of both HM recovery and safe disposal. While use of non-accumulators will yield a HM-poor, large-volume biomass, which can be economically unfeasible for metal recovery and also costly for safe disposal *(Ali et al., 2013)*. So what are the advantages of growing bioenergy plants on contaminated soil?

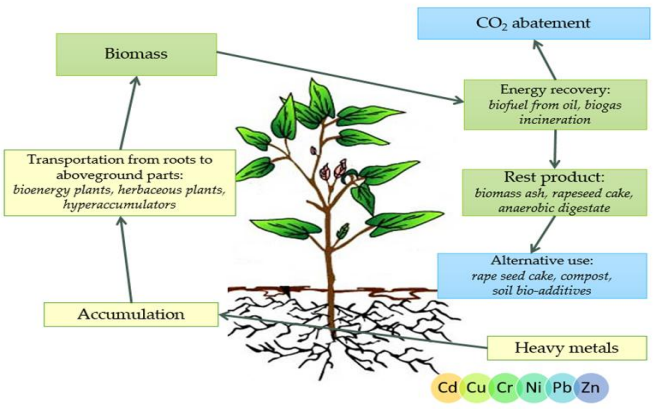


Fig. 1. *Conceptual model for phytoextraction technology using bioenergy plants*

Growing high biomass yielding energy crops on HM contaminated land could be rewarding for several reasons. Firstly, competition for a food-fuel land could be avoided, as contaminated soil is not suitable for growing conventional crops anyway *(Tilman et al., 2006)*. Secondly, polluted runoff, soil erosion and HM percolation to groundwater could be decreased due to the closed vegetation layer. All this leads to risk reduction, which is the main goal of phytoremediation and any other remediation technology. Such approach is well compatible with an alternative land use and, furthermore, generation of an additional income for land owner because of the produced energy. Figure 1 presents a conceptual model, how phytoextraction can be combined with energy recovery from high biomass yielding plants.

Harvested plant biomass can be transformed into energy through two main paths: thermo-chemical conversion including pyrolysis, gasification, and direct combustion; and bio-chemical conversion including fermentation and anaerobic digestion. Heavy metals after biomass combustion will be concentrated in slag, ash (bottom and fly ash), and dust particles. The quantity and quality of residual products is strongly dependent on the biomass properties as well as combustion technology. *Ministry of the Environment (2011)* has set rules for the management and use of ash from woody biomass. Maximum permissible values are established for HM in the ash to be used for agricultural and land reclamation purposes: 30 mg/kg dry weight (DW) for Ni and Cr, 5 mg/kg DW for Cd, 3 mg/kg DW for As, 50 mg/kg DW for Pb, 200 mg/kg DW for Cu, and 1500 mg/kg DW for Zn. Although, this document applies to ash from woody biomass, somewhat similar MPC values should serve for the ash from herbaceous plants as well

3. Materials and Methods

Historically HM-contaminated soil was used in the phytoextraction experiment. Composite sample of the technogenic soil was taken from three different spots at the Molainiai former septic drain fields. This contaminated territory is located in the northern Lithuania in the city of Panevėžys with a total area of about 96 ha. According to local drinking and wastewater management company JSC "Aukstaitijos vandenys", sewage sludge containing various amounts of HM was pumped into the Molainiai septic drain field by the companies that did not have their own wastewater treatment plants. Ltd "Ekranas", Ltd "Elektrotechnika" and state-run factories of compressors for motor vehicles and of precise electrotechnics involved HM compounds in processes like tin dipping and galvanization. Septic drain fields with the biological filtering purpose were installed and started its activity in 1961. Their exploitation was finished in 1978. Green recreational areas were designed to be built in this territory in the general city plan. According to previous investigations *(DGE Baltic Soil and Environment, 2010; Geotestus, 2013)*, the concentration of more than four HM exceeded the MPC values in the selected sampling places. Contaminated soil was excavated using a stainless-steel sampling shovel from 0-0.2 m depth and placed into plastic buckets, transported to the university greenhouse, mixed thoroughly, sieved to pass a 20-mm mesh screen, homogenized, and then used for the below-described vegetative phytoextraction experiment. Subsamples were taken from a thoroughly homogenized bulk soil to determine plant nutrients and HM content.

Uncontaminated soil (without known contamination) was taken from an agricultural field at a local experimental station of a former Aleksandras Stulginskis University and was used as a control for the comparison of further results. Soil samples were also taken from three different spots, mixed together, sieved to pass a 20-mm mesh screen, and subsamples from a thoroughly homogenized bulk soil were used for physico-chemical analysis as well.

Rapeseed *(Brassica napus)* Jerusalem artichokes *(Helianthus tuberosus)* were further selected as energy crops for HM phytoextraction experiment. Both contaminated and uncontaminated soils were separately divided into subsamples and placed into the plastic buckets of 26 l volume. One hundred seeds of summer rapeseed cultivar "Fenja" were seeded into each bucket. Pot-experiment was carried out under greenhouse conditions where temperature was kept at 25°±2° C and tap water used to maintain stable moisture content. The experiment was implemented in

triplicates. Throughout the 13 weeks of experiment plants were thinned on three occasions: at the initial stem growth phase, at the bud formation phase and at the flowering phase until 21±3 plants in each bucket were left. Stem height and root length of uprooted plants were measured to compare the growth of rapeseed on HM-contaminated and uncontaminated soils. Pods with seeds were cut using scissors and shucked, stems with leaves were separated from the roots. Vegetative parameters of rapeseed: dry weight, stem height, root length, and weight of 100 seeds were recorded after harvesting the plants. At least three randomly selected plants from each bucket were measured for this purpose.

Jerusalem artichoke plants were also grown under controlled greenhouse conditions. Uncontaminated and contaminated soils were separately divided into subsamples averaging 21 kg each and placed into plastic buckets. Two seedlings of the Jerusalem artichoke cultivar "Sauliai" were planted in each bucket. During the repot seedlings were ~0.7 m height. The length of tubers together with smaller rootlets was 0.10-0.12 m. Each plant had 8 to 10 fully-formed leaves. Before the repot Jerusalem artichoke was grown in an open-air agricultural (without known contamination) field for four weeks. Tap water was used to keep moisture and the temperature in the greenhouse chamber was maintained automatically at 25±2º C. This vegetative experiment was also carried out in triplicates.

In order to assess the effects of potential HM toxicity throughout the 22-week pot experiment, selected vegetative characteristics of Jerusalem artichoke plants including stem height, number of leaves and blossoms were measured 5 times. When plants were reaped and tubers dug-out, wet weight was recorded as well. Separate parts of air-dry energy plants: stem with leaves, roots, pods, seeds, were grinded into fine powder using laboratory grinding mill and preserved for HM analysis.

Soil samples were dried at 40±5° C temperature in an oven, homogenized with mechanical ball-mill, sieved to pass 2 mm mesh. For total HM concentration, sub-samples were wet-digested with *aqua regia*. *Plant* parts were dried out after harvesting, milled with lab grinder and wet-digested with a mixture of HNO_3 and H_2O_2. Extraction from *ashes* after combustion experiment was carried out through the application of strong mineral acids. After cooling and diluting with deionised water, HM concentrations in all digestates were determined by ICP-OES. Acid digestions and other analytical procedures were always performed at least in triplicate. Calibration using standard solutions was performed before all instrumental analysis.

All HM phytoextraction/accumulation vegetative pot experiments were carried out during 2014-2016 at Aleksandras Stulginskis University mainly in the newly constructed greenhouse of the Faculty of Agronomy.

4. Results and Discussions

Vegetative pot experiments were used as the main tool to evaluate phytoextraction efficiency using energy crops. Two species of high biomass yielding plants, Jerusalem artichoke and rapeseed were cultivated on historically HM-contaminated soil; biomass was obtained and used for further combustion experiment. Ash qualitative parameters at the end of the experiment were compared with qualitative characteristics of ashes originated from biomass combustion plants in Lithuania.

In general, rapeseed plants from contaminated soil at the end of the vegetation produced more biomass, larger seeds as well as exposed higher resistance to pests in comparison to plants grown on uncontaminated soil (Fig. 2). Similar findings were obtained by *Marchiol et al.* (2004) and *Brunetti et al.* (2011) as both studies indicate that rapeseed exhibited diminutive symptoms of toxicity when grown on HM contaminated soil under greenhouse conditions. *Ghnaya et al.*, (2009) tested the resistance of four rapeseed cultivars to Cd and Zn stress and concluded that the response depends both on cultivar and metal.



Fig. 2. *Rapeseed development on contaminated (taller, yellowish plants with first flowers) and uncontaminated (dark green plants without flowers) soil*

Despite of manifold higher than background Cd, Cu and Zn content in the soil, rapeseed development was similar to the control samples grown on uncontaminated soil. Rapeseed produced even heavier seeds when cultivated on contaminated soil. This is a very important characteristic for oil-bearing plants, such as rapeseed. Our experiment showed that rapeseed can be successfully cultivated on HM contaminated soil as an energy crop with moderate phytoextraction performance and subsequent liquid biofuel production from rapeseed oil – rapeseed not only matured high weight seeds, nor seeds did accumulate dangerous amounts of heavy metals.

Significantly increased Cd, Cu and Zn concentrations were detected both in aboveground and belowground biomass/plant parts of rapeseed grown on contaminated soil. In case when plants were grown on contaminated soil, Cd concentration in roots was higher by 62 times, in stem and leaves by 24 times, in pods and seeds by 10 times than in the same parts of rapeseed grown on uncontaminated soil. The highest Cd concentration in plants from contaminated soil was detected in the roots, while in stem and leaves of plants from uncontaminated soil. Concentration of Cu in the roots was higher by 27 times, in stem and leaves by 12 times, in pods by 4 and in seeds by 2 times in comparison to their counterparts from the uncontaminated soil. In both cases, the highest concentration was recorded in the roots. Differences between Zn accumulation in plants grown on contaminated and uncontaminated soil were the smallest among the three analyzed elements. Concentrations of Zn in roots and stem with leaves from plants grown on contaminated soil were higher by 7 times than in the corresponding parts of rapeseed plants from uncontaminated soil; while in pods and seeds accumulated Zn amount was almost the same.

The total biomass of Jerusalem artichoke grown on contaminated soil was again 1.6 times greater than the biomass of plants grown on uncontaminated soil. Plants grown on contaminated soil started to blossom one week earlier than those grown on uncontaminated soil. Leaf and stem color of Jerusalem artichoke from uncontaminated soil was dark green, whereas leaves of plants from contaminated soil were a lighter green color.

Values of heavy metal bioconcentration (BCF) and translocation (TF) factors for Jerusalem artichoke plants are presented in Table 1. A BCF is a ratio between element concentration in the tubers (roots) and element concentration in the soil. When the value is greater than unity, it may be considered as an indication of a plant's potential to be a hyperaccumulator and thus to effectively uptake HMs from the soil. Translocation factor is a shoot-to-root ratio. Therefore, it can also be an indicator for the presence of hyperaccumulation, because non-hyperaccumulator plants tend to hold bigger concentrations of HM in the root zone rather than transfer them to aboveground parts *(Martinez-Sanchez et al., 2012)*. According to *Baker and Brooks* (1989), hyperaccumulators tend to accumulate >1000 mg/kg of Cu, Co, Cr, Ni, or Pb, and >10 000 mg/kg of Mn or Zn.

Table 1. *Heavy metal bioconcentration and translocation factors for Jerusalem artichoke*

Element	Contaminated soil		Uncontaminated soil	
	BCF	TF	BCF	TF
Cd	0.03	7.0	0.66	2.2
Cu	0.03	1.3	0.78	1.1
Zn	0.06	4.5	0.57	1.5

According to the obtained results, Jerusalem artichoke cannot be identified as a hyperaccumulator, as none of BCF values exceeded unity. Higher Cu and Zn transfer from roots to shoots coefficient can be explained by both Cu and Zn being essential micronutrients for plant metabolic processes *(Alloway, 2013)*. Translocation factor for Cd was the highest amongst the other elements.

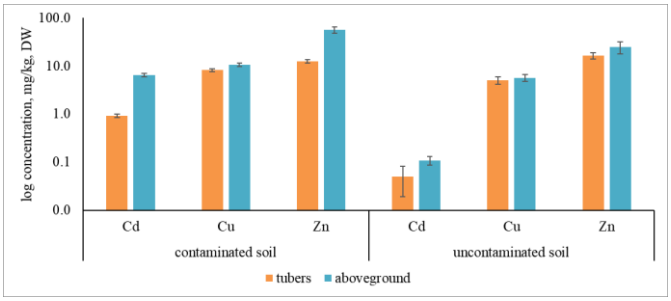


Fig. 3. *Heavy metal accumulation in Jerusalem artichoke tubers and aboveground biomass*

Results on HM accumulation in Jerusalem artichoke biomass are given in Fig. 3. As expected, plants grown on contaminated soil accumulated higher amounts of metals when compared to plants grown on uncontaminated soil.

Combustion experiment showed that straw ash from agricultural waste exhibited similar concentrations of Cu as ash of Jerusalem artichoke from uncontaminated soil; whereas Cd and Zn concentrations were significantly higher in straw ash but similar to those in Jerusalem artichoke ash from contaminated soil. Cadmium content was very similar in rapeseed from contaminated and uncontaminated soils, but Cu and Zn differed significantly.

5. Conclusions

Obtained results indicate that both tested bioenergy plant species: rapeseed and Jerusalem artichoke can be grown on low to moderately heavy metal-contaminated soil and give equally high yield as their counterparts from uncontaminated soil. Both species were identified as HM excluders, i.e., they have rather low potential for HM extraction but may be efficient for phytostabilization purposes, when plants are grown on marginal land to avoid soil erosion and percolation of contaminants to groundwater.

Jerusalem artichoke and rapeseed grown on heavy metal contaminated soil in most cases produced more aboveground biomass, heavier seeds and larger tubers, and plants were less sensitive to pest attacks in comparison to plants grown on uncontaminated soil. This proved that bioenergy plants can be successfully cultivated on moderately contaminated soil both for phytoextraction and for energy recovery purposes and mitigate competition for arable land.

Biomass produced on moderately contaminated soil does not necessarily mean that rest products of energy recovery will have high metal content. Ashes from Jerusalem artichoke biomass produced on contaminated soil exhibited similar heavy metal concentrations to the ones in ashes obtained from biomass power plants operating in Lithuania. None of the metals exceeded maximum permissible values according Lithuanian legislation and such ashes could be used as fertilizers both in forestry and agriculture.

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MODEL BASED ROBUST ENGINEERING APPROACH FOR PARAMETER OPTIMIZATION OF ELECTRON BEAM INDUCED GRAFTING PROCESSES

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Abstract: *Electron beam irradiation has the ability to modify polymer substrates by the process of graft copolymerization in order to synthesize water-soluble copolymers having flocculating properties. The influence of the variation of the process parameters acrylamide/starch (AMD/St) weight ratio, electron beam irradiation dose and dose rate is investigated. Models of the means and variances for the dependencies of the quality characteristics (monomer conversion coefficient, residual monomer concentration and apparent viscosity) from the described process parameters are estimated by implementation of the robust engineering methodology for quality improvement. Multi-criteria optimization involving requirements for economic efficiency, assurance of low toxicity and high copolymer efficiency in flocculation process is also presented.*

Keywords: GRAFT COPOLYMERIZATION, ELECTRON BEAM IRRADIATION, WATER-SOLUBLE COPOLYMERS, STARCH, ACRYLAMIDE, FLOCCULATION PROPERTIES, RESPONSE SURFACE METHODOLOGY, MULTI-CRITERIA OPTIMIZATION.

1. Introduction

Electron beam (EB) grafting process involves the modification of the polymer substrates by implementing radiation-induced graft copolymerization in order to yield water-soluble copolymers for flocculation processes [1-3]. The advantages of EB induced grafting process are connected with the ability of the electron beam to ionize polymers with limited reactivity in chemical processes. The generation of polymer radicals is performed by clean non-chemical method, which can be precisely controlled, modified and integrated into complete process lines and uses low energy. During the EB graft process the depth of EB energy deposition into materials can be controlled by the accelerating potential of the equipment, the composition and the density of the material being irradiated. EB irradiation grafting is used to develop a wide variety of ion exchangers, polymer-ligand exchangers, chelating copolymers, hydrogels, affinity graft copolymers and polymer electrolytes, having various applications in water treatment, chemical industry, biotechnology, biomedicine, etc. [4, 5].

Robust (not sensitive to noises and errors) engineering approach can be implemented when analyzing experiments during which the variance is non-homogeneous over the factor (process parameters') space and when the noise factors cannot be identified nor an experiment to study them can be conducted [6, 7]. The observations in this case are called heteroscedastic (variance varies with the factor levels). On the other hand, many performance characteristics depend on both quantitative and qualitative factors. In this case models for the mean and the variance of the quality characteristics of the product, based on repeated observations and taking into account the influence of the qualitative factors, can be estimated. Parameter optimization in terms of obtaining repeatability of the product parameters and quality improvement by minimization of variations in the quality characteristics can be performed.

Response surface methodology for the case in presence of both quantitative and qualitative process parameters should be applied after some generalizations. The model selection problem is an important task, because it is associated with the choice of an experimental design, prediction accuracy of the mean value and the variance of the performance characteristic in production conditions or product's usage, the complexity of the optimization procedures, etc.

In this paper multi-criteria optimization involving requirements for economic efficiency, assurance of low toxicity and high efficiency of the synthesized copolymers in flocculation processes is presented. Models, describing the dependencies of the means and the variances of the quality characteristics: y_1 - monomer conversion coefficient (%), y_2 - residual monomer concentration (%) and y_3 - apparent viscosity (mPa•s) on the variation of the process parameters: EB irradiation dose, dose rate and acrylamide/starch (AMD/St) weight ratio are estimated.

2. Experimental conditions

Experimental investigation of the modification of starch by grafting acrylamide using electron beam irradiation in order to synthesize water-soluble copolymers having flocculation properties is performed. The synthesis of graft copolymers was carried out into two stages:

Stage 1: Preparation of solutions based on starch and monomer, resulting in various acrylamide/starch (AMD/St weight ratios) homogenous aqueous solutions - Starch aqueous solutions were prepared by dissolving corn starch in distilled water. Acrylamide was added to starch aqueous solution with further stirring and different acrylamide/starch (AMD/St weight ratios) homogenous aqueous solutions were obtained.

Stage 2: Electron beam irradiation of the prepared solutions – the homogenous aqueous solutions, prepared in *Stage 1*, were exposed to electron beam irradiation. The irradiations were carried out at ambient temperature and pressure by using a linear electron accelerator of mean energy of 6.23 MeV with different irradiation doses and dose rates.

The synthesized graft copolymers were characterized by the following performance quality parameters: y_1 [%] - residual monomer concentration, y_2 [%] - monomer conversion coefficient and y_3 [mPa•s] - apparent viscosity.

The variation regions [z_{min} - z_{max}] of the process parameters for each experiment set are presented in Table 1.

Table 1: *Experimental design with one dummy variable*

Parameter	$z_{i, min}$	$z_{i, max}$
EB irradiation dose [kGy]	0.65	5.50
Dose rate [kGy/min]	0.41	1.50
AMD/St weight ratio	2.00	11.00

There were 30 process parameter experimental sets and for each set three replicated measurements are used for estimation of the means $\bar{y}_{ui}$ and the variances s_{ui}^2 of each quality characteristic of the graft copolymers:

$$(1) \quad \bar{y}_u = \frac{1}{n}\sum_{i=1}^{n} y_{ui} \qquad s_u^2 = \frac{1}{n-1}\sum_{i=1}^{n}(y_{ui} - \bar{y}_u)^2 \qquad u = 1, 2, ..., N,$$

where n is the number of replications (n = 3), N is the number of experimental sets (N = 30).

The observed variations are due to unmeasured and uncontrolled factors and internal and external noises, as well as errors in the controlled process parameters, and depend on the values of the process parameters.

3. Models for the mean and variance of the quality characteristics

The estimated mean value $\bar{y}_{ui}$ and s_{ui}^2 variance can be considered as two responses at the design points, and ordinary least squares method can be used to fit the regression models of the mean value and the variance for the quality characteristic [7, 8]:

$$(2) \quad \tilde{\bar{y}}(\vec{x}) = \sum_{i=1}^{k_y} \hat{\theta}_{yi} f_{yi}(\vec{x})$$

$$(3) \quad \ln\left(\tilde{s}^2(\vec{x})\right) = \sum_{i=1}^{k_\sigma} \hat{\theta}_{\sigma i} f_{\sigma i}(\vec{x}),$$

where $\hat{\theta}_{yi}$ and $\hat{\theta}_{\sigma i}$ are estimates of the regression coefficients, and f_{yi} and $f_{\sigma i}$ are known functions of the process parameters x_i.

The variance of normally distributed observations has a χ^2-distribution. The use of the logarithm transformation of the variance function makes it approximately normally distributed, which improves the efficiency of the estimates of the regression coefficients.

Table 2: *Models for the means of the product quality characteristics*

	Models for the means of the product quality characteristics	R
$\tilde{\bar{y}}_1(\vec{x})$	-4.3456957x_1 + 5.3915161x_1^2 - 1.5283048x_2^2 - 1.3886159x_1x_2 -5.0568769x_1x_3	0.8913
$\tilde{\bar{y}}_2(\vec{x})$	86.89582 + 34.751905x_1 - 7.1056848x_2 -34.141859x_1^2 + 34.945289x_3^2 + 33.500225x_1x_3	0.9097
$\tilde{\bar{y}}_3(\vec{x})$	1.8341046 - 1.4972781x_1 + 1.5368173x_1^2 + 1.401751x_3^2 - 1.3446153x_1x_2 + 1.1090262x_2x_3 - 3.1125045x_1x_3	0.8470

Table 3: *Models for the variance of the product quality characteristics*

	Models for the variance of the product quality characteristics	R
$\ln\left(\tilde{s}_1^2(\vec{x})\right)$	-8.1907995 - 2.4376459x_1 -2.0808965x_2 + 1.2422924x_3 + 3.3800892x_1^2 + 3.0435881x_3^2 - 3.064369x_1x_2	0.8520
$\ln\left(\tilde{s}_2^2(\vec{x})\right)$	-2.0505708x_2 + 1.1227946x_3 + 1.3503166$x_1x_2^2$ + 2.2543255$x_2x_3^2$ - 2.8020033$x_1x_3^2$	0.8670
$\ln\left(\tilde{s}_3^2(\vec{x})\right)$	-5.3591952 + 1.6879963x_1^2 + 1.7422987x_3^2 - 2.1837351x_1^3 - 1.6195118x_1x_3 + 2.7501263$x_1x_2^2$	0.6779

The models are estimated for the coded in the region [-1÷1] values of the process parameters, using the following equation:

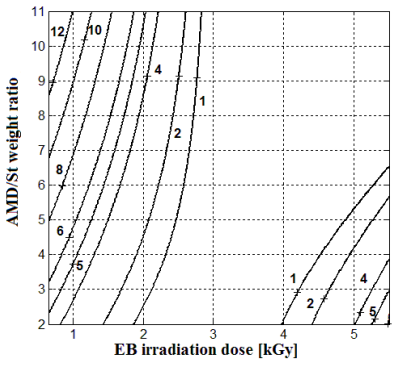
$$(4) \quad x_i = (2z_i - z_{i,\max} - z_{i,\min})/(z_{i,\max} - z_{i,\min})$$

where x_i and z_i are the coded and the natural values of the process parameter, correspondingly, $z_{i,min}$ and $z_{i,max}$ are the minimal and the maximal values of the parameter experimental variation region.

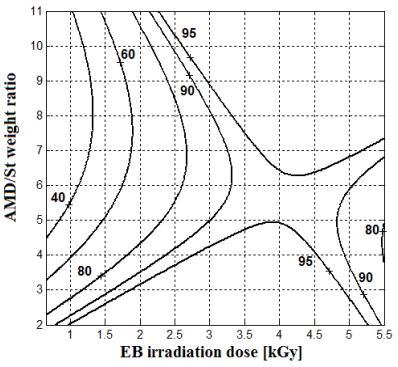
The dependencies of the means and the variances of the product quality characteristics: y_1 – residual monomer concentration (%), y_2 – monomer conversion coefficient (%) and y_3 – apparent viscosity (mPa•s) on the variation of the process parameters: x_1 – electron beam irradiation dose, x_2 – electron beam irradiation dose rate and x_3 – AMD/St weight ratio are estimated.

The obtained regression models are presented in Table 2 and Table 3, together with the values of the corresponding multiple correlation coefficients R.

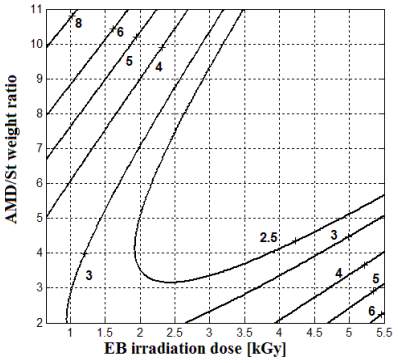
These coefficients are tested for significance and their values are measures of the accuracy of the estimated models. The closer to 1 the value of R is, the better the model describes the variations of the quality characteristics as a function of the process parameters. All models have enough high and significant values of their multiple correlation coefficients and consequently the models are good for prediction and optimization of the considered quality characteristics.



a) $\tilde{\bar{y}}_1(\vec{x})$



b) $\tilde{\bar{y}}_2(\vec{x})$



c) $\tilde{\bar{y}}_3(\vec{x})$

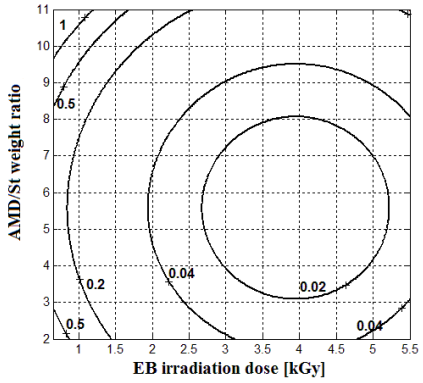
Fig. 1 *Contour plots of the mean values of the product quality characteristics, depending on the variation of EB irradiation dose (z_1) and the AMD/St ratios (z_3) for constant EB irradiation doses z_2= 0.955 kGy/min: a) monomer conversion coefficient - $\tilde{\bar{y}}_1(\vec{x})$; b) residual monomer concentration - $\tilde{\bar{y}}_2(\vec{x})$ and c) apparent viscosity - $\tilde{\bar{y}}_3(\vec{x})$.*

In Fig. 1 contour plots of the mean values of the product quality characteristics, depending on the variation of EB irradiation dose (z_1) and the AMD/St ratios (z_3) for constant EB irradiation dose rate z_2 = 0.955 kGy/min are presented.

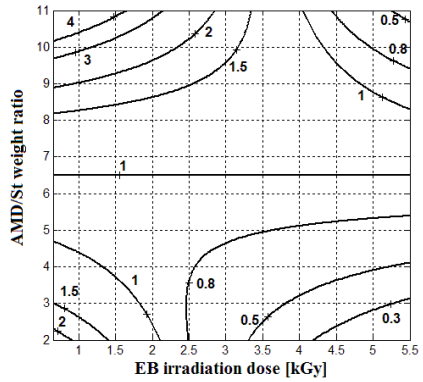
The standard deviations of the product characteristics are calculated by the equation:

$$\tilde{s}_i(x) = \sqrt{e^{\ln(\tilde{s}_i^2)}} \quad (5)$$

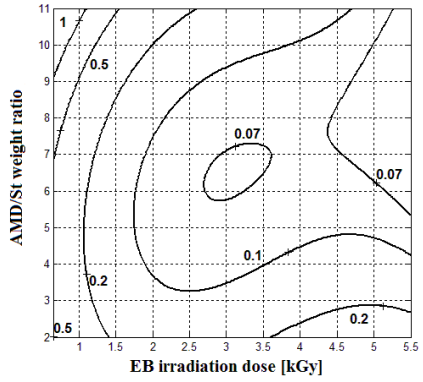
Contour plots of the standard deviations $\tilde{s}_i(x)$ of the product characteristics, depending on the EB irradiation dose (z_1) and the AMD/St ratios (z_3) for constant EB irradiation dose rate z_2= 0.955 kGy/min is shown in Fig. 2. It can be seen that the standard deviation $\tilde{s}_2(x)$ of the process parameter monomer conversion coefficient ($\tilde{\tilde{y}}_2(\vec{x})$, %) has the highest values within the experimental region.



a)



b)



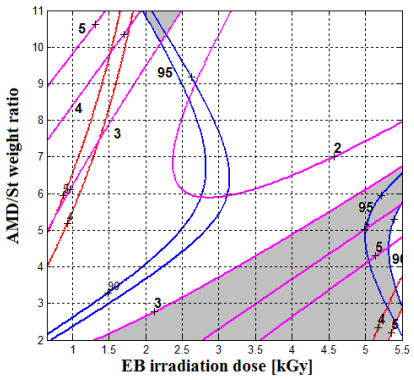
c)

Fig. 2 *Contour plots of the standard deviation of the variance of the product quality characteristics, depending on EB irradiation dose (z_1) and the AMD/St ratio (z_3) for EB irradiation dose rate z_2= 0.955 kGy/min for a) $\tilde{s}_1(x)$; b) $\tilde{s}_2(x)$; c) $\tilde{s}_3(x)$.*

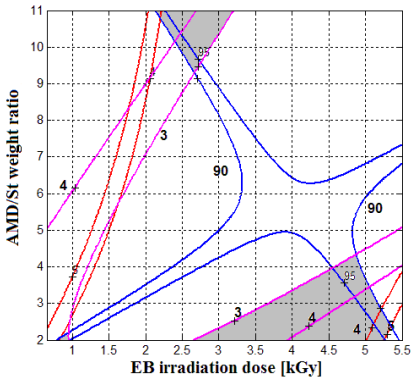
4. Optimization

Multi-criteria graphical optimization unifying requirements for economic efficiency, assurance of low toxicity and high copolymer efficiency in flocculation process is performed. The set of all performance characteristics' requirements is the following:

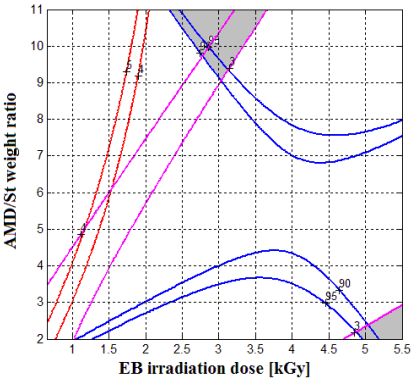
- $\tilde{\tilde{y}}_1(\vec{x}) < 5\%$ - residual monomer concentration in this region ensures low toxicity;
- $\tilde{\tilde{y}}_2(\vec{x}) > 90\%$ - monomer conversion coefficient values are related to the economic efficiency;
- $\tilde{\tilde{y}}_3(x) > 3$ mPa·s - apparent viscosity copolymer values are related to the efficiency in the flocculation process.



a) z_2= 0.41 kGy/min



b) z_2 = 0.955 kGy/min



c) z_2=1.50 kGy/min

Fig. 3 *Graphical optimization – optimal regions of EB irradiation dose (z_1) and the AMD/St ratios (z_3) where: $\tilde{\tilde{y}}_1(\vec{x})$ is red; $\tilde{\tilde{y}}_2(\vec{x})$ - blue and $\tilde{\tilde{y}}_3(\vec{x})$ - violet.*

Table 4: *Pareto-optimization – optimal process parameters, values of the means* $\tilde{\bar{y}}_i(x)$ *and the standard deviation* $\tilde{s}_i(x)$ *of the product characteristics*

№	z_1	z_2	z_3	$\tilde{\bar{y}}_1$	$\tilde{\bar{y}}_2$	$\tilde{\bar{y}}_3$	$\tilde{s}_1$	$\tilde{s}_2$	$\tilde{s}_3$
1	5.3458	1.0832	2.0041	4.9985	91.3731	5.5340	0.0321	0.1633	0.3206
2	5.0177	0.9880	2.6926	3.3337	94.7047	4.6124	0.0284	0.2753	0.2181
3	5.1486	1.0500	2.4059	3.9071	93.2699	4.8829	0.0269	0.2229	0.2570
4	5.0814	1.0879	2.4617	3.4793	93.8116	4.5735	0.0215	0.2386	0.2593
5	4.7856	0.5546	4.5061	1.0922	96.0325	3.8484	0.0795	1.4995	0.1836
6	4.8009	0.6463	4.1560	1.5822	95.4245	3.9507	0.0602	0.9987	0.1661

Graphical optimization is conducted in order to find the regions of the process parameters where the requirements for the quality characteristics are fulfilled simultaneously. The optimal regions are obtained by superimposing the contour plots of the calculated limit values of the characteristics, thus finding the section of all the admissible values of the process parameters. Fig. 3 presents the optimal values' regions of the EB irradiation dose (z_1) and AMD/St weight ratios (z_3) for EB irradiation dose rate (z_2) of 0.41 kGy/min, 0.955 kGy/min and 1.50 kGy/min, i.e. for the lower, middle and the upper limits of the experimental region.

It can be seen that at middle and highest values of the EB irradiation dose rate the working region is small and is obtained for big values of the EB irradiation dose and AMD/St ratios less than 3 or middle values of the EB irradiation dose and AMD/St ratios more than 9.

From the Fig. 3a it can be seen that the decrease of the EB irradiation dose rate to z_2 = 0.41 kGy/min increases the working area for the EB irradiation dose and AMD/St ratio. There are many possible process parameter sets, fulfilling the defined requirements. The choice between them can be done by adding supplementary requirements or criteria. Such criteria can be, for example, the minimization of the standard deviations of the product characteristics.

For improving the reproducibility of the obtained results the variations of the product quality characteristics should be minimized. This puts additional requirements for the solutions that are obtained through graphical optimization. In order to minimize the variances of the product parameters, multi-criterion optimization is performed and compromise Pareto-optimal solutions are obtained. Some of the estimated results are presented in Table 4. If these compromise solutions are compared two by two, one can note the property of these solutions – some of the obtained optimal product characteristic values are better but at least one value is worse than the one in another compromise solution. The compromise choice should be made according additional criteria or requirements or estimated weight coefficients, giving the relative importance of the optimized performance characteristics.

5. Conclusions

Investigation of the modification of starch by grafting acrylamide using electron beam irradiation in order to synthesize water-soluble copolymers having flocculation properties is performed. Models for the mean values and the variances of the investigated product quality characteristics depending on the variations of the process parameters were estimated.

Optimal regions of the process parameters that satisfy the specified optimization criteria based on the estimated models for the mean values of the product parameters are obtained by implementation of graphical optimization.

In order to meet simultaneously the requirements for economic efficiency, assurance of low toxicity and high copolymer efficiency in flocculation process the EB irradiation doses (z_1) should be higher than 2.0 kGy, AMD/St weight ratio (z_3) should be lower than 5 and EB irradiation dose (z_2) should be 0.41 kGy/min.

Parameter optimization in terms of obtaining repeatability of the product parameters and quality improvement by minimization of variations in the quality characteristics is performed. Compromise Pareto-optimal solutions within the investigated experimental region of the process parameters are obtained.

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CERAMIC BEEHIVE - CONCEPTUAL PAPER

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Abstract: *The present article is a conceptual paper which aims to be a foundation for future experimental work. The conceptual work discusses different aspects of a new utility model – a ceramic beehive. The evidences are based on theoretical models based on the optimal living conditions of the bee family and the specifics of the changing external environment. Along with these factors are considered the ceramic properties and the relevance of the ceramic material as a construction material for the brood (the beehive body). In order to reach the aim of the paper are used the following empiric and non-empiric methods: literature review, expert evaluation, experiment. The results from the study confirm the conceptual model and reason the hypnotized properties of the experimental model for optimization of the living conditions of the bee family. This is supported by evidences in increasing of the honey production in the ceramic beehive.*
Keywords: *CERAMIC, BEEHIVE, CERAMIC BEEHIVE*

Introduction

The importance of the honey bees for the nature of our planet is indisputable- their presence is vital as pollinators (Aslan, Liang, Galindo, Kimberly, & Topete, 2016) of the agro ecosystems, ensuring the productivity and stability in nature (Rogers, Tarpy, & Burrack, 2014), having great importance for national and world economy (Rucker, Thurman, & Burgett, 2012; Southwick & Southwick, 1992) as whole industries benefit and exist due to the bees and their products- agriculture, beekeepers economic sector, the market of honeybee products, cosmetics, pharmacy, etc.

During the last 10 years an alarming event is observed and reported in many North American and European countries- colony loses and the so called "Colony Disease Disorder" (CDD). CDD is associated with complete absence of the colony with no dead bees in/around the colony; presence of capped brood; presence of food stores that are not robbed by other bees or typical colony pets (Ellis, Evans, & Pettis, 2010). The collapsing (weakening) of the colonies can be due to 1. An insufficient number of bees to maintain the amount of brood in the hive; 2. The workforce is composed largely of younger adult bees; the queen is present; 3. The cluster of bees is reluctant to consume food provided to them by the beekeeper. Although the event is not new in the nature, recently its size is going much beyond the normal. Other disturbing facts are concerning increased loses and lethality which can be caused by different factors most commonly connected to bee pathogens and parasites (Genersch, 2010; McMenamin & Genersch, 2015), chemical usage (Gashout, Goodwin, & Guzman-Novoa, 2018), chronic sublethal stress (Bryden, Gill, Mitton, Raine, & Jansen, 2013), etc.

In order to be ready to face the problem, countries like the USA are allocating huge amounts of money for forming ”consortium of investigators working in a coordinated manner to reduce institutional redundancy and optimize the discovery and delivery of sustainable bee management practices”. (Pettis & Delaplane, 2010). This common world problem should attract the attention not only of the academic society but also to the industries and policy makers to join efforts towards finding solution of this problem which is of global importance.

The present paper aims to offer a possible solution matching the reasons for the managed bees loss and the CCD with some specific properties of the baked clay materials. We find it reasonable to explore the potential for a beehive constructed dominantly from ceramic to be a technical solution for improving the living conditions of the managed honey bees. The motivations behind the present study are multidimensional.

The idea for using clay as construction material for beehive is not a new one and we assume that its applicability is already historically proven. There are existing evidences dated back to 2450 BCE when the Egyptians had developed sophisticated apiculture for beekeeping in clay hives which later had spread throughout the Mediterranean (Kritsky, 2017) The continued usage of the clay beehives is evidenced from remainings from the Iron age at the lands of Jordan Valley (Mazar, Namdar, Panitz-Cohen, Neumann, & Weiner, 2008) to different periods from the human history (Francis, 2009) (Harissis & Mavrofridis, 2012; Taxel, 2006).

Combining the example of our ancestors with the trends and development of the technologies in clay processing, theoretically justifies the idea of producing an advanced model of contemporary ceramic beehive. The main reasons for this are in the specific advantages of the ceramic in comparison with the traditionally used for beehive production wooden material. Here we will highlight some of these advantages which we consider as most important.

RH, %	Wood MC (Weight %)	Face Brick MC (Weight %)
50	~9	0.02
80	16	0.09
90	20	0.19
95	24	0.38
100	29+	4.3
100	n/a	5–7

Table 1 Table 1 Correlation of Relative Humidity, Wood Moisture Content, and Brick Moisture Content

Firstly, from technical point of view, one of the most important properties of clay is that when it is baked at high temperatures (over 950 ° C), it is irreversibly transformed into a solid stone-like body that has high strength, fire resistance and low water absorption. What is more, the backed clay is a pore "breathing" structure with high frost durability(Hansen & Kung, 1988) and is performing better in terms of water retain (table 1) which is important when considering the fact that the increased humidity and moisture content of the material are predispositions for bacteria and other microorganisms occurrence in the beehive. This would make the conceptualized ceramic beehive model especially useful for geographical regions characterized with extreme temperatures, high temperature amplitudes between the seasons as well as places with higher risk of fires or windy areas (the relative higher weight of the ceramic lowers the risk of sweeping) which cause serious material damages to the beekeepers. Because of the properties of the baked clay and its relatively higher endurance in terms of physico-mechanical and operational properties, a ceramic beehive is expected to be able to provide an optimal solution for unfavorable environmental conditions both for the bees and the beekeepers.

Additionally, the endurance of the ceramic materials in their solid baked form does not require any successive treatment as it is in the case of the wood materials. The wooden beehives require regular treatment with wood preservatives which affect the quality

of living of the bees as well as the quality of the bee products. Authors who worked on the topic argue that the wood preservatives such as chromated copper arsenate, tributyltin oxide, pentachlorophenol are associated with winter losses of colonies (Johnson, 2015; Kalnins & Detroy, 1984) and increased arsenic content in the products. Wood materials have relatively short life cycle in comparison with the bricks. With the time, the wear resistance of the wooden materials decrease and wood declay process takes place due to the wood-inhabiting bacteria and the actinomycetes (Clausen, 1996; Johnston, Boddy, & Weightman, 2016). The process causes effects on the level of hygiene within the beehives well. In this respect, the ceramic beehive is a more hygienic material which does not favor the development of bacteria, it is rot–proof, impermeable, non–absorbent, insulating and easy to clean and disinfect. Usage of ceramic material has also an environmental advantage as the production of ceramic beehives is not connected with cutting trees.

Considering all the above mentioned we assume that there are enough evidences to hypotize that a ceramic beehive would find a good application in the beekeeping industry providing better conditions for the bees and assuring better quality of the bee products.

Methods

In order to reach the aim of the study, is used a complex of non-empirical and empirical methods such as theoretical analysis, expert evaluation, experiment. The expert evaluation has been conducted in two stages - before and after construction design of a model of the conceptualized beehive. The expert evaluation aimed to gather experts who work in different fields connected to beekeeping (beehive production, beekeepers experts, academicians and researchers, constructors) in order to critically evaluate the idea and generate guidelines for the production of the first experimental model. The first experts' evaluation meeting took place in the spring of 2012. Following the production of the first experimental model, another experts evaluation took place in order to discuss practical aspects of the design, construction and production process. In 2014 starts the consequent process of inhabitation of the experimental model with bee families. The beehives are constantly observed and improvements of the construction of the beehive has been done in timely manner. The last upgraded version of the model has been inhabited in 2017.

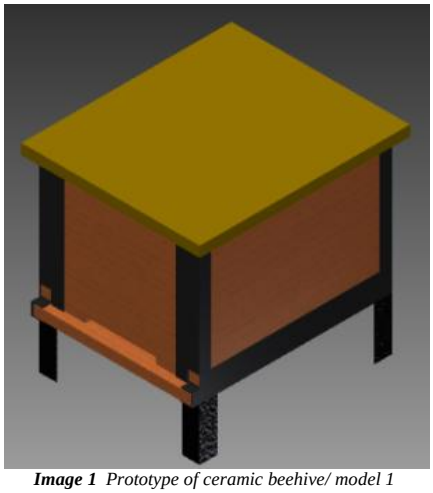


Image 1 *Prototype of ceramic beehive/ model 1*

Results and discussion

The first experts' analysis of the idea gives ground for development of the first utility model. The assumed benefits and advantages of the ceramic beehive have been confirmed by the experts. It was agreed that at this stage of the model development it is most appropriate to be designed and produced only the body (brood) and the top cap as it is the place where the queen lives and where the bees are during the winter season. The construction of the hive consists of ceramic plates and supporting metal structure as it is shown on image 1. The sizes of the design of the prototype is in full compliance with the standard for Langstroth hives enabling the usage of the standard wooden boxes above. The choice of Langstroth standard is not done randomly but because it is the most common used beehive in Bulgaria.

The realization and implementation of the idea has been discussed at the second expert evaluation meeting when advantages and disadvantages of the result has been analyzed. It was concluded that the main disadvantage is the weight of the body so lightening of the construction has been recommended. This led to research and development of new technological solutions ending up with design and production technology of ceramic plates with 66,66 % cavity (image 2). Apart from lightening the construction, the new single plates provide better isolation within the box because of the airbags (the inner part of the plate is filled with air) which ensures better living conditions and optimal temperature, significantly reducing the work of the bees in providing better living conditions.



Image 2 *Ceramic plate with increased cavity*

Along with the utility model has been developed the technology for production of the plates as currently there are model equipment for producing of different types of plates as show in table 2.

Table 2 Specification of the models for production of plates

Size [mm]	**Cavity [%]**	**Water saturation [%]**	**Compressive strength [MPa/ kg/cm^2]**	**Weight [kg]**
310 x 375 x 25	66.66	<10%	28 / 2800	2.900
310 x 500 x 25	66.66	<10%	28 / 2800	3.800
260 x 500 x 25	66.66	<10%	28 / 2800	3.000
260 x 375 x 25	66.66	<10%	28 / 2800	2.600



Image 3 *Ceramic beehives, improved experimental model*

Following the recommended modifications, 14 beehives have been produced and put in natural conditions with bees inhabited in apiaries in different geographical regions. The beekeepers who participated in the experiment were asked to observe the bees' behavior and to report problems and impressions they have from the exploitation of the experimental model. From all the beekeepers feedback has been collected. During the experiment, in summer periods in two of the apiaries occurred fire. In both places the only remaining hive from the burning beehives is the experimental ceramic one. The last report on the results of the usage of the ceramic beehive is from the autumn of 2018 when the beekeepers report 30% increase in the honey production in comparison with the production in the wooden hives. For none of the ceramic hives is reported bee loss or CDD.

Conclusions

The results obtained from the research confirm the conceptual model and reasons the hypnotized properties of the experimental model for optimization of the conditions for life of the bee's family. The idea has been registered as utility model in the Patent Office of Republic of Bulgaria with application number 2412/14.05.2013. Further experimental work is recommended in order to be laboratory tested the qualities of the honey produced in the ceramic beehive as it is assumed that the optimized internal conditions may also have effect not only to the quantity but also to the quality of the bee products.

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ANAKLIA DEEP-WATER PORT AS A MAJOR FACTOR OF INCREASING THE TRANSIT CAPACITY OF GEORGIA

ГЛУБОКОВОДНЫЙ ПОРТ АНАКЛИЯ – ВАЖНЫЙ ФАКТОР УВЕЛИЧЕНИЯ ТРАНЗИТНОГО ПОТЕНЦИАЛА ГРУЗИИ

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Abstract:*Anaklia Port is Georgia's first deep-water port. Anaklia is located on an important section of the Old Trade Road and represents a new Silk Road's key transport point linking China to Europe.*

Anaklia Deepwater Port will be built in several stages, and the process consists of 9 phases. The port is being built on the area of 400 hectares, and its construction and development cost is $ 2.5 billion. The port's capacity is 100 million tons per year.

In the phase I, the capacity of the Anaklia deep-water port will reach 9.3 million tons. The first phase of the construction is planned to be completed by 2020, after which the port will have a capacity to handle ships of the panamax and post-panamx types.

Anaklia Port will be able to become a leader in comparison with its competitors existing in the region, with the best road, rail and communications infrastructure and innovative equipment.

KEYWORDS:*CONTAINER SHIPPING, LOGISTICAL COSTS, LOGISTICS MASCINES, STORAGE FACILITIES*.

1. *Introduction*

Anaklia is located on an important section of the Old Trade Road and represents a new Silk Road's key transport point linking China to Europe. Anaklia Port is Georgia's first deep-water port, and it will be built in several stages, and the process consists of 9 phases. The port is being built on the area of 400 hectares, and its construction and development cost is $ 2.5 billion. The port's capacity is 100 million tons per year.

In the phase I, the capacity of the Anaklia deep-water port will reach 9.3 million tons. The first phase of the construction is planned to be completed by 2020, after which the port will have a capacity to handle ships of the panamax and post-panamx types.

Anaklia Port will be able to become a leader in comparison with its competitors existing in the region, with the best road, rail and communications infrastructure and innovative equipment. The depth of the port will be 16 meters, which will enable it to receive vessels with 10,000 containers (TEU).

Georgia lies on the strategically important section of the Silk Road on the route of the Belt and Road initiative, the shortest route between China and Europe. This makes it the main gateway during the process of cargo transportation in the regions of Central Asia and Caucasus, which have no access to the sea. The Anaklia port will serve the markets in the Caucasus region (Georgia, Azerbaijan and Armenia), with 17 million of customers in Central Asia (Kazakhstan, Uzbekistan, Turkmenistan, Kyrgyzstan and Tajikistan) and in northern Iran, with a total of 147 million people. The main reasons for attracting cargo will be the port location, and technical and infrastructural capacities. In addition, the ongoing infrastructural projects aiming at supportingthe Belt and Road initiative in the regionrepresent one more important indicator of strengthening trade among Europe and China in the future [1].

In summer 2017, the SSA Marine officially became the container terminal operator of the Anaklia deep-watersea port. SSA Marine is one of the world's largest terminal operators operating on 250 strategically important locations, and it is distinguished by the best experience and productivity. The company's experience is an important factor for the Port ofAnaklia port to become the main gateway in trade among Europe and Asia. SSA Marine is also the basic capital investor of the Anaklia Development Consortium.

2. Preconditions and means for resolving the problem

Georgian ports in Batumi and Poti are not ableto handlewith capacity more than 1500 containers,while shipseven with 10,000-container capacity enter the Black Sea. It has this become necessary to transfer cargo from the large ship to the small one, which adds to the transportation costs. To thisis also added that in Poti they need 3-7 days to empty, while vessels with 10,000-container capacity equipped with modern technologies are emptied in 48 hours. Taking into consideration all this, the average transportation-emptying costs of 1 container run $ 160 over. Due to this, cargo entered the territory of Georgia in 2015became $ 40 million more expensive in in total.

The Government of Georgia committed itself to increasing the railway cargo turnover to 100 million tons stage-by-stage, and within the limits of spatial planning, it will spend $ 4 billion in 2021 on the improvement of road infrastructure.

The involvement of Georgian government in port development is of high importance. It provides the closest road and rail link to the port. The Government of Georgia is responsible for the Population Resettlement Project, which was implemented according to international standards. According to the investment agreement concluded between the Government of Georgia and the "Anaklia Development Consortium", the port has been transferred to the consortium with the right to use it as a structure, for a term of 52years, on the principle of Build-Operate-Transfer (BOT). Under this Agreement, the Government of Georgia provides theAnaklia Development Consortium with 330 hectares of land and 225 hectares

of marine territory to enble the Consortium to build and operate it. On October 30, 2017, the Anaklia Development Consortium received official permit for the implementation of the first phaseof the construction [2].

In 52 years, according to the right of of structure, the port will be returned to the State. Direct investment of $ 2.5 billion will result in total economic benefits of $ 60 billion. The final capacity will reach 100 million tonnes per year by 2069. The port will be located on a 1000-hectare area and the water depth of the dock will be 16 meters. It is planned that 3400 people will be employed during the construction process, and 6400 people when launching operations, and 19,000 people at the end of the final phase. The first phase, according to the plan, must be completed in 2020. During the first phase,the container terminal will be constructed on 60 hectares of land, which will handle 900,000 containers and 1.5 million tons of cargo.

Anaklia deep-watersea port will have two breakwaters and one dock. There will be 7 container depots in the main dock. The depots intended for solid cargo will be located near breakwaters existing in the north, along with marine service/coast guard establishments. Three docks intended for liquid cargo are placed on southernbreakwater. As the study of the impact on transportation reveals, the one-way entrance channel is sufficient for the long-term traffic of vessels in the port. The space intended for turning back is located in front of the third and fourth docks, the radius of which is absolutely sufficient to turn back the ships with the largest capacity (10 000 TEU, 300 m).

The construction of the Anaklia deep-waterport began at the end of 2017. The construction warks are performed by the Anaklia Development Consortium, winner in the tender announced in July 2014. The consortium was founded bythe TBC Holding and American Conti International. The project is being implementedat several kilometers away from the occupied Abkhazia's administrative border and the US company's participation considerably reducesthe risks. In addition, US Vice President Mike Pence,during his stay in Tbilisi,expressed support to this port.

There are also specialists skeptical of the Anaklia port, but their number is not too large. Instead, the number of the interested parties and supporters is large. The ContiInternational, "MTBS," "VAN OORD," "SSA MARINE" –of the listed ones, the first one is an investor, the second one has taken part in the development of a master plan and design, the third one has performed the pre-construction works, which once designed the new Suez Canal and the famous Dubai Palms, and thefourth in this list is to oerate this port.The company "SSA MARINE" serves 250 terminals and 27 million containers per year.

The countries located in the south-east like Armenia, Azerbaijan, Turkmenistan, Uzbekistan, Tajikistan, Kyrgyzstan, Kazakhstan and Afghanistan have no access to the sea. The total population of these countries reaches 160 million people. Just this number says a lot. The date is unknown, but the United States will have to withdraw troops and equipment from Afghanistan some day. There are two options for this: 1) through the territory of Pakistan by land, entering the Arabian sea, and then getting to the ocean; 2) Turkmenistan, the Caspian Sea, Azerbaijan, Georgia, the Mediterranean Sea and the ocean (Fig. 1), [3].



Fig.1. *The shortest way from Central Asia (South) to the Atlantic Ocean.*

Chinese factor is of high importance for the Anaklia port. In 2016, this state'sexports amounted $ 2.2 trillion and exceeds by $ 700 billion the US ranking the second.15 years ago, in 2002, China'sexports amountedless than $ 247 billion. China's economy, at a slower pace, but is still rising by leaps and bounds. More products require more routes, more new roads. If only 1% of cargo will go through Georgia, this will amount $ 22 billion, part of which will be depositedin Georgia. At present, 340 million tons of cargo from China to Europe are being sent to Europe, but almost nothing goesthrough the territoryof Georgia. In recent years, the decline in China's exportsis due to the strengthening of the US dollar. In 2014-2016, China's exports increased from 14.2 to 14.4 trillion yuan. In January 2018,the Georgia-China Free Trade Agreement entered into force, which should increase trade turnover between two countries.

It is also noteworthy that the main segment of the Anaklia port is the large container ships such as the panamax and post-panamx. Consequently, the fear that Anaklia's port will leave no roomforPoti to exist on the market is irrelevant. The Poti Port serves relatively

smaller cargo vessels and it can have very few crossing points with the Anaklia port.

In parallel to the development of the port, there will be createdadditional infrastructure. The State guarantees the construction of the motorway and railway to the Anaklia port, which makes the dock project even of a larger scale. In addition, local small and medium businesses will be developed, including food, hotels and shops businesses. Overall, after the completion of the nine phase, investment in the project will reach $ 2.5 billion, which will be one of the largest investments in the history of Georgia.

The construction of the AnakliaCityis also plannedon the territory adjacent to the port. There will be organized free industrial zone. Priority will be given to planting of greenery and energy efficiency. The idea of the cargo airport was also voiced at the Silk Road Forum, which was held in Tbilisi at the end of November. However, details about the AnakliaCity are not yet completely studied. For how many people will be designed the city by 2030 or 2050, and which industries will be developed - will be known later. Anaklia builders study the experienceof Asia, which had developed rapidly in the short time. The tender will be announced in the spring for city management.

The Anakliadeepwaterport became associate member organization of the the same Trans-Caspian International Transport Route (TITR) of the MiddleCorridor [4]. The decision on this was made at the TITR session in Baku. The Trans-Caspian International Transit Route brings together the countries participating in the Silk Road project and important regional players. Its members are the leading maritime and transport companies from Kazakhstan, Azerbaijan, Georgia, Ukraine, China and Turkey. The Union aims to popularize the Middle Corridor, accelerate and simplify cargo transportation procedures between Asia and Europe and develop special preferential tariffs. In the view of shipping between the West and the East, the Middle Corridor competes with northern and southern routes. The Parties agree that the promotion of the Anaklia port is an important task for all regional players and the successful completion of the current large infrastructural projects is essential for the development of the Corridor.

Georgia is one of the most important players of the Trans-Caspian International Transport Route. The existence of a deep-water port is a prerequisite forimproving the competitiveness of the Middle Corridor in our country. The interest in the Anaklia port is significantly increasing despite the fact that it does not yet operate and is being at the early stage of the construction. This further underlines the importance of the project for both Georgia and the entire region.

3. Conclusion

The Trans-Caspian International Transit Route brings together the countries participating in the Silk Road project and important regional players. Its members are the leading maritime and transport companies from Kazakhstan, Azerbaijan, Georgia, Ukraine, China and Turkey. The Union aims to popularize the Middle Corridor, accelerate and simplify cargo transportation procedures between Asia and Europe and develop special preferential tariffs. "Trans-Caspian International Transit Route" combines the countries participating in the silk road project and important players of the region. Its members are leading maritime and transport companies from Kazakhstan, Azerbaijan, Georgia, Ukraine, China and Turkey. The union aims to popularize the middle corridor, accelerate and simplify cargo transportation procedures between Asia and Europe and make special preferential tariffs. In the view of shipping between the West and the East, the Middle Corridor competes with northern and southern routes. The Parties agree that the promotion of the Anaklia port is an important task for all regional players and the successful completion of the current large infrastructural projects is essential for the development of the Corridor.

The importance of the Anaklia port is also increased by the fact that it is located on a few dozen kilometers away from the occupied territories. In good weather, from this territory, the Ablhazianconturs are also clearly visible. Obviously, no one has the illusion that the conflict will be solved by the construction of the Anaklia port, but in the case of public diplomacy and the settlement of relations, the project is proving toa key one. The Anaklia port will employ several hundred people at the first stage, and after the of completion, there will be employed several thousand people. Consequently, economic stability in the regionwill be increased considerably.

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PECULIARITIES OF INDUSTRIAL ENTERPRISES` INVESMENT RESOURCES FORMATION

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Annotation. *The main features of enterprise`s investment resources formation have been studied. A wide range of sources, tools and methods of investment activity funding and their impact on financial and business processes of industrial enterprises have been defined. It has been pointed out that enterprise`s capital directed to reinvestment can also act as the background of investment resources formation. Tendencies and forms of industrial enterprises` investment activity have been marked. The proposals about enterprise`s investment resources classification according to the main features have been made. This allows industrial enterprises to form investment resources taking into account their mobilization aimed at meeting goals or restructuring of enterprise`s financial tools portfolio.*

KEYWORDS. *CLASSIFICATION, INVESTMENT RESOURCES, SOURCES, TOOLS, METHODS AND INVESTMENT INSTRUMENTS, ATTRACTIVENESS, PLANNING, STAGES.*

Definition of the problem. Environment factors and external environment affect the management object, i.e. the enterprise by shaping input and output parameters. The management object is only the enterprise's managers and staff who utilize investment resources in accordance with the purpose of the activity. External environment includes suppliers, competitors, consumers, lenders, intermediaries and other organizations. Environment factors affect raw materials, financial resources, fuel, engineering support, which are delivered to the enterprise and determine the parameters and requirements for volume, quality and range of products, services and innovative technologies. Provided that unplanned changes in the functioning of the management system elements take place, this will adversely affect the final performance.

The internal environment factors only affect the management object, i.e. the process of formation, utilization and allocation of financial resources, circulating assets, organization of production process, replacement of obsolete equipment, organizational structure, development strategy, allocation of responsibilities and interaction of staff, speed and quality of production, timely payment of tax obligations, marketing policy and so on. The consideration of these factors is important in determining the compliance of the enterprise's strategy and objectives of the investment project.

Presentation of key topics. One of the basic tasks of investment activity is its financing organization that allows to provide investment projects with investment resources which consist not only of monetary resources but also of other investments in a money equivalent, including fixed assets and intangible assets, credits, loans, rights to use land, etc.

The basic feature of generating investment resources is use of a wide range of sources, facilities and methods of financing investment activity and their influence on financial and economic activities of enterprises (Picture 1).

They are as follows:

1. All directions and forms of investment activity are carried out at the expense of investment resources generated by enterprises directly.

2. Investment resources generation is carried out at the expense of the available assets concentration with their further use in the investment activity.

3. To some extent, the basis of an enterprise's investment resources generation is its capital allocated to reinvestment; the forms of such reinvested capital used in the process of generating investment resources are depreciation deductions from the fixed assets and depreciated tangible assets; means received form selling capital assets retired; returns from selling separate financial instruments of investment, etc [1, c.110].

4. Investment resources generation accompanies all the stages of the enterprise's life cycle related to its further economic development. Starting with the "birth" of the enterprise and finishing with its "ageing", the process of generating investment resources has a regular character. Thus, every stage of the enterprise's life cycle is characterized by its distinguishing features in the rates and sources of generating investment resources.

5. Generation and use of investment resources is related to all the stages of the investment process at the enterprise. On the pre-investment stage investment resources are formed for financing the preparation of the real projects, carrying out project works, their examination, etc. On the investment stage investment resources are generated for carrying out necessary construction and assembly works, acquisition of separate capital assets or integral property complexes. On the post-investment stage investment resources are generated for the operating goals, in particular, for financing the circulating assets of the investment objects in operation [2, c. 176].

6. Generating the investment resources of an enterprise is a non-interruptible process. While actual or financial investments can be made by an enterprise irregularly and differ substantially, the process of generating its investment resources is non-interruptible. Mostly this continuity is characteristic of own internal sources of generating investment resources - depreciation deductions and income directed to the production development. However, the attention should be paid to the fact that continuity of the process of generating investment resources does not mean the time-dependent evenness of their generation volumes. These volumes can substantially fluctuate in time depending on attracting investment resources from outside [3, c. 64].

7. The process of generating investment resources is of a determined and regulated character. Determinability of this process is characterized by its quantitative definiteness in time by volume, structure and other parameters. The ability of this process to be regulated is determined by the system of specified operating methods of investment management, which allow to attain and maintain the preset parameters of investment resources generation. Determinability and ability of the process of generating the enterprise's investment resources to be regulated allow to carry it out on the planned basis [4, c. 182].

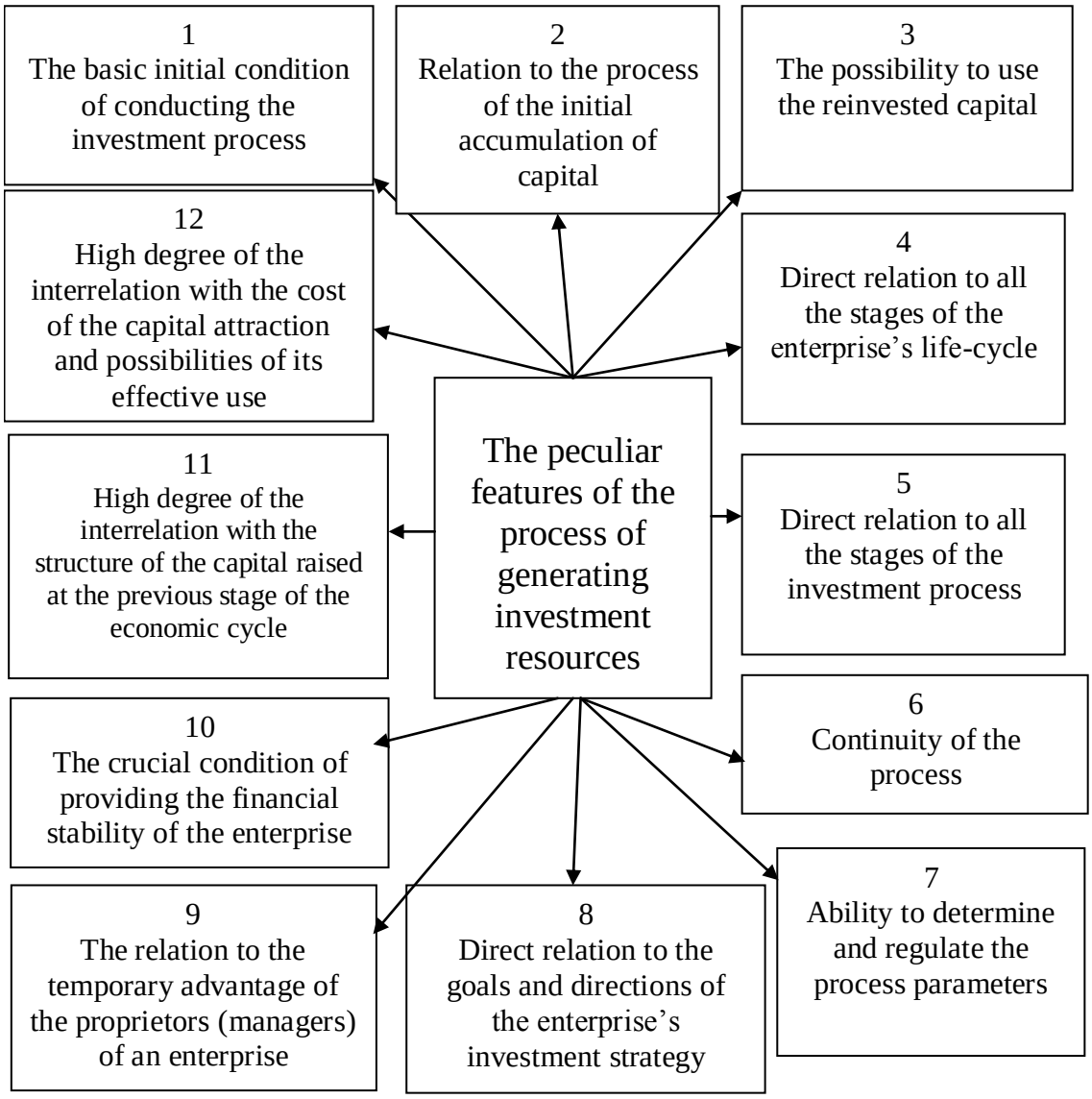
8. Investment resources generation is inseparably linked with the goals and directions of the enterprise's investment strategy. Being the financial basis of pursuing the selected investment strategy of an enterprise, investment resources generation, as a rule makes up its independent special-purpose block, according to which strategic special-purpose standards are developed. In some cases the possibilities of generating investment resources determine the rates of the enterprise's strategic development.

9. The rates of generating the investment resources of an operating enterprise at the expense of the income are determined by temporary advantage of its proprietors (managers). The process of such a generation (accumulation of new equity investment assets) is carried out through the mechanisms of the dividend policy (policy of allocating the newly made profits). The level of the income capitalization stipulated by a temporary advantage of its consumption is made at each enterprise individually considering the peculiar features of its investment activity and terms of the external investment environment [5, c. 67].

10. The effective generation of investment resources in terms of their separate sources is the major condition of an enterprise's financial stability. The rational structure of the sources of the investment resources under generation allows to reduce the level of investment risks exposure in the future activity of an enterprise, to prevent its bankruptcy [6, c. 17].

11. The possibility of generating the enterprise's investment resources is determined, to a great degree, by the capital structure built at the previous stage of its economic cycle. In the first turn it concerns generating the additional investment resources due to loan sources. There is an inverse relation between the specific gravity of the loan capital actually used by the enterprise and possible volumes of its additional attraction for investment purposes. This feature must be taken into account when forecasting the potential and rates of generating investment resources.

12. To a great degree the volumes and sources of generating investment resources are determined by the cost of their attraction (the cost of capital). Thus the average weighted cost of the investment capital under generation must be necessarily compared with the effect from its use in the process of the real or financial investment [7, c. 351].



Picture 1 *Basic peculiar features of the process of generating the enterprise's investment resources*

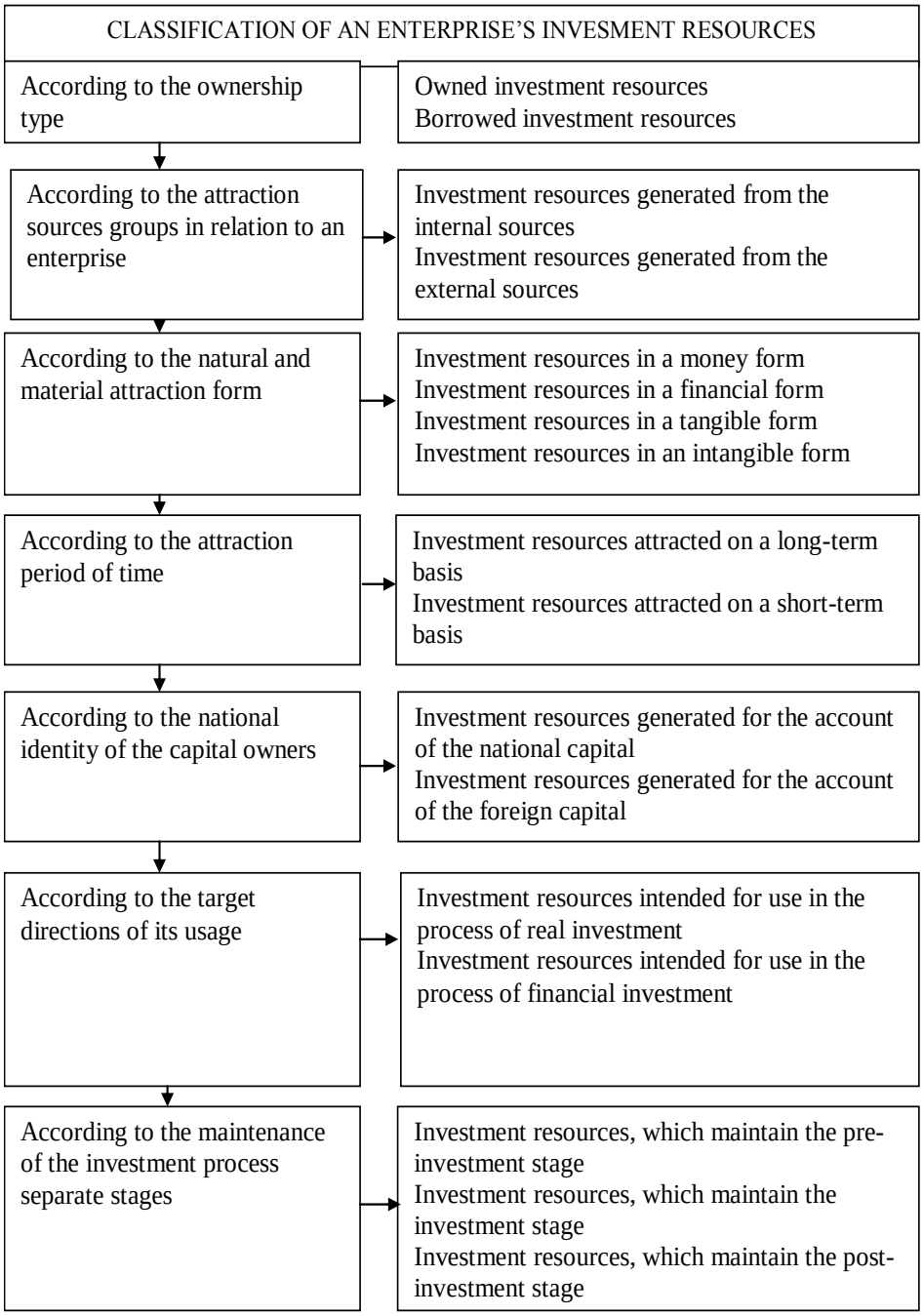
The investment resources, which the enterprise generates, are classified according to many features. The basic ones are as shown in Picture 2.

1. According to the ownership type investment resources generated by an enterprise are divided into two basic groups - owned investment resources and borrowed investment resources. In the system of the sources of generating investment resources such a division is of a determinative character [8, c. 35].

Owned investment resources characterize the total worth of an enterprise's means, which maintain its investment activity and that which belongs to it under the ownership rights. The means granted to the enterprise free of charge for making target investment are referred to owned investment resources.

Borrowed investment resources characterize the capital generation by an enterprise in all its forms on a pay-back basis. All forms of loan capital, which are used by an enterprise in its investment activity, are its financial obligations which are subject to redemption within a specified period of time.

2. According to the attraction sources groups in relation to an enterprise there are investment resources raised from the internal sources and investment resources raised from the external sources.



Picture 2 *Classification of an enterprise's investment resources basic features*

Investment resources attracted from internal sources characterize equity and borrowed financial means generated directly at an enterprise for maintaining its development. The basis of the equity generation from internal sources is its capitalized part.

Investment resources attracted from external sources characterize their part which is raised from outside the enterprise. It embraces both the equity and the loan assets attracted from outside.

3. According to the natural and material attraction form, the contemporary investment theory distinguishes the following types of investment resources: investment resources in a money form; investment resources in a financial form; investment resources in a tangible form; investment resources in an intangible form. Investment of capital in these forms is permitted by the law when setting up new enterprises, increasing their equity capital size [9].

Investment resources in a money form are the most widespread type attracted by an enterprise. The universality of this type of investment resources is in the fact that they can be easily converted in any form of the assets necessary to the enterprise for executing its investment activities.

Investment resources in a financial form are attracted by an enterprise in a form of various financial instruments included into its equity capital. Shares, bonds, savings accounts and certificates of banks can act as these financial instruments. In the national economic practice raising capital in a financial form is used by enterprises extremely rarely.

Investment resources in a tangible form are attracted by an enterprise in a form of various capital goods (machines, equipment, buildings, premises, raw material, materials, semi-finished goods, etc.).

Investment resources in an intangible form are attracted by an enterprise in a form of various intangible assets, which do not have a material form but participate directly in its economic activities and profits. The rights to use separate natural resources, patent rights to use inventions, "now-how", rights to use industrial prototypes and models, trademarks, computer programmes and other non-material types of property values are referred to this type of the invested capital.

4. According to the attraction period of time the following types of investment resources are distinguished [10, c. 304].

Investment resources attracted on a long-term basis. They consist of equity capital and loan capital with the term of the use of more than one year. The aggregate of the equity capital and long-term borrowed assets raised by an enterprise for investment purposes is characterized by the term "permanent capital".

Investment resources attracted on a short-term basis. They are raised by an enterprise for a period of one year for meeting temporary investment needs.

5. According to the national identity of the capital owners, investment resources generated for the account of the national capital and foreign capital are distinguished.

Investment resources generated for the account of the national capital are characterized by the biggest number of sources. This type of investment capital, as a rule, is more available for enterprises of small and medium-sized business.

Investment resources generated for the account of foreign capital provide carrying out large real investment projects of an enterprise mainly related to reshaping its activity line, reconstruction or technical reequipment. Although the volume of the capital supply on the world market of capitals is considerably sufficient, the terms of its raising by national businesses for economic purposes are very limited due to a high level of economic and political risks for foreign investors.

6. According to the target directions of usage, there are the following resources: the investment resources intended for the use in the process of real investment, their volume and structure are planned separately for every real project within the framework of the set investment programme of an enterprise.

Investment resources intended for the use in the process of financial investment, their attraction is directed to achieving the aims or restructuring the financial instruments portfolio for enterprise's investment.

7. According to the maintenance of the investment process separate stages, the following types of investment resources are distinguished. They are as follows:

- investment resources, which maintain the pre-investment stage;
- investment resources, which maintain the investment stage;
- investment resources, which maintain the post-investment stage.

Such a division of investment resources is used only in the process of providing the implementation of the separate real investment projects.

Conclusions. The project team consists of a project manager and team, i.e. investors, customers, managers, suppliers, intermediaries, a designer, subsidiary structures and organizations, managers of project units and personnel. Project managers can be not only investors but also representatives of enterprises (clients) who are equally responsible for the project results, objectives attainment, intended use of financial resources, compliance with the project's schedule. Project managers receive necessary informational support for the enterprise's activities, that is, financial statements, contracts, documentation to assess financial position and make appropriate decisions. After processing the data on the enterprise's activity, evaluating the project prospects, management subsystems are formed by each project unit, i. e. building of subsystems for managing the implementation time, human resources, risks, finances, sales, raw materials supply, allocation of resources, production process and project objectives. The reasons for project termination can be as follows: increasing threats from external environment; violation of the schedule terms; conflicts between investors and executives of the enterprise; lack of financial resources; reduced effectiveness of the project and increased costs; development of more efficient investment projects. The project team affects the management object by making management decisions, adhering to the functions, principles and management methods.

The management process begins with definition of the purpose and shaping of the goals and objectives, without which no investment project is feasible and there are no reasons for its implementation. Goals and objectives of the investment project should correspond to the interests of the enterprise. Then the analysis of the enterprise's financial activity results is made with the aim of concluding new contracts and obtaining loans.

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FACILITATION OF SME`S DEVELOPMENT IN UKRAINE BASED ON COMPETITIVE FISCAL ENVIRONMENT FORMATION

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Abstract. *The priorities of the simplified taxation system implementation in European countries aimed at the entrepreneurial incentives development, innovation introduction, and formation and strengthening of the SMEs competitiveness and economic growth have been studied. It has been found out that empirical findings show that high taxation rates potentially negatively affect entrepreneurial environment and high tax burden has sufficient adverse impact on SMEs business environment. Instruments of business support by the state both in the EU countries and in Ukraine have been determined. The main risks of the simplified taxation system for local budgets and entrepreneurial structures have been stated. The further fiscal system reforms aimed at SMEs motivation have been suggested.*

Definition of the problem. One of the most significant challenges today is to transform the simplified tax system and bring it into line with the pan-European approaches, which is particularly difficult, given a large share of the single tax in the structure of local budget revenues.

Analysis of recent investigations and published papers. It should be emphasized that the fiscal role of SMEs is not generally defined as a state policy objective [1]. In the EU,the fiscal efficiency of the sector is viewed as a concomitant element, which is a natural result of the growth of economic activity in general, increase in the value added and provision of effective demand for domestic supply of goods and services. Accordingly, we can determine the following priorities for the SME existence in the EU: development of entrepreneurial initiative; innovation; job creation and self-employment; strengthening of competitiveness and economic growth. In this case, the SME fiscal value is not considered as a state policy objective. Thus, we can conclude that in the EU,the SME fiscal efficiency is considered as a concomitant element, which is a natural result of the economic activity growth.

The state policy with regard to business environment is shaped under the impact of socio-economic characteristics of countries and on the basis of the theoretical concepts regarding the state'sinfluence on economic processes. Researchers and representatives of the expert community are unanimous in the fact that tax levers often do not provide a consensus of fiscal interests of all parties to the taxation process. However, the results of the empirical studies [2, 3, 4] indicate a possible negative affect of the high level of taxation in a country on entrepreneurship. A high tax burden exercises significant influence on business activity as well [5].

The modern applied theory of taxation of entrepreneurship is formed under the impact of strengthening its role in the world'seconomy. In this context, as it was already noted, there emerged a new type of tax relationship – an alternative one based on the need to strengthen support for SMEs.

The results of the following scientists' researches [6, 7, 8, 9] enabled us to assert that the implementation of alternative taxation systems for small and medium-sized businesses in different countries is a confirmation of existence of qualitatively different economic systems at different stages of their evolution. The advantages and disadvantages of the approaches to shaping fiscal policies are stipulated by the objectives of their implementation, impact on competitive environment, degree of shadowing of economic processes and propensity of entrepreneurs to opportunistic behaviorin terms of taxation.

The experience of the countries around the world in tax stimulation of small business development says about the use of various instruments in this area. Developed countries are characterized by the use of some tax benefits, among which there are the following: reduction of tax rates, special procedures for amortization charges, tax holidays, loans and discounts, deductions, simplified accounting and reporting. As a rule, the purpose of these tools application is to stimulate development, innovations and employment. Developing countries and the poorest states are largely characterized by other instruments. They primarily apply special (alternative) taxation regimes, which are implemented through adoption of a single tax, patents and separate taxes on certain activities. Here, the main purpose is economic stabilization, employment and self-employment, creation of conditions for an adequate standard of living of individuals and households.

Special attention in developed economic systems is paid to state support for small business based on its social importance. It should be emphasized that state support for business can take many forms, from tax incentives and tax holidays to creation and funding of business parks, and is based on its close relationship with the welfare of citizens [10].

The analysis of tax levers in the EU countries enabled us to assert that the basis of stimulation consists of measures for investment and innovation activities, development of the material component of business entitiesbased on technological advantages. The most used discount is that of introducing preferential rates for separate regions or sectors of the economy (there are 27 of them in 19 EU countries), as well as accelerated depreciation and research and development benefits. They are implemented within the framework of the state policy of business entities support and are aimed at reducing the SMEs non-productive costs of administration and tax payment, leveling inflation processes when compensatingthe assets value through depreciation.

Presentation of key topics. In 2016, small and medium-sized enterprises in Ukraine accounted for 67% of the employed population and 59.8% of the gross value added created in the non-financial sector of the economy. At the same time, the share of microenterprises in the total number of enterprises in this sector reached 96.5%, the number of employed – 34.7%, gross value added – 13.2%respectively. Unfortunately, unlike the EU, a significant number of small businesses in the structure of the Ukrainian enterprises do not show a significant value added and high official employment rate in the sector [11]. In Ukraine, a simplified system of taxation of business entities is used, which is implemented through the adoption of a single tax, with the gradation of tax rates depending on the turnovervolume. The Tax Code of Ukraine contains a separate subsection "Simplified system of taxation, accounting and reporting", which has the regulatory parameters according to Table 1.

Thus, in itscurrent form, the simplified taxation system only provides for one type of compulsory payment – a single tax, which is the source of revenue for local budgets. Regardless of this, entrepreneurs pay a single social tax to the Pension Fund of Ukraine. The taxpayer may select the simplified taxation system in accordance with the established criteria.

Table 1. *Parameters of activities of single tax payers in Ukraine*

Entities of the taxation system		Number of employees	Annual income size	Single tax rate
group 1	An individual – business entity	Work without employees	Annual income per calendar year does not exceedUAH 300 000	Up to 10 % of the minimum wage per calendar month
group 2	An individual – business entity	The number of employees does not exceed 10 people	Annual income must not exceedUAH 1500 000	Up to 20 % of the minimum wage per calendar month
group 3	An individual – business entity	The number of employees is not limited	Annual income must not exceed UAH 5 000 000	3% of income for VAT payers 5 % of income for VAT non-payers
	Legal entity – a business entity of any legal form			
group 4	Agricultural producers	If the share of agricultural production for the previous fiscal (accounting) year equals or exceeds 75 %		Per one hectare of agricultural land and/or land included in the Inventory of water resources;depends on the category (type) of lands, their location and accounts for (as a percentage of the tax base)

Source: compiled by the author based on the Tax Code of Ukraine

In general, under Article 11 of the Tax Code, special taxation regimes, except for exemption from payment of certain taxes and fees, provide for a system of measures for the special taxation procedures for certain categories of business entities as well as for the definition of certain elements of compulsory payments. The said regime provides for the special procedure for determining the elements of tax and levy, exemption from payment of certain taxes and levies, tax benefits and the procedure for their application.

Over the years of our country'sindependence, the goals of business development have changed many times, which has led to changes in the taxation of small businesses. Despite the application of the special taxation regime, SMEs in Ukraine are considered exclusively in terms of fiscality, which results in constant reductions of the existing preferences, attempts to regulate SMEs activities and make them more fiscal, and, eventually, to eliminate the special taxation regimes for the economy segment, which is considered to be a "source of growth and innovation" by the leading economic powers. Today, it is important for our country to create conditions under which SMEs will be interested in expanding their activities and increasing their share in the value added. After all, their share in the total value added of the country is extremely low. Until 2015, the single tax was the key one in volume out of local taxes and fees, which should be taken into account when transforming this tax into the forms of state support applied in the EU. In 2016, the single tax amounted to 11, 69% of the tax revenues to local budgets of Ukraine. Out ofUAH 9.9 billion revenues from the single tax,UAH6.2 billion were paid by individualentrepreneurs of the first and second groups, despite the decrease in their number in recent years (Table2).

Table 2*. Local budget revenues from the single tax, million UAH [1].*

	2016	2015	2014	2013	2012	2011
Total, including:	9 898,35	10 975,09	7 413,25	6 640,52	4 815,64	1987,91
Single tax from legal entities	1 941,01	2 206,15	2 008,47	1 743,29	1 204,76	874,70
Single tax from individuals	6 204,68	6 744,72	5 404,78	4 897,23	3 610,88	1113,21
Single tax from agricultural producers	1 752,65	2 024,23	0,00	0,00	0,00	0,00

Source: compiled based on the official website of the State Treasury Service of Ukraine. Reports on budget execution // URL:http://www.treasury.gov.ua/main/uk/doccatalog/list?currDir=146477

It should be noted that the decrease in the number of individual entrepreneurs from 2012 to 2016 by 213.3 thousand persons is associated both with the development of the crisis phenomena in the Ukrainian economy and with the placement of restrictions on the range of persons who can apply the simplified taxation system. The main users of the simplified taxation system are representatives of micro-businesses, mainly individuals that cannot be ignored when reforming the taxation scheme for this sector.

The inconsistency of the SME taxation system used in Russia leads to the reform or abolition of the simplified taxation system, which has remained one of the most pressing issues for a long time. To this end, it is necessary to develop a transitional transformation taxation model for micro and small businesses with a gradual restriction of the special taxation regime. As well,the control regulations should be improved, and local authorities should be motivated to inform the fiscal authorities of suspicion and identification of non-registered business activities in the administrative-territorial unit.

The main risks of the simplified taxation system functioning in Ukraine includeas follows: creation of informal employment; a possibility of understating tax liabilities due to control fallibility; participation in the schemes of tax evasion for enterprises under the general taxation system; uncontrolled cash payments, which allow freely realizing goods illegally imported into the country; informal settlements with employees on wages and understating of employees'official incomes. The opportunism of domestic taxpayers and single tax payers, in particular, combined with control fallibilitycreate insufficiency of budget revenues, distortion of competitive environment and inhibition of the European integration processes.

The totality of the above-mentioned problems makes any innovation development of the national economyalmost impossible under the conditions when the legal guarantees provided by the state are, in fact, only declarations: the tax rates fixed in the tax laws are nominal, and the real tax burden can significantly exceed the level provided for by the law; state financial planning aims exclusively to solve short-term tasks of filling the state budget; the operating conditions of start-ups established by SME can be radically worsened at any time, which does not allow us to expect the implementation of innovation projects, especially those with the payback period over 1 or 2 years.

Under the current conditions,the introductionof investment and innovation incentives, such as: accelerated depreciation or amortization discounts, VAT exemptions for imported equipment, special taxation regimes for industrial parks and so on, will have a very limited effect, since there are no guarantees of stability of such incentives in the medium- and long term.

Further reform of the taxation system should be aimed, in particular, at stimulating the inflow of investments while strengthening the management of tax risks aimed at preventing tax evasion and combating the erosion of the tax base. The need to attract capital exported from Ukraine to the economy and expand the tax base requiresenhancing the implementation of the regulatory and incentive functions as well as general conditions for doing business in the country and tax administration, limiting the possibilities of large businesses to abuse the simplified tax system by the following ways:

- introduction of objective hardware methods of accounting for retail trade operations (entry of information on transactions into a certain database using technical means – cash registers, smartphones, pads, etc.). The advantage of using multifunctional devices like smartphones with specialized softwarelies in reduction of administrative and financial pressure on entrepreneurs (there is no need to buy a specialized fiscal device – a cash register; the ability to control the formal compliance with the regulations on registration of settlement operationsdecrease), however, a larger number of such operationsundergo primary accounting;
- strengthening the motivation of entrepreneurs of the small business segment to further growth by expanding investment and innovation opportunities, namely: reduction of the object of taxation for the amount of costs of the fixed assets acquisition for production and innovation. Not only will this allow stimulating active innovation activities of the entities, but it will also require establishing cost accounting on a voluntary basis, preparing the entity for further growth and transition to the general taxation system (if necessary);
- formation of a system of control over the participation of a business entity in tax evasion schemes on the basis of a risk-based control system and remote monitoring of risk indices.

The reform of the individuals'taxation in Ukraine should provide for the preservation of simple accounting operations for entrepreneurs. However, in our opinion, at the stage of development of new forms of state support and approaches to taxation and accounting of business transactions, it is advisable to temporarily maintain a simplified taxationsystem on the basis of a single tax for the category of individualentrepreneurs included in the first group of taxpayers, which does not contradict the Recommendation of the European Commission.

At the same time, it is necessary to abandon the practice of manipulating tax rates and restrictions, and focus on opportunities for the development of entrepreneurs based on the category of small business. A gradual, step-by-step detailing of the accounting elements will allow harmonizing the conditions with the general system of taxation and form the conditions for application of benefits for innovation and investment activities in the SME area.

Thus, individualentrepreneurs (group 1 of the single tax payers) within the special taxation regime are offered: to keep records of business transactions (income) on the basis of simple forms and annual reports, with the electronic reporting and administrationexpanded;to temporarily (until the law of Ukraine "On state support for business entities" becomes valid) assess taxes based on the single tax, effective as of 1 January 2018.; to preserve a possibility of transition to taxation under the general rules (personal income tax), with broadening the limits of accounting the costs of doing business similar to deductions, which are widely used in European countries in the taxation of incomes of individuals engaged in business. To ensure greater controllability (including ensuring the effectiveness of the introduction of objective methods of income control), we suggest taxation of the 2nd group of single tax payers based on revenues. At the same time, we also suggest introducing simple forms of accounting for business transactions for such persons, which will provide for the possibility of accounting fixed assets and their depreciation as well as costs of employees'wages, thus adopting the simplest compulsory cost accounting. Legal entities (group 3 of the single tax payers) and individual entrepreneurs (group 2) under temporary preservation of the single tax are offered: to be subject to the taxation based on revenues within the special taxation regime until the law of Ukraine "On state support for business entities" becomes valid and to get the mechanisms aimed at SMEsdeveloped; to enjoy the introduction of instrumentsfortax regulation of depreciation when executing simplified accounting in order to determine the tax base; to have a possibility of reducing the object of taxation for the amount of costs of wages and depreciation.

In order to strengthen the motivation of entrepreneurs of the small business segment to further growth, we consider it necessary to change the current legislation on the regulation of taxation of small businesses, whichuse the general system by introducing the following: within the framework of the general system of taxation, to increase the maximum amount of income, which enables not to apply adjustments of the pretax financial result to tax differences. In the taxation of incomes of enterprises which, under the terms of the general taxationsystem, are obliged to calculate tax differences, it is offered to increase twice – up to UAH40 million – the threshold value of the annual income from any activity provided for by Art. 134 of the Tax Code (for deduction of indirect taxes) calculated by accounting rules for the last annual accounting (taxation) period in value terms. This will allow small and micro enterprises – legal entities with the turnover from UAH20 million to UAH 40 million, when purchasing equipment, technologies and implementing innovations, not to increase the administrative burden due to the complexity of accounting tax differences. In order to reduce the administrative burden on developing business entities caused by doing separate accounting of tax differences and stimulate the renewal of fixed assets and equipment, it is offered to introduce a simplified procedure for writing off the cost of newly acquired production fixed assets of the fourth group tothe costsof production. This mechanism will stimulate innovation investment in small business projects.

Domestic small business needs effective instruments to reduce the tax burden for investment-active entities. Changing the rules of depreciation, in particular, by making alterations and amendments to the Tax Code, will stimulate the development of small businesses, especially in the field of assets renewal. The amendments to the Tax Code of Ukraine require the adjustment of all related regulations.

It should be noted that the modern approach to the taxation of small business (single tax), mainly focuses on changes

in tax rates depending on the category of small business. Insteadof this, it is offered, depending on the category of business, to gradually detail the elementsof accounting for the purpose of taxation and taxation of the objects for SMEs, harmonizing them with the general system, as the relevant entities are developing.

Conclusions. The further transformation of the special taxation regime continues in the context of changing the priorities and the purposesof its application, which are currently more fiscal than stimulating, as well as based on theEuropean integrationvector. One of the steps to harmonize the system of SME stimulation in Ukraine with the European approaches is the Law of Ukraine "On development and state support for small and medium-sized enterprises in Ukraine", which entered into force in 2017 and provides for non-financial as well as investment and innovation mechanisms of state stimulation.

Based on the analysis of the employment indices, value added and tax revenues, it was determined that the role of SMEs in the economy has increased significantly compared to the first and second stages of development, tax revenues from SMEs applying the simplified tax regimehave increased. However, further stimulation of SMEdevelopment and growth as well as formation of a competitive environment for doing business and taxation, which corresponds to the European principles, require the improvement of the appropriate taxation mechanism based on the European approaches.

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IMPACT OF IRRIGATION REGIMES IN DRIP IRRIGATION OF RASPBERRIES ON THE YIELDS

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SUMMARY : *Berry cultures - strawberries, raspberries, blackberries, blackcurrants, etc. are of great economic importance due to growing demand and high productivity. In general, they are susceptible to droughts and are so demanding for soil moisture, and their growth and yield depend to a large extent on the presence of sufficient soil moisture.*
In order to establish the irrigation regime of raspberriesin drip irrigation conditions, field experiments were conducted on the experimental field Chelopechene-Sofia. Irrigation was carried out with a pre-irrigation humidity less than 85% of WHC and variants watered with irrigation rate reduction of 20%, 40% compared to the variant irrigated at 100% of WHC and non-irrigated variant.
Realized irrigation regimes in individual years have had an impact on the yields obtained, with the highest yields being obtained for the irrigated variants with 100% irrigation rate and the lowest in non-irrigated variants. The highest increase in yield was obtained in 2004 (dry), which is with 67% more compared to non-irrigated variants, and the smallest increase of 33% was obtained in the humid 2005.
The analysis of meteorological factors shows that the rainfall in the country is insufficient to satisfy the requirements of plants of soil moisture, and the temperature sums over ten-days periods over the whole vegetation period considerably exceed the respective norms. This requires the use of drip irrigation for the successful production of raspberries under conditions of water deficiency and relatively high temperatures.
KEY WORDS*: RASPBERRIES, IRRIGATION REGIME, DRIP IRRIGATION, RAINFALL, TEMPERATURES, DROUGHT, YIELDS.*

INTRODUCTION

Increasing water deficit requires the use of irrigation technologies in the practice of irrigation agriculture, as well as research to optimize irrigation regimes for agricultural crops to achieve water saving and achieving economically viable yields.

In determining the impact of drought on crop yields, the most significant of the meteorological indicators are the sum of rainfall and the sum of the temperatures during the different periods of the crop development or for the whole vegetation period. The yields obtained in irrigated and non-irrigated conditions reflect their impact on the development of crops during their vegetation period, depending on the biological and physiological requirements during their individual developmental phenophases.

In this case, information on yields obtained from multi-year field experiments in optimum irrigation and in water deficit conditions is extremely important. These and other results are needed to adapt crop cultivation technology to drought conditions.

The studies carried out so far on raspberries irrigation, show that for the yields to grow it is very important water be provided before the ripening of the fruits and during the whole harvest period (Kuiesza, W., 1973). According to the same authors, droughts have the greatest negative impact on yield two weeks before fruit harvesting and during ripening. Through maintaining a limited water deficit in the soil, the yield of raspberries increased by over 9.6% and in dry years by 27.6% compared to non-irrigated variants. (Mackenrron, 1982).

One single study has been carried out in our country on raspberry irrigation, resulting in determining some parameters of the irrigation regime in drip irrigation (Ivanov, Al., 1998), and for the double bearing(everbearing) varieties of raspberries entering the country massively, research is almost lacking.

It has been established from our global practice that drip irrigation (Drupka, W., 1979, Kireva, R., V. Petrova, 2014) is the most suitable for their biological requirements. This mode of irrigation ensures that you get biologically optimized yields with high quality fruits and significant water savings. (Kuiesza, W., 1973)

The aim of the study is to determine the influence of irrigation regimes on the yield of raspberries grown in drip irrigation in years with different provision of meteorological factors.

Material and method

In order to establish the effect of irrigation regimes on raspberries yields, tests were conducted at the experimental field of the Pushkarov Institute in Chelopechene- Sofia (2001-2005).

The following irrigation options have been researched:

- 1.Option without irrigation.
- 2.Option irrigation with 100% irrigation rate;
- 3.Option irrigation with 80% irrigation rate;
- 4.Option irrigation with 60% irrigation rate;

Irrigation was performed by surface dropping with droppers KP-4.6, perforated tubing between 0.60 m. The soil is leptosol, slightly sandy loam in the plowing layer, formed on the base of an old diluvial cone made of sediment materials. It is poorly stocked with nitrogen, average stocked with phosphorus and well stocked with potassium. On average, for the layer 0-60 cm, the soil has the following water-physical properties: a water holding capacity/WHC/ - 22.1%, a humidity till wilting 12.3% by weight of absolutely dry soil, bulk dencity at WHC 1,47 g /cm3. For the soil layer 0 - 100 cm, the same indicators have the following values: WHC - 21.8%, humidity till wilting - 12.3% and bulk density - 1.50 cm3. The soil is suitable for growing raspberry plantations.

Results

Meteorological conditions of the experiments

Regarding the amount and distribution of rainfall during the April-September vegetation period, the conditions during the individual years are characterized by variety and manifestation of extremes. According to the provision of rainfall, defined in the 1956-2005 series (Table 1 and Figure 1a), three of the years - 2001, 2002 and 2005 are humid, one - 2003 - average and one - 2004 - very dry (Table 1, fig. 1). A humid spring was observed in 2001 and 2003, and a humid autumn in 2002. Summer droughts lasting more than ten days were observed throughout all the years of the surveyed period. Their manifestation is mainly in June (2002, 2003, 2004 and 2005), and only in two years (2001 and 2002) - in July. For some ten days periods in 2002, 2003 and 2005, ten-day amounts significantly exceeded the average.

Table 1: *Rainfall during raspberries vegetation period (2001– 2005 years.)*

Periods	Total rainfall, mm					Rainfall factor security, (%)				
Year	2001	2002	2003	2004	2005	2001	2002	2003	2004	2005
м. IV – IX	358	418	329	258	765	37,1	17,3	59	94,6	1,4
Average multi-annual	365	365	365	365	365	-	-	-	-	-
м. VII – VIII	75	158	104	73	400	76,8	9,3	47	74,8	1,4
Average multi-annual	110	110	110	110	110	-	-	-		

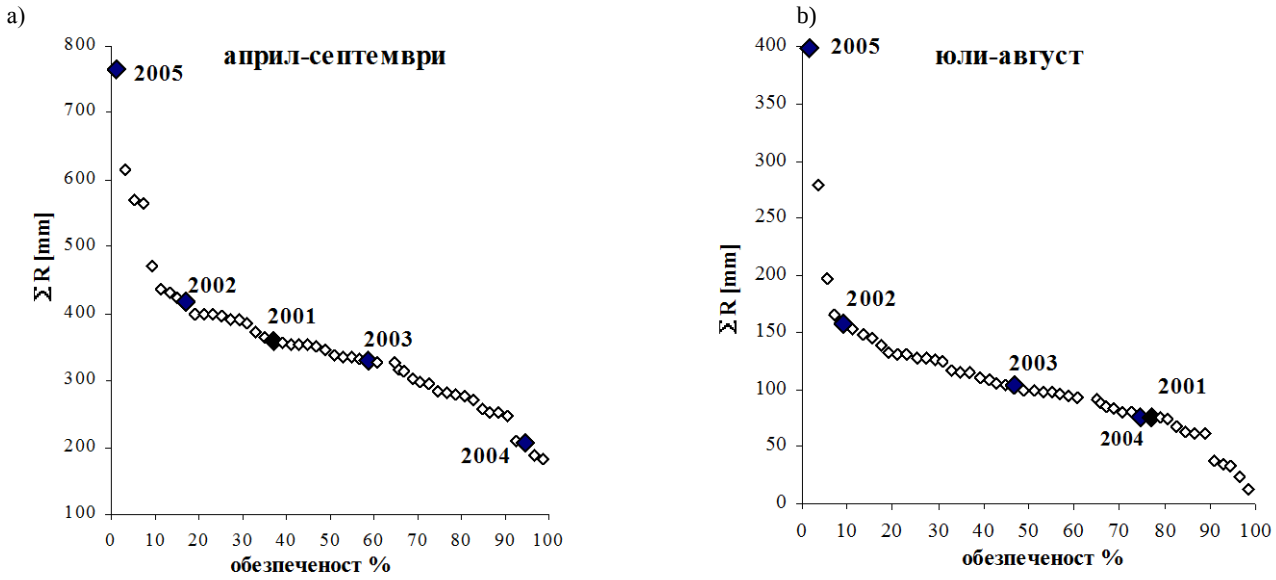


Fig. 1 Coverage curves for the fifty-year series (1956-2005) for the periods: (a) April to September; b) July-August

The temperature and deficiency of saturation of air with water vapor influence the speed of the life processes of the plant, incl. on the intensity of photosynthesis. The temperature sums, both for the April-September and the July-August vegetative period, show that without exception the years are warm (Figure 2). In 2002 conditions were close to the average. The same shows the dynamics of ten-day temperatures compared to the average of the 1901-2005 averages. The smallest deviations are observed in 2001. The values for August and September 2002 are below the norms for these months. The ten-day period temperature sums for the whole growing season of 2003, 2004 and 2005 significantly exceeded the relevant norms.

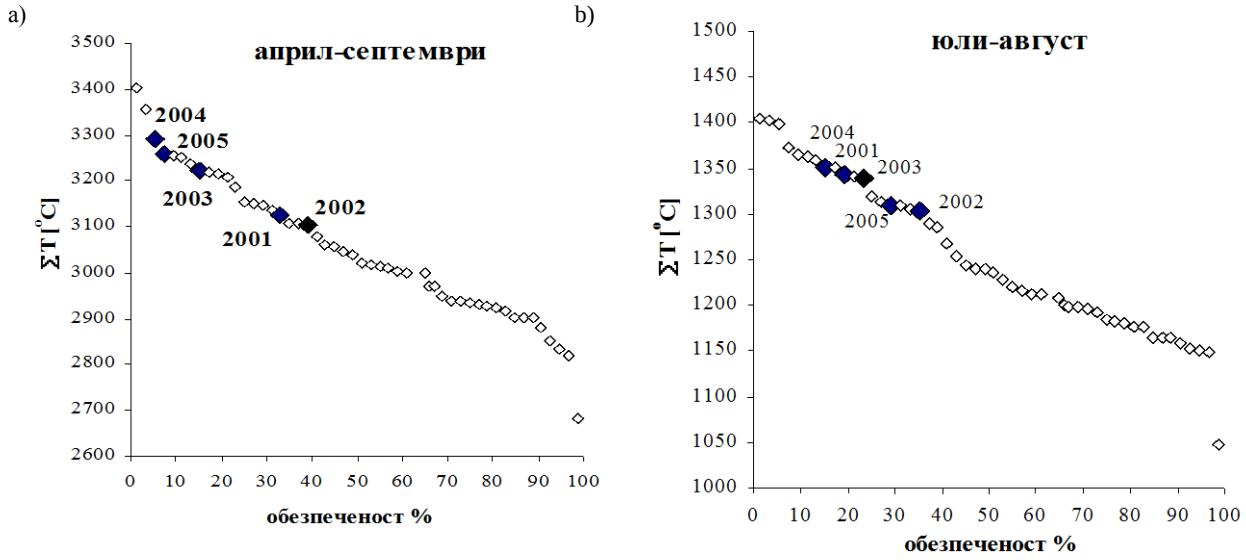


Fig. 2. *Coverage of the temperature sums for the fifty-year series (1956-2005) for the periods: a) April-September; b) July-August*

The need for irrigation to maintain optimum soil moisture in the 0-60 cm layer is mainly due to the amount and distribution of rainfall during the vegetation period of the crop. The irrigations are realized with a soil moisture drop in the layer 0-60 cm below 85% of the WHC.

The results from the five-year long studies show that irrigation norms depend on the meteorological conditions (rainfall) over the different years and the number of irrigations varies from 8 to 22.

The results obtained for the raspberry harvest during the different years from humidity point, show the influence of the irrigation regimes on its size. The greatest increase in yields was obtained during dry years (the July-August period for two years - 2001 and 2004 is very dry). The increase in yields is 67% more than the non-irrigated option, and the 33% increase was obtained during the humid 2005.

The irrigated regimes during the years also affected the yields obtained. The highest yields were obtained in the variants irrigated with 100% irrigation rate - 929 kg / dca (raspberries) and the lowest in non-irrigated variants 406 kg / dca (raspberries). The reduction of the irrigation rate by 20 and 40% has led to a reduction in raspberry yields of 8% and 17%, respectively (Table 3).

Of the tested irrigation regimes in biological terms, the irrigation regime is most suitable with the implementation of a 100% irrigation norm, which is recommended under conditions of good water supply. In the case of a water deficit occurring, apply irrigation regime with a 20% reduction of the irrigation rate, which produces satisfactory yields in both cultures.

Table 3 :*Yield of raspberries using drip-irrigation in the area of Sofia – Chelopechene district*

Years / Variant	2001		2002		2003		2004		2005		Average 2001-2005г.	
	Yeild kg/dka	Relative yield%	Yeild kg/dka	Relative yield%	Yeild kg/dka	Relative yield%	Yeild kg/dka	Relative yield%	Yeild kg/dka	Relative yield%	Yeild kg/dka	Relative yield%
Non irrigation	248	100	424	100	350	100	331	100	672	100	406	100
100% M	871	351	822	194	955	272	1000	302	991	147	929	228
80% M	769	306	794	187	885	252	936	283	914	136	860	211
60% M	689	277	788	186	798	228	794	239	828	120	779	191

Conclusions

1.The analysis of meteorological factors shows that the rainfall in the country is insufficient to satisfy the requirements of the plants from soil moisture and the ten-day temperature values for the whole vegetation period considerably exceed the respective norms, which necessitates the optimization of the irrigation regime and the use of water-saving irrigation technology for the successful production of raspberries under conditions of water deficit and relatively high temperatures.

2. The largest increase in raspberry yields was obtained during the dry years, which is 67% more than the non-irrigated option, and the smallest increase of 33% was obtained during the humid 2005.

3. Reduction of the irrigation rate by 20 and 40% results in a reduction in the yield of raspberries from 8% to 14%

4. From the tested irrigation regimes, from biological perspective, the irrigation regime most suitable is with the implementation of a 100% irrigation norm, which is recommended under conditions of good water supply. In the case of a water deficit occurring, apply an irrigation regime with a 20% reduction of the irrigation rate, which yields satisfactory yields for both crops.

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OVERVIEW AND ANALYSIS OF THE DEVELOPMENT OF URANIUM MINING IN THE REPUBLIC OF BULGARIA

ПРЕГЛЕД И АНАЛИЗ НА РАЗВИТИЕТО НА УРАНОДОБИВА В РЕПУБЛИКА БЪЛГАРИЯ

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Abstract: *A historical aspect of uranium mining in Bulgaria has been made until its eradication in 1992. Described are the measures taken pursuant to Decree-Law No. 74 / 27.03.1998 on the liquidation of the consequences of uranium mining and processing and the gaps to be eliminated in this regard. Up to the end of uranium mining in 1992, the annual uranium yield was 660-680 t, of which 430 t was obtained by geotechnical method - drilling with drilling of the sand-type uranium. They are poor in uranium (below 0.05%), but with a few times cheaper yields (an average of $ 40 / kg for 1970-1990). Possible new uranium extraction from this type of field and mine wastewater could reach 350 t per year at a value not exceeding 80 $ / kg. It is possible to investigate and prove 40-50 000 tons of new uranium ore deposits in Bulgaria mainly in the sand-type deposits at a depth of up to 650 m.*

KEYWORDS: *URANIUM MINING, BULGARIA, URANIUM DEPOSITS, LIQUIDATION , LOCATION*

1. Introduction

Uranium mining in Bulgaria has 47 years of history (1945-1992) and is one of the earliest in Europe. Uranium deposits in Bulgaria (48 in number - Figure 1) include a variety of genetic and industrial types [1]. 48 mines have drained uranium under Decree No. 74 of the Council of Ministers of 1992, whereby the government of Philip Dimitrov took the decision to liquidate the uranium mining and another 30 were in the stage of exploration and trial exploitation.

Many experts believe that the liquidation of uranium mining in Bulgaria in 1991. was carried out hastily, as a result of which a number of technical solutions for this activity were not realized in a number of areas. No adequate measures have been taken to fully recultivate the areas around uranium mining and uranium processing plants.

The world practice shows that no country, except Bulgaria, has protected its uranium deposits without being completely exhausted, and even after that it is producing uranium from the old embankments around the mines. And neither party eliminates its uranium production if there are nuclear power plants. Bulgaria, however, shut down uranium mining in 1992 and threw more than 50 million leva from the budget and much under the PHARE program for mine clearance and land reclamation.

2.1. Historical overview of the production of uranium ore in Bulgaria

First began to extract uranium in Bulgaria the Germans - in 1938 in Buhovo. Already in the first year they emit 100 tons of metal. In 1939, with the beginning of the war, they stopped. After the end of the Second World War uranium mining was renewed in strict secrecy, but already by the Soviet-Bulgarian mining company. It existed until 1956, when the uranium mining hat created the unification of „Rare metals“, which is called the "state in the state". It employs 13,000 people. It controlled geological exploration, extraction, processing and export of the resulting uranium concentrate [7]. Under his hat were the other companies: Buhovo, „Trakia“ - Plovdiv and „Rodeo“ - Smolyan. The Bulgarian product bears the name "triamine octooxide" (or oxide-zinc).

The classical technology of digging uranium ore is at a loss. This is an expensive process, but because of the strategic production of the raw material is still maintained in a number of mines.

The other scheme is geotechnology. It is clean and very cheap. There are only tailings ponds at the two uranium ore processing plants - Eleshnitsa and Buhovo. Modern technologies allow uranium to be extracted from much poorer ores, and uranium can be extracted from the pits in both tailings ponds. The yellow cake - the commercial product with a 30% to 60% uranium content was obtained after processing at the Eleshnitsa plant, and in Buhovo it was further baked and a concentrate with a uranium content of about 80% was obtained. From there it was transported in containers to the Soviet Union where the nuclear fuel was produced and it was back to our Kozloduy NPP.

By genetic types, the uranium deposits in Bulgaria are magmatic, hydrothermal and exogenous (sandstone and infiltration type). As industrial types, they refer to small (stocks up to 1000 t) and medium (up to 10 000 t). The magmatic fields are associated with alkaline and acidic magma massifs and are characterized by high contents of radioactive elements (uranium and thorium). They do not represent an industrial interest. However, it is possible to refer to the deposits related to primary uranium enrichment in the leptitoid gneiss (the Narechen and Zdravets locality in the Narechen ore region). They are connected with the infiltration deposits created by the uranium enrichment of the airbaths grown on granites (Playşti, Senokos, Selishte, Smilyan-Lipetz, Beslet etc.)[9].

Relatively large is the group of hydrothermal deposits. By age, they are Old Middle-Eastern, located in the Balkan and Srednogorsk areas (Buhovo, Proboinitsa, Kurilo, Sliven, Rosen) and young Alpesian - in the Rila-Rhodope region (Partizanska Polyana, Beli Iskar, Kostenets, Dospat, Cheroka, Sarnitsa, dozens of redundancies) [7]. Common characteristics of this type of field are: strict structural control of the ore; relatively large vertical width (up to 600-1000 m); close mineral associations - cast-quartz-carbonates, often zeolites.

Another group is also the exogenous (sandstone) deposits of paleogeneogenic age localized in the peripheral and inland gravel basins of the Rila-Rhodope massif: Gorna Trakia (14 fields - Momino, Belozem, Haskovo, Maritsa, Okop, Tenevo etc.). Fig. 2, Local (Eleshnitsa) and Strumski graben (Simitli, Melnik, Zlatolist). Only the uraniums of the Smolyanovtsi and Vinishte (Montana) localities are associated with non-oxidized Upper Persian sediments [4].

The researched and proven stocks in the history of uranium mining in Bulgaria are 35 374 t [1]. Of these, the amount of uranium extracted is 16 255 t by classical (mining) and geotechnical

method. As of 1992 (the year of uranium mining termination), the residual stocks and resources of 19,748 t were distributed in 31 fields related to two genetic types - endogenous (hydrothermal) and exogenous (sandstone and infiltration). At that time, the localities of Proboinitsa, Smolyanovtsi, Simitli and Gabra were studied and prepared for mining. The exploitation of the fields of the Buhov and Smolyan ore fields, Eleshnitsa and Sborishte, as well as a large part of the localities of the Thracian-Tundzha region [3], was not completed.

Currently, on the basis of geological, ecological, economic, infrastructure and other considerations, industrial interest represents 14 studied and partially exploited exogenous (sandstone) deposits from the Thracian-Tundzha uranium ore region. They are located in three geographical regions: Plovdiv, Haskovo and Yambol and are located in permeable rocks (sandstones), limited in margins. As a result of the researches and geological exploration works in the period 1970-1985, Paleo-Prussian (Mominsky, Marishka, Sokolishka, Tundjanska) and Paleo-Lagoon (East Maritsa) structures were found in these regions [2]. Proven reserves and resources of these revenues are 10 384 t, of which 6750 t can potentially be harvested. The industrial interest in them is determined by the proven opportunity to apply the geotechnological extraction method (drilling variant), one of the most progressive and ecological methods for extraction of minerals in the world. At present, 45% of the world's uranium yield is made by this method.

The localities of Eleshnitsa, Smolyan and Simitli, which have been exploited so far under the classical (mining) method, with total reserves and resources of 7828 t of uranium, can be exploited in the future by the so-called combined method [6].

2.2. A short geo-economic assessment

The uranium deposits, which are supposed to organize uranium mining, are of the sandy type, of which the production of 430 t of uranium was achieved in 1988 by geotechnical means. The cost of the extracted concentrate to this period does not exceed 40 $ / kg of metal. The area on which the geotechnical extraction of uranium is located is ~ 11 700 decares on the territory of the Thracian-Tundzha Uranian region.

After the elimination of the mining (1992-1994) and the technological liquidation, technical and biological reclamation, all exogenous (sandstone) deposits are at the stage of exploration of resources and the start of mining, including the construction of a new installation for re- extraction to obtain a yellow cake product - ammonium uranyl tartarate (AVTK).

Expert estimates, including the 7 exogenous deposits from this uranium region, indicate that the cost of the uranium-based concentration will be between 60 and 80 $ / kg (average 70 $ / kg). At a cost of uranium concentrate currently, on average ~ $ 100 / kg (according to Ux Consulting Company, LLC), yield in this region will be effective. This cost includes all the necessary ecological costs and reclamation of the area under the deposits. The annual yield can reach 200-350 t, a quantity that would fully satisfy the needs of Bulgaria's nuclear power industry. To this amount will be added the extracted uranium concentrate (AUTK) as a result of purification of waste water from the uttanowing sites Katina (Iskra site), the Choora shaft from the Buhovo ore field, the White water mine and in the perspective of the construction of new sorbent installations of the column № 9 of the Eleshnitsa deposit, the bowl № 93 from the V-shahta section of the Seslav locality, the bulk № 1 from Selishte section, ver. shaft № 3 from the Izgrev section of the Dospat ore field, etc. This is actually a profitable production of uranium concentrate, obtained mainly as a product from the purification of effluent mining waters polluted with radionuclides and in particular with dissolved natural uranium in them [2].

Within the scope of the mines from the classical, underground extraction (Mills Druzhba 1 and 2 in Eleshnitsa, Smolian and Buhovo ore field, Narechenski ore area, etc.), huge amounts of mining are accumulated at the end of the winding and reclamation activities water due to the decommissioning of water in the mines after the uranium mining cease and the natural recovery of the deposits and the STN (static water level) in the sites Only in the

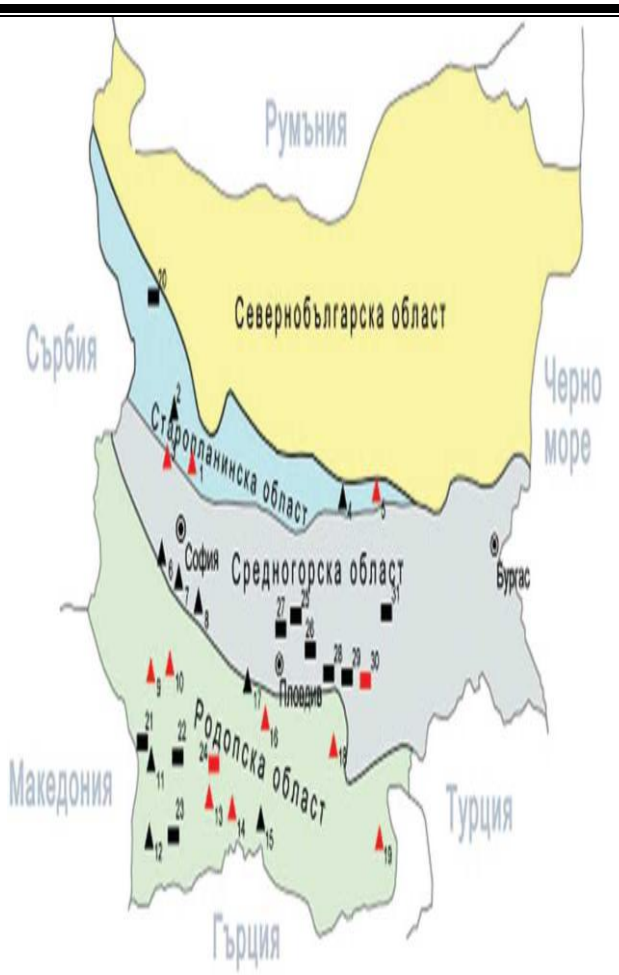


Fig. 1. Scheme of the location of uranium deposits in Bulgaria. Field deposits (red triangles - exploited, black triangles - decommissioned and not exploited)*: 1 - Buhovo; 2 - The pier; 3 - Kurilo; 4 - Gathering; 5 - Sliven; 6 - Gabra; 7 - White Water; 8 - Kostenets; 9 - Beli Iskar; 10 - Partizanska polyana; 11 - Senokos; 12 - Gameplay; 13 - Beaslet; 14 - Dospat; 15 - Smolyan (Grazovitsa); 16 - Narechen, 17 - Zdravetz; 18 - Sarnitca; 19 - Mountain Planet.* ***Sandstone fields (red rectangles - operated, black rectangles - decommissioned and not used):*** *20 - Smolyanovtsi; 21 - Simitli; 22 - Eleshnitsa; 23 - Melnik-Goldman; 24 - Settlement; 25 - Momino-Tsereteles; 26 - Belozem-Trilist-Debar; 27 - Manole; 28 - Haskovo; 29 - Navunsen-Troyan-Maritsa; 30 - Wise-Vladimir-Orlov Dol; 31 - Okop-Tenevo*

"Druzhba" mine 1 and 2 are accumulated about 42-45 million m3 of mining waters that have overwhelmed all the good stocks with residual and off-balance-sheet stocks. In the 9th cistern, the mine waters with the uranium dissolved in them broke on the surface under pressure [4]. The construction of a water pumping installation (mine water mobilization), through which instead of 10 ÷ 20 l / sec to pass 200-300 l / sec, will increase the yield of AVU to 20-25 t per year only from the district of the Druzhba 1 and 2 mine. If equipments of the Buhovsko, Narechensko Olevo pole and other classical mines are equally equiped, the yield can reach 50-60 t of the AVU per year only from the accumulated mine waters and passing through batteries This is the practice in Germany of the main mine in the Königstein de¬to annual yield with the two other large deposits Lichtenberg and Ryonenburg is ~ 200-250 t AUTC [2].

This approach to constructing such mine-only mining equipment also has a certain ecological effect because sooner or later the mining waters run to the surface and create a potential danger of contamination of surface run-off waters with

radionuclides of 2-3 orders above the PAH (marginal acceptable standards).

After the cessation of uranium mining and uranium processing, a number of biological recultivation activities have been carried out in all sites. These include meliorative activities to restore the soil fertility of agricultural lands within the boundaries of geotechnical plots. Total for the period 1997-2002 were recultivated and returned to the owners in real boundaries with restored soil fertility ~ 11 700 decares of arable land [4].

Liquidation of each mine starts with the closure of shafts and horizontal galleries. The entrances are blocked with concrete walls, while the above-ground bunkers and buildings are destroyed, and then technical and biological recultivation of the affected lands is undertaken.

Parallel to the above-mentioned activities since 1998 and nowadays, radiation monitoring of the waters for the assessment of the quality of the underground and surface waters, the impact of the uranium mining activity as well as the results of the biological recultivation are performed in all sites. Through monitoring the water quality and the content of radionuclides as a consequence of the uranium mining activity were monitored over time.

What does the state of the former uranium fields look like today?

The overall process of rehabilitation of these plots and their conservation has not been fully completed, despite the degraded millions of levs from our government and the Phare program and funds from other countries and institutions. This is a major concern both among professionals and the local population because it has a direct impact on its everyday life, livelihood, livelihood, and lifestyle. Most of these are mountainous areas and the population is mainly engaged in the production of plant and animal products and tourism. Extremely alarming is that there is no marking or it is not in good condition in these places, and they are located near tourist routes, eco-paths, settlements and more.

Following the liquidation, some of the mines "resurrect" with new features. The closed uranium mine in the Rhodope village of Barutin was turned into a regional landfill of four municipalities - Devin, Borino, Dospat and Satovcha. Near Kostenets also has the idea of using a closed uranium mine as a garbage disposal site. Under legally defined conditions, mines could be used as landfills or quarries. Only sanitary requirements and norms to prevent incidents related to the past of these sites should be observed [8].

Many people from the region of the Iskar Gorge, including Svoge, have worked in the Uranian mine near Lakatnik. For its time, the mine was the newest and most modern uranium mine in Bulgaria. More than 600 meters of underground galleries and shafts were excavated in search of the ore. The area has been thoroughly studied, and the Balkan mine, as they once called it, has been given great hopes, said Vassil Chanev, director of the state-owned company "Ecoengineering PM", which liquidated and reclaimed uranium mines in Bulgaria. More galleries had to be excavated, even the deck of the Potebnica river had been diverted and passed through the underground canal. However, it has never been possible to get the real reserves and extraction. The ore was extracted, but in small quantities, from the gravel in the digging of the galleries, and now uranium can only exist in the soils around it. So the still unfinished mine went directly into technical liquidation, and later technical and biological reclamation, and eventually to get to ... its current semi-operational exploitation. Semi-gravelly, because, according to people living in the area, inert materials are still used to make roads and rail embankments from uranium embankments from former mines. And even used in construction [7].

To the south of Melnik are the villages of Lozenitsa and Vinogradi. It is very curious for the casual people that the shaft of the old mine "Melnik" is located 10 meters from the bus stop between the villages. Those waiting here know about it, but it is not visible to strangers, it does not bother anyone. Random passers by this route also ignore it as there is no mark indicating an increased background. And there is.

At the foot of Western Pirin there are other uranium deposits - Brejani, Senokos, Simitli, Eleshnitsa, Igleshi.

Mines Melnik was closed half a century ago and was therefore not considered too dangerous in the 1990s when the list of mines for technical liquidation was defined. However, it is one of the 30 sites identified by government decree at the end of 2007, subject to risk assessment.

25 km away from our capital, near the town of Buhovo were some of the mines richest in uranium in Bulgaria. The first uranium mining activities in this area date back to 1938 when the Germans began to harvest this valuable raw material. Later, a plant was constructed to process the extracted ore and extract uranium and tailings pond to it.

For rehabilitation of the TMF and adjacent sections, over 6 million leva have been allocated under the PHARE program, the necessary events have been made and the necessary information is placed in prominent places. But no one can prevent the local population from going through these territories, growing fruit and vegetables near the recultivated areas and feeding their livestock from the pastures around the settlements.

In the immediate vicinity of the Seslavtsi quarter of Sofia are some of the mines richest in uranium in Bulgaria. They are located next to the village and the end houses are bordered by the territory of the uranium mining enterprise. Even the fences of many of the houses are made of blocks from the former mines, the wind is constantly receiving radioactive dust, and the rainwater flowing over the yards enriches the yards with "enriched" material. Unfortunately, the millions of leva given for the reclamation of uranium masses have failed to reach this remote region of our country.

The problem with uranium mines in Bulgaria has existed for a long time and the measures taken to solve it are not effective enough or the result is not satisfactory. In the area of the village of Eleshnitsa there is the famous area for processing and extraction of uranium ore. There is also a tailing pond near the Zvezda processing plant. It is said that Eleshnitsa is the best rehabilitated area compared to the rest of the country and perhaps with the most invested resources. There are, however, views on stolen funds and incomplete rehabilitation leading to landslides and leakage from the TMF in the Maritsa River. In terms of measured surface values, they are around norms.

Consideration of uranium resources and uranium mining in the Republic of Bulgaria is not the first time. Every time it has been emphasized that the resources of uranium ores and uranium ore resources and the most up-to-date mining technologies used (geotechnical drilling and combined geotechnical) for decades of the last century are the most serious arguments for the restoration of this activity in the country .

No matter how much alternative energy sources are highlighted, mankind will resolve and work hard to solve its energy problems by using nuclear power. Uranium is needed to develop energy. Nuclear power guarantees long-term independence, even more so if it is tied to the resumption of uranium mining in Bulgaria.

3.Conclusions:

1. Government documents have been adopted for solving the problems with the consequences of priority liquidated sites of uranium mining and uranium processing;

2. Some objects of uranium mining and uranium processing are without monitoring networks for radiation control and do not carry out official monitoring, there are no warning signs and no explanatory work is done among the local population;

3. Liquidation and recultivation works have already been compromised due to their poor design and / or performance and insufficient technical support of existing facilities;

4. There is a radio-ecological risk because of unresolved management problems and the complex cleaning of contaminated by natural radionuclides waters emanating from uranium mining sites.

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THE PRO-ISRAELI AND PRO-ARAB LOBBY IN THE UNITED STATES

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Abstract: *The process of decision making in developed democracies is a difficult one. Arriving at a decision or shaping new legislation is time-consuming, demanding, and requires extensive knowledge. It is a natural state that the decisionmakers and legislators need external experts to guide and advise them. That is the role of lobby groups, bodies, and individuals. The Middle East is a strategic region for the USA for a number of reasons such as: the presence of strategic natural resources; the existence and possibility of proliferation of weapons of mass destruction; and is the home to two of America's most vital partners in the region, Israel and Saudi Arabia. Therefore, the shape of American Middle East policy is of fundamental importance. This policy is also important for the local states in the region who want American policy to be in line with their expectations and interests. This policy is also vital for ethnic minorities and Americans who can trace their roots to the Middle East. These minorities, organized in formal and informal lobbies, work alongside the policymakers consulting and advising them, aiming for a more preferential policy towards the country of their interest.*
Therefore, comparing and contrasting the pro-Israeli and the pro-Arab lobby helps to understand the process of shaping American policy towards the Middle East. The two lobby groups, while operating in a common environment, differ significantly: the size of the lobby, the wealth, and also their place in American society, all have implications as to the effectiveness of their actions. Understanding American Middle East policy, how the USA shapes and executes its interests and policies in this strategic region, requires understanding of the pro-Israeli and pro-Arab lobby in the USA. This knowledge is also essential to formulate our own opinions and positions on this difficult subject.
KEYWORDS: *THE USA, THE MIDDLE EAST, LOBBYING, THE PRO-ISRAELI LOBBY, THE PRO-ARAB LOBBY*

The process of governmental decision making in fully and well-developed democracies, is a process that is delineated by the constitution. A state's strategic decisions must have transparent purposes, meaning, and a goal understood by society and its constituents. And the USA and American society is of such kind, kind that functions under and with alliance to the constitution. The political decisions of the government are transparent and well presented to society. Lobbying, the action performed by lobby groups, at first sight, should not correspond to the actions of the government and its decision-making process. Yet, in the United States, it is fully aligned with the American constitution, political tradition, and political processes.

The origins of lobbying in the USA go back to the 18th century, to one of the Founding Fathers and the 4th President of the United States, James Madison, who published the paper *Federalist No 10*, in which he addressed the issue of the management of factions, i.e. groups of individuals who share a common purpose in various interests: social, economic, or intellectual (Nogris, 2016). Madison, in his paper, argued that lobby groups (as they are known today) and their activity, must be regulated. They should be either banned or avowed and legally regulated with regard to their influence in the political game. Regulation of such upwards initiatives and actions allows for a greater participation of society in governing, and is a channel for voicing citizens' concerns, moreover, in theory, it minimizes space bribery and corruption. Despite the idealistic assumption of Madison, by now we know, that financial gratification is among the most popular and effective means of influencing the decision makers.

There is a wide variety of issues, policies, and decisions that might be vital to different groups and individuals. Therefore, the types, the origins, and the goals of such lobby groups are most manifold in industry interest groups, business ones, ones that are social issues oriented (especially in the multicultural and multiracial United States) and also place American foreign policies and relations as being of the greatest importance. Lobbying can vary because of its focus, but another vital difference is the style it is performed in. There is the formal one – registered and transparently carrying out its activities, but also the informal one – that is loosely organized individuals who are not indifferent about a certain issue and voice their preferences.

A distinctive lobbying area concerns American policy towards the Middle East and the Middle East conflict. This region is of strategic importance to the United States for two main but equally important reasons. These two interests that have persisted over half a century now, are the presence of natural resources in the Middle East and the existence of a key American ally in the region, that is Israel (Pastusiak, 1973). Not only is the existence of oil and gas vital for the USA, but also securing and ensuring the free flow of these resources. Israel, as the only recognized democracy in the Middle East, is a natural American partner in the region. Another interest for Washington in the Middle East is maintaining the stability of friendly Arab states in the region, since this state promotes stability of global prices of strategic natural resources (Czornik, 2009). American policy towards the region faces a challenging obstacle, because historically Israel and the Arab states of the region were conflicted. Today, the Middle East conflict is best represented by the relationship of Israel and Palestine.

The Middle East conflict has a dimension in the United States. The Arab countries and Israel have their supporters in American society who actively voice their concerns, and work on behalf of U.S. interests in the region and help shape American foreign policy. For better comprehension of this political phenomenon of ethnic lobbying in the United States, key crucial differences between the pro-Israeli and pro-Arab lobbies requires critical comparison, presented below in a table and commented on further.

Pro-Israeli lobby	**Pro-Arab lobby**
Single goal	Multi-goal
Treated as Americans	Treated as aliens
Sympathy (WWII)	No sympathy (9/11)
Fighting terrorism	Are terrorists
Well financed	Poorly financed
Prominent in society	Underrepresented

Source: own work

Lobby goals and vital statistics

A key factor differentiating these lobby groups is their representation and the goals of their activities. The Pro-Israeli lobby is well defined, since the main focus of their activity is building a strong relationship between the USA and Israel. While the pro-Arab lobby is more complex within. The pro-Arab lobby consists of ethnic groups rooted in various countries (depending on the definition and methodology, about 20-23 different countries) who might share culture and religion, but who often might be conflicted or indifferent about other issues, which is a reason for a certain disunity within the lobby. The pro-Arab lobby might speak in one voice on common issues but might by in opposition on others, whereas the pro-Israeli lobby is unified in most matters. There is also a significant difference in the size of these ethnic minorities in the USA. According to the Pew Research Center, the estimated number of Jews in the USA is about 5.3 million. The total number of Arabs is 1.2 million Arabs

of whom only 85,000 are Palestinians. This above statistic is magnified by the fact that, according to the U.S. Census Bureau, the Arab population is concentrated in five states (key to winning the electoral college), and is still dwarfed by that of the Jews (except Michigan):

State	Arabs as % of total state population	Jews as % of total state population
California	.56	3.3
Florida	.48	3.7
Michigan	1.16	.90
New Jersey	.85	5.5
New York	.63	8.4

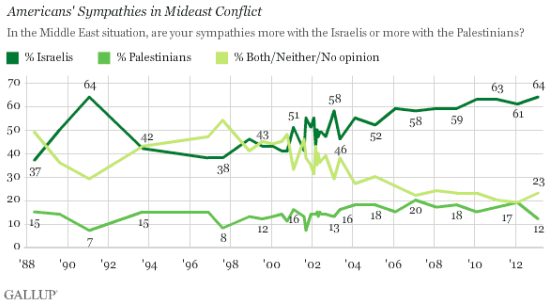
Source: own work

This disproportion, among other significant factors, contributes to the strength and effectiveness of the pro-Israeli lobby in comparison to the pro-Arab one.

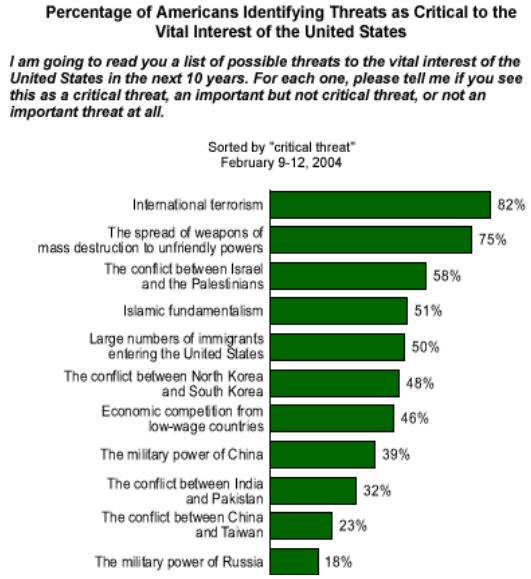
The fact that the pro-Israeli lobby (ethnic minority) is more numerous and is concentrated in key electoral college states is strengthened further by the fact that American Jews are politically aware and active. This is a result of above-average educated citizens, and this is the case of Americans Jews who attend colleges and universities investing in education. The two factors, practicing democratic virtues of voting and speaking in one voice, make these minorities especially effective and valuable in the eyes of politicians. In contrast, the Arab ethnic minority is less numerous and less active. As Harry Truman remarked "In all of my political experience I don't ever recall the Arab vote swinging a close election' (Mearsheimer, Walt, 2007). Therefore, the politicians do not recognize this ethnic minority and the pro-Arab lobby as either a source of power or a threat and strategically (reaching personal goals) do not find it attractive.

The question of sympathy

Lobby organizations do not operate in a void but within society, among citizens and individuals who have their preferences, who have their sympathies and who also might be and are naturally biased. If it comes to the two discussed ethnic groups, they are differently perceived in American society. As the graph below shows American approach towards the actors of the conflict is disproportional (Saad, 2010):



This approach is reflected in the United States as well. Americans have sympathies with Jews and American Jews for a few reasons: The Holocaust experience, shared democratic values, and fighting terrorism. Despite the fact that Israel is targeted by local terrorism, Israel as a state, just like the USA, is a target of attacks. Consequently, Arab minorities in the United States are perceived as different, alien, and even a threat. The 9/11 attacks were carried out by terrorists from the Middle East. Also, Americans perceive aspects connected to Arabs, Muslim and the Middle East as the source of the biggest threat to the United States (Carroll, 2004):



Such an approach of Americans to minorities allows the pro-Israeli lobby, in comparison to the pro-Arab/Palestinian one, operate more freely in a friendly environment, and thus be more effective.

Place in society

As argued above, the pro-Israeli minority has an upper hand in American society over the pro-Arab/Palestinian one. Lobbying is a process, an activity, that requires funding. Such operations without sufficient monetary instruments are less effective. Therefore, effective lobbying and ethnic representation demands capital. Capital is correlated with prominence in the society and follows a logical pattern: good (expensive) education ➔ well paid profession ➔ successful career ➔ wealth and prominence. Prominent, successful, well-off individuals who are dedicated towards a cause, become sponsors and donors. Analyzing the two ethnic groups through these criteria, it must be noted that Arab Americans are neither as wealthy, well organized, numerous, or politically active as Jewish Americans. As a group, Arab Americans have not been as successful in reaching prominent positions in academia, business, and the media, and they are also less visible in politics (Mearsheimer, Walt, 2007). This phenomenon can be explained by the fact, that Jewish immigration has a longer tradition, while the Arab one is relatively recent. And it is not the first generation of immigrants who are present in important positions. There is the trace of the second, third, and next generations who become more affluent and successful. According to The Jewish Virtual Library, the list of prominent companies founded by American Jews is exceptionally long, which proves how effective this minority is, among these companies are: Dunkin Donuts, Facebook, Google, Goldman Sachs, Oracle, Starbucks, Warner Bros. Pictures, and Dell. Naturally not all successful Jewish businessman are lobbyists, but globally, Jews show a high level of identity awareness. In fact, about a third of American Jews do not identify Israel as a particularly salient issue (Cohen, 2006). Yet, Arab Americans, on the average, are less successful and prominent in American society.

A similar pattern can be spotted in American politics, where the decision-making process is taking place. Because of the facts discussed above as being less numerous, less prominent and possibly, averagely, not as well educated, American Muslims (a much broader) are underrepresented in politics. There were 30 Jews in the 115th Congress and 9 senators while only 2 members of Congress are followers of Islam (Cooney, 2016). Therefore, also in Washington, where the decision processes are taking place, the presence of Jewish Americans dominates that of Arab Americans. These politicians not only guide the legislative processes but also represent a certain ethnic minority. As a

consequence, these statistics add to a picture of a more influential Jewish ethnic group in the USA.

Structure of the lobby

Groups of interest, commonly known as lobby groups, consist of formal and informal components. The first and foremost difference between the two is the level of openness in supporting a case. It is widely accepted that formal lobby groups and individuals must be registered. They must function with accordance to the law and within a legal frame. That especially refers to the methods and tools of lobbying, mostly the transparency of any money transferred.

The informal lobby will be individuals and organizations who sympathize with a cause. In case of the pro-Israeli lobby, it will be Jewish Americans, Christian Americans who support Israel and U.S.-Israel for moral and religious matters, and Americans who see Israel as a friendly state and Jews as a minority who have historically suffered. This support is difficult to measure since the effects of verbal, moral support, writing emails, and calling congressman does not have a numerical value. This high political pro-Jewish activism forces the policymakers to consider their voting approach. There are no benefits to candidates for taking an openly anti-Israel stance and considerable costs in the potential loss of campaign contributions and votes from Jews and non-Jews alike (Bard, 2017).

For the reasons elaborated on earlier, the pro-Arab lobby is far less effective. Among other disadvantageous characteristics such as being less numerous, less visible, and not as well-off, the pro-Arab minority is characterized by disunity. It is precluded from effective representation of the Arabs. A number of human rights organizations have voiced their concern about the mistreatment of Arab Americans (this was especially visible following the 9/11 attacks) and have also warned about the violation of human rights in the Middle East, such actions can hardly be treated as lobbying.

The organization that formally and directly lobbies the U.S. government on behalf of Israel and the one with widest scope and recondition is AIPAC – American Israeli Public Affairs Committee. AIPAC is possibly the most powerful PAC (political action committee) coordinating the work of various pro-Israeli organizations. PACs are institutions that pool campaign contributions from members and donates those funds to campaigns for or against candidates or legislation actions. Yet, it must be clarified that AIPAC is not registered as a PAC (yet it operates as one) with the Federal Election Commission. It does not rate, endorse, or finance candidates, but it guides other PACs and also the informal lobby on how to take pro-Israeli action. For nearly the last 70 years, AIPAC has remained nonpartisan, thereby keeping friends among both political parties. A second, and equally important pro-Israeli organization is the Conference of Presidents of Major Jewish American Organizations. It is composed of 55 different organizations and is responsible for formulating and articulating the official Jewish-American position on foreign policy matters. Members of these organizations, lobbyists themselves, are mostly Capitol Hill veterans who know and understand the complexity of decision-making processes.

Similarly, the formal pro-Arab lobby is built of former government officials. It is slightly younger than the pro-Israeli one and dates back to 1972 (NAAA – National Association of Arab-Americans). It was consciously patterned after AIPAC. Yet, pro-Arab activities for a more even-handed American Middle East policy is often dominated by major oil companies' actions that concentrate on the natural resources of the Middle East and the countries rich in these resources. Again, a lack of one unified voice, make the pro-Arab lobby diluted.

Campaign donation

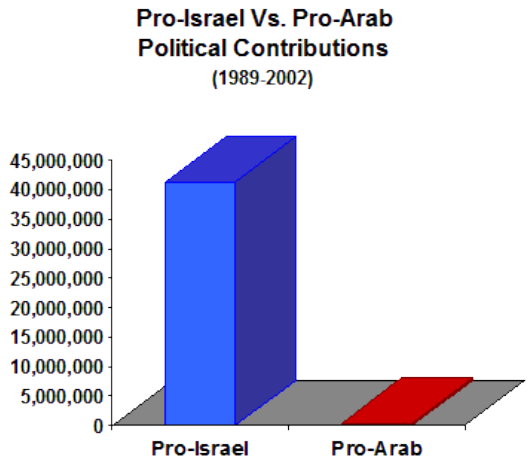
It's difficult to measure, but without a doubt, political campaign contributions are considered an important means of influence, thus a frequently and preferably used tool by different groups of interest including the lobby groups.

The campaign contribution scale shows another disproportion between the pro-Israeli and pro-Arab lobby. The most transparent method of analyzing contribution engagement is through a PAC and their sponsoring actions. It must be noted that financial measure can be used to promote a candidate, a politician, or to minimize the chances of him being elected by discrediting him. The chart below presents the disproportion of financial engagement of pro-Israeli and pro-Arab PAC's in election cycles (Jewish Virtual Library, 2016):

Election Cycle	Pro-Israel PACs	Pro-Arab PACs
2016	$3,366,343	$95,550
2014	$2,913,897	$99,266
2012	$2,977,189	$44,100
2010	$3,186,082	$80,740
2008	$3,381,779	$143,755
2006	$3,155,891	$121,176
2004	$3,350,438	$143,950
2002	$2,918,589	$55,550
TOTAL	**$25,250,208**	**$784,087**

This disproportion has resulted in greater visibility for the pro-Israeli lobby and is the reason why they are more welcome on Capitol Hill.

This unequal pattern (seen in the graph below) is followed by the general volume of contributions, not only by PAC's but by lobby groups in a broader understanding (Pro-Israel and Pro-Arab Interests: The Money, 2002):



As will be presented below, financial support can be used to promote or discredit a politician. A bigger budget allows for greater coverage of promoting or defaming a candidate. Yet, the greater financial resources of the pro-Israeli lobby is used also to educate politicians. Congressman and other decisionmakers are invited to vicinity tours of Israel. There, they learn the history and culture of Israel, they also are given an opportunity to understand more in-depth, the uniqueness of Israel and the importance of U.S.-Israeli relations (Abourezk, 2007). Such trips are not offered, officially, by the pro-Arab lobby organizations.

Means of influence

Ethnic lobby methodologies and tools are like any other lobby. The ethnic specificity does not require development of any other specific techniques of putting pressure on the decision makers. Naturally, the most commonly used method, described above, is voting power, the basic tool that citizens have in a democratic state. What must be emphasized however, is that the Jewish American vote has a unique power. The Jewish American

population is concentrated in a few key electoral college states, they have high voter turnout and what is more, American Jews tend to follow the Jewish organizations' voting guidelines and are compatible with both traditional Republican and Democratic agendas. Thus, the Jewish ethnic minority has swing vote power. It has the potential of being decisive in the most important key states.

The other means of influence also discussed is the power of money. Above the fact that the Jewish lobby is economically superior, it also skillfully organizes and distributes donations. AIPAC does not donate funds itself, but it connects donors with political figures it chooses to support. Such personal targeting makes the political candidates personally responsible to a donor. In case of winning a political race, the politician is taken on a trip to Israel, which only strengthens his or her sympathy for Israel and the donors.

Another method used by lobby groups is to establish think tanks – expert, advisory bodies that employ academics, experts, and politicians (often retired). Such bodies are present in the media and also serve as external experts. Again, the number of pro-Israeli think tanks dominate the pro-Arab ones and are ever-present in Washington D.C. According to Mearsheimer and Walt, "pro-Israel figures have established a commanding presence at the American Enterprise Institute, the Center for Security Policy, the Foreign Policy Research Institute, the Heritage Foundation, the Hudson Institute, the Institute for Foreign Policy Analysis, and the Jewish Institute for National Security Affairs (JINSA) (Mearsheimer, Walt, 2007). To a great extent these think tanks do play an informative role and they do explain the Middle East complexity, but this pro-Israeli think tank activity dominates the discourse on the Middle East.

The educational dimension of lobby groups is present also at American universities and colleges. Establishing student clubs, interest groups, or other student bodies aimed at educating young people, fighting discrimination (anti-Semitism), and also teaching the importance of political activity at the grassroots level. Both ethnic minorities are active at this level, yet again it is the Jewish one which has better organization and funding, which is crucial for its existence. While a growing number of students from the Middle East attend American universities (they can afford high tuition fees), they are not active in promoting their home countries.

Lobby in action

Both of the discussed ethnic lobby groups succeed in their actions on numerous occasions.

One example, broadly analyzed and discussed, was the role of the pro-Israeli lobby in driving the U.S. to war with Iraq in 2003. Advisors to George W. Bush originated from the neoconservative movement. A hawkish political movement advocating for peace through strength. Neoconservatives grew in strength and influence during the administration of George W. Bush (in the wake of the 9/11 attacks), when they played a major role in promoting and planning the 2003 invasion of Iraq. Prominent neoconservatives in the George W. Bush administration included Paul Wolfowitz, Elliott Abrams, Richard Perle, and Paul Bremer, who all view Israel as a strategic partner for the U.S. and who are widely associated with pro-Israeli movements. They argued, that even if evidence does not link Iraq directly to the 9/11 attacks, the eradication of terrorism and its sponsors must include removing Hussein (Mearsheimer, Walt, 2007). The consequence of the war against Hussein and removing him from office was a long-lasting destabilization of the Middle East and the birth of ISIS.

Yet a spectacular failure of the pro-Israeli lobby was the U.S.–Saudi Arabia AWACS (surveillance planes) sale in 1986-87, then the largest foreign arms sale in U.S. history. Arming Saudi Arabia with the most modern equipment was not received warmly on Capitol Hill, the Pentagon, American society, and the pro-Israeli lobby, seeing this sale as a direct threat to Israeli security (Bard, 2010). This deal was seen as *technology for oil access* but jeopardizing the security of Israel. A May 1981 poll showed that 52% of those surveyed opposed arms sales to any country, and only 19% wanted the U.S. to sell AWACS to Saudi Arabia. The Senate was divided on this deal voting 52 to 48 to permit the sale of AWACS planes and other air combat equipment to Saudi Arabia (Mohr, 1981). This deal shows the effectiveness of the pro-oil lobby which at that time (and possibly still today) shared many interests with the pro-Arab lobby, and the weakness of the pro-Israeli lobby at the same time.

Both presented examples are equally fascinating and startling, how well-organized ethnic minorities can influence decision makers in the United States.

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HUMAN INTELLIGENCE IN DIFFERENT OPERATIONS

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Abstract: *Human intelligence, or HUMINT, is the gathering of information through human contact. It is, along with signals intelligence and imagery intelligence (SIGINT and IMINT respectively), one of the three traditional means of intelligence gathering. Analysis of HUMINT training of the Humint teams is a very important part of improvement of their military training. It is a formal, cognitive process used to convert sensory stimuli into meaningful reliable and verifiable information that can be used to solve a problem, answer a question, make a decision, or add to a learner's knowledge of the word.*

KEYWORDS*: HUMINT TRAINING, MILITARY TRAINING, MILITARY DECISION MAKING PROCESS (MDMP), COGNITIVE PROCESS, HUMAN INTELLIGENCE, HUMAN INTELLIGENCE PLANNING, HUMINT, HUMAN CONTACT, INFORMATION, COLLECTION OBJECTIVES, PLAN, PREPARE, EXECUTE, AND ASSESS.*

Getting information from HUMINT is a term for actions performed by various formations and specialized structures to get a sense of feeling in the combat area. This includes obtaining information during patrols, convoys, escorts, security and other military activities, obtaining information from irregular and unintentional contacts, occasional conversations, contacts with the local population and authorities, and contacts with friendly forces[3][4]. When conducting crisis response operations, intelligence can provide much of the intelligence needed [10].

Over the past two decades, our military intelligence has encountered a number of serious challenges in the preparation and participation of crisis response operations. Participation in missions has helped to accumulate valuable experience that has been used, directly or indirectly, in the process of preparation, provision and implementation of missions abroad. The lessons learned from participating in different missions should be studied, analyzed, applied in the preparation, development of capabilities and the involvement of the Bulgarian Armed Forces in crisis response operations. The development of science and technology, to study the Earth's surface and, above all, space technologies create conditions for the improvement and new quality of geo-information products that will be useful in humint operations.[1]

From the study of the participation of human intelligence teams and the HUMINT tasks, it has been found that there is a lack of adequate training related to human intelligence tasks and lack of staff (trained, prepared and certified). This greatly reduces the possibilities for obtaining information from human sources and increases the threats to our and coalition forces in the operation area [7].

Developing a methodology for preparing human intelligence teams in operations requires a thorough analysis of the preparation and definition of guidelines for its improvement. This will be achieved by analyzing the HUMINT training system in NATO and the Military Intelligence Training Program [13].

The preparation of NATO intelligence teams.

Based on the theoretical analysis of human intelligence, crisis response operations, and the study of the participation of HUMINT teams in such operations, the scientific methodological foundations for the development of a system for improving the preparation are highlighted. This creates the conditions for the effective preparation of HUMINT teams to participate in overseas missions. As a result of this activity, a flexible and refined intelligence process will be built, taking into account the changes in the modern military-political environment. Different types of linguists can be used in a similar way. They can be more than language specialists. linguists can apply their intuition of local customs and traditions in the area and respect local culture and behavior.[2]

[1] Иванов, М., Дистанционни методи за измервания на земаната повърхност, В. Търново, 2016, стр. 16

[2] Лазаров, В., Разузнаване с хора (HUMINT), С., 2009, стр. 84-85

The preparation of human intelligence teams is directly related to overall military training and involves updating tactics, techniques and procedures for human intelligence. It is necessary to systematize and coordinate intelligence efforts at all levels. Inter-linked forms and training methods should be used to achieve tactical integration between our intelligence teams and the coalition partners' teams.

On the basis of the analysis of the research problem, we can determine the preparation of the human intelligence teams to participate in crisis response operations as a purposeful process for building and consolidating professional knowledge, habits and skills that allow for the qualitative performance of missions abroad. The following principles are used to build the process of training human intelligence teams: a clear goal, continuity, consistency and completeness, which provide comprehensive training. In the developed armies of NATO special attention is paid to HUMINT training. Leading countries in this area of intelligence are: USA, Canada, Britain, Romania and others [15].

NATO's intelligence structures have created a need to pool efforts, align the regulatory framework, apply experience and interact with the preparation and use of HUMINT. On 23 April 2009, a NATO conference was held, with a Memorandum of Understanding on future HUMINT activities. On this basis, a NATO Humint Center of Excellence (HCOE) was established in Oradea, Romania.

The HCOE performs the following basic tasks: developing standardization documents, contributing to the development of the NATO intelligence doctrine, providing expertise on HUMINT operations in the mission area, testing and validating intelligence concepts.

On this basis, the HCOE has the following responsibilities:

- Support Alliance with mobile humint teams to improve the planning, preparation and execution of intelligence operations in the mission area;
- Examine, validate, and implement new tactics, techniques and intelligence procedures based on the experience of participating in different operations.

The mission of the Training Center is to provide quality training for human intelligence teams and the production of HUMINT products in response to NATO Command requirements. The Center develops the following main directions: preparing human intelligence teams, developing doctrines, setting up programs to prepare and deploy experience from participating in missions.

The HUMINT Training Center has developed a number of projects, the most important of which are: validation of human intelligence terminology, development of the HUMINT operator's manual, characterization of human resources in the surrounding operational environment, maintenance of the NATO concept for combating hybrid threats.

Validation of human intelligence terminology.

The aim of the project is to standardize the terminology used in human intelligence based on NATO's general military terminology

and the HUMINT experts' opinion. The ultimate goal is to create a vocabulary with word-terms in human intelligence.

Develop a manual of the HUMINT operator.

The task of the project is to create detailed guidance with the lowest degree of classification to serve a larger number of soldiers during preparation. The leadership will be based on the NATO Human Intelligence Doctrine, HUMINT good practices, and experience from participation in various operations around the world.

Characteristics of human resources in the surrounding operational environment.

The aim is to optimize the human resources information base in the operation area to improve the Alliance's approach to action. It also acts as a catalyst for multidisciplinary human resources research.

Hybrid threats.

The HUMINT Training Center supports NATO's concept of countering hybrid threats by conducting a study on the applicability of HUMINT teams in the fight against them. Hybrid threats represent a diverse and dynamic combination of opposing military forces, paramilitary formations, partisan groups and criminal structures, united by the common goal of mutual benefits.

The Human Intelligence Training Center conducts training courses for HUMINT soldiers. The main course is for collectors of intelligence from human sources. It covers all aspects of the Human Intelligence Alliance doctrine, HUMINT tactics, techniques and procedures and intelligence regulations. Students acquire knowledge, habits and skills as collectors of intelligence from human sources. They are trained in conducting interviews, interrogations, debriefing tactics, setting guidelines and methods for intelligence gathering, preparing to interpret extracted information and produce and distribute intelligence products. Other areas of preparation include: retrieving information from the local population, risk assessment, and screening of sources.

Preparation of intelligence teams in the Bulgarian Army (BA).

Planning and organizing of human intelligence teams is based on experience from the involvement of BA and NATO in crisis response operations. For this purpose a "Program for preparation of HUMINT units" was prepared. The program was designed to provide training for HUMINT human intelligence capabilities in accordance with "The Armed Forces Goal E 0630" performed by HUMINT's team of intelligence battalion. It has been developed on the basis of regulatory intelligence documents and the experience of HUMINT teams in missions and exercises.

The HUMINT program is in line with: "Doctrine for Armed Forces Training in the Bulgarian Army", "Military Intelligence Training Program for Military Intelligence", "Vision for Training of Land Forces", courses and instructions in the Bulgarian Army.

Planning the preparation.

The preparation of the intelligence teams is planned, organized and conducted on the basis of the "Doctrine of Training of Troops and Forces", "Military Training Directive", "Guidance on Planning and Reporting the Training of Commanders, Staff and Troops in the Bulgarian Army, Annex A to the Planning and Reporting Guide for the preparation of commanders, staffs and troops in the Bulgarian Army, the plans for the preparation of the commanders, the headquarters and the units, as well as the program for preparation of HUMINT teams.

For this purpose, a prospective and ongoing plan for the preparation of commanders, headquarters and units is being developed for HUMINT Company. The company is subdivided into human intelligence teams.

The plan is being developed for three years. At the end of each year the plan is reviewed and adjustments are made. The corrections shall be written as an annex to the plan for the relevant year and shall be approved by the senior staff. The current plan is being developed for each preparation period. A weekly schedule of classes is being developed in the Human Intelligence Team. Commanders are given the opportunity to create creativity in the planning of the learning process. The specific tasks performed by the humint teams, shall be obliged:

- The company commander - to determine the amount of hours per subject and occupation;
- Team commanders - determine the content and duration of the sessions on each topic.

When planning the combat assembly of the teams, the following training time is set: for the company - up to 60% and for the team - up to 40%. A reserve of hours is planned each year. It is scheduled for exams, demonstrations, visits to historical sites and cultural monuments and other events outside the program.

Organization of preparation.

The program has been developed for three years, each with duration of 12 months. The year is divided into two periods of 6 months. During the first and the second training period of the first year, the following stages are progressing: preparation of the team and preparation of the company. During the first period of the second year the stage of improvement of the team's preparation was completed and in the second period the crisis response operations (CRO) were studied.

Practical survival classes with teams are conducted within field exercises, tactical classes and special teachings. The HUMINT teams run tactical exercise at the end of the second period in the first year and end of the first period in the second year, with duration of 2-3 days. When designing and conducting the exercise, it is possible for some of the teams to participate as Role Players. The HUMINT teams conduct complex lessons in the subject matter, lasting no less than 6-8 hours, at the end of the first period in the first and third years.

Conduct preparation.

The basics of personnel training for human intelligence teams are practical exercises in equipped cabinets, tactical training fields, shooting ranges, simulators, computer-simulated exercises and other audiovisual systems.

The information process is a set of consecutive actions (operations) performed with the data (data, primary information, facts, ideas, hypotheses, etc.) to obtain the information necessary for the purpose. Information processes always take place in a system (social, military, biological, etc.). The information processes carried out by a certain information technology and in an appropriate organizational environment are the basis for carrying out information activity by the person.[3]

Special training is subject to all other disciplines. In the course of the sessions and exercises conducted, the teams are trained individually or in interaction with other units to carry out HUMINT management tasks, learn HUMINT operator tactics, techniques and procedures for collecting intelligence information, surveillance techniques, non-verbal communication, and working with translators, conducting conversations and interrogations, marching in difficult conditions at high speeds in populated and outlying settlements. Protection of electronic warfare is considered to be a complex of technical and organizational events conducted to ensure the sustainable operation of its own systems and means of troop management under conditions of electronic impact by the enemy.[4]

On the basis of the analysis of the first and second year training, trainees should:

- To build skills for team work, endurance, psychological sustainability, discipline and efficiency;
- To know the techniques, the means of intelligence and communication;

[3] Иванов, М., Основи на геоинформационните технологии, В. Търново, 2016, стр. 17

[4] Лазаров, Л., Основи на електронната война, В. Търново, 2018, стр. 18

- Be trained to seek and enter into direct contact with representatives of the local population and local institutions, as well as representatives of the international community;

- To conduct non-verbal communication techniques and basic techniques such as HUMINT operators;

- Be able to hold conversations and interviews with potential and recruited sources of information;

- To have the techniques for analyzing the extracted information;

- To produce the necessary intelligence reports and documents for summarizing the extracted information;

- To be able to obtain the necessary intelligence through the creation of intentional and unintentional contacts with the local population, the administrative structures of the local government and other governmental and non-governmental organizations;

- To have a clear understanding of the historical past, economic situation and current situation in the geographic regions of the upcoming missions;

- To build trust and maintain good relations with the local population;

- To be able to provide and provide the necessary medical care and evacuation in all conditions;

- To improve the acquired qualities: physical endurance, psychological sustainability, discipline, performance and field training;

- To be able to fire with personal and collective weapons.

Various obstacles can be introduced when moving on the site. Under difficult stretches of the area, we have to grasp steep, grassy slopes, slopes and sheer rocks.[5]

From the analysis of the training in the third year, the trainees should:

- To improve knowledge, skills and habits;

- To develop the qualities: determination and assuming a reasonable risk in performing the tasks.

The theoretical analysis of the problem we are studying allows us to define human intelligence training as a purposeful process for building and shaping professional knowledge, skills, habits and personal qualities that enable humint teams to participate in crisis response operations [8].

Control, report and analysis of preparation.

At the end of each period, a review and assessment of teams' readiness is performed. In the course of these checks, personnel tests are carried out to give an individual assessment of their preparation. At the end of the year, examinations are held to certify the teams. Analysis in the formation takes place after each training period and at the end of the year, with a review of the plan. The Company's commander analyzes the preparation of all personnel at the end of each week in self-training hours, and team commanders - daily, after each occupation. The results of the preparation are reflected in the combat training [9].

Analyzing and studying international experience shows the need to improve the individual and team training of HUMINT troops for tactics, techniques, procedures, and intelligence tools to build effective teams for coalition operations [12].

An important guideline for improving the training of HUMINT operators and teams is the pre-selection of military personnel. They must have undergone some professional development and realization, be mature and laid-back. The refinement of selection procedures is crucial in the future preparation of human intelligence teams [11].

The analysis of the preparation of human intelligence teams and its reconciliation with the modern tactics, techniques and procedures for HUMINT in NATO allows us to draw the following conclusions:

1. There is no modern and correct approach to the selection, construction, training and use of human intelligence teams.

2. Due to the multiplicity of crisis response operations, the preparation of human intelligence teams should be in accordance with the specifics of the particular operation.

3. New guidelines are being developed to improve the selection and preparation of human intelligence teams.

The use of HUMINT teams in crisis response operations is based on the flexible process of human intelligence that helps to extract, process, analyze and disseminate information.

It can be concluded that, in the absence of appropriate theory and practice for HUMINT, and in the wrong selection of human intelligence teams, conditions are created to delay the development of this kind of intelligence in the Bulgarian army. The versatility of actions in response to crises leads to new tasks for human intelligence teams [14].

CONCLUSIONS:

1. Human intelligence operations are characterized by dynamic actions and unpredictability, which requires the implementation of a modern and correct approach to the selection, construction, training and use of intelligence teams. There is a need to improve the professional training of human intelligence teams.

2. The experience of the crisis response operations led to a review of HUMINT tactics, techniques and procedures. Due to the versatility of this type of operations, the preparation of human intelligence teams should be done in accordance with the specifics of the particular operation.

3. The training of human intelligence is a purposeful process for the formation of professional knowledge, habits and skills, allowing their future development as commanders of HUMINT teams.

4. Using the experience of coalition partners, HUMINT can adapt to Bulgarian conditions. It is necessary to develop guidelines for improving the preparation of intelligence teams for crisis response operations. On their basis, an appropriate methodology will be created, implemented and prepared for the preparation of HUMINT teams for participation in crisis response operations.

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MAIN MOTIVATIONAL SCIENTISTS FOR THE SELECTION OF THE MILITARY PROFESSION

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Abstract: *Choosing a profession has always been difficult for most of young people. When choosing a profession, most of them follow the dream of a future good realization.*

The aim of the article is to outline their main motivating incentives in choosing the military profession as their professional perspective . In clarifying this objective, the main task was to outline the basic material and non-material incentives associated with the military profession.

Keywords*: PROFESSION, ARMY, MOTIVATION, WORK, FACTORS DMLS, LASER SINTERING, 3D PRINTING, MICROSTRUCTURE*

1. Introduction

"Peace is not only better than war, but it is also much more difficult. "

George Bernard Shaw

The military profession has always been one of the toughest today and in the past. In our history, when we talk about decent Bulgarians, there are a lot in different professions, but perhaps the most in the field of defence. Historically, the names of General Vazov, Boris Drangov, Spisarevski and many others remain. These people were also the pioneers of the Bulgarian spirit, for whom the Motherland, honour and dignity were leading in their lifestyle. They are examples and inspiration for many young people engaged in the military profession. As well as in the past and now, from the professionalism of the Bulgarian army depends on the protection of the territory of our country, the protection of the nation and the future of our country. Only in peace can we have peace of prosperity and security. From defending and guaranteeing peace, we can have economically prosper in the country and successfully work in all areas and in most economic sectors. Currently, "over 20% of the army positions are vacant and the real number is below the critical minimum of 20000 people, with vacancies 5,500. Free sergeants 'positions are 12%, for officers' candidates 18,2% and for officers 19.67%. "And our army is 60th in the world for 2018 in the PowerIndex ranking of the specialized edition Globalfirepower. In the ranking, Bulgaria ranks after Finland, Chile and Hungary and is before Austria, Slovakia and Portugal. The ranking is created after analyzing a total of 136 armies with 55 indicators. The most powerful is the US Army, followed by Russia and China. Americans have 2 million troops, including those in the stock.Also, the army has 13,000 aircraft, about 6,000 tanks, and has a budget of $ 647 billion, which for the next year is increased to 716 billion dollars. The second-ever Russian army has a budget of $ 47 billion dollars. It has 3.5 million troops, about 4,000 aircraft and over 20,000 tanks. The Chinese Army, ranked third, has 2.7 million troops, 3 thousand airplanes and 7,700 tanks.''[1] Still, Bulgaria is a small country and we can hardly reach these parameters, but we still rely on quality human resources and invest in human capital is important because the military profession is related to the protection of the sovereignty of the country . These statistics for our country are a consequence of the various social and political changes over the last thirty years. They were born because of alliance change and transition from membership in the Warsaw Pact of Bulgaria to belonging to NATO's military-political organization. In 2007 our country became a member of the European Union. With these changes and the new tasks of the army reduced in the past in the 1990s, the so-called "professionalisation" of the Bulgarian army began.

With regard to the types of troops, we differ, and basic professions are targeted at land troops, air forces, anti-air defence troops and naval forces. In more detail, they include:

• Ground-arm troops: motorized, missile, artillery, tank, anti-air defence troops, etc.

• The Air Force is divided into aviation generations: fighter, fighter-bomber, bombardment, reconnaissance, etc.

• Air Defence Forces have artillery and antiaircraft, fighter, radio, and other kind troops

• The navy has the following types: surface ships, submarines, shore rockets and artillery, aviation, and more.

This heterogeneity of the directions in choosing a military profession also requires certain qualities associated with available physical and psychological parameters of personality growth. The main incentive mechanisms are basically two-material and intangible.

Material incentives include

- Good pay;
- Providing office accommodation
- Early retirement
- Social compensation
- Working conditions and rest

Non-material incentives include:

- Public recognition
- Improvement of qualifications and growth
- Additional leave
- Qualification courses

Salvation in the army to the present moment is not particularly good, and this is one of the leading motives for the outflow of the profession. "The basis for determining the amount of the basic monthly salary for the lowest position of the military and other employees in the security sector remains in the next year 380 lv. This is clear from the published draft state budget for 2019. There will not be a serious change in the amount of military wages. This is also confirmed by the estimated staff costs in the MoD budget. They are BGN 995 922, while for this year they amounted to BGN 911 730 thousand. The increase is by BGN 84 192 thousand. This is also the amount, which will increase the expenditure part of the budget of the Ministry of Defence. From BGN 1 193 319 thousand it will be BGN 1 277 511, 3 000. It is noteworthy that there is no change in the amount of capital expenditures. They are still 55,364 thousand leva. " [2] In the light of the above, it is concluded that the attitude towards servicemen in the countries is determined by the maturity of society and, above all, by the ability of the government of the country chosen and, by definition, to defend national interests by integrating them into alliances.

Providing office accommodation

(1) The Ministry of Defence's Departmental Housing Fund shall consist of the following properties[3]:

1. available dwellings, studios and garages;

2. dwellings rented for renting;

3. living quarters in dormitories.

Early retirement-

"From 1 January 2018, servicemen shall be entitled to a pension at the age of 53 years and 2 months and 27 years of general insurance under the Social Security Code. 18 years must actually be served as soldiers under the Defence and Armed Forces Act or as reservists of active duty under the Armed Forces Reserve Act.''[4]

" Officers with the rank of Major / Captain III rank and higher who have not exercised their pension entitlement may serve three more years. This is clear from the proposals of experts from the Ministry of Defence for amendments to the Law on Defence and Armed Forces (LRA). They have found some tension in the relationship between military servants with a right to retirement, and those who refused to retire but occupy the same posts. In the military service, they believe that in the foreseeable future this negative trend could have a negative impact on service motivation

According to Art. 2. (1) Ordinance on the letting and disposal of properties by the Ministry of Defense's Departmental Housing Fund and for the payment of compensatory amounts to the personnel servicemen who use the dwelling under the terms of free negotiation.

For example, 60 officers with military rank "Major / Captain III rank" and above were released in 2018, while about 90 officers were to be released in 2019.At the same time, most of the soldiers, although entitled to a pension, find it immoral to exercise it. This saves considerable financial resources for the country. The main motive behind them is that there is no other NATO and EU army in which retired soldiers continue to serve.[5]

And if these problems are solved, the military and society must remember the words of Jawaharlal Neru[6] and not let them down as a society. "War is a denial of truth and humanity. It's not about killing people because one day one goes away, but a conscious and persistent spread of lies and hatred that little by little roots in people." And so the responsibility of the military profession is so great and the state and society must work to improve the working and living conditions of our soldiers!

Literature:

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