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EFFECT OF PLASMA DENSITY ON RESIDUAL BACTERIAL NUMBER AND APPLIED VOLTAGE

Yuki Arimoto[1], Tatsuro Machida[1], Yuto Kijima[1], Masato Hosoya[1], Miyo Arikado[1], Koji Kakugawa[1], Takeshi Tanaka[1], Katia Vutova[2]

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Abstract: *Plasma basic ion implantation (PBII) with high negative voltage pulses has been applied to test specimens in a sterilization process as a technique suitable for three-dimensional workpieces. Pulsed high negative voltage was applied to the electrode in this process at the gas pressure of oxygen. It was reported that the PBII process reduced the numbers of active Bacillus pumilus cells using self-ignited plasma N_2 gas generated by only pulsed voltages. The number of bacteria survivors was reduced by 10^{-5} with a few min exposure. As the ion energy is the most important processing parameter, a simple method to estimate the oxygen ion energy calculated using distribution for oxygen in Si implanted by PBII was estimated. In this work, the Effect of Plasma Density on Residual Bacterial Number and Applied Voltage is studied.*

Keywords: ELECTRONS, IONS, PLASMA BASED ION IMPLANTATION (PBII), OXYGEN, PLASMA DENSITY

1. Introduction

Plasma is an ionized gas, which is a fourth state in addition to solids, liquids and gases. Technology that makes use of plasma is wide-ranging, especially that used in semiconductor manufacturing technology. As one example of this, there is thin film forming technology and microfabrication technology. These technologies have been developed in response to the higher integration and higher performance of integrated circuits and accompanying miniaturization of circuit patterns.

In addition to semiconductors, much research is being conducted on plasma application technology, including environmental improvement technology and medical related technology. In particular, application to biotechnology and medical care is being carried out [1] [2].

The plasma ion implantation method (PBII method), which is one technique that uses plasma, is applied to sterilization technology in the sterilization of medical equipment, etc. There are some plasma devices used for sterilizing medical equipment that use hydrogen peroxide [3].

However, it has been pointed out that there are effects on health. In order to find the technology needed to replace it, experiments on sterilization by the PBII method have been attempted [4].

Besides medical devices, microorganisms adhering to foods are also considered as objects for sterilization. In general, sterilization of food is done by heat sterilization. However, there is a danger that food quality will be impaired through the heating process. Thus, a new kind of non-heat sterilization method is attracting attention as a sterilization technique.

In this study, the energy of the implanted ions was evaluated in the sterilization using active gas (O_2) by the PBII method [5].

2. Bacteria culture method

Bacillus stearothermophilus was used as a test bacterium, and was cultured at 55 ° C for 1 to 2 weeks using a sporulation medium. The spores formed were confirmed with a microscope then the spores were collected with a platinum loop. The collected spores were heated at 80 ° C for 10 minutes, washed three times with a phosphate buffer using a centrifuge (room temperature, 1 minute, 12000 rpm), and the spores were heated again at 80 ° C for 10 minutes to obtain 1.0 × CFU / ml. This was used as test spore fluid.

3. Experimental device - method

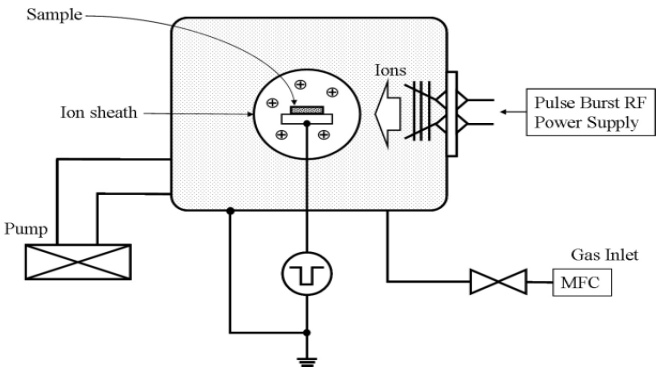


Fig. 1 *Schematic diagram of the experimental apparatus.*

The chamber size of this device is 485 mm in height, 590 mm in width and 470 mm in depth. The SUS target electrode has a diameter of 140 mm and a thickness of 20 mm, is insulated from the grounded chamber, and is installed at the center of the chamber. The high-pressure modulator (manufactured by Kurita Seisakusho Co., Ltd.) used in this experiment can irradiate the target with a pulse voltage of 2 to 30 μs with a pulse voltage of up to 15 kV with a maximum capacity of 1000 pps and a maximum of about 8 A.

For vacuum evacuation, use a rotary pump with a mechanical booster pump and mass flow together, evacuate the chamber to 10 Pa, and introduce oxygen gas (purity 99.99995%) to 1 kPa. After that, conditions are set by the computer control system and discharge is performed.

4. Calculation of plasma density

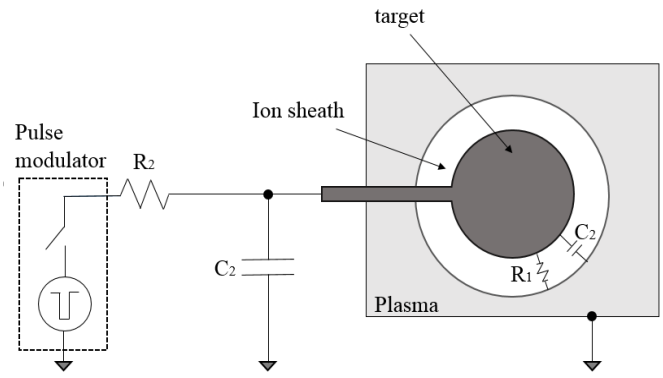


Fig. 2 *Modulator Equivalent Circuit.*

The constants representing the sheath are R_1 and C_1 in Fig. 2. Here we deal with a case where the ion sheath structure is flat, and the calculation of these constants will be described.

Generally, the ion sheath resistance R is determined by using the resistivity ρ, the length s of the object and the area A of the object.

$$R_1 = \rho \frac{s}{A} \tag{1}$$

Collision does not occur in the sheath. If the mass m of the ion species, the applied voltage V_p of the target, the electronic charge e, and the ion velocity v in the sheath,

$$\frac{1}{2} m v^2 = eV_p \tag{2}$$

$$v = \sqrt{\frac{2eV_p}{m}} \tag{3}$$

is obtained. On the other hand, the current density j at the target surface is expressed by conductivity σ and electric field E as:

$$J = en_i v = \sigma E = \sigma \frac{V_p}{s} \tag{4}$$

then, from:

$$en_i \sqrt{\frac{2eV_p}{m}} = \sigma \frac{V_p}{s} \tag{5}$$

$$\rho = \frac{1}{\sigma} = \frac{V_p}{s} \cdot \frac{\sqrt{m}}{en_i \sqrt{2eVp}} \tag{6}$$

comes

$$\rho = \frac{\sqrt{m}}{en_i s} \cdot \frac{\sqrt{V_p}}{\sqrt{2e}} \tag{7}$$

and

$$R_1 = \rho \frac{s}{A} = \frac{1}{en_i A} \sqrt{\frac{mV_p}{2e}} \tag{8}$$

is desired. Expression (8) shows that it is not dependent on sheath length. Also, by giving V_p to equation (8), plasma density n_i (ion density in sheath) on the target surface can be obtained by knowing R_1 by experimental values, etc.

Using the ion density n_i [m^{-3}] and the volume C [m^3] of the chamber, ~~for~~ the number of ions N [pieces] is:

$$N = C \times n_i \tag{9}$$

Using the frequency f [Hz], processing time t [s], and equation (3), the number of injected ions X [pieces] is:

$$X = f \times t \times Cn_i \tag{10}$$

$$Ie = X \times V_p \tag{11}$$

The energy per 1 eV $\backsim 1.602 \times 10^{-19}$ is subjected to ion energy and the unit is changed from [eV] to [J].

On the other hand, the ratio p [%] hitting the bacteria is calculated from the area S [m^2] of the fungus and the area A [m^2] of the target:

$$p = \frac{S}{A} \times 100 \tag{12}$$

to find the ion energy V_B [J] hitting the fungus from here:

$$V_B = Ie \times 1.602 \times 10^{-19} \times p \tag{13}$$

assuming that the number of sterilization is N_s [pieces], the energy Y [J] necessary for killing one bacterium is:

$$Y = \frac{V_B}{N_s} \tag{14}$$

5. Results and discussion

***Table 1**: Measurement conditions (pulse width).*

Gas	O_2
Gas Pressure [Pa]	3
Pulse Rate [pps]	500
Pulse Width [μs]	5,10,15,20
Pulse Voltage [kV]	-6
Delay time [μs]	50
RF Power [VA]	240
Exposure Time [min]	10

***Table 2**: Measurement conditions (delay time).*

Gas	O_2
Gas Pressure [Pa]	3
Pulse Rate [pps]	500
Pulse Width [μs]	5
Pulse Voltage [kV]	-6
Delay time [μs]	30,40,50,60,70
RF Power [VA]	240
Exposure Time [min]	10

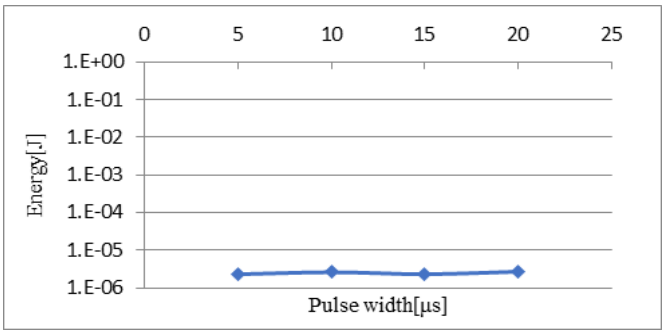


***Fig. 3** Pulse width - energy characteristics necessary to kill one bacterium.*

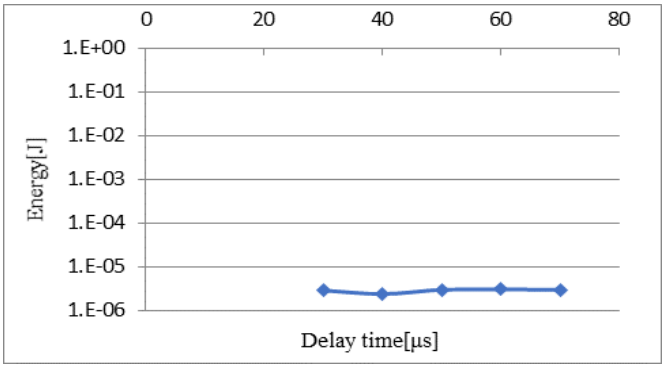


***Fig. 4** Delay time - energy characteristics necessary to kill one bacterium.*

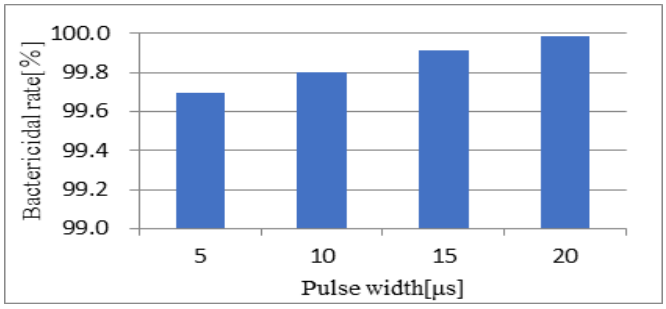


Fig. 5 *Bactericidal rate - pulse width characteristics.*

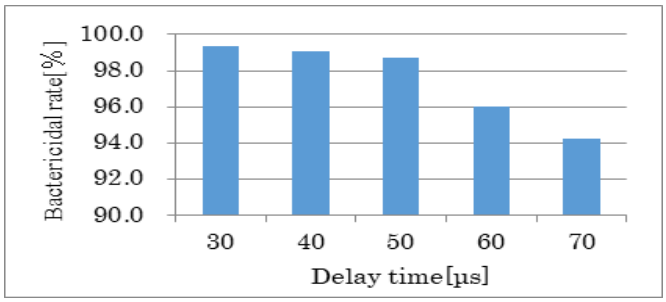


Fig. 6 *Bactericidal rate - delay time characteristics.*

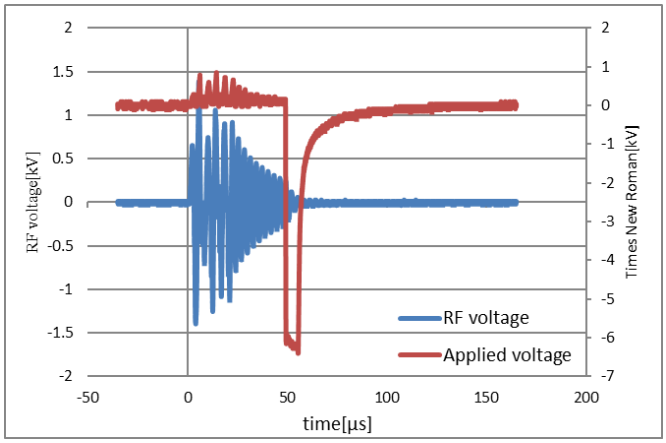


Fig. 7 *RF voltage and applied voltage.*

In Fig. 3, no significant change was observed between 30 and 70 μs.

In Fig. 4, no significant change was observed between 5 and 20 μs.

In Fig. 5, it can be seen that the sterilization rate increases as the pulse width increases.

Fig. 6 shows no significant change from 30 to 50 μs, but gradually decreases from 50 onward.

In Figures 3 and 4, the energy required to kill one bacterium is one and the same - between 2.35 x 10^{-6} [J] and 3.08 x 10^{-6} [J].

Therefore, it was found that even if the delay time and the pulse width were changed, the required energy was one and the same, so there was no change.

In Fig. 7, an external RF voltage is applied from 0 to 50 μs, and no RF voltage is externally applied after 50 μs.

From this, we see that there is a correlation between Fig. 5 in which the sterilization rate gradually increases between 5 and 20 μs, and in Fig. 6 in which this rate decreases after 50 μs.

6. Conclusion

Measurement was carried out with oxygen in this work. Superoxide, which is a free radical, shows sufficient activity in a short time and has high reactivity, microorganisms may be killed by the oxidizing action of these active molecules [7].

It is thought that the oxidizing action of ozone affects sterilization by sterilization under air and oxygen atmosphere [7].

From this, we would like to measure gas species from oxygen of active gas to inert gas such as nitrogen and argon in the future.

Also, if we change the number of bacteria, frequency and treatment time, we want to examine whether the energy required for killing one fungus is the same.

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References

[1] E.E.Kunhardt and L.H.Luessen: Electrical Breakdown and Discharges in Gases, Plenum Press, ISBN 0-306-41195-4, New York, 1983.

[2] Plasma ion implantation research committee: Plasma ion implantation method and its application, Technical Report No. 860 of the Institute of Electrical Engineers of Japan (Section A)

[3] Hiroshi Manase, Toshio Tanabe, Takashi Ikehata: Plasma generation and its control for material process, Metal surface technology, 39, pp.368-374, (1988).

[4] Institute of Electrical Engineers · Plasma Ion Advanced Utilization Process Investigation Committee: Plasma Ion Process and Its Application, Ohmsha (2005).

[5] Yukimura Ken: Plasma-based ion implantation and its application to three-dimensional materials**,** Surface and Coatings Technology**,** Vol.136, Iss. 1–3, (2001), pp.1-6.

[6] T.Tanaka, T. Hironaka, S. Hayashi, I. Koyama: Disinfection and sterilization by using plasma-based ion implantation, ELECTROTECHNICA & ELECTRONICA E+E, vol. 47, (2012), pp.268-272.

[7] Satoshi Watanabe, Takeshi Tanaka, Toshinori Takagi, Ken Yukimura, Estimation of plasma density in after-glow region of RF burst plasma based on voltage–current characteristics, Surface & Coatings Technology, 186, (2004), pp.53–56.

[8] Takayuki WATANABE, Sterilization by Electrical Discharges and Plasmas, Plasma and Fusion Research, 75, (1999), pp.651–658. (in Japanese).

AN APPROACH FOR CLUSTERING SOCIAL MEDIA TEXT MESSAGES, RETRIEVED FROM CONTINUOUS DATA STREAMS

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Abstract: *Using k-means clustering algorithm, a new approach to handle evolving topics and discussions in social media environment is proposed. Different segmentation techniques and applications to handle large volumes of data are explored. Relevant works that consider using fading functions and half-life weight measurements as a tool to remove inactive clusters are discussed. A set of rules and a controlling variable called time to recover are introduced as a simple means of managing cluster lifecycles. Short case study is conducted with Twitter data retrieved between the 19th and 22nd of January 2018.*

Keywords: SOCIAL MEDIA MINING, ONLINE STREAM CLUSTERIZATION, FADING FUNCTION, CONTINUOUS TEXT CLUSTERIZATION

1. Introduction

Text mining has become one of the major focuses of research in recent years. Due to the speed and volume of data that originates on the web, text processing techniques are evolving. Statistical algorithms are pivotal in dealing with variety of unstructured data management problems. To answer these problems clustering has been applied to continuous streams as means to analyze patterns in real time. Online clustering is being used in telecommunications, network surveillance, weather conditions monitoring, website traffic analysis and so on **[1]**. Processing unstructured textual data, retrieved from social media platforms however, is somewhat more difficult than traditional clustering tasks. When monitoring network traffic there is always a general idea of what processes or actions are within the regular norm and anything else can be treated as a threat. However social media text messages are often short, unpredictable in their format and can be semantically similar, while morphologically very different. Another issue is the fast emerging topics of discussion and their eventual fading out. To combat the challenges of streaming clustering several algorithms have been developed. In this paper we propose a new function to address the need evolving topics in text messages create, in terms of active and inactive discussions.

2. Overview of continuous text stream clustering algorithms

Clustering is a process aimed to organize and categorize data based on some traits. To cluster text one needs to transform documents, paragraphs or sentences into vectors. The way to represent text as an object in the Vector Space Model is to build a matrix of all words that are mentioned in the dataset and compare it to the number of times individual words appear in individual documents. Often to engineer such matrix tf-idf (Term Frequency – Inverse Document Frequency) is used.

A common algorithm for clustering is k-means and his variations – k-means++, OSKM (Online Spherical K-Means), Mini Batch k-means, k-medians, k-medoid, etc. The basic steps are as follows:

1) determine k for the number of clusters;
2) build k clusters and approximate their centers;
3) assign objects in high dimensional space to clusters, based on the distance between the objects and the closest cluster center;
4) repeat step 3 until it is impossible to move objects from one cluster to another.

According to different research **[2][3]** the definitive advantages of k-means are the low-cost implementation and high performance capabilities of the algorithm. K-means is very efficient in software environment because it only requires memory to maintain vector`s coordinates and calculate distance between them. When looking at continuous data streams it is important to handle incoming points and assign them to either existing clusters or create new ones. Aggarwal et al. **[4]** present one of the first ideas to split the incoming data stream into chunks. Microclusters are stored systematically at particular moments in time called snapshots. These segments are organized in a structure, resembling a pyramid, where each row contains snapshots of the active microclusters. On the top levels of this structure a small number of older snapshots remain, while lower levels represent recent microclusters. Row l contains segments, which appeared in a timeframe of 2^l of the stream. Any segment that is divisible by 2^{l+1} is removed from the row and does not generate a microcluster (see Fig.1).

row l	*time snapshots*
5	32
4	16 ~~32~~ 48
3	~~16~~ 24 ~~32~~ 40 ~~48~~
2	36 ~~40~~ 44 ~~48~~ 52
1	46 ~~48~~ 50 ~~52~~ 54
0	51 ~~52~~ 53 ~~54~~ 55

Fig. 1 *Structure of microcluster snapshot pyramid*

Ackermann et al. **[5]** proposes splitting the stream into small segments in order to reduce the number of dimensions. Initially *n* number of segments are present, that contain *m* number of data points. All segments following the first one contain between 0 and *m* points. The first segment is used as a safety net for incoming vectors. When a partition reaches its maximum capacity all points are moved to the next segment. If that one is full as well both partitions are paired into a new segment and cleared of all points, so that they can accept fresh data (see Fig. 2).

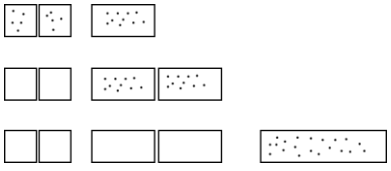


Fig. 2 *Structure of segmented data stream*

Zhong **[6]** presents an algorithm under the name of Online Spherical K-Means (OSKM) that deals with large volumes of data by taking into account both time and significance of data. The technique is aimed at splitting the incoming data into segments or chunks. Zhong`s algorithm loops through all the streaming data without any interruptions or pauses and thus results are kept in the machine memory. While segmented into chunks the dataset is easier to cluster because cluster centroid information can be read in runtime. In order to prioritize new data points Zhong proposes a

variable that measures the period of time cluster information is kept in memory. In the context of social media mining, information about recent messages is more valuable than older topics of discussion which tend to diminish rather quickly. The variable Zhong introduces is called a **decay factor** and is used to determine the historical weight of existing clusters. To calculate the weight, a decay factor between 0 and 1 is accepted and then multiplied by the number of vectors in the cluster. The decay factor is reciprocal to the period of time the cluster has existed and eventually becomes infinitely small.

Similar idea can be found in the works of Aggarwal and Yu **[7]**, who introduce a **fading function** that determines cluster weight while taking into account the last moment in time a data point was assigned to a specific cluster. That way clusters that are not accepting new vectors are labeled as inactive. To manage active and inactive clusters Aggarwal and Yu also rely on a variable that measures the time needed for a data point to lose half of its weight or significance – **half-life** variable. Half-life is also used when a new vector is introduced in the high dimensional space and it is labeled as an outlier or an anomaly. If within one half-life period another point close to the first one is delivered via the stream, then the anomaly is accepted as a new cluster. If no such vector is encountered the anomaly is treated as such and no new cluster is formed. Following this approach any clusters that are inactive for a period of time greater than their half-life are nullified or broken down.

Modern algorithms consider other metrics as well, but the main basis for developing fading functions are the variables time and significance or weight of clusters. We consider Zhong and Aggarwal to be a starting point for creating a modest rule set that can be applied in continuous stream text clustering. Our goal is to have an automated process that manages active and inactive clusters in the context of developing and diminishing topics in social media platforms.

3. Period of recovery for inactive clusters

To efficiently cluster text data, retrieved from social media platforms in real time, it is necessary to understand user behavior and how discussions happen. Let us assume there are two general reasons for users to post anything online – the first is a natural inclination to share information that comes from within and the second is provoked by events or people that happen without our direct involvement. In general the majority of people participate in more than one online chat group or comment on more than one subject. Politics, natural disasters, sports outcome or entertainment news can all spark discussions that last days, weeks or months. Some less important occurrences might go unnoticed if we only look at the big picture and decide to cluster data only in predetermined topics. Furthermore it is almost an impossible task to predict all the possible categories of human interest on social media which means creating a static distribution of vectors into cluster group is not an effective solution. A possible solution is to label clusters as active, inactive and nullified, based their and how they develop in time.

We represent time with three variables:

1) t_a – time, as a sum of all periods of activity for a specific cluster;
2) t_s – time, as a sum of all periods of inactivity for a specific cluster
3) T – time, that expresses the "life" of a cluster, as a sum of t_a and t_s;

Active is a cluster that continues to accept data points in his vicinity. It also has a sum of periods of inactivity lesser than the sum of periods of activity. Inactive is a cluster that in two successive moments in time does not get any vectors assigned to it. If none of the clusters receive any new points, then their t_s does not increase as to account for stream inconsistencies. Apart from that another reason could be an outlier or an anomaly that is actually a new topic. A cluster is nullified when after being inactive is terminated and no longer exists in vector space. So for a cluster K if (1) is true we consider it active and we keep it intact.

$$t_s < t_a \tag{1}$$

A simple rule like that can be easily calculated in runtime without a significant impact on performance. To account for new emerging clusters we also need to take note of the number of objects that enter the high dimensional space. In order to preserve the inequation (1) and address historical significance it is important to look at how time and cluster weight are related. Because both variables are not homogeneous first we take note of the number of data points that enter vector space while a cluster is alive. Furthermore we choose to look at the average rate at which high dimensional objects are sent via the data stream and are assigned to all present clusters. So if there are N total points in vector space, then on average $\frac{N}{T}$ points are assigned to clusters per time frame. Therefore the product

$$\frac{N}{T} * t_a, \qquad T \neq 0 \tag{2}$$

gives us the approximate maximum number of points that cluster K could have in his vicinity. On the other hand the product

$$\frac{N}{T} * t_s, \qquad T \neq 0 \tag{3}$$

can be used to measure the approximate maximum number of points that are outside of K and are assigned to other clusters. If we take a look back at (1), add (2) and (3) we keep the original inequation.

$$\frac{N}{T} * t_s < \frac{N}{T} * t_a, \qquad T \neq 0 \tag{4}$$

Now however both sides represent number of vectors rather than sum of periods of time. From a theoretical stand point such rule can be only applied if cluster K has a number of points equal or greater than all other clusters in the high dimensional space. Statistically it is more likely that the inequation (4) is untrue for the majority of the data stream. To summarize, it is not possible to determine if a cluster should be active without accounting for the significance on the objects assigned to it. In addition, important clusters need a **period of recovery t_r** that allows them to remain inactive before completely being nullified. As a general rule, clusters which are not historically important or which do not assimilate enough data points are subject to being nullified after long inactivity.

Under usual circumstances, when t_s becomes greater than t_a the recovery period will act as a balancing variable that factors in cluster significance. Cluster unit weights can be calculated with tf-idf, word2vec probabilistic distribution, chi squared and others **[8]**. Assuming $\boldsymbol{\omega}$ is the weight of a cluster K and n is the number of data points that are assigned to it, $\frac{\omega}{n}$ results in an average weight per point. Because (2) gives us the maximum possible amount of objects cluster K can receive for a period of activity t_a, with formula (5) we can determine an approximate maximum significance $\boldsymbol{\omega'}$.

$$\boldsymbol{\omega}' = \frac{N}{T} * t_a * \frac{\omega}{n}, T \neq 0, n \neq 0 \tag{5}$$

When calculating the recovery period t_r we will take into Aggarwal and Yu`s idea of a half-life measure (the period of time it takes for a unit to lose half of its significance). However we are choosing to measure the time it takes for the real significance ω to decrease to a value of $\frac{1}{2} * \omega'$. As a result the closer ω to ω' or the better a cluster performs in terms of receiving important and relevant data points, the bigger the period of recovery t_r would be.

On the other hand if there is a large difference between the values of ω to $\omega^{'}$, that would indicate that cluster *K* has been performing poorly and its significance is lower than expected. To illustrate this better we propose the following example.

In a coordinate system, where the abscissa represents cluster weight and the ordinate represents time, we create points for $\omega = 10$ (see Fig. 3) and $\omega^{'} = 15$ (see Fig. 4) against a period of activity $t_a = 10$. We choose to gradually increase ω from point A to point B, in such a way that resembles an identity function with the sole purpose of facilitating an easier comprehension (e.g. a value of 1 weight per 1 moment of time). As soon as point B is reached, the period of inactivity t_s also starts increasing until it becomes equal to t_a. At this moment a period of recovery t_r should be measured and extended to cluster *K* to either become active again or be nullified.

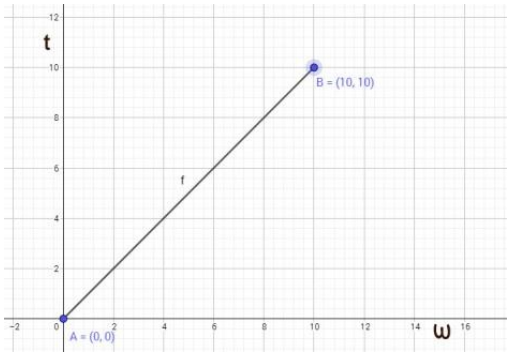


Fig. 3 *Real significance of cluster in B*

Let us assume that during the period of activity of cluster *K* the number of points that are introduced in vector space is equal to three times the number of vectors in that particular cluster ($N = 3 * n$). Referring back to (5) we calculate $\omega^{'}$

$$\omega^{'} = \frac{N}{T} * t_a * \frac{\omega}{n} = \frac{3 * n}{t_a + t_s} * t_a * \frac{\omega}{n} = \frac{3 * n}{10 + 10} * 10 * \frac{10}{n} = \frac{3 * 10 * 10}{20} = 15 \quad (6)$$



Fig. 4 *Approximate maximum significance of a cluster in B*

The time it would take for ω to reach $\frac{1}{2} * \omega^{'}$ we can measure either with a custom multiplier or as it is in our example with a decay factor $\gamma = 1$ of 1 weight point loss per 1 moment in time.

$$t_r = \left(\omega - \frac{1}{2} * \omega^{'}\right) * \frac{1}{\gamma} = 2.5, \ \gamma \neq 0 \quad (7)$$

Segment DE on Fig. 5 represents the time to recover t_r needed for ω to reach $\frac{1}{2} * \omega^{'}$. Surpassing a period of 2.5 without any new vectors entering the cluster`s vicinity would result in the nullification of said cluster.

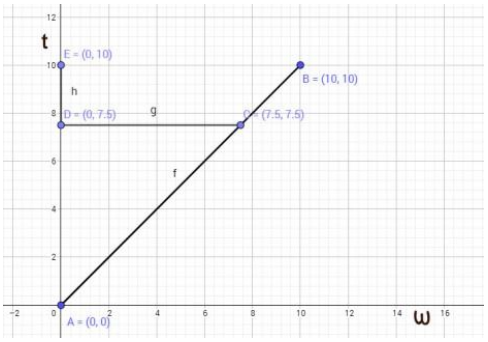


Fig. 5 *Period of recovery measured in segment DE*

We assumed that the number of data points introduced in vector space was 3 times bigger than the number of points assigned to cluster *K*. A question might arise as to why we did not choose $N = 1.5 * n$ or $N = 2 * n$ for example. As a matter of fact any number lower or equal to $2 * n$ would mean that cluster *K* either contains the majority of points or has an amount equal to the sum of all points that do not belong to it. If that is the case then we can use (4) to determine if it needs to be nullified.

A larger the amount of data points in vector space as well as a higher value of individual cluster`s significance will result in a longer period of recovery being issued. On the other hand a smaller number of points in the cluster alongside a higher life period will be followed by a shorter recovery period.

4. Results and discussion

To test our algorithm we choose to download data from Twitter using the platform`s Streaming API published in the span of 4 days between 19th and 22nd of January. Twitter supplies researchers with a rich and structured output that contains plenty of labeled data such as publishing date, location, user information and so on. We choose to retrieve text messages that are mainly in Bulgarian. As a result we received a little over 50000 messages before applying sanitization filters. Because clustering does not offer one single solution and needs to be run multiple times with different parameters such as batch size, maximum number of iterations, number of clusters, etc., we choose to look at 5 to 10 clusters and compare results. In our dataset there were 4 distinct and 1 free-for-all categories. Over the period the major topics that dominated chat messages were Boyko Borissov, Angela Merkel, the Istanbul convention and traffic accidents (see Table 1).

Table 1: *Number of data points in the clusters for the whole period*

Date\Topic	Merkel	Borissov	Istanbul	Accidents
2018.01.19	441	352	480	233
2018.01.20	1385	755	300	216
2018.01.21	693	603	240	210
2018.01.22	445	537	1080	370

However when looking at individual data distribution throughout the day two of the big clusters existed alongside smaller ones which were nullified and assimilated after they stayed inactive for too long. An underlying topic found within discussions about Angela Merkel was the Schengen Area agreement (see Fig. 6), which was more of a secondary subject in user messages and did not outperform the German Chancellor. The second theme that did not have a strong representation on its own was the Pirin mountain discussion that often was mentioned in tweets addressing Bulgarian Prime Minister (see Fig. 7).

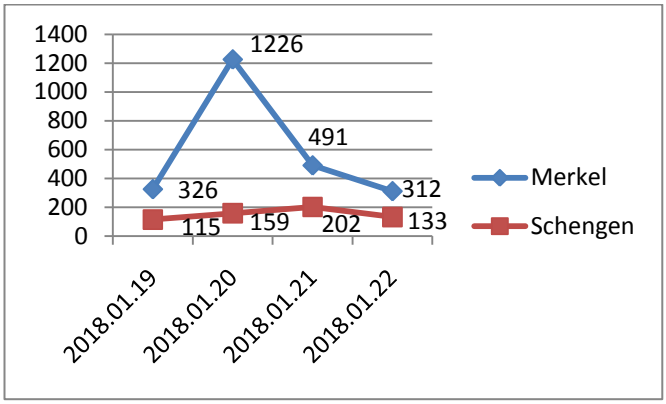


Fig. 6 *Number of points in individual clusters*

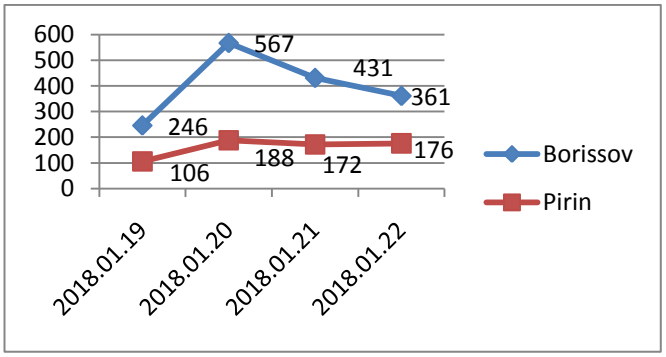


Fig. 7 *Number of points in individual clusters*

5. Conclusion

All clustering algorithms are aimed at summarizing vast amounts of data. When it comes to categorizing live streams techniques have been evolving in the past decades. Sometimes data can be hard to evaluate if we only look at the big picture. In this paper we presented a fast and easy to use set of rules that can be applied in continuous clustering. Determining the time to recover value does not significantly complicate the process. Although a fairly simple concept, our approach can be easily implemented as it does not require heavy computations.

6. References

[1] Mousavi, M., A. Bakar, M. Vakilian. Data stream clustering algorithms: A review. *International Journal of Advances in Soft Computing and its Applications*. vol. 7, no. 3, 2015, pp. 1-153.

[2] Kwale, F. An Overview of VSM-Based Text Clustering Approaches. *International Journal of Advanced Research in Computer Science*. vol. 5, no. 1, 2014, pp. 69-73.

[3] Jing, L., L. Zhou, M. Ng, J. Huang. Ontology-based distance measure for text clustering. *SIAM SDM workshop on text mining*. 2006.

[4] Aggarwal, C., J. Han, J. Wang, P. Yu. A framework for clustering evolving data streams. *Proceedings of the 29th international conference on Very large data bases*. vol. 29, 2003, pp. 81–92.

[5] Ackermann, M., M. Märtens, C. Raupach, K. Swierkot, C. Lammersen, C. Sohler. StreamKM++: A clustering algorithm for data streams. *Journal of Experimental Algorithmics (JEA).* vol. 17, 2012, pp. 2-4.

[6] Zhong, S. Efficient Streaming Text Clustering. *Neural Networks*, vol. 18, no. 5-6, 2005, pp. 790-798.

[7] Aggarwal, C., P. Yu. A Framework for Clustering Massive Text and Categorical Data Streams, *SIAM Conference on Data Mining*, 2006, pp. 479-483.

[8] Lan, M., S. Sung, H. Low, C. Tan. A comparative study on term weighting schemes for text categorization. *Neural Networks.* vol. 1, 2005, pp. 546-551.

MICROBIAL CLEANING OF MINE WATERS FOLLOWED BY ELECTRICITY GENERATION[*]

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Abstract: *Acid mine drainage waters polluted by iron, several non-ferrous metals (mainly copper, zinc and cobalt) and sulphates as the main pollutants were efficiently treated by a lab-scale passive system consisting of an alkaline limestone drain and a permeable reactive multibarrier connected in a series. The multibarrier was filled by a mixture of solid biodegradable organic substrates (mainly of plant biomass) and was inhabited by different metabolically connected anaerobic microorganisms (mainly different heterotrophs including some iron-reducing and sulphate-reducing bacteria). The effluents from this system were rich in soluble organic compounds and were treated in a microbial fuel cell in which consortium of electrochemically active microorganisms used these compounds as donors of electrons for electricity generation.*

Keywords: MINE WATERS, CHEMOLITOTROPHIC MICROORGANISMS, ELECTRICITY GENERATION

1. Introduction

It is well known that the generation of acid drainage waters (both under natural conditions and as a result of the human activity) is a very serious environmental problem. This is due to mainly to the fact that in most cases, apart from the sulphuric acid, such waters contain different toxic elements, mainly heavy metals, radionuclides and arsenic. The prevention of this process is usually more desirable than the subsequent treatment of such waters. However, the intensive development of mining and/or of mineral processing in many countries worldwide is an essential factor for their industrial development and increasing of their living standard. Unfortunately, the efficient prevention of acid generation in the huge dumps consisting of rich-in-sulphides low-grade waste ores or other mineral wastes is usually a difficult and costly process. For that reason, since a long time in several countries such dumps are subjected to leaching of the relevant useful components by means of acidophilic chemolithotrophic bacteria (Groudev, 2015). At present, apart from the extraction of some valuable components from the pregnant leach solutions, the treatment of the residual waste waters by adding some biodegradable organic substrates and different heterotrophic bacteria using sulphates and/or ferric ions as electron acceptors can be used for generation of electricity by means of especially constructed fuel cells (Du et al., 2007; Rabaey and Verstraete, 2005; Spasova et al., 2014, 2016).

2. Materials and Methods

Acid drainage waters generated during the bioleaching of a polymetallic sulphide ore were subjected to treatment by means of lab-scale permeable reactive multbrriers. The multibarriers were plastic cylindrical columns 120 cm high, with an internal diameters of 30 cm. The columns were filled with a mixture of limestone (crushed to a particle size of minus 10 mm) and a biodegradable organic matter consisting of a mixture of spent mushroom compost, fresh leaf compost, animal manure and saw dust. The columns were inoculated by microorganisms of different types: No 1 - by means of mixed populations of sulphate-reducing bacteria; No 2 – by means of mixed population of iron (III)-reducing bacteria; No 3 – by means of mixed populations of sulphate-reducing and iron-reducing bacteria. The pH of the solutions inside the different columns was maintained at different levels - from 5.5 to 9.5.

The solutions from the multibarriers were enriched in soluble organic compounds and were used separately from each other in the experiments for electricity generation by the microbial fuel cells. Each of these cells was a Plexiglas cylindrical column 80 cm high, with an internal diameter of 12 cm. A perforated slab graphite – Mn4+ anode and a graphite – Fe3+ cathode were located in the bottom and in the top sections of the column, respectively. The two sections were separated by a permeable barrier of 5 cm thickness consisting of a 2.5 cm layer of glass wool and a 2.5 cm layer of glass beads. The feed stream, i.e. the effluents from the multibarriers, was supplied to the bottom anodic sections of the column and the effluents passed through the cathodic section and continuously exited at the top. Air was injected during the treatment to the cathodic section.

The quality of the waters treated by means of the permeable reactive multibarriers and by the microbial fuel cells was monitored at the inlet and the outlet of these components of the system for the water cleaning and electricity generation. The parameters measured in situ included: pH, Eh, dissolved oxygen, chemical composition, and temperature. The isolation, identification, and enumeration of microorganisms were carried out by the classical physiological and biochemical tests (Karavaiko et al., 1988) and by the molecular PCR methods (Sanz and Köchling, 2007; Escobar et al., 2008).

3. Results and Discussion

Data about the composition of the polluted waters before and after the treatment by means of sulphate-reducing bacteria as well as by mixed populations of sulphate-reducing and iron-reducing bacteria are shown in Table 1. The sulphate-reducing bacteria used in this study were related to six different genera (*Desulfovibrio, Desulfobacteric* and *Desulfococcus* which were able to oxidize the organic substrates to CO_2 as a final product, as well as the genera *Desulfobulbus, Desulfomonas* and *Desulfomicrobium* which were able to oxidize the organic substrates only partially to CO_2 and acetate).The bacteria related to the first group as a whole degraded the organic substrates and reduced the sulphates at higher rates than the sulphate-reducing bacteria related to the second group. However, some mixed populations of bacteria from the two groups were also very active. Some iron (III)-reducing bacteria from the genera *Geobacter* and *Schewanella* were able to degrade the

organic sources of energy used in this study at rates close or even higher than these achieved by means of most of the sulphate-reducing bacteria tested in this study. However, the treatment of the polluted waters by means of iron (III) – reducing bacteria acting independently was not efficient, These bacteria were able to transfer electrons from the dissolved organic substrates in the anoxic section of the microbial fuel cells via their own respiratory chains and extracellular matrix directly to the anode located also in this section of the microbial fuel cell. It is well known that some members of the two genera mentioned above differ considerably from each other with respect to their mechanisms of the extracellular electron transport from the relevant organic substrates to the cytochromes of c-type present in their respiratory chains. Furthermore, it is known that the reduction of the Fe (III) – acceptors and the growth of Fe (III)-reducing bacteria depend not only on the type, composition, and concentration of the organic substrates but also on the structure and surface of the iron (III) acceptors.

Table 1. *Treatment of polluted waters by means of different anaerobic microorganisms*

Parameters	Initial content of the waters	Data about the water treatment by means of:	
		sulphate-reducing bacteria	a mixed population of sulphate-reducing bacteria and iron-reducing bacteria
pH	1.70 – 3.25	6.75 – 7.10	6.90 – 7.21
Eh, mV	(+345) – (+530)	(-190) – (-260)	(-172) – (-280)
Total dissolved solids, mg/l	3250 – 5560	510 – 1320	521 – 1270
Dissolved O_2, mg/l	1.0 – 1.9	0.1 – 0.2	0.1 – 0.3
Dissolved org. C, mg/l	1.9 – 3.7	260 – 480	240 – 460
Sulphate, mg/l	640 – 1490	170 - 305	190 – 325
Cu, mg/l	5.0 – 23	<0.1 – 0.40	<0.1 – 0.35
Zn, mg/l	9.5 – 35	<0.1 – 0.35	<0.1 – 0.44
Co, mg/l	2.5 – 12	<0.1 – 0.30	<0.1 – 0.31
Cd, mg/l	0.1 – 0.3	<0.01	<0.01 – 0.3
Mn, mg/l	3.5 – 14	0.21 – 0.28	0.17 – 0.23
Fe, mg/l	560 - 1270	4.4 – 8.2	2.8 – 5.1

Apart from the experiments for treatment of the polluted waters some of the more active sulphate-reducing and iron (III)-reducing bacteria were used in experiments for generating electricity by means of the constructed microbial fuel cells. It was found that the different representatives of these two groups of anoxic microorganisms differed considerably from each other with respect to their ability to generate electricity from biodegradable organic substrates (Table 2).

The sulphate-reducing bacteria as a whole were considerably more efficient in this aspect from the iron(III)-reducing bacteria. However, the high electricity generation during these investigations was achieved by means of a mixed culture consisted of both sulphate-reducing and iron(III)-reducing bacteria.

Table 2. *Electricity generation by means of different anaerobic microorganism in the anodic section of the microbial fuel cell*

Microorganisms	COD, mg O_2/l.h	Cells/ml	Power, mW/m^2
Sulphate-reducing bacteria	400 – 2100	$>5.10^8$	1700 - 3500
Sulphate-reducing bacteria + Iron(III) reducing bacteria	600 - 2300	$>7.10^8$	2600 - 4200
Iron(III) reducing bacteria	500 - 1700	$>3.10^8$	1200 - 2300

Note: Experimental conditions: 37°C, pH 7.1 – 7.5, O_2 dissolved, 7.7 – 8.0 mg/l, COD/SO_4^{2-} ratio 2.1 – 4.1

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References

Du, Z., Li, H., Gu, T., 2007. A state of the art review on microbial fuel cells: A promisising technology for wastewater treatment and bioenergy, Biotechnology Advances, 25, 464 – 482.

Escobar, B., Bustos, K., Morales, G., Salzar, O., 2008. Rapid and specific detection of *Acidithiobacillus ferrooxidans* and *Leptospirillum ferrooxidans* by PCR, Hydrometallurgy, 92, 102 – 106.

Groudev, S.N., 2015. Biohydrometallurgy in Bulgaria – achievements and perspectives, Acta Microbiologica, 1, 81 – 92.

Karavaiko, G.I., Rossi, G., Agate, A.D., Groudev, S.N., Avakyan, Z.A., 1988. Biogeotechnology of Metals. Manual, GKNT Center for International Projects, Moskow.

Sanz, J.I., Köchling, T., 2007. Molecular biology techniques used in wastewater treatment overview, Process. Bochem., 42, 119 – 133.

Spasova I.,Nicolova, M., Georgiev, P., Groudev, S., 2014. Mine waters cleaning connected with electricity generation, Annual of the University of Mining and Geology, Sofia, 57(II), 137 – 139.

Spasova I.,Nicolova, M., Georgiev, P., Groudev, S., 2016. Bioleaching of metals from a waste ore in connection with copper recovery, environment protection and electricity generation, Annual of the University of Mining and Geology, Sofia, 59(II), 167 - 171.

Rabaey, K., Verstraete, W. 2005. Microbial fuel cells: novel biotechnology for energy generation, Trends in Biotechnology, 23 (6), 291 – 298.

EVALUATION OF CUSTOMER RELATIONSHIP MANAGEMENT SELECTION CRITERIA

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Abstract: *This research is about evaluation of Customer Relationship Management (CRM) selection criteria for construction industry in Turkey. It is difficult to implement CRM in construction industry because of its characteristics specifications like transactions and operations volume both in customer and company site. Therefore CRM selection is also as important as CRM implementation. The aim of this research is to evaluate the criteria for CRM selection and then determine the weights of the chosen criteria. The method is going to be Analytic Hierarchy Process (AHP).*

Keywords: ANALYTIC HIERARCHY PROCESS, MOBILE CUSTOMER RELATIONSHIP MANAGEMENT

1. Introduction

The topic intended in this study is the Mobile Customer Relationship Management (mCRM), but we cannot proceed without understanding Customer Relationship Management (CRM) as the basics. The main aim of every organization is to acquire new customers, keep them and increase their number [1]. As new companies enter into new market they push away the existing ones by weakening their customer base. This is a very big challenge to the old companies and also a challenge for the new companies. The increasing competition in market has caused customer relationship management to be the leading agenda in most companies [2].

Customer relationship management isn't just a system that provides organizations with information about their customers but rather it is a way to know how organizations interact with their customers [3].

Companies regardless of the size, be it small or big, have chosen to utilize the opportunities the new technologies offer to captivate individual customers [2]. With large number of 3-G and 4-G smartphones sales in the past 8 years, it has become a necessity for any organization that wants to succeed to adopt the mobile customer relationship management. [4] stated that over 968 million smartphones sales in 2013, which is an increase from the previous year with a 42.3 percent. In 2014, it was recorded that 1.2 billion smartphones sales, an increase of 28.4 percent from the previous year [5]. And in 2015 1.4 billion smartphones sales was recorded [11].

These Improvements in technologies have caused a different approach in the retail sector, how they conduct and manage businesses to make it easier for customers [6] and [7] explain that the coming of mCRM as a tool in the form of text messaging has given companies a chance to have distinct one-on-one relationships with their customers. A prove of this statement is a research that was made in 2013, which showed that adverts in mobile devices had grown up to 75%.

2. Research Aim

Many CRM selection research studies have determined several selection criteria for CRM selections. These studies, however, discussed the selection criteria from different prospective and in different contexts.

The aim of this study is determine weights of the CRM selection criteria for construction industry. Since construction industry is a complex one, CRM selection criteria is going to be same as others but weights may differ

3. M CRM, Benefits and Selection

The breakthrough of CRM has caused a lot to see its importance and since then there have been many definitions of CRM. There is no agreed, comprehensible, explicit and direct definition of CRM because there are still many discussions in academic literature on what CRM precisely refers to [8] .

Since CRM does not depend on its technological aspects only, rather it has many other aspects; so many definitions could come about it. [9] explain that CRM weighs heavily on users at all stages regardless, whether it is in the organization, business partners or customers. This also gives us an idea that truly many definitions could come about from any of the sectors as these sectors have wide scopes. [10] states that these kind of systems affect enterprise functions such as customer retention, product planning, parts purchasing, sales forecasting, product allocation, etc. So it actually depends on which or from what aspect a person would tend to define CRM.

Furthermore [8] explains that CRM are of four different types namely, operational, collaborative, strategic and analytical. He explained that scholars may come up with different definitions depending on which of these four CRM he/she may try to derive the meaning of CRM from. This is one of the main reasons scholars have different definitions.

From these definitions we see and we should agree that the common and most important goals and key items in CRM are as follows.

- Is to recognize the customers
- Acquire new customers
- Satisfy the customer needs
- Retain the profitable customers

In today's fast growing business and also with the competitive market growing rapidly, CRM is vital and necessary [8], [9] and [10] states that CRM has both external and internal benefits.

[11] explains the benefits of CRM as follows

- CRM helps companies to better interact with their customers because of the foreseen and near accurate data they have of their customers. And companies provide a system that follows and communicate with their customers regularly.
- CRM enables companies to have a better understanding of their customers, as of how customers deal from their purchase funnel to their sales.
- It also assists companies from letting their customers to get lost or be forgotten through lost leads.
- CRM helps companies to know what are the risks or what is trending and opportunities. These attributes that could pass without anyone noticing and taking advantage of.

Mobile customer relationship management is a kind of customer relationship application that is made to deal with executions, operations and it should be assessed through the mobile platform.

It was predicted by Gartner (2014) that in 2014, the use of mobile internet would overtake desktop internet usage. [4] predicted that mobile CRM apps would grow by 500%. In some places, already mobile traffic has grown to and has surpassed desktop traffic. Research shows that in Europe less than 34% percent companies are using the mobile CRM.

[4] also stated that the shipment of PC had declined in the third quarter of 2013, and this is not only the case but rather it has been dropping throughout the 2013 quarters.

[12] states that there are six advantages of mCRM

- Increase sales values growth
- Reduce sales cycles
- Increase cash flows speed
- Gather information at the source
- Increase productivity
- Enhance insight

Mobile medium have no comparative alternative in the case of a continuing dialogue between companies and customers). It is a power powerful opportunity to reach customers, by giving various ways for companies to plan and implement more advanced way to communicate with their customers. They also allow high-speed message delivery, high retention and low cost.

According to [13] CRM give users the following benefits

- It allows users have the latest and correct information to their customers.
- Users have a lot of peace, in the sense that they expect few or no calls at all as they have availability of real time access and information.
- Sales people can manage a lot of things easily, they can manage things online everywhere and anytime.

Mobile CRM has lots of benefits but the most important fields were mCRM has its most influence are in; sales productivity, CRM user adoption, sales effectiveness, timelier follow-up of leads or improved lead conversion rates, gaining a competitive edge and reducing the cost associated with sales staff turnover

[13] explains that if you want to succeed when using mCRM then the best thing is to start by listing what necessary things you want to achieve. It is important then to have a close view at these few points.

- Internal buy-in – Since the sales teams are the people that would use your mobile application, then must get internal buy-in from sales force before you decide on implementing a CRM application. And to achieve that you need to have external-in house training on how to use the application.
- Provide the device – It is important that one should provide the device to your sales force free. In summary you need them and they go mostly for the free and the best. Providing the device and also include the pre-installed application.
- Mobile app usability – Though it is almost impossible to give the sales force a perfect usage without accessing their desktop, one should try his outmost best to provide the essentials like email, scheduling a meeting, updating contact information, etc.

[14] also gave some tips on how to succeed and they are as follows

- Start with use cases – A sales person has lots of use cases and they are in different forms depending on value, while the contact center use cases are very few.
- Consider ERP integration – Mobile CRM users have a richer data experience when they have or use CRM systems that have tight integration with ERP applications. "Enterprise resource planning (ERP) is a business process management software that allows an organization to use a system of integrated applications to manage the business and automat many back office functions related to technology, service and human resources"
- Use the mobile devices unique capabilities – To lure more users, it is important that you use the unique qualities that are found only mobile and not in desktops. Such unique capabilities like a touch screen navigation and geo-positioning.
- Focus on the user experience – It is a well-known fact that the PC and mobility operation should not be the same. You should provide the users with an easier way to see and use things. Most users are okay with a context form of view. One should make information entry as automatic as it could be and the keystrokes should be minimized.

3. Methodology

This study is about determining the weights of mCRM selection criteria. In order to determine the mCRM selection criteria, a survey was conducted on industry experts. After that the first four has been taken as selection criteria which are: Quality, Cost, IT Convenience, Cross Culture.

Analytic Hierarchy Process is used in this study, which is one of the multi criteria decision making methods that proposed by T.L. Saaty in 1977. The analytic hierarchy process (AHP) is a decomposition multiple-attribute decision making (MADM) method. It was developed by Saaty [15] (1977), who proposed a method that can represent human decision making process and help to achieve better judgments based on hierarchy, pair-wise comparisons, judgment scales, allocation of criteria weights and selection of the best alternative from a finite number of variants by calculation of their utility functions [16].

AHP method has 4 main steps to apply. Process of normal AHP is generated as follows;

1. Representation of structure by a hierarchy.
2. Paired comparison between elements at each level.
3. Calculations of weight at each level.
4. Priority of an alternative by a composition of weights [17].

The second step of AHP is pairwise comparison of criteria. There is a table that contains priority scale for the alternatives. This table was generated by Saaty who developed AHP method. Pairwise comparison table should be used by decision-maker to compare alternatives.

Table 1: *Pairwise Comparison Scale [15].*

Importance	**Explanation**
1	Two criterion contribute equally to the objective
3	Experience and judgement slightly favor one over another
5	Experience and judgment strongly favor one over another
7	Criterion is strongly favored and its dominance is demonstrated in practice
9	Importance of one over another affirmed on the highest possible order
2,4,6,8	Used to represent compromise between the priorities listed above

The third step of AHP is about calculation of weight for each level. The weights of the elements, which represent grade of importance among each element, are calculated from the pairwise comparison matrix. Firstly, values on each column of matrix are summed and then, each value of the column is divided by summation of matrix column. The results will give us the weight for each level. The calculation of consistency ratio is also done in the third step.

In order to apply the AHP methodology for determining the weights of mCRM selection criteria a AHP survey was conducted among the experts. After calculating the geometric mean of the results and checking the consistency of the results the weights are founded as follows:

Table 2: *mCRM Selection Criteria Weights*

Criteria	W
Quality	0.13
Cost	0.50
IT Convenience	0.28
Cross Culture	0.09

Consistency Index CI	0.0170
Consistency Ratio CR	0.0188

Since CR is smaller than 0,1 the results are consistent.

According to Table 2 cost and IT Convenience are the most important criteria among others. Quality is more important than Cross Culture.

It is specific in construction industry that there is a tough competition among companies in order to finish the current projects and take new ones. It is inevitable to be unsuccessful in implementation of the mCRM project. Therefore, almost 80% of the weight is from cost and IT convenience. If any mCRM vendor that could not satisfy those needs, then mCRM Construction industry project is going to fail

3. Conclusion

In fact construction industry is a challenging one for mCRM implementation because of its structure, complexity, volumes and so on. In such industries, selection of the CRM is as hard as implementing it. The aim of this study is just determining the selection criteria and weighting them. The result is different from a defense industry or strategic one case because quality is in the third place and cross culture in the last one. Although the weights of the criteria differ from strategic sectors it is so common in this case because of the competitiveness of the industry cost is really a vital parameter.

4. References

[1] Peppers, D. & Rogers, M. 1993. The one to one future: building relationships one customer at a time. New York: Currency Doubleday

[2] Adrian, Payne (2005). Handbook of CRM: Achieving Excellence in Customer Management. Oxford: Butterworth-Heinemann.

[3] Ontario (2013) E-Business Toolkit: How You Can Profit from E-Business. Queen's Printer.

[4] Gartner (2014) Gartner Says Annual Smartphone Sales Surpassed Sales of Feature Phones for the First Time in 2013.

[5] Gartner (2015) Gartner Says Worldwide Smartphone Sales Recorded Slowest Growth Rate Since 2013

[6] Dheeraj Verma & Dr. Devendra Singh Verma (2013) Managing Customer Relationships through Mobile CRM In Organized retail outlets. International Journal of Engineering Trends and Technology (IJETT) Vol. 4. Issue 5.

[7] Don E Schultz & Scott E Bailey (2000) Customer/Brand Loyalty in an Interactive Marketplace. Journal of Advertising Research Vol. 40. Issue 3. Pg. 41-52.

[8] Buttle, F. 2004. Customer relationship management – concepts and tools. Oxford: Elsevier Butterworth – Heinemann.

[9] Keramati, Abbas and Fatemeh Shapouri. "Multidimensional Appraisal of Customer Relationship Management: Integrating Balanced Scorecard and Multi Criteria

[10] Kristin Anderson & Carol Kerr (2002) Customer Relationship Management. New York: McGraw-Hill.

[11] Gartner (2016) Gartner Says Worldwide Smartphone Sales Grew 9.7 Percent in Fourth Quarter of 2015.

[12] Bose, R. 2002. Customer relationship management: key components for IT success. Industrial management and data systems, 102(2):89-97.

[13] Leif Nordstrand & Gargi Varu (2011) The net benefits of Mobile Customer Relationship Management: From the perspectives of suppliers, resellers and users. Master thesis, Lund University.

[14] Peelen, E. 2005. Customer Relationship Management. Edinburgh Gate. England: Pearson Education Limited

[15] Saaty, T.L. (1996). Decision Making With Dependence And Feedback: The Analytic Network Process. Pittsburgh: RWS Publications.

[16] Franek, J., Kresta, A., (2014). Judgment scales and consistency measure in AHP, Procedia Economics and Finance, 12, 164-173.

[17] Ohnishi, S., Yamanoi, T., (2014). On fuzzy priority weights of AHP for double inner dependence structure, Procedia Computer Science, 35, 1003-1012

THE CROWDFUNDING PROCESS – AN UNDERESTIMATED OPPORTUNITY IN BULGARIA

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Abstract: *This article represents a review of good practices in crowdfunding. The subject is the opportunities which create conditions for using the crowdfunding process by entrepreneurs and perspectives for implementation of this good practice in Bulgaria. The concept of crowdfunding in Bulgaria is mentioned a lot but barely in the last few years can be observed the standing out of pronounces examples and good practices. The appearance of financial instruments for starting technological companies promises to become an accelerator for the entrepreneur ecosystem in Bulgaria. This paper examines how different platforms in crowdfunding campaigns influence the entrepreneur's choice of targeted crowdfunding goal.*

Keywords: CROWDFUNDING, BUSINESS PROCESS, ENTREPRENEURSHIP, SMALL BUSINESS

1. Introduction

The development of markets and market relations leads to enhanced competition and increased consumer demands, making quality a factor in the success and survival of organizations. **The significance of the topic** is central to discussions, research and organizational activities in the field of manufacturing and services, as a prerequisite for improving quality are the opportunities for flexible financing of organizations (Angelova and Pastarmadzhieva, 2017). Despite the growing importance of crowdfunding, academic research is still very limited and typically focused on understanding the dynamics behind the decision on the form of crowdfunding to adopt or engage in, and the characteristics of successful campaigns (Mollick, 2014). Crowdfunding has become a key research trend in recent years providing a new form of acquiring funding for innovation projects from users prior to the realization of the product in a 'market before the market' (A.Brem et.al., 2017).

The dynamically changing macroeconomic environment as well as the conditions of the ongoing economic crisis put businesses in the everyday need to „fight for survival", to be flexible, to respond adequately to the newly created conditions and to constantly adapt to them. This in turn implies seeking new forms of competitive behavior strategically placed and helping not only to keep them on the market but also to ensure their sustainable development. Leaders, good practices, offering innovative solutions, achieving innovations, delivering higher value to consumers are successful. In the context of the above mentioned (and not only) the issue of boosting competitiveness through innovation financial solutions such as the crowdfunding process is becoming more apparent and becoming an imperative for both business units and the economy at national and global level.

The object of this report is the crowdfunding process and its implementation in the Bulgarian business practice.

The subject is the opportunities which create conditions for using the crowdfunding process by entrepreneurs and perspectives for implementation of this good practice in Bulgaria.

The researcher's thesis in this report is that the adequate use and implementation of good practices and mechanisms for crowdfunding by entrepreneurs is a condition for a successful realization and future development and as a result providing a competiveness of the Bulgarian economy.

The concept of crowdfunding in Bulgaria is mentioned a lot but barely in the last few years can be observed the standing out of pronounces examples and good practices. The appearance of financial instruments for starting technological companies promises to become an accelerator for the entrepreneur ecosystem in Bulgaria. In the last years had been founded a lot companies that produce for the global market. But this is just the beginning and following the words of Brad Feld (a successful investor in technological companies in the USA) in one of his books "to build well - functioning entrepreneur ecosystems every day must have a vision about what must be done for the next 20 years" (Feld, 2012).

The predominant opinion is that in the middle of 2017 the business climate in the country becomes better and the activation of economy gives hope that Bulgaria starts to go out of crisis. In the press and official sources more often appear hopeful statistic data and macroeconomic analysis. The basic reason for that is the ongoing reconstruction of Western Europe that influences Bulgarian exportation to those countries.

2. What is crowdfunding?

Crowdfunding is a subject of growing interest for both scholars and policy makers. Many studies in the literature have analyzed crowdfunding market, participants' motivations, benefits and drawbacks, mainly on the basis of real user-experiences on the most popular crowdfunding platforms i.e. M. M. Gierczak (2016), Guidici et. al. (2013), J. Hemer (2011), etc. Crowdfunding is on the rise: its volume grew 1000% in only three years and is about to outpace worldwide venture capital spending (A. Hoegen, 2017).

While collective financing has a long history going back to the 18th century, crowdfunding is typically situated in the emerging literature on crowdsourcing. Since the term emerged in 2006, crowdsourcing has been of interest to industry and academics alike. With the power of the Internet, it has been used by individuals and organizations to efficiently outsource tasks to large undefined groups of people (Howe, 2006).

It should be mentioned that interesting opportunities are offered by the crowdfunding and this process is investigated by many scientists who gave some guidelines to entrepreneurs for running a successful campaign. Crowdfunding can be loosely defined as the fundraising for a project or a venture by a group of individuals, instead of professional parties (e.g. banks), usually taking place online - without any intermediary or through dedicated platforms (Schwienbacher and Larralde, 2012). It represents a promising source of funding for many types of actors that do not find solutions suited to their financing needs, mainly valuable for small and medium enterprises (OECD, 2015). There are number of investigations focused on this topic and should be mentioned the approved good practices in Bulgaria.

Angela Mariani et. al. (2017) investigates a case study research that explores the experience of the first wine-dedicated crowdfunding platform, namely Fundovino. The crowdfunding reward model, mainly in the form of pre-selling, represents a great opportunity and is ideally suited for the wine sector since an overwhelming majority of producers is represented by small entrepreneurs that have difficulties in accessing other forms of financing, but also because of some products and consumers' specific features (Mariani et al, 2017).

Theodore Lynn et. al. (2017) investigates the network characteristics of an issue-centred public on Twitter organised

around the hash tag crowdfunding. They examine the characteristics of the crowdfunding public including the degree of connectedness and prominence of sub-networks, and key brokers within these sub-networks. Being the first study to examine the crowdfunding public on Twitter, their paper provides original insights into the characteristics of the crowdfunding public on Twitter.

Ajay Agrawal et. al. (2015) examines a crowdfunding platform that connects artists with funders. Although the Internet reduces many distance-related frictions, local and distant funders exhibit different funding patterns. Local funders appear less responsive to information about the cumulative funds raised by an artist. These findings provide a deeper understanding of the abilities and limitations of online markets to facilitate transactions and convey information between buyers and sellers with varying degrees of social connectedness.

Social media and the so-called 'power of the crowd' is being used to solve problems for organisations through contests, collaborative communities, crowd complementors and crowd labour markets. For early stage start-ups, the combination of social media and crowdsourcing is solving two problems – attracting external finance and early-stage, often pre-product, customers (T. Lynn et al, 2017).

3. Investigation of the crowdfunding in Bulgaria

3.1. Good practices and examples using the crowdfunding process

The unclear regulations and restrictions over business are on principle one of the basic enemies of the entrepreneurship. When employees participate in organizational crowdfunding, they seek partial funding from their existing social networks. Among proposers of projects, teams with larger social networks tend to be more successful in reaching their funding goals. In Bulgaria an obstacle for developing of this environment is the lack of personnel as well as the lack of entrepreneur culture. It's necessary the creation of positive examples for entrepreneur's image improvement in the country together with building the idea in owners for the opportunities that crowdfunding provides.

The current economic and financial crisis mostly come to the fore the key meaning of entrepreneur activity that is expected to be an engine of the economy revival and society as a whole including their post crisis development. The global economic history gives a lot examples how people's willingness to create and manage own companies taking a definite risk is a basic force of economics' revival after depressions and crisis. The current crisis puts the entrepreneur culture, sense and behavior of the humanity using such challenges but in a new more complicated and specific context.

While the literature offers a detailed and comprehensive picture of decision-making for traditional startup financing or bank loans, it does not provide a holistic understanding of decisions to invest in crowdfunded ventures (A. Hoegen et. al., 2017).

Crowdfunding changes the way of thinking, transforms the way people exchange their products and in practice it changes everything that needs good financing. It should be investigated how crowdfunding impacts constituent dimensions of user innovation theory such as user motivation, user role, user community, collaboration between users and user investments. In the last years are observed many websites that propose different aspects of crowdfunding. These websites can be divided into two basic subgroups: donation-based funding site and investment-based funding site.

The donation-based funding sites are focused in donations for creative and innovative companies. These sites do not bring any kind of profits or share for the investors. Usually the funders receive different kinds of rewards or discounts according the level of particular financing. This crowdfunding is used when you need fast gathering money for the idea.

The investment-based funding sites receive financing in exchange of stocks or share incomes of the company or organization. In this case the funders are determined as investors.

The most famous and trusted crowdfunding websites are:

1. www.kickstarter.com

It is one of the pioneers in the crowdfunding process. This is the most famous donation-based funding site that gives an opportunity for fast gathering funds for personal art projects. Kickstarter helps artists, musicians, filmmakers, designers, and other creators find the resources and support they need to make their ideas a reality. Tens of thousands of creative projects — big and small — have come to life with the support of the Kickstarter community.

2. www.indiegogo.com

It gives crowdfunding opportunities for personal needs, to find clever and unconventional things that solve everyday problems large and small. By giving entrepreneurs everywhere a platform to launch new and groundbreaking products, this website helps surface innovations in tech, design, and much more, all before they go popular.

3. www.gofundme.com

Gofundme is a personal fundraising website based upon crowdfunding for family and friends. The campaign can be published in social media like Facebook, Twitter, etc. and the company's motto is "Crowdfunding for everyone". Launched in 2010, GoFundMe is the world's largest social fundraising platform, with over $5 billion raised so far. "With a community of more than 50 million donors, GoFundMe is changing the way the world gives".

4. https://quirky.com/

Quirky is suitable for financing of different technological and IT inventions. It is a free community-led invention platform that brings real people's ideas to life. This websites provides a good start for young researchers who wish to realize their innovative projects. Quirky makes inventing and selling products possible by pairing inventors with product designers and big manufacturing companies that can bring their ideas to life.

5. www.crowdfunder.com

Crowdfunder has the largest investors net in crowdfunding. Through access to capital and education, they empower thousands of entrepreneurs to grow high-impact ventures. Crowdfunder is the equity crowdfunding leader for sourcing and funding high-growth ventures with a network of over 130,000 entrepreneurs and investors. Crowdfunder and its VC Index Fund provide the opportunity for direct online investment into single ventures, as well as diversification into a broad VC-led portfolio (Index Fund) of early-stage startups - backed by many of the world's leading Venture Capital firms and private investors. It includes $160,000,000 investment commitments on the platform; 12,000 individual and institutional investors; 36,000 companies; funded 100+ deals at an average deal size of $1.8M.

6. www.investedin.com

INVST is an invite only investment platform for sophisticated accredited investors to invest in institutional quality deals. Utilizing proprietary social technology, INVST streamlines and amplifies the capital introduction process while offering relationship, tracking and deal management tools for fund managers, third-party marketers and investors. The entrepreneur can launch a custom crowdfunding platform in minutes. It provides everything to run a successful crowdfunding company.

Z. Wu (2017) presents a model to study market incentives of crowdfunding platforms' optimal information reporting strategy when there is uncertainty on projects' returns. In the report she finds that under certain conditions, the potential competition from a new

entrant gives the incumbent crowdfunding platform an incentive to bias the information on borrowers' risky projects. However, the uncertainty resolution provided by a third party (e.g., regulator, media) could reduce the incentive.

One of the best examples for a company that had used crowdfunding in Bulgaria is Oculus Rift – after they had been rejected by the traditional financial services they publish their campaign in Kickstarter, gather financing for a very short time and start business development that as a result becomes very successful and they sell the company for a lot of money (Iv.Ivanov, 2017).

3.2. A focus in crowdfunding problems

The investigations in the field of crowdfunding give opportunity for gathering a correct idea of the problems in front Bulgarian entrepreneurs. The negative influence of crisis can be generalized in the next fields:

- Little is known about the consequences of participation on employees' social networks, during and after the crowdfunding campaign;

- A lack of courage and positive examples in the society for achieving success by crowdfunding that falls down the motivation level;

- A lack of information about the crowdfunding process;

- A difficulty in finding a support by the organizations and the lack of a regional based center for financing innovation ideas.

In a study of Michael Muler et al (2018) of activity logs and social networks from a very large scale organizational crowdfunding campaign, is found that people in different crowdfunding roles experienced different degrees of growth in their social networks, during and after the crowdfunding campaign, as compared with baseline nonparticipants.

Many researchers argue that crowdfunding platforms may give rise to a more widespread occurrence of user entrepreneurs, who found a firm to commercialize their product or service in a marketplace they have created for their own need (A. Brem at.al., 2017). Hence, they show the development from traditional user innovation to crowdfunding-enabled user innovation, which democratizes not only the creation but also the more large-scale commercialization of new products and services.

4. Conclusion

The economic crisis in Bulgaria affects almost all economic operators and sectors in the country because the market compression had a negative influence over the business and entrepreneurship activity. Together with this the crisis creates also many opportunities which can be used by people with entrepreneur potential like crowdfunding but it's necessary the country to create conditions for raising the entrepreneur's activity and to support enterprises that create additional value in economy. The ratification and assistance of current and future entrepreneurs is a basic mechanism for reviving the Bulgarian economy and put the foundation of after crisis development. The underestimation of innovations and the necessary competencies in entrepreneurs and managers obviously will slow down the Bulgaria's going out of crisis. Even more, it will be missed the opportunity for laying a stable foundation of the successful and sustainable competitive post crisis development especially because the fact that is not observed the identification of new post crisis entrepreneurs. It's deeply noticed the lack of a strategy and support for financial innovations like crowdfunding that provide to start-ups in Bulgaria a fast way for realizing their ideas. Precisely they can be the development engine uniting technical and business skills, abilities for taking risks, avoiding mistakes and drawing lessons from the current crisis.

REFERENCES

1. Angelova, M., Pastarmadzhieva, D. (2017) *Challenges and opportunities for flexible crediting of small and medium-sized enterprises in Bulgaria*, Journal "Fundamental Sciences and Applications", ISSN 1310-8271, vol. 23/2017, pp.167-170;
2. Agrawal, A., Catalini C., Coldfarb, A. (2015) *Crowdfunding: Geography, Social Networks, and the Timing of Investment Decisions*, Journal of Economics & Management Strategy 24(2), DOI10.1111/jems.12093
3. Brem, A., Bilgram, V., Marchuk, A. (2017) *How crowdfunding platforms change the nature of user innovation – from problem solving to entrepreneurship*, Technological Forecasting and Social Change, DOI 10.1016/j.techfore.2017.11.020
4. Feld, B. (2012) *Brad Feld's Burning Entrepreneur - How to Launch, Fund, and Set Your Start-Up On Fire*!, Hyperink, ISBN 1614644888, 9781614644880
5. G. Giudici, M. Guerini, C. Rossi-Lamastra (2013) W*hy crowdfunding projects can succeed: the role of proponents' individual and territorial social capital*, Social. Sci. Res. Netw. (SSRN) pp. 1-20;
6. Gierczak, M.M., U. Bretschneider, P. Haas, I. Blohm, J.M. Leimeister (2016) *Crowdfunding: outlining the New Era of Fundraising*, In D. Brüntje, O. Gajda (Eds.), *Crowdfunding in Europe State of the Art in Theory and Practice*, Springer International Publishing, pp. 7-23;
7. Hemer, J. (2011). *A Snapshot on Crowdfunding*, Working Papers Firms and Region, R2, pp. 1-39;
8. Hoegen, A., Steininger, D., Veit, D. (2017) *How do Investors Decide? An Interdisciplinary Review of Decision-Making in Crowdfunding*, Electronic Markets DOI 10.1007/s12525-017-0269-y
9. Howe, J. (2006) *The rise of crowdsourcing*; Wired Magazine, 14(6), pp.1-4
10. Lynn, T., Rosati P., Nair, B. and Bhaird, C.M. (2017) *Harness the Crowd: An Exploration of the #Crowdfunding Community on Twitter*, Conference: ISBE 2017, Belfast
11. Mariani, A., Annunziata, A., Carmela, M., Nacchia, A.F. (2017) *Crowdfunding and wine business: Some insights from Fundovino experience*, Int. Journal Wine Economics and Policy, *6*(1), pp. 60-70
12. Mariani, A., A. Annunziata, F. Nacchia, A. Vastola (2015) *Crowdsourcing in wine business: co-creation and fundraising experiences*, In G. Szolnoki, L. Thach, D. Kolb (Eds.), *Successful Social Media and Ecommerce Strategies in the Wine Industry*, Palgrave Pivot, pp. 93-114
13. Mollick, E. (2014) *The Dynamics Of Crowdfunding: An Exploratory Study*, Journal Of Business Venturing, 29(1), pp. 1–16
14. Muller, M., Mitra T. and Geyer, W. (2018) *Growth in Social Network Connectedness among Different Roles in Organizational Crowdfunding*, Conference: the 2018 ACM Conference, DOI10.1145/3148330.3148335
15. OECD (2015) *New Approaches to SME and Entrepreneurship Financing: Broadening the Range of Instruments*, Paris
16. Schwienbacher, A., B. Larralde (2012) *Crowdfunding of Entrepreneurial Ventures*, In D. Cumming (Ed.), *The Oxford Handbook of Entrepreneurial Finance*, Oxford University Press, pp. 369-391
17. Wu, Z. (2017) *Crowdfunding Platforms: The Role of Information Providers*, Conference: Workshop on E-Business, DOI 10.1007/978-3-319-69644-7_21
18. http://www.bloombergtv.bg/v-razvitie/2017-06-02/kraudfanding-v-balgariya-misiya-vazmozhna, 28.01.2018

RISK ASSESSMENT FOR THE PRODUCTION PROCESS

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Abstract: *Risk management constitutes currently one of the most important elements of the management of an enterprise, which is crucial to its security and continuous improvement. This is a several-stage process, and its implementation should systematic and principled in character. The article sets out the risk assessment for activities performed in conjunction with individual operations of a manufacturing process, and specifically, the book production process. The risk assessment was preceded by the identification of hazards to technological, transport and control operations, followed by their analysis using an indicator method. Operations have been identified, which are characterized by the highest risk, and preventive and prophylactic actions using various control measures (technical, organizational, legal, individual and collective) have been proposed. Risk assessment for a task is a primary outline for the use and implementation of risk management issues that go beyond the commercial risk assessment in an enterprise.*

Keywords: RISK MANAGEMENT, RISK, ANALYSIS, ASSESSMENT, HAZARDS, PRODUCTION PROCESS

1. Introduction

Undoubtedly, risk management is an important and increasingly common element of an enterprise's functioning, as it relates to a broad spectrum of its activity. It guarantees the improvement of safety, the ability to foresee the consequences of hazards, and the proper decision-making and strategic planning. Moreover, risk management helps with recognizing the whole area of the organization's activity, monitoring hazards and preparing for the occurrence of crisis situations in the company. Risk management determines the weaknesses and strengths of an enterprise, which enables its continuous improvement.

The risk management process comprises several stages: the definition of the activity context, the identification, analysis and assessment of the risk and the response to the risk, along with continuous monitoring and communication [8,11].

The determination of the context is to indicate the main targets and objectives of an entity, for which the hazards are being considered, and to establish all circumstances of the functioning of the process. The identification involves the establishment of the actual or potential hazards, their causes and effects, and the subjects and objects affected by the hazard. Risk analysis relates to the selection of the appropriate risk measurement method that uses the parameters of the risk (in the study, the value of probability, effects and exposure has been determined). In turn, the job of risk assessment is to establish the actual risk level and then to select the appropriate variants of actions [9, 11].

In a modern enterprise we deal with the examination of the level of different risk types: production, financial, commercial, legal, technological, innovation-related, etc. An interesting concept, on the other hand, is also the practice related to the assimilation of risk assessment in the production process for specific process operations and individual tasks performed in conjunction with them. This is a new look at the hazard of the entire production process (being useful during the implementation of new technologies, transformation of the production line and development of the job-stand instruction), as well as in the context of the Health Safety of employee work.

The production process is an ordered sequence of activities, as the result of which the consumer obtains products and services. This is part of the production system and comprises: technological operations denoted conventionally with the symbol of a circle; storage operations (triangle); control operations (square); and transport operations (arrow) [1].

The book production process constitutes part of the production system. Therefore, in order that it could be carried out, input elements, such as materials, utilities, fixed assets, information and personnel, are needed. The output product is a book with appropriate utility, economic, natural, ergonomic and technical features, as well as waste material and impurities. In the printing and publishing process, all factors that constitute potential hazards to it (i.e. production materials, such as adhesives, paints and solvents that could be hazardous, or e.g. noise emitted by machinery, which is a by-product of the process) should also be taken into account.

The paper is focused on the book production process, though, obviously, printing companies deal with the manufacture of various products and their product-range variety is constantly expanding. Therefore, the printing and publishing industry in Poland is developing vigorously and dynamically. Indeed, an increase in demand for its products and an increased employment in this industry have been observed in recent years. In terms of its revenues, the Polish printing and publishing sector remains the largest sector in Central and Eastern Europe and is placed eighth in the European Union. Currently, almost 8800 printing businesses are active in Poland [7, 10].

2. Prerequisites and means needed to solve the problem

The book printing and publishing process is composed of three phases: printing preparation (pre-press), printing and bookbinding and shipment activities. From among them, six operations were selected, for which risk assessments were made.

In order to make risk assessment for the production process, it was necessary to perform the following activities for its individual tasks and operations:

- establish the individual operations of the production process and to define their types (using conventional symbolism);
- identify potential hazards and to determine their effects (technical, commercial, outer factors-related and information safety-related hazards);
- make a risk analysis using the indicator (*risk score*) method using three risk parameters: probability, exposure and effects;
- perform the proper risk analysis of the identified production process hazards;
- select the means of control (preventive and control actions, collective, individual, technical, organizational and legal measures) for hazards characterized by the highest risk level; and
- develop conclusions and recommendations.

The risk assessment for individual production process operations was made based on the printing and publishing process of a selected printing company active on the Polish market.

3. Risk assessment for the book production process

Table 1 shows selected operations of the book printing and publishing process, the identification of risks and their potential effects.

Table 1: *Identification of risks for individual phases of the book production process*

Phase/ Operation name/	Risks	Effects
Pre-press 1. editing 2. matrix-moulding 3. making printing formes 	a. accidental disclosure and/or loss of information b. computer viruses c. hardware failure d. harmful radiation from hardware e. mains failure f. UV radiation g. contact with chemicals h. mechanical, machine-in-motion hazards i. stress and working under time pressure j. inadequate lighting k. static and dynamic employee loads	disclosure of information and data to unauthorized people, no material available for editing, extended working time, repair and service costs, excessive exposure, harmful effects of chemicals on human body, poisoning, feeling unwell, fractures, bruises, crushing, pricks, cuts, inefficient employee work, working discomfort, body function disorders, power outages
Printing: 1. pre-press proofing 2. run printing 3. quality control during printing and making corrections 	a. harmful radiation b. contact with chemicals c. noise d. vibrations e. electrocution f. mains failure g. mechanical and machine-in-motion hazards h. inadequate lighting i. surface configuration hazards (difference in levels; slippery, uneven surfaces) j. no procedures and machinery instruction manuals translated into the native language k. static and dynamic employee loads l. changing microclimate ł. confined space m. water-pipe network failure n. poor working ergonomics o. working alone p. machine/equipment failure r. stress and working under time pressure s. dustiness, chemical vapours and gases t. room or building structure collapse u. faulty production/run, excessive spoilage	working discomfort, body function disorders, fractures, bruises, crushing, pricks, cuts, electrocutions, burning, dislocations, spraining, allergies, overexposure, vision impairment, harmful chemical effects on human body, filling unwell, accidents at work, infrastructure damage, material losses, power outages, prolonged threat response time, added production costs, work disruption and destabilization, communication problems
Bindery and shipment: 1. transport to bindery 2. cutting 3. folding 4. transport to stitching 5. thread sewing 6. pressing 7. glueing 9. book bulk trimming 10. setting individual cover elements 11. book back forming 12. book cover stamping 13. suspending book bulk into the cover 14. book bulk and cover inspection 15. pressing 16. jacket folding and putting on 17. transporting to the packing stand 18. packing into packets 20. transporting to the finished product storage 	a. fire b. explosion c. noise d. vibrations e. mechanical and machine-in-motion hazards d. hazards involved with non-routine repairs of machines and their parts e. static and dynamic employees loads f. confined space h. collapse of a building or a structure part h. traffic accident i. incorrectly designed fire protection j. no fire-fighting equipment available at the proper distance from the job stand and at the adequate quantity k. no active safety system l. falling objects ł. radiation m. stress and working under time pressure n. dustiness, chemical vapours, liquids and gases o. electrocution p. microclimate r. water-pipe network failure s. mains failure t. inadequate lighting u. traffic accident w. surface configuration hazards (difference in levels; slippery, uneven surfaces) y. poor working ergonomics x. faulty production/run, excessive spoilage z. working alone	working discomfort, body function disorders, fractures, bruises, crushing, pricks, cuts, electrocutions, burning, dislocations, spraining, allergies, overexposure, vision impairment, harmful chemical effects on human body, filling unwell, accidents at work, infrastructure damage, material losses, power outages, traffic disruptions, prolonged threat response time, added production costs, work disruption and destabilization, extended working time

Source: The authors' compilation based on the data obtained from the enterprise

Table 2 shows the risk analysis of the identified book production process risks using the risk score method that makes use of three risk parameters: probability, exposure and effects. The description of the method provided in Tables 3 through 5, respectively, was used for this purpose. Table 3 provides the description of the exposure along with values assigned to it. The description of probability together with its values is given in Table 4. Whereas Table 5 shows the description and values of effects for the selected method.

Table 2: *Risk analysis of the identified printing and publishing process risks*

No.	Risk	P	E	S	W
1.	fire	0.2	3	15	9
2.	explosion	0.2	3	15	9
3.	noise	10	6	1	60
4.	vibrations	10	6	1	60
5.	mechanical and machine-in-motion hazards	6	6	7	252
6.	hazards involved with non-routine repairs of machines and their parts	0.5	2	3	3
7.	static and dynamic employees loads	1	6	1	6
8.	confined space	3	6	1	18
9.	collapse of a building or a structure part	0.1	0.5	40	2
10.	traffic accident	1	0.5	15	7.5
11.	incorrectly designed fire protection	0.1	0.5	7	0.4
12.	no fire-fighting equipment available at the proper distance from the job stand and at the adequate quantity	0.1	0.5	7	0.4
13.	no active safety system	0.5	1	7	3.5
14.	falling objects	6	3	3	36
15.	radiation	10	6	1	60
16.	stress and working under time pressure	1	3	1	3
17.	dustiness, chemical vapours, liquids and gases	6	6	3	108

18.	electrocution	6	6	3	108
19.	microclimate	1	3	1	3
20.	water-pipe network failure	0.2	0.5	3	0.3
21.	mains failure	0.5	0.5	3	0.75
22.	inadequate lighting	3	6	1	18
23.	surface configuration hazards (difference in levels; slippery, uneven surfaces)	6	6	3	108
24.	accidental disclosure and/or loss of information	1	0.5	3	1.5
25.	computer viruses	6	6	3	108
26	hardware failure	6	2	3	36

Source: *The author's study*

Table 3: *Estimation of the parameters of exposure to risks in the risk score method*

E- exposure to the risk	
Value E	**Exposure description**
10	Permanent exposure
6	Frequent (everyday)
3	Once a week
2	Once a month
1	Several times a year
0.5	Rare (once a year)

Source: [2, 6]

Table 4: *Estimation of the probability parameters in the risk score method*

P - risk occurrence probability			
Value P	**Description**	**Chance in %**	**Probability**
10	Very probable	50	0.5
6	Quite probable	10	0.1
3	Practically possible	1	0.01
1	Little probable, though possible	0.1	0.001
0.5	Only sporadically possible	0.01	0.0001
0.2	Thinkable	0.001	0.00001
0.1	Theoretically possible	0.0001	0.000001

Source: [2, 6]

Table 5: *Estimation of the effect parameters in the risk score method*

S - possible risk effects			
Value S	**Estimated losses**	**Human losses**	**Material losses**
100	Severe disaster	Numerous fatalities	Over 30M Zl
40	Disaster	Several fatalities	10 – 30M Zl
15	Very large	One fatality	300K – 1M Zl
7	Large	Serious injuries	30 – 300K Zl
3	Medium	Absence from work	3 – 30K Zl
1	Small	Offering first aid	Below 3K Zl

Source: [2, 6]

The main stage of the studies presented in this paper included the risk assessment of the identified risks to the printing and publishing process along with control mechanisms (corrective and preventive actions) assigned to them. This assessment is illustrated by Table 6 based on the risk categories presented in the *risk score* method (Table 7).

Table 6: *Risk assessment of the identified production process risks along with control mechanisms*

Risk number	**Risk assessment**	**Control mechanisms**
1.	acceptable	Control recommended
2.	acceptable	Control recommended
3.	Low	Control needed
4.	low	Control needed
5.	high	Immediate risk mitigation is required. The use of the LOTO system, installation of proper shields, provision of job stand training, adherence to safety instructions, translation of instruction manual into native language, proper maintenance of machines and frequent inspection of machinery and equipment are needed.
6.	acceptable	Control recommended
7.	acceptable	Control recommended
8.	acceptable	Control recommended
9.	acceptable	Control recommended
10.	acceptable	Control recommended
11.	acceptable	Control recommended
12.	acceptable	Control recommended
13.	acceptable	Control recommended
14.	low	Control needed
15.	low	Control needed
16.	acceptable	Control recommended
17.	significant	Risk mitigation is required. Adequate ventilation and air conditioning, personal protective equipment (safety glasses, gloves, etc.), measurements of noxious agents at work stations and extraction equipment are needed.
18.	significant	Risk mitigation is required. The inspection of technical equipment condition, job stand training, following the strictly defined procedures and taking measurements using a mains parameter measuring instrument are needed.
19.	acceptable	Control recommended
20.	acceptable	Control recommended
21.	acceptable	Control recommended
22.	acceptable	Control recommended
23.	significant	Risk mitigation is required. Install guard rails, provide job stand training, maintain tidiness, wear suitable protective shoes, employ anti-slip protection, logistic solutions, industrial lining
24.	acceptable	Control recommended
25.	significant	Risk mitigation is required. The protection of services, software, communications, data storage media safeguarding, personal safety and data protection (locks, passwords, information and data encoding) are needed.
26	low	Control needed

Source: the author's study

Table 7: *Risk assessment – risk categories in the risk score method*

Risk - R		
Value	**Category**	**Preventive action**
At most 20	Acceptable	Control recommended
At most 70	Small	Control needed
At most 200	Significant	Risk mitigation required
At most 400	Large	Immediate risk mitigation required
Over 400	Very large	Work withholding

Source: [2, 6]

3. Conclusions

To sum up the discussion of the risk assessment of the printing and publishing process under consideration, the following conclusions can be drawn:

- the pre-press phase of the book printing of publishing process comprises chiefly technological operations, while the printing phase relies both on technological and control operations. In the bindery and shipping phase, on the other hand, we deal with both technological, control and transport operations. So, in the technological process under investigation, operations that are characterized by the highest risk concern mainly the printing and bindery phases;
- a risk type that most often occurs in the printing and publishing process, in all its phases, includes risks associated with mechanical and chemical hazards, as well as radiation, noise and vibrations;
- the highest probability of occurrence is exhibited by hazards, such as noise and vibrations. The greatest risk exposure applies to: noise and vibrations generated by machines, mechanical and machine-in-motion hazards, dynamic and static loads, radiation, confined space, motion, dustiness, chemical liquids and gases, electrocution, inadequate lighting, surface configuration hazards (difference in levels; slippery, uneven surfaces) and information safety hazards, chiefly computer viruses. Whereas, the risks characterized by the largest material and human losses are: the collapse of a building or a structure part, fire, explosion and a traffic accident;
- the highest risk level of all the identified risks applies to hazards, such as (high risk) mechanical and machine-in-motion hazards. A significant level, on the other hand, was assessed for the following risks: dustiness, chemical vapours, liquids and gases, electrocution, computer viruses and surface configuration hazards (difference in levels; slippery, uneven surfaces);
- using control mechanisms is necessary at both high and significant risk levels, while at the remaining levels, the control is either needed or recommended. Therefore, from among the preventive and control actions, the following individual, collective, organizational, legal and technical measures are recommended to be used: the LOTO system, proper shields for machinery and equipment, job stand training, adherence to safety instructions, translation of instruction manuals into the native language, the proper maintenance of machines, frequent inspection of machinery and equipment, guard rails, maintaining jobs station tidiness, using relevant logistic solutions, anti-slip protection, information protection, personal safety, adequate room ventilation and air conditioning, or noxious factor measurements;
- the risk assessment of a production process should be made cyclically, especially with the aim of verifying the effectiveness of control mechanisms used (so-called residual risk), each time after process changes, job station rotations, or the implementation of innovative solutions.

4. References

1. Durlik I., *Inżynieria zarządzania, cz. 1. [Management Engineering, Part 1]*, Placet Publisher, Warsaw 2015.
2. https://www.ciop.pl/ [29.01.2018]
3. Training material, Zarządzanie ryzykiem z wykorzystaniem narzędzia informatycznego e-risk [Risk management using the e-risk software tool], PBSG Publisher, Poznan 2015.
4. Material obtained from the enterprise.
5. *Orange book- Management of Risk*, HM Treasury, 2004.
6. Romanowska- Słomka I., Słomka A. *Ocena ryzyka zawodowego [Commercial risk assessment]*, Ed./ Kraków- Tarnobrzeg 2015. Tarbonus Sp z o.o Publisher.
7. Report: *Rynek poligraficzny i opakowań z nadrukiem w Polsce [The printing and publishing and printed package market in Poland]*. Edition 2016, KPMB Publisher, 2016
8. Skomra R.(ed.), *Metodyka oceny ryzyka na potrzeby systemu zarządzania kryzysowego RP [The methodology of risk assessment for the purpose of the emergency management system of the Republic of Poland]*, BEL Studio, Sp. z o.o. Publisher, Warsaw 2015.
9. Risk Management Standard, FERMA, 2003.
10. Ubowska A., *Charakterystyka zagrożeń i przyczyn wypadków w branży poligraficznej* [*Characterization of hazards and accident causes in the printing and publishing industry*], Bezpieczeństwo Pracy Journal, 4/2015.
11. *Zarządzanie ryzykiem. Zasady i wytyczne [Risk management. Principles and guidelines]. PN-ISO 31000* Polish Standardization Committee, Warsaw, March 2012

EXPLORING THE IMPACT OF IRRIGATION TECHNOLOGIES ON THE YIELD OF HYBRID SUNFLOWER VARIETIES

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***Summary**: A Polish experience with 10 hybrids of sunflower field was made on the Chelopechene Field, Sofia, on cinnamon forest soil. Sunflower hybrids are grown under non-irrigating conditions and under irrigation conditions with drip irrigation and microwaving.*

The meteorological conditions during the study period determined the number of irrigations and the size of the irrigation and irrigation norms of the culture.

It has been found that the yields obtained under irrigation conditions are higher than 13 to 46%, with drip irrigation giving better results than sprinkling.

The Maritsa, San Luka and A58xC23 hybrids have been shown to be suitable for growing in non-irrigated conditions, while the hybrids "Vokil", "Michaela" and "Maritsa" hybrids are irrigated.

***KEY WORDS**: SUNFLOWER, IRRIGATION, YIELD, IRRIGATION REGIME, DRIP IRRIGATION, MICRO IRRIGATION.*

Introduction

The changing conditions in agriculture as a result of the onset of climate change require adaptation of varieties and traditional technologies for growing sunflower with limited resources, including water.

The change in the overall technologies of agricultural production, in accordance with the new conditions and needs of the agricultural crops, also requires the use of water-saving and energy-saving irrigation techniques and technologies appropriate to their type and parameters and adapted to the biological needs of agricultural crops

The good dry resistence of the sunflower allows us to grow in irrigated conditions in our country. Its ability to overcome soil and atmospheric droughts is due to its biological features - high power and plasticity of the root system, xerophilic construction of the leaves and the stem. At the same time, the sunflower is sensitive to moisture, it responds very well to irrigation, and droughts, especially in the critical phases, lead to a drastic reduction in yield and severe deterioration in its quality. Under very unfavorable conditions, even a lack of yields is possible in some years.

Cultivation of crops under non-irrigated conditions is a prerequisite for allowing water stress during most of the vegetation period, which is the reason for the reduction in yield. (Hang, A.N., D.W.Evans, 1985).

Critical in regards to water stress is the period 20 days before and 20 days after flowering (Putnam, D.H., E.S. Oplinger, D.R. Hicks, 2007). Critical phase lunches provide an average of 79% of the optimal yield (but the range of variation is great - from 47 to 98%), (Mehandzhieva, A., R. Lazarov, 1978). According to (Duane, R.B. 2003), a 20% reduction in the irrigation rate during this phase leads to a 50% reduction in yield, with the yields deteriorating sharply. The same reduction in the initial "sprouting - inflorescence" phase yields only a 5% reduction in yield.

Research (Angelova, M., 2003) found that from the emergence to the flowering of the sunflower, 26% of its wateruse is at the expense of autumn-winter reserves in the soil layer. The sum of the monthly precipitation during the autumn-winter, spring and summer periods (August inclusive) has a positive effect on the yields of sunflower. (Stoyanova, Y. et al., 1977). The results of the research in the Plovdiv region (Tachsin, 2006) show that the productivity of a number of modern sunflower hybrids is not different from that established for other regions of the country.

Irrigation has a large reserve to obtain extra yields of the order of 30-40% (Mihov, Iv. 1972.). In the Sofia field, 450-500 kg / dka sunflower seed was obtained by spraying (Kraftti, G.)

The development of new hybrids of sunflower is also a potential for obtaining high yields. Their adaptation to the diversity of soil and climatic conditions of our country and the climate change in the modern climate is insufficiently explored. This calls for field trials to clarify the possibilities for growing these hybrids in different regions of the country and to realize their productive potential under irrigation conditions.

In the implementation of the project "National Program for Improvement of Dry Resistance and Cold Resistance of Important Agricultural Cultures", subproject "Sunflower", on the territory of the experimental field of IMM in Chelopechene, Sofia there were experiments on the impact of water-saving irrigation technologies (drip and microworld) yields of new hybrid varieties of sunflower crops and assessing their drought resistance.

Main objective: To investigate the influence of the main irrigation technologies (drip and micro irrigation) on the growth, development and formation of yields in hybrid varieties of sunflower crops, in the soil and climatic conditions of the Sofia field.

Methodology of research

The researches were carried out in the field of experimentation of the Institute of Meliorations and Mechanization - Chelopechene, Sofia. The determination of sunflower productivity in non-irrigated and irrigated conditions was carried out according to developed and approved methodologies of IMM. The experience was set in three replicates of 12.5 m2 plots. Each iteration covered 2 lines x 25 nests from each hybrid. It is produced with hybrid varieties of cultural sunflower: "San Luca", "Maritza", "Michaela", 217 "s244R," Vokil ", A125xRHSP-1R, 134AxC6, 2607AxC23, A125xC37, A58xC23 under the conditions of the fourth agglomeration group of the irrigation areas, in particular on the Sofia field (Fig.1 and Fig.2).

Agrotechnics

The cultivation of the crop was carried out at a standard agricultural equipment: sowing - 18-21 April; precursor - wheat; sowing scheme: 0,70 m (line spacing) x 0,35 m (distance between the nests inside the row); soil treatments: autumn deep plowing at a depth of 0.25 - 0.28 m, discovery, spring pre-sowing treatments, fertilization with phosphorus and potassium - $P_{10}K_{10}$; feeding with $N_{20.}$ The experience was brought to leavened leptosol. It is characterized by the following water and physical properties: FWD - 20.2% relative to the absolute weight of the soil, volume density at FWD - 1.54 g / cm3 and wetting 10.38% by weight of the absolutely dry soil.

To monitor the dynamics of soil moisture, soil samples were taken and the size of irrigation norms was calculated.

Phenological observations and biometric measurements were performed during vegetation.

Reported parameters: 1) The occurrence of phenological phases - germination, budding, flowering, physiological maturity, technical maturity; 2) Biometric indicators - plant height, diameter of the cake in technical maturity; 3) Yield: seed weight of one plant and weight per 1000 seeds, seed yield per unit area.



Fig. 1. Experimental plot with drip irrigation system.



Fig. 2. Experimental plot with micro irrigation system.

Irrigation

During the sprinkling, pre-irrigation humidity (PIH)in the soil is maintained - 80% of the PIH, and 85% of the PIH in drip irrigation. Irrigation standards are calculated using the following formula:

$$M = 10H\alpha\left(\sigma_T^{ППВ} - \sigma_T^{Пр.вл}\right),$$

Where:

M is irrigation norm [mm]

H - the depth of the active soil layer [m]

α - the bulk density of the soil [g/cm^3]

$\sigma_T^{ППВ}$ - marginal land moisture [% of absolute dry weight of soil]

$\sigma_T^{Пр.вл.}$ - soil humidity at the corresponding pre-irrigation humidity [% of absolute dry weight of soil]

In drip irrigation variants, an irrigation rate reduction ratio is used in accordance with the sowing scheme.

The sprinkling irrigation was realized through seasonal stationary "Water Bird" system with the following parameters: polyethylene pipes Ø20 mm, spray nozzle radius 3.0 m, working pressure 2-2.5 atm, intensity 7.1 mm / h. With a sprinkler arrangement of 3.0 x 3.0 m, the system's flow rate is 0.32 l.

Drip irrigation is accomplished through Aqua Trax seasonal system: 8 mm wall thickness of the seasonal pipeline, 16 mm perforated by 0,20 m, working pressure 0,7-1,0 atm, flow 0,87 l / h . The pressure in the irrigation systems is regulated by a pressure regulator and the amount of water supplied is measured by automatic water meters.

Meteorological conditions for 2009

The management of the irrigation regime in a particular year depends on the dynamics of meteorological factors - rainfall, air temperature and air saturation with water vapor. Their manifestation, coupled with the transpiration features of crops, determines the speed and dynamics of depletion of the productive water supply in the soil. Timely compensation of the water deficit and the satisfaction of the needs of the crops with water is a prerequisite for obtaining the planned yields and profitability of the agricultural production, especially in the current conditions of warming and drought.

The coverage of rainfall for the period April - September (392.9 mm) in the series 1901 - 2009 is 27.2% and characterizes the vegetation period as a moderately humid (Table 1). The rainfall for the April-September vegetation period is 26.4 mm or 7.0% higher than the average for the period 1901-2009. Fallen rainfall during crop vegetation is unevenly distributed, which has led to watering in the critical phases of sunflower development. The July-August period when the flowering and pouring of the grain in the sunflower is wet with a 5.45% yield, favorable to the development of the crop. The precipitation amount for July is 77 mm (Table 1 and Fig. 3), close to the precipitation values for the average long-term for the period 1901-2009, and in August the rainfall is of the order of 128 mm, which are 50 mm more than average. During the buttoning until the flowering, the inflorescence and the number of seeds, the rainfall was insufficient for the development of the crop, which caused the need for irrigation. The April-June period is dry with a guarantee of 82.7%. The May-June period is also dry with a guarantee of 78.8%. The sum of rainfall in June is 47 mm, which is 34 mm less than the average for the same period. In Fig. 4 shows that precipitation during the sunflower growing season is mainly during the first and second ten days of July, as well as during the first and second ten days of August.

Air temperature and water vapor saturation rate influence the rate of lifecycle processes of the plant. Temperature conditions during the 2009 sunflower growing season are unfavorable to the growth and development of sunflower. The temperature sum for the period April-September (3228,2^{o}C) characterizes the year as very warm with a guarantee of 19,2% (Table 2). The July-August period is on average warm with a provision of 37.1% (Table 2). Temperatures during the months from April to September exceeded the average for many years, from 3.9% to 7.2%, with the largest excess being observed for May. Month July is colder with a deviation below the average for the 108-year period a sum of -1.6%.

Table 1. Amounts of rainfall and air temperature by months and deviations from the average for the period 1901-2009.

N	Month	Amounts of rainfall, mm				Sum of average day and night air temperature, ° C			
		2009	Average for the period	Deviation from the average for the period		2009	average for the period	Deviation from the average for the period	
			1901-2009	mm	%		1901-2009	°C	%
1	April	28,5	50,5	- 2,2	- 43,6	326,3	312,5	13,8	4,4
2	May	58,5	76,6	- 18,1	- 23,6	502,5	468,9	33,6	7,2
3	June	47,0	80,8	- 33,8	- 41,8	586,3	555,2	31,1	5,6
4	July	77,1	61,9	15,2	24,5	641,3	652,1	- 10,8	- 1,6
5	August	128,0	49,6	78,4	158,0	655,7	630,9	24,8	3,9
6	September	53,8	47,1	5,9	12,5	516,5	489,6	26,9	5,5
Total	April-September	392,9	366,5	26,4	7,2	3228,6	3109,2	119,4	3,8
	May-September	364,4	316,0	48,4	15,3	2902,3	2796,7	105,5	3,8

Table 2. Provision of meteorological factors for 2009

Periods	Provision of air temperature %	Provision of rain in %
April - September	19,2	27,2
May - September	21,2	19,2
April - June	-	82,7
May - June	-	78,8
June-August	27,2	-
July August	37,1	5,4

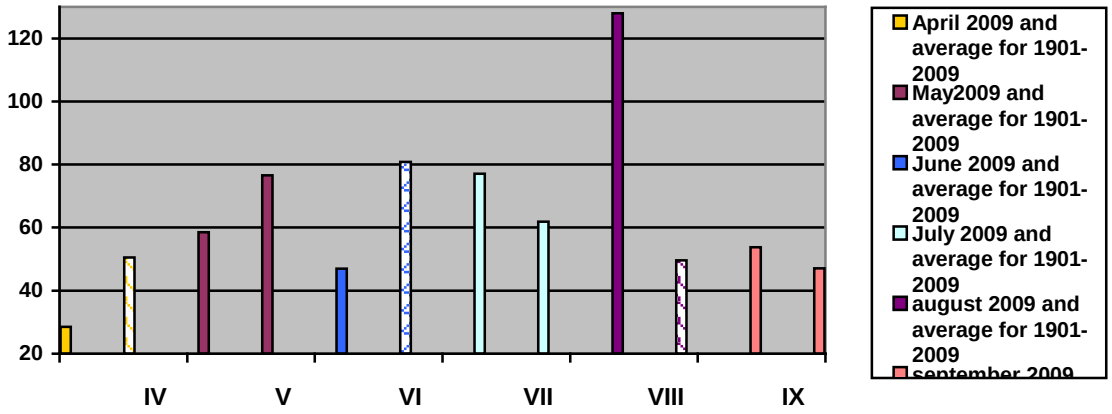


Fig.3 Amount of rainfall by months for 2009 and average for the period 1901-2009
■ - monthly for 2009 г. ▒ - average for period 1901-2009 г.

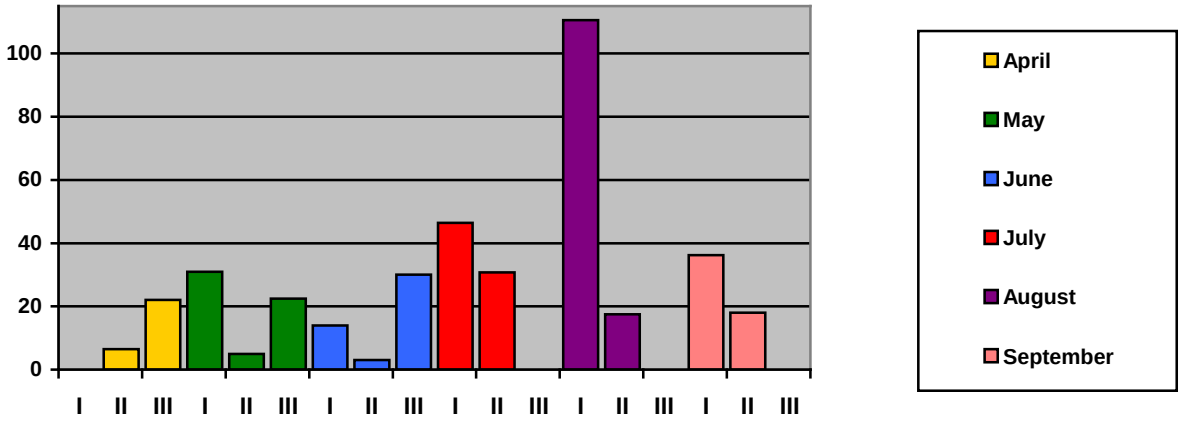


Fig. 4. ainfall for ten days for April-September 2009

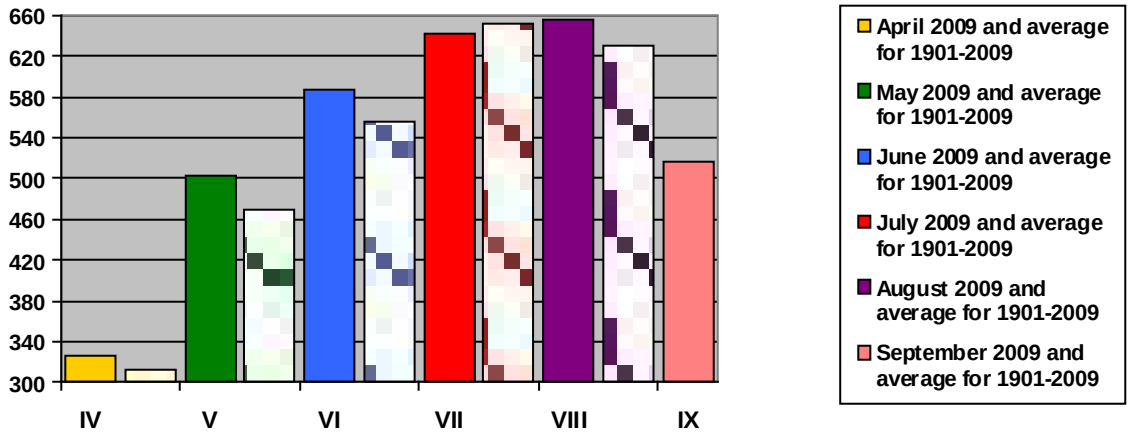


Fig. 5. The sum of the temperature by months for 2009 and on average for the period 1901-2009
■ - monthly for 2009 г. ▒ - average for period 1901-2009 г.

Results and discussion

Phenological development

The sowing of the sunflower in the Chelopechene - Sofia field was done manually on April 16th. The mass sprouting for this region is reported on May 11-13, and the buttoning on June 16-17. The flowering of the plants began on July 1-2, and the mass flowering of all hybrids occurred during the period 6-13 July, first beginning the flowering of the hybrid "San Luke", followed by hybrids "Maritsa", "Michaela", "A58xC23 ". Later, the hybrids "217♀x244R", "2607AxC23" and "A125xC37" bloomed. The harvesting of the hybrids takes place between September 15-16. (Table 3).

Таблица 3. Phenological development

Stage of development	Date of onset	Days from the beginning of the vegetation
Sowing	16 April	0
Sprouting	11 may	26
Budding	17 june	63
Mass bloom	13 july	89
Harvesting	16 september	154

Watering and irrigation regulations

The need for humidity of plants changes during vegetation. The irrigation period for Sofia region for 2009 covers the time from the second ten days of June to the third ten days of July. The amount and timing of the irrigation depends on the quantity and distribution of precipitation during the vegetation period, the water and physical properties of the soil, the needs of the water culture and the dynamics of the weather factors.

Sunflower sprouting begins in the first ten days of May (May 10-11 and by the second ten days of June there was enough moisture from precipitation for the normal development of the crop.) At the end of the first ten days of June due to lack of precipitation the first watering was filed on June 10. During the next phase of "budding", two more irrigations were made during the second and third ten days of June (17-20 June), as the rainfall was insufficient.

Despite the fact that the year is moderately humid, the uneven distribution of precipitation during the growing season is the reason for the decrease of the moisture in the soil through the critical phenophase "mass blooming", the developing of the grain, which gave rise to the necessity of irrigation. During this period, 2 irrigations with an average irrigation rate of 35 mm were used for the drip irrigation in the period (July), and for the micro-irrigation - one irrigation with an average irrigation rate of 40 mm. They were submitted for the period 23-29 July. (Table 4).

Evapotranspiration

In non-irrigating conditions, the size of the evapotranspiration depends on the meteorological complex and on the natural water

supply of the sunflower, and in irrigation conditions - soil humidity, rainfalls and irrigation rate.
The natural moisture evapotranspiration (non-irrigation) in the hybrids is 232 mm (Table 4), which is formed only by rainfall - 100%.

Evapotranspiration values for drip irrigation and micro irrigation are about 407 and 402 mm respectively. The rainfall is 57%, and the irrigation rate provides 43% of the evapotranspiration.

Table 4.

Sunflower irrigation regimen 2009

Irrigation technology	Pre-irrigation humidity	Actual irrigations				aturation rate, mm
		Total number	Next irrigation	Date	Irrigation rate, mm	
Sprinkle irrigation	80% from PIH	4	I	June 10th	40,0	170
			II	June 18th	50,0	
			III	June 31	40,0	
			IV	July 23rd	40,0	
Drip irrigation	85% from PIH	5	I	June 10th	35,0	175
			II	June 18th	35,0	
			III	June 31	35,0	
			IV	July 23rd	35,0	
			V	Jul 29th	35,0	

Table 5.

Evapotranspiration and forming elements - sunflower – 2009

Options	ET mm	rainfall		Irrigation rate	
		mm	%	mm	%
1. Non-irrigated	232	232	100	-	-
2. Drip irrigation	407	232	57	175	43
3. Sprinkle irrigation	402	232	57,7	170	42,3

Yields from hybrids of sunflower under non-irrigated conditions

The formation of yields from sunflower hybrids grown under non-irrigated conditions is the result of natural soil moisture. The data from Table 6 and Figure 6 show that in 2009 for the soil-meteorological conditions of the Sofia field the highest yields were from the hybrids: Maritsa -213 kg / dka, followed by the San Luca hybrids -190 kg / dka, A58xC23-187 kg / dka. The yields of the A125xC37-106 kg / dka and 134AxC6-109 kg / dka hybrids are low, indicating that they are demanding for soil moisture (Table 6). of the studied hybrids - biometric measurements and seed characteristics**.**

Table 6.

Crops non-irrigated sunflower 2009 г.

Hybrids	Yields kg/dka	Relative yields %
1. San Luke	190	89
2. Maritsa	213	100
3. Michaela	162	76
4. 217♀x244R	115	53
5. Vokil	134	63
6. A125xRHSP-1R	174	75
7. 134AxC6	109	51
8. 2607AxC23	171	80
9. A125xC37	106	50
10. A58xC23	187	88

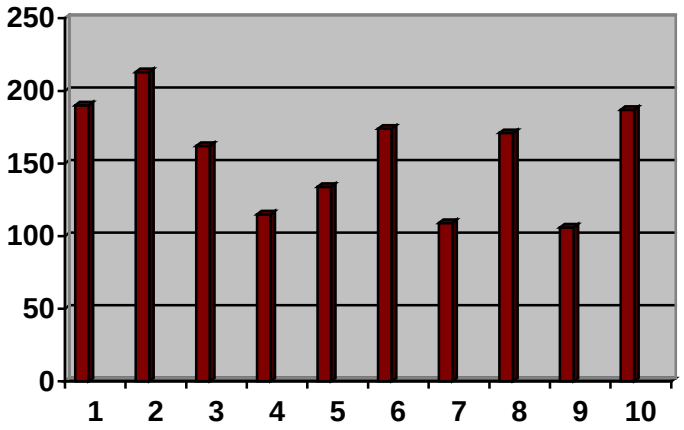


Fig. 6. Sunflower yields in kg / dka on average humid year without irrigation: 1 - "San Luca", 2 - "Maritsa"; 3 - "Michaela", 4 - 217 of which are 244R, 5 - Vokil, 6 - A125xRHSP - 1R, 7 - 134AxC6, 8 - 2607AxC23, 9 - A125xC37, 10 - A58xC23.

Table 7. Results of biometric measurements and characterization of sunflower seeds in irrigated and non- irrigated conditions

Hybrids	non- irrigated		Drip	Drip	Sprinkle	Sprinkle
	Diameter of the cake, cm	weight of 1000 seeds, g	Diameter of the cake, cm	weight of 1000 seeds, g	Diameter of the cake, cm	weight of 1000 seeds, g
1. San Luke	17	50,3	18	60,7	20	61,0
2. Maritsa	18	59,8	16	66,7	18	67,3
3. Michaela	17	47,8	17	56,8	20	60,1
4. 217♀h244R	15	62,8	18	81,9	18	81,4
5. Vokil	15	54,8	19	64,8	18	49,1
6. A125xRHSP-1R	15	62,6	15	76,6	17	70,7
7. 134AxC6	15	41,2	18	63,1	16	48,1
2607AxC23	17	50,7	20	55,8	18	53,0
9. A125xC37	16	48,4	20	59,1	16	52,1
10. A58xC23	16	68,5	18	57,1	19	56,2
Average	16	55	18	64,3	16,1	60

The data show that the diameter of the cake in the irrigation variants varies from 15 to 20 mm. The largest sizes are the cakes in the hybrid varieties - Vocil, A125xC37, 2607AxC23, drip irrigated, and Snt. Luke and Mihaela- with spraying.

The weight of 1000 seeds also grows in irrigated hybrids, with the heaviest grains being 55.8 to 81.9 g drier, and 52.1 to 81.4 g when sprinkled. The heaviest are the seeds of the variety 217 and XX24R in both irrigation techniques (Table 7).

On average, of the ten tested hybrid sunflower varieties, irrigation increased the weight of 1000 seeds by 15% (drip) and by 9% (sprinkling) to non-injected hybrids, with the highest increase in the "217♀x244R"-24% two irrigation techniques. The mass of 1000 seeds in non-irrigated sunflower is on average 55.0g, ranging from individual hybrids from 41.2 to 68.6g

Yields hybrids of sunflower under irrigation conditions.

The plants' needs for moisture during the growing season are determined by both the hybrid characteristics and the weather factors. With the irrigation being fed through the critical phases of sunflower development, the need for readily available moisture is satisfied. Watering with both types of irrigation systems have been implemented in the phase of buttoning and mass flowering. The highest yields under irrigation conditions were obtained with the Maritsa hybrids - 254 kg / dka (drip irrigation) and A58xC23 - 248 kg / dka (table 8 and table 9), (Fig.7 and Fig. 8). The results show that they respond well to irrigation the hybrids: 2607AxC23 - (251kg / dka), "Vokil" - (246kg / dka) - dripping and microdilution hybrids - 2607AxC23 - (235kg / dka) - (232 kg / dka), "San Luca" - (227 kg / dka).

The increase in yields is from 13 to 46%, with the highest increase in yield due to irrigation at 46% (drip) and 38% (micro irrigation) hybrids, followed by the 134AxC6 hybrid 40% (tab 10) and (Figure 9).

In microbonds, the hybrids were best suited to irrigation: "Vocall" - 38%, "217♀x244R"- 29%. Less irrespective of irrigation Maritsa hybrid with 9-17% increase of yield in both irrigation and San Luke with 13-16%. This shows that in the soil-climate conditions of the Sofia field, these hybrids can be grown without irrigation.

When comparing the two irrigation techniques, a larger increase in yields due to the irrigation applied is obtained by drip irrigation.

Table 8. Yields - drip irrigation- sunflower 2009

		According to type. 1
Hybrids	Yield kg/dka	Average yield, %
1. San Luke	216	84
2. Maritsa	256	100
3. Michaela	233	91
4. 217♀h244R	172	67
5. Vokil	246	96
6. A125xRHSP-1R	234	91
7. 134AxC6	181	70
2607AxC23	251	98
9. A125xC37	144	56
10. A58xC23	234	91

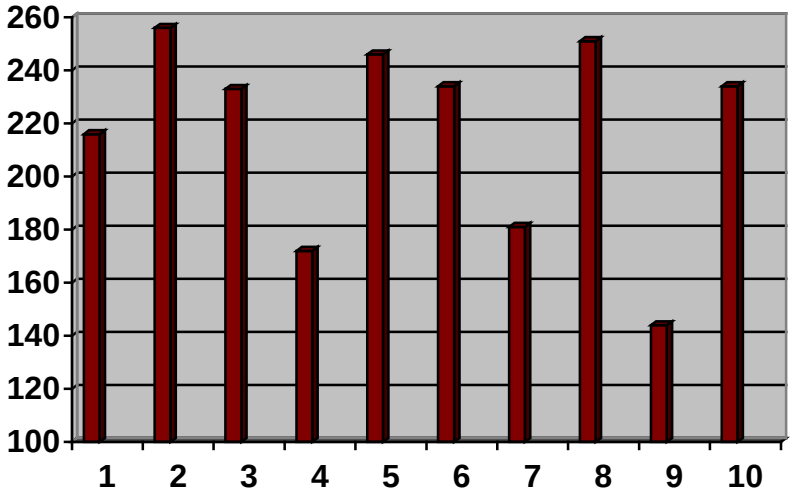


Fig. 7. Sunflower yields in kg / dka in medium humid year and drip irrigation: 1 - "San Luca", 2 - "Maritsa"; 3 - "Michaela", 4 - 217♀x244R, 5 -" Vocil ", 6 - A125xRHSP - 1R, 7 - 134AxC6, 8 - 2607AxC23, 9 - A125xC37, 10 - A58xC23.

Table 9. Yields – Sprinkle irrigation- sunflower 2009.

		According to type 1
Hybrids	Yield kg/dka	Average yield %
1. San Luke	227	97
2. Maritsa	234	100
3. Michaela	232	99
4. 217♀h244R	160	68
5. Vokil	213	91
6. A125xRHSP-1R	198	85
7. 134AxC6	145	62
2607AxC23	235	100
9. A125xC37	124	53
10. A58xC23	248	106

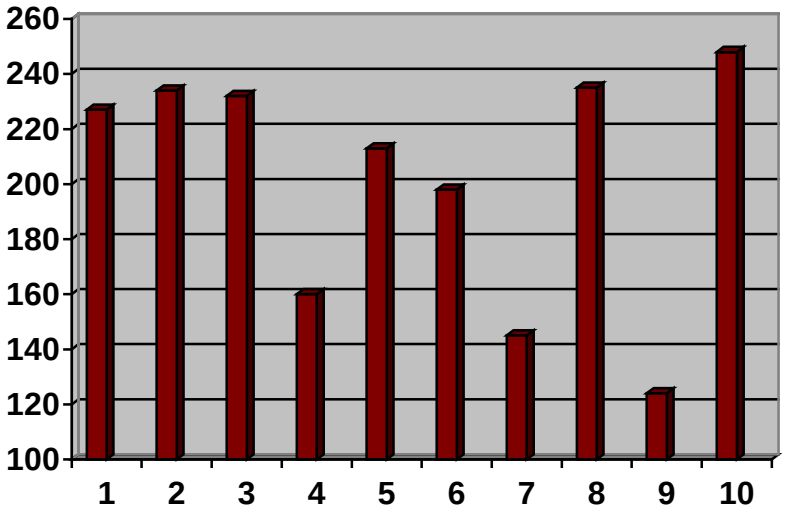


Fig. 8. Sunflower extracts in kg / dka in average humid year and sprinkle irrigation: 1 - "San Luca", 2 - "Maritsa"; 3 - "Michaela", 4 217♀h244R, 5 - Vokil, 6 - A125xRHSP - 1R, 7 - 134AxC6, 8 - 2607AxC23, 9 - A125xC37, 10 - A58xC23.

Table 10. Sunflower yields at different ways of irrigation – 2009

Hybrid	Yield in kg / dka at standard humidity 11%				
	Non irrigation	Drip irrigation	Growth against the non-irrigated type %	Sprinkle irrigation	Growth against the non-irrigated type %
1. San Luke	190	216	13	227	16
2. Maritsa	213	256	17	234	9
3. Michaela	162	233	31	232	31
4. 217yyy244R	115	172	34	160	29
5. Vokil	134	246	46	213	38
6. A125xRHSP-1R	174	234	36	198	13
7. 134AxC6	109	181	40	145	25
2607AxC23	171	251	32	235	28
9. A125xC37	106	144	27	124	15
10. A58xC23	187	234	21	248	25

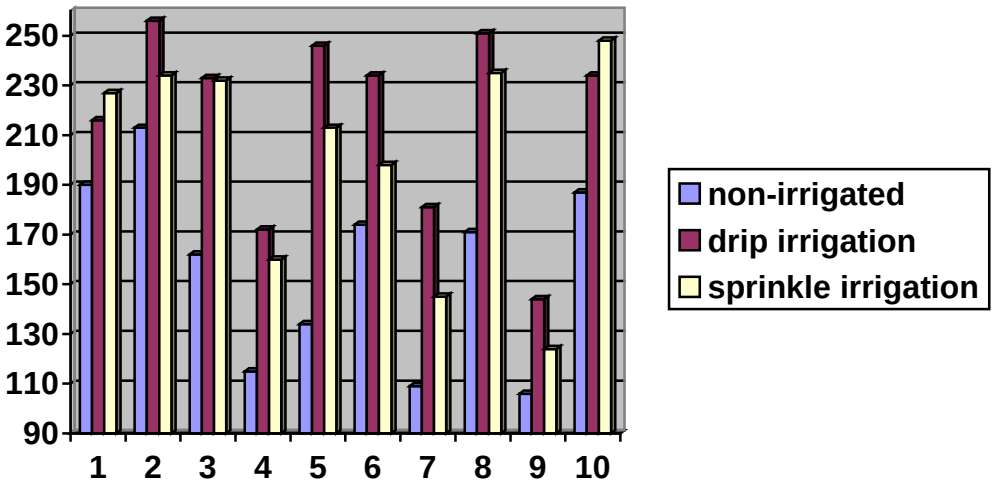


Fig. 9. Sunflower yields in kg / dka in average wet year: 1 - "San Luke", 2 - "Maritsa"; 3 - "Michaela", 4 - 217? X 244R, 5 - Vokil, 6 - A125xRHSP - 1R, 7 - 134AxC6, 8 - 2607AxC23, 9 - A125xC37, 10 - A58xC23.

Conclusion

1. When growing sunflower under irrigation conditions, the yield increases from 13 to 46%. The largest is in the Vokil Hybrid - 46% (drip irrigation) and 38% (micro irrigation).
2. The highest irrigation yields are obtained from the Maritsa hybrid - 254-234 kg / dka and A58xC23 - 251-235 kg / dka. The 248 kg / dka, "Michaela" (232 kg / dka) and the A58xC23 - (248 kg / dka) also respond well to irrigation, with an increase in irrigation yields of 25 to 46 percent.
3. The highest natural moisture yield (non-irrigating conditions) were obtained from the Maritsa hybrids -213 kg / dka, followed by the San Luca hybrids -190 kg / dka and the lowest in the hybrids A125xC37 -106 kg / dka and 134AxC6 -109 kg / dka, indicating that in their critical phase – flowering, these hybrids are sensitive to soil moisture.
4. The smallest increase of the yield in both irrigation methods was reported for the Maritsa, San Luka hybrids. The increase is from 9 to 17%, indicating that in the Sofia region these hybrids are suitable for growing without irrigation.
5. A meteorological feature of the year of study was developed, which justified the implemented irrigation regime of the crops.

References:

1.Ангелова, М., 2003. Влияние на някои агрометеорологични условия върху добива от слънчоглед, отглеждан на карбонатен чернозем в Северозападна България, Екология и Бъдеще, год. II, № 3, 57-59)

2.Крафти, Г., Л. Ценова, Ст. Цонев. 1972. Оптимален и нарушен режим на напояване на слънчогледа, Доклади от Научна сесия на Института по пшеницата и слънчогледа, Добрич

3.Механджиева, А., Р. Лазаров, С. Угърчински. 1978. Степенуване на селскостопанските култури при недостатъчна вода за напояване. В помощ на техническия прогрес във водното стопанство, № 2, 22-31

4.Михов, Ив. 1972. Поливен режим на слънчоглед при условията на Югоизточна България, Дисертация, 193 с.

5.Стоянова, Й. и др., 1977. Слънчогледът в България, БАН, София, 37-38

6.Тахсин, Н., Б. Янков, 2006; Сравнително изпитване на хибриди слънчоглед при почвено-климатичните условия на Пловдивски регион; Изследвания върху полските

7.Putnam, D.H., E.S. Oplinger, D.R. Hicks, B.R. Durgan, D.M. Noetzel, R.A. Meronuck, J.D. Doll, and E.E. Schulte. 2007. Sunflower.

8.Hang,A.N,D.W.Evans,1985. Dfiat Srinkler irrigation of Sunflowerand Safilower-Agron.J,77 (588-592)

IRRIGATION WATER PRODUCTIVITY FOR RASPBERRIES GROWN IN DRIP IRRIGATION CONDITIONS

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***Abstract**: To determine the irrigation water productivity for raspberries during their cultivation in the soil-meteorological conditions of the area of the village of Chelopechene - Sofia, studies have been carried out with drip irrigation of a plantation with the variety "Lyulin". Various regimes have been studied - from full satisfaction of the daily needs of the culture to water, to irrigation with 20% and 40% reduction in irrigation regulations.*

The meteorological conditions during the study period determined the number of irrigations and the size of the irrigation and irrigation norms of the culture.

On average, over the survey period, the highest yields were obtained with the watered with 100% irrigation norm option. The increase in yields resulting from the irrigation is about three times the non-irrigated option in surface drip irrigation.

The highest irrigation water productivity of 4.3 kg of raspberries per cubic meter of water is obtained in variants irrigated with a 40% reduced irrigation rate.

***KEY WORDS:** IRRIGATION, YIELD, IRRIGATION SCHEDULING, DRIP IRRIGATION, IRRIGATION WATER PRODUCTIVITY, RASPBERRIES*

Introduction

Reducing the water supplies as a result of climate change and a steady rise in the cost of irrigation water raises the question of its rational and sparing use. This implies the use of water-saving technologies, techniques and irrigation regimes for agricultural crops.

The studies carried out 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 author, 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, D. K. L., 1982). Growth and fruit bearing can be regulated through the so-called irrigation with regulated deficit of drip irrigation(RDI). In this case, 100% irrigation rate is reduced by observing moderate levels of water stress in plants (Goodwin and Boland, 2002).

Growing of crops in areas with unsustainable natural humidity implies optimization of the parameters of the irrigation regime by growing crops in the conditions of regulated water deficit. Research carried out in this field shows that the desired end result is the maximum saving of irrigated water with minimal yield losses (Goranov, Hr., G. Kraftti, 1982), (Zhivkov, G., A. Matev 2004 .), (Kireva R., J. Zhivkov, 2003) (Kireva, R., V. Petrova, 2016).

Applying a proper irrigation regime to drip irrigation of raspberries and establishing yields and loss of production at reduced irrigation rates are a real basis for increasing irrigation water productivity.

The aim of the study is to establish the irrigation water productivity in raspberry drip irrigation and production losses in reducing the irrigation rates.

Material and method

In order to establish the effect of irrigation,watering and irrigation norms, losses of production from barred water, and its productivity in the experimental field of the Pushkarov Institute in Chelopechene, Sofia, a multi-year Polish experiment with raspberries in drip irrigation conditions, was carried out. The soil is leptosol, slightly sandy loam in the plowing layer. It is 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. Suitable for growing raspberry plantations.

The following irrigation options have been researched:

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

The irrigation rate is calculated using the formula of Frecman and Garzoli. (Frecman and Garzoli, 1980). To monitor the dynamics of soil moisture soil samples were taken in option 1 (100% i.r.) at a depth of 0-60 cm over 10 cm, which were processed by the weight-thermostatic method. Irrigation is carried out with a droplet installation type Drospach.

Results

Meteorological conditions of the experiments

The productivity of each agricultural crop depends on a set of factors, the main ones being: the type of crop, the variety characteristics, the applied agro-technology, the number of irrigations, the way in which water was deposited and, last but not least, the meteorological conditions.

Available data over a multi-year period indicate that the temperature sums during the vegetation of the main crops are relatively stable, i.e. they are not a limiting factor for their normal growth and development. That is not the case with precipitation/ rainfall. In terms of quantity and distribution, they vary significantly not only by months and ten days but also by years.

The unstableness of this meteorological factor predetermines irrigation as a major event of the agro-technical complex, with a significant contribution to obtaining high and sustainable yields from cultivated crops.

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

Periods	Total rainfall, mm					Rainfall factor security, %				
Years	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	-	-	-		

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 1), three of the years - 2001, 2002 and 2005 are humid, one - 2003 - average and one - 2004 - very dry. Summer droughts lasting more than ten days are observed during all years of the surveyed period.

The sum of precipitation in 2001, which is characterized as averagely humid in April - September, is almost the same as the average multi-year series - 358 mm, and in July - August it is 75 mm (Table 1). In the dry 2004, rainfall for the April to September period is 258 mm, which is 30% lower than the average for the period. In July and August the rainfall was 73 mm, almost the same as in the averagely humid year (2001). This rainfall was insufficient for the development of raspberries, which also predetermined a larger number of irrigations. In the series of annual rainfall sums, 2002 is characterized as very humid, with a provision of 15.3%. This is due to the falling unusual rainfall in July, August and September. The most humid year with 1.4% coverage of the rainfall factor during both subperiods is 2005, which is characterized by extremely high rainfall for the period April - September 765 mm, which are 1.7 to 5.7 times higher than the average for the 104-year series.

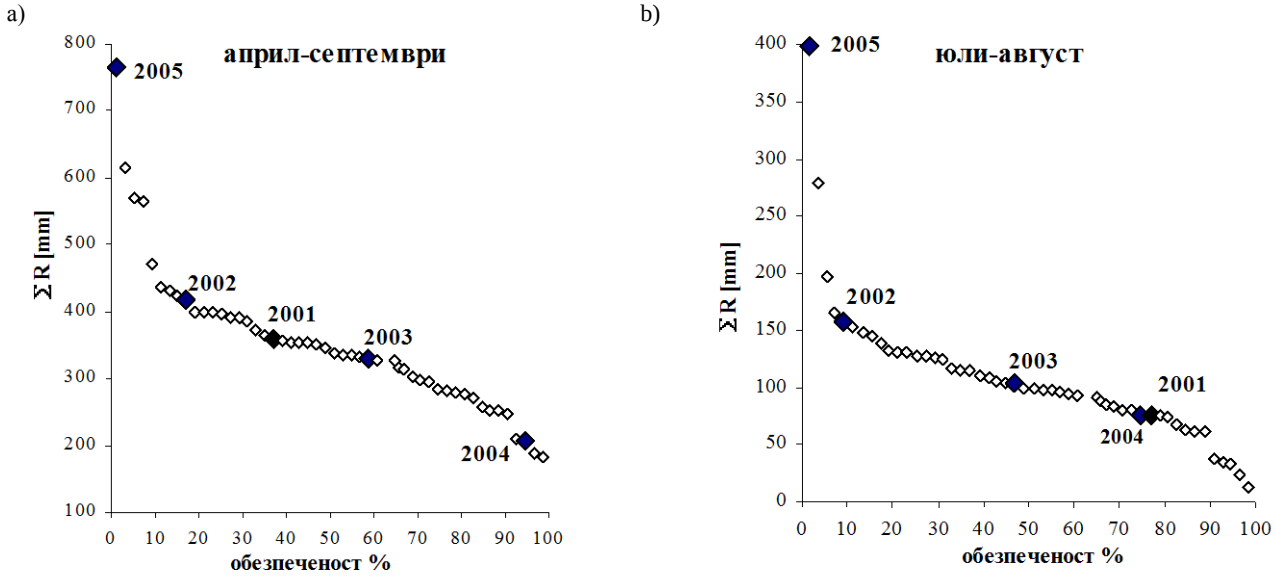


Fig. 1 *Coverage curves for the fifty-year series (1956-2005) for the periods: (a) April to September; b) July-August.*

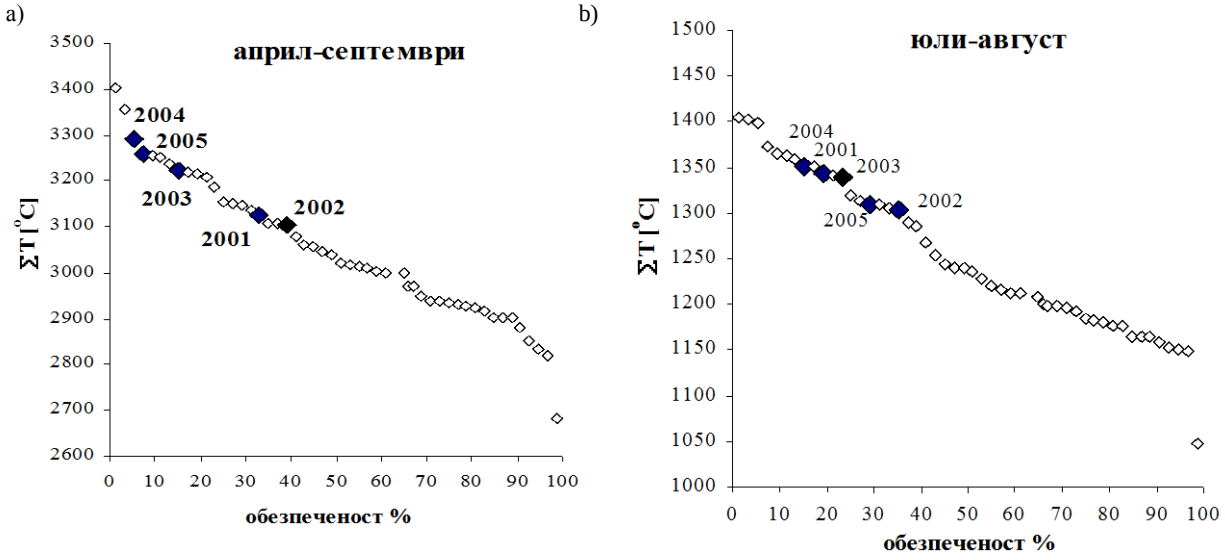


Fig. 2*. Coverage of the temperature sums for the fifty-year series (1956-2005) for the periods: a) April-September; b) July-August.*

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).

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 lounges are realized with a soil moisture drop in the layer 0-60 cm below 85% of the WHC. The results show that in individual years, the number of irrigations varies from 8 to 22, and the irrigation rate from 1440 to 4000 m3 / ha. On average, during the vegetative period of the rape, 16 irrigations with an average irrigation rate of 180 m3 / ha and an irrigation rate of 2880 m3 / ha were submitted, with the

highest number of irrigation being carried out during the dry year 2004, at least during the wet 2005 -8 pieces.

In accordance with the concrete manifestation of meteorological factors, the basic quantity and distribution of rainfall in the first three years for the optimization of the water factor have been realized from 15 to 18 irrigations and in the dry 22 units. For variants with a 20% and 40% reduction in irrigation, the watering rate during the years of research is from 928 to 3159 m3 / h (Table 2). The optimization of the factor water, leads to an increase of the yields in each year by more than two times compared to the non-irrigated option, which is indicative of the fastidiousness of the culture to the soil moisture (Table 1). The resulting yields in the realized irrigations predict a good productivity of the supplied water. The results obtained by years and the average for the survey period, indicate that the different irrigation regimes of raspberries affect the irrigation water productivity. On average, over the period of the survey, the highest irrigation water productivity was 4.3 kg of raspberries per cubic meter of water, was obtained for variants irrigated with a 40% reduction in irrigation norm with the highest irrigation water productivity for the tested variants was obtained in the humid year 2004 - 9 kg of raspberries for one cubic meter of water, the lowest is the productivity of the water supplied in the variant, irrigated with 100% irrigation norm. The results show that lowering the water supply of the plants reduces the irrigation water productivity.

The amount of loss of raspberry production from not provided water in individual years is predetermined by the specific occurrence of meteorological factors and the size of the deficit. Production losses, both by years and on average over the study period, are reduced from 5-12% in the 20% reduction of irrigation options and reach 21% with a 40% reduction in the irrigation rate. The results obtained, show that the reduction in raspberry yield is not adequate for the reduction of the irrigation rate. It is found that reducing the irrigation rate due to limited water supply leads to a corresponding reduction of the maximum possible yield, but not proportionally. In all cases, the reduction in yield is less than the decrease in the irrigation rate (Table 3). On average, during the study period, the reduction of the irrigation rate by 20% resulted in a 5% decrease in the yield of raspberries, while in the case of a 40% reduction in the irrigation rate, the yield decreased by 21%. The data show that with an increase of the irrigation rate, the yield is increasing, which shows that fort the raspberries yields are produced with significant amounts of water, and the nature of the meteorological conditions has also a big impact.

Table 1 *Yield of raspberries using drip-irrigation*

Years	2001		2002		2003		2004		2005		Average	
Variant	Yield kg/ha	Relative yield %	Yield kg/ha	Relative yield %	Yield kg/ha	Relative yield %	Yield kg/ha	Relative yield %	Yield kg/ha	Relative yield %	Yield kg/ha	Relative yield %
Non irrigation	2480	100	4240	100	3500	100	3310	100	6720	100	4050	100
100%M	8710	351	8220	194	9550	272	10000	302	9910	147	9278	229
80%M	7690	306	7940	187	8850	252	9360	283	9140	136	8600	212
60%M	6890	277	7880	186	7980	228	7940	239	8280	120	7790	192

Table 2 *irrigation water productivity for raspberry per years*

Years	2001		2002		2003		2004		2005		Average	
Variant	Irrigation rate m^3/ha	Water producti-vity,, kg/ m^3	Irrigation rate m^3/ha	Water producti-vity,, kg/ m^3	Irrigation rate m^3/ha	Water produ cti-vity, kg/ m^3	Irrigation rate m^3/ha	Water produ ctivity , kg/ m^3	Irrigation rate m^3/ha	Water produ c-tivity, kg/ m^3	Irrigation rate m^3/ha	Water producti-vity, kg/ m^3
100%M	3060	2,8	2640	3,0	3294	2,8	3960	2,5	1440	6,8	2880	3,2
80%M	2448	3,14	2115	3,75	2628	3,4	3168	3,0	1152	7,9	2303	3,7
60%M	1972	3,5	1695	4,64	2106	3,8	2552	3,2	928	9,0	1830	4,3

Table 3 *Yields at optimal irrigation and water deficit*

Years	2001		2002		2003		2004		2005		Average	
Variant	Yield kg/ha	%	Yield kg/ha	%	Yield kg/ha	%	Yield kg/ha	%	Yield kg/ha	%	Yield kg/ha	%
100%M	8710	100	8220	100	9550	100	10000	100	9910	100	9290	100
80%	7690	88,0	7940	95	8850	92	9360	93	9140	92	8600	92
60%	6890	79,0	7880	95	7980	83	7940	79	8280	83	7790	84

Conclusions

1. Drip irrigation of raspberries during the growing season leads to an increase in yields on average over the study period of 40 to 57%.

2. Growing raspberries under conditions of irrigation water shortages by reducing irrigation rates does not lead to a proportional reduction in yields. As the water deficit rises from 20% to 40%, the yields decrease from 5 to 21% compared to the yields obtained at 100% of the irrigation rate

3. It has been established that, when reducing the irrigation norms, the irrigation water productivity increases to 9.0 kg of raspberries per cubic meter of water in the variant with a 40% reduction in the irrigation rate.

Resources:

1.Горанов, Хр., Г. Крафти.1982. Възможности за намаляване на напоителните норми при оптимален и нарушенполивен режим на соя и царевица в Северна България. В помощ на техническия прогрес във водното стопанство, No 1, 35-36

2.Живков, Ж., А. Матев.2004. Отглеждане на соя в условията на дефицит на вода за напояване. Field Crops Studies,т. 1, кн. 3, 470-477

2. **Kireva, R., V. Petrova, 2016,** Irrigation scheduling and irrigation water productivity of vegetable crops, cultivated under drip irrigation, Soil Science Agrochemisty and Ecology, 50, 3-4/2016, p 30-3

4.**Кирева,** Р., **В. Петрова**, 2014. Поливен режим и продуктивност на водата за напояване на малини при капково напояване, Сборник доклади от Научна конференция с международно участие стр. 275-283. *ISBN 978-954-332-114-8.*

5.Кирева Р., Ж. Живков.,2003 Продуктивност на водата за напояване на основни зеленчукови култури, отглеждани чрез капкуване, Сборник научни доклади на ЛТУ. Международна научна конференция, 50 години Лесотехнически Университет, 2003 г., София, стр. 150-151.

6.Goodwin, I.and D.MBoland,2002-Sheduling deicit irrigation of fruit trees for optimizing water use efficienc,FAO Tehnical Papers,Water Reports22:67-78

7.Kuiesza, W., 1973, Zeszyty naukowe, Academi rolniczo – technicznei wolsztynie, Rolnisctwo – Olsztyn. (4)

8.Mackenrron, D. K.L., 1982 Journal Hoticultural Science, 57 (3)

ANALYSIS AND EVALUATION OF THE EU ACTION PLAN TO ENHANCE PREPAREDNESS AGAINST CHEMICAL, BIOLOGICAL, RADIOLOGICAL AND NUCLEAR SECURITY RISK AND THE NATIONAL PROGRAM FOR ITS IMPLEMENTATION

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Summary: *The present report considers the EU Action Plan to enhance preparedness against chemical, biological, radiological and nuclear security (CBRN) risk, adopted in 2009 by the EU Council. The Action Plan's overall goal is to reduce the threat of, and damage from, CBRN incidents of accidental or intentional origin, including terrorist acts. The Plan provides possibilities for the EU member states to implement the listed standards by including them into the national legislation. The National Program developed subsequently in Bulgaria for the implementation of the EU CBRN Action Plan is also analyzed. The strengths and weaknesses of the document are revised as well as the progress of its implementation.*

Key words: CBRN MATERIALS, PLAN, TERRORISM, STANDARD, NATIONAL PROGRAM

Introduction

In the recent years, the risks and threats of the possible use of chemical, biological, radioactive and nuclear (CBRN) materials from terrorist groups have been defined at European Union (EU) and at national level. Trends in the development of CBRN terrorism are considered as a potential threat to the critical infrastructure objects and the population as a whole. In this regard, coordinated actions have been undertaken, resulting in measures to prevent and detect such incidents.

In 2009 the Council of Europe has adopted the EU CBRN Action Plan on Strengthening Chemical, Biological, Radiological and Nuclear Security in the European Union [1]. The purpose of the Plan is reducing the threat of, or the damage from CBRN incidents, occurring accidentally or by intentional actions, including terrorist attacks.

Generally, in the event of a CBRN threat, the responsibility for the reaction lies primarily on the respective EU member state. Historically, at EU level, the first actions related to the identification of measures to counteract CBRN threats were undertaken in 2001; later a Program to improve cooperation in the European Union for preventing and limiting the consequences of chemical, biological, radiological or nuclear Terrorist Threats [2] was adopted in 2002. The latter was incorporated into the EU Strategy against Proliferation of Weapons of Mass Destruction (EU WMD Strategy) [3], adopted in 2003, updated and revised in 2008 when the "New lines for action by the European Union in combating the proliferation of weapons of mass destruction and their delivery systems" were adopted, and it was also incorporated into the EU Counter-Terrorism Strategy (2005) [4], as well.

The EU CBRN Action Plan

In 2008 a CBRN Task Force was set up, to work on the EU policy on CBRN materials. As a result of its activities, in January 2009 the basis for the EU CBRN Action Plan (adopted later in the summer of that year) was developed. The main objective of European policy in this field is to minimize threats and damage to the population in CBRN incidents through: physical protection and security of the relevant facilities developed on the basis of the risk assessment; effective protection of the CBRN materials; improving information exchange between member states; development of detection systems in the EU and providing tools needed to manage CBRN incidents.

The Action plan concentrates on the following three main areas:

• *Prevention*, where the main focus should be on the development of risk assessment procedures to prioritize the high-risk CBRN materials. The next focus is on the security and control of these materials and related facilities. Follow-up actions are directed towards developing a high security culture for staff, enhancing the identification of suspicious transactions and behavior related to high-risk CBRN materials, improving the transport security, information exchange, import and export regimes, and strengthening cooperation on the security of nuclear materials.

• *Detection* – availability of capacity for detection is a necessary complement to the prevention, and on the other hand it is crucial to ensure an adequate response to CBRN incidents. In this regard, the plan subsequently provides for the detection system to be established within the territory of each of the member states as well as at the EU external borders. At EU level, standards for detection as well as standards for testing and certification should be developed and the exchange of good practices for CBRN detection should be improved.

• *Preparedness and response* - the measures consist in the ability to effectively respond to CBRN-related incidents and to recover after such incidents as quickly as possible. Further action has been identified to reinforce the existing measures, in particular with regard to malicious CBRN incidents. Special attention has to

be paid to planning of CBRN emergencies, increasing the responsiveness, strengthening the information flows and improving the crime investigation capacity.

These three areas of work are supported by a number of horizontal measures that are applicable to the entire CBRN activity. The horizontal actions focus on international cooperation, public communication, training, staff reliability assessment, research and estimation on the need and possibilities for criminalization of the CBRN-threatening activities.

Implementation of the EU CBRN Action Plan is intended to be applied by existing structures, both at European Commission level and at national level in each member state.

In 2012 a review of the implementation of the CBRN plan has been carried out at EU level and the strong and weak points in the implementation of the measures have been identified in a specifal progress report. For the period 2010-2015 there have been some significant successes at EU level, including the development of the CBRN-E Glossary provided to member states, opening of an EU Learning Center in Karlsruhe, Germany, and the European Nuclear Security Training Center (EUSECTRA).

Implementation of the EU CBRN Action Plan in the Republic of Bulgaria

An inter-department working group was established in Bulgaria to implement the measures set out in the Plan, which foresees participation of representatives from the departments with competences in the field of CBRN materials. On the basis of the EU-developed plan, an consent was achieved on the adoption of a National Program for its implementation. The latter reflects the responsibilities of each department for implementing the measures at national level as well as the deadlines for their implementation, respectively vertically and horizontally.

With the adoption of the National Program, inter-department working sub-groups were set up, and priority was given to the fields of activity - chemical, biological and radioactive/nuclear materials respectively. The Ministry of the Interior had the leading role in the implementation of the planned measures. For the implementation of concrete measures of the Plan responsibilities were assigned to a number of departments according to their competencies.

At the time of implementation of the measures set at the national level a number of problems were determined concerning the effective implementation of the National Program for Implementation of the CBRN Action Plan of the EU [5]. The following issues have been identified:

- The large volume of actions embedded in the EU CBRN Action Plan (124 actions) implies the commitment of serious human resources to their implementation and the coordination of joint work by several institutions in one measure. The latter further complicates and hinders the effective implementation of the Plan. Problems exist in the exchange of information resulting from the presence of co-ordinating procedures requiring coordination of each action of inter-department group participants with different hierarchical levels in the respective departments, which further slows the implementation of tasks and hinders their timely implementation.

- Holding of meetings of the inter-department working sub-groups was not possible due to the permanent replacement of the participants. The reason for this were structural reforms implemented in the respective departments, which concern the sectors of activity with competence in the problems; leaving/replacing employees; long-term/short-term missions in the country and abroad of the participants in the working groups, etc., which leads to lack of continuity and consequently inability to fulfill the commitments under the National Program.

- At EU level, the implementation of the Plan was carried out in accordance with the deadlines set by the CBRN Advisery Group, while at a national level the information flow was fragmented, incomplete and at one stage completely discontinued, due to the fact that different representatives from different agencies were involved at the CBRN meetings at EU level without respecting the principle of continuity. Separate departments undertook their responsibilities implementation, others abdicated because of insufficient time and human resources. As a result the implementation of the measures was taken sporadically, inconsistently and in the incomplete volume of the actions.

- During the period of action of the Plan, it was found that the exchange of information on a CBRN incident of any kind occurring in the territory of the country is difficult, and in some cases totally absent, resulting in ineffective, untimely and inadequate response to competent authorities in the performance of their duties in terms of competence. It has been identified that the Ministry of Defense of the Republic of Bulgaria also has competence in responding to CBRN incidents but its participation in the implementation of measures of the plan was not foreseen.

- Last but not least is the fact that the measures set in the CBRN Action Plan are of recommending rather than binding nature.

A successful approach for improving the implementation of measures outlined in the EU documents at national level is development of projects within the member states. For Bulgaria, a significant contribution in this field was realization of the EU granted project ”Development of tools needed to coordinate inter-sectoral power and transport CIP activities at a situation of multilateral terrorist threat. Increase of the capacity of key CIP objects in Bulgaria” - HOME/2010/CIP/AG/019. The project was implemented in the period 2011-2013 by the Institute of Metal Science, Equipment and Technologies “Acad. Angel Balevski” – BAS (leading organization), Directorate “Fire safety and protection of the population” at the Ministry of Interior, Military Academy “G.S.Rakovski” and the University of Russe. As a result of the joint activities, complex measures for protection of critical infrastructure facilities in Bulgaria from multi-variant terrorist threats, including CBRN materials threats, were elaborated. These results were presented in a comprehensive final report and popularized in [6-12] as well as in a number of other publications.

Conclusions

1. The effectiveness in the area of EU CBRN policy would be higher if the focus on implementing concrete measures was avoided but instead the strategic approach to the problem was emphasized.
2. It is necessary to consider the possibility taking specific measures in the CBRN field to be bound by specific obligations which are to be fulfilled by the member states.
3. It is essential to respect the principle of continuity in the member states, which is a coherent policy pursued by each institution, both in terms of participation according to its competencies and the fulfillment of the commitments.
4. There is insufficient exchange of information on CBRN incidents both at the country and at EU level. This is also the problem of coordinating actions to implement horizontal and vertical actions. As a result, a part of the measures concerning the involvement of different departments, as well as representatives of the private sector, are partially implemented.
5. It is advisable to consider engaging the Ministry of Defense at both national and EU level, given the capabilities available to the military.
6. Protecting the population from terrorism must remain a top priority for the EU and each of the member states. In this regard, international and national efforts to combat CBRN terrorism should be aligned with the new challenges and united in their overcoming. In October 2017 the EU adopted a new Action Plan to improve preparedness against chemical, biological, radiological and nuclear safety risks. An adequate and responsible approach by the member states to the problem will contribute to the commitments fulfillment.

References

[1] EU CBRN Action plan 15505/1/09.

[2] Program for Improving EU Interaction for the Prevention and Reduction of the Consequences of Chemical, Biological, Radioactive or Nuclear Terrorist Threats

[3] EU Strategy against Proliferation of Weapons of Mass Destruction

[4] EU Counter-Terrorism Strategy

[5] National Program for Implementation of the EU CBRN Action Plan

[6] Stoychev K. Integrated model for security and protection of critical infrastructure objects. Proceedings of Third Nat. Conf. with Int. Part. "Metal Science, Hydro- and Aerodynamics, National Security '2013", Sofia, October 2013, ISSN 1313-8303, pp. 309-323.

[7] Dimitrov D. A methodology for modelling the critical infrastructure: Measures for protection of the critical infrastructure. Proceedings of Third Nat. Conf. with Int. Part. "Metal Science, Hydro- and Aerodynamics, National Security '2013", Sofia, October 2013, ISSN 1313-8303, pp. 288-293.

[8] Stoichev K., D. Bratanov, S. Burdjiev, D. Dimitrov, V. Panevski, A. Tumbarska, G. Damianov, Improving and enhance the tools needed to coordinate inter-sectoral actions to protect critical infrastructure in a situation of complex terrorist threats (CISCOT), Proceedings of IVth Nat. Conf. with Int. Part. "Metal Science, Hydro- and Aerodynamics, National Security '2014", Sofia, October 2014, ISSN 1313-8303, pp. 356-359.

[9] Nikolova V. Protective clothing and equipment used at anti-terrorist operation at airports. Collection of the results of the implementation of the tasks under project HOME/2010/CIPS/AG/019. Sofia, 2012, pp. 51-56.

[10] Nikolova V. Use of individual equipment in risk sub-objects of "Kozloduy" NPP. Collection of the results of the implementation of the tasks under project HOME/2010/CIPS/AG/019. Sofia, 2012, pp. 57-62.

[11] Nikolova V. Protective clothing and equipment used in gas fields accidents. Collection of the results of the implementation of the tasks under project HOME/2010/CIPS/AG/019. Sofia, 2012, pp. 45-50.

[12] Stoychev K., A. Popov, N. Lichkov. Technologies and systems for fight against terrorism. Textbook. Sofia, 2012, 270 p

THE INTERNATIONAL LAW AND THE AMBIGUITIES CONCERNING CHEMICAL NON-LETHAL WEAPONS

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Abstract: *The present-day geopolitical landscape and the nature of modern conflicts, in which opponents are often mixed with the civilian population, impose significant limitations on the use of force. Minimizing the number of victims in armed conflicts is fundamental principle of both International law (IL) and the Non-lethal weapons (NLWs) concept. The IL, however, still seems insufficiently adapted in respect to NLWs, creating paradoxes in which use of conventional weapons, causing massive death and damage, prove to be preferable to non-lethal force. This paper examines the unresolved issues in the relationships between IL and the chemical non-lethal agents.*

Keywords: NON-LETHAL WEAPONS (NLWs), RIOT CONTROL AGENTS (RCAs), INTERNATIONAL LAW

Introduction

According to literary data, while by 1950 civilians accounted for about 50% of the victims of military operations, by 1980 this value has risen to about 80%. "This alarming trend has continued in the 1990s, with increasing numbers of refugees, immigrants, and noncombatants caught in the crossfire of civil and ethnic strife and battles involving states, rogue states, failed nation-states, and terrorists". [1] The current operations, although for the most part represent so-called "operations other than war" could pose an even greater risk of causing incidental casualties and destruction, as they are mainly carried out in densely populated areas where combatants are usually mixed with civilian population. Civil wars in many parts of the world are much cruel than international conflicts, taking about 80% of the victims of armed conflicts around the world. A study of the International Committee of the Red Cross (ICRC) in 2001 "reveals, in essence, that modern wars have become conflicts without limits. Civilians have - both intentionally and by accident - been moved to center stage in the theater of war, which was once fought primarily on battlefields. This fundamental shift in the character of war is illustrated by a stark statistic: in World War I, nine soldiers were killed for every civilian life lost. In today's wars, it is estimated that ten civilians die for every soldier or fighter killed in battle". [2] Although some authors question the credibility of such data, they recognize that "it seems more than fair to conclude that since the turn of the twentieth century, civilian deaths have outnumbered military deaths in nearly all wars". [3]

As for combatants, unlike civilians, they are considered legitimate military targets - nations at war are allowed to kill each other´s combatants without legal consequence. "While for many centuries no humanitarian thought was given to military casualties on the enemy´s side, this is changing. Capture when possible as opposed to kill is becoming the norm, at least among Western nations with democratic and liberal value systems". [4]

The first international agreement imposing warfare restrictions is the St. Petersburg Declaration of 1868. Although refers to a specific weapon (explosive projectiles weighing less than 400 g), it sets the basis for IHL's approach to the methods and means of warfare, namely that the needs of war must be in accordance with the laws of humanity. These principles underline the further efforts for regulating the weapon technology and the manner in that armed conflicts are conducted. The efforts are focused on two directions: imposing prohibitions and restrictions on the use of certain weapon technologies and adopting common principles and rules on all methods and means of warfare.

The non-lethal weapons (NLWs) are defined as "weapons, devices, and munitions that are explicitly designed and primarily employed to incapacitate targeted personnel or materiel immediately, while minimizing fatalities, permanent injury to personnel, and undesired damage to property in the target area or environment. Non-lethal weapons are intended to have reversible effects on personnel and materiel". [5]

Non-lethal weapons development and use is influenced by several factors. The most frequently mentioned factor is the changing nature of military operations in the post-Cold War world. Contemporary low-intensity conflicts and interventions such as peacekeeping and peace enforcement operations, as well as controlling and neutralizing insurgency, ethnic violence, terrorism, drug trafficking and domestic crime, demand application of minimum force capable to effectively deter the perpetrators without reaching the threshold of violence. Incessant presence of the media at every hot spot around the world contributes to rise of the public disgust and intolerance to the violence of conflicts. Political and military leaders, responsible for such situations, can't afford the negative impact which would result by the widespread video records showing civilian casualties and suffering.

NLWs and new methods of force application can significantly change the way of conducting wars and crisis resolving. Many believe that NLWs offer a real alternative to either doing nothing or killing people. "The reasons for use of force will not abate. Alternatives to bombs, missiles, tanks and artillery must therefore be found. NLWs are not a panacea but do offer the best hope of minimizing casualties while allowing nations or alliances the means to use force in protection of national or regional interests". [6]

Although non-lethal weapons reflect the purpose of the International law to make armed conflicts more humane through minimizing the civilian casualties and incidental damage, the IL is one of the main factors limiting the NLWs development and use.

A brief review of International law regulating weapons and armed conflicts

The public IL is a broad set of treaties, customary law, principles and norms, traditionally regulating relationships between states. Obligations to the international community are governed by a combination of treaties and customary law. Treaties are written conventions in which states formally establish certain rules. Customary international law is not written but derives from general practice accepted as law and exists independent of treaty law. "Customary international humanitarian law (IHL) is of crucial importance in today's armed conflicts because it fills gaps left by treaty law in both international and non-international conflicts and so strengthens the protection offered to victims". [7] A study of the ICRC in 2005 found that recently "the principles and rules contained in treaty law have received widespread acceptance in practice and have greatly influenced the formation of customary international law. Many of these principles and rules are now part of customary international law. As such, they are binding on all States regardless of ratification of treaties". [8] One of the positive effects of this fact would be the limiting the opportunities of powerful

states to control content of the law of war by refusing to ratify international treaties or to give their consent to development of relevant norms for preventing the use of some technologies.

International humanitarian law (IHL), also known as Laws of war or Law of armed conflict (LOAC), is the legal framework applicable to situation of armed conflict and occupation. It aims, for humanitarian reasons, to limit the effects of armed conflicts, through a set of principles and rules. The fundamental principles of IHL are: 1) the protection of persons who are not, or are no longer, participating in hostilities; 2) the right of parties to an armed conflict to choose methods and means of warfare is not unlimited. Basically, the IHL represents a balance between military necessity and humanitarian considerations in the conflict. The military necessity is the justification of the measures necessary to achieve a military objective, provided that such measures are in accordance with the IHL. Humanity, as the cornerstone of the IHL, is an imperative to relieve suffering and save lives, and to the humane and respectful attitude of each individual during the conflict. Balancing humanity and military necessity is expressed by the founding rules of the IHL on discrimination (the parties in armed conflict must always distinguish between civilians and fighters, and between civilian objects and military targets) and proportionality (the balance to be struck between the achievement of a military goal and the cost in terms of lives). The additional principles of the IHL are: obligation to take precautions to spare civilian population before and during the attack; prohibition of indiscriminate attacks; prohibition on causing unnecessary injury and excessive suffering.

The International law related to chemical NLWs

With regard to non-lethal weapons development and use, the International law imposes significant constrains: first – directly, through regimes for control of conventional, biological and chemical weapons, and second – indirectly, through the law of war.

The following international treaties affect the chemical non-lethal agents: 1) The Protocol for the Prohibition of the Use in War of Asphyxiating, Poisonous or other Gases, and of Bacteriological Methods of Warfare of 1925; 2) Convention on the Prohibition of the Development, Production and Stockpiling of Bacteriological and Toxin Weapons and on Their Destruction (BTWC), 1972; 3) Convention on the Prohibition of the Development, Production, Stockpiling and Use of Chemical Weapons and on their Destruction (Chemical Weapons Convention, CWC), 1992. The LOAC is codified in the Hague Conventions, the Geneva Conventions on the protection of war victims of 1949 and the Additional protocols, resolutions of the UN General Assembly and other documents. The following documents are related to NLWs: 1) Protocol No 1 (1949) in addition to the Geneva Conventions, concerning the methods and means of warfare; 2) Protocol No 2 (1977) in addition to the Geneva Conventions, concerning the protection of victims of non-international conflicts. These legal regimes, however "often have difficulty keeping up with the pace of technology and sometimes restrict the use of potentially more humanitarian weapons systems. One such example is the development of non-lethal weapons". [9]

Concerning NLWs, two points should be mentioned. First, the standards of IHL apply to all weapons, even to those which have not yet been subjected to a special regime from the conventions, including weapons in development, i.e. nor the intent behind their creation, nor the label "non-lethal" creates some relief in their consideration under the rules of IL. [10] Second, while the potential military applications of NLWs are mainly determined by international agreements, the potential use of non-lethal weapons by the police is largely governed by domestic law of the states.

The relationship between International law and non-lethal weapons is rather complicated. On the one hand, the existing IL seriously affects the NLWs limiting the development and potential use of some NLWs, mainly through the regimes for control of conventional, biological and chemical weapons, "while remaining silent use of other types of NLW, other than general provisions applicable to all weaponry used in armed conflicts" [11]. At the same time, "the depth of the crisis with ethical and international legal controls on armed conflict makes the development of "non-lethal" weapon technology appealing because the concept of "non-lethal" weapons restores some hope to the fundamental value of regulating armed conflict". [11] However, the literary sources show that the IL does not provide adequate clarity regarding NLWs, causing debates related to various interpretations of some texts. On the other hand, the NLWs (especially new technologies) pose serious challenge to the IL. It seems that the speed of new technologies development outstrips the efforts of IL to regulate them. "Treaties and other legal instruments are still not largely adapted to the unprecedented pressures and modern weapon capabilities". [12] While the debate on the impact of these new weapons on existing armaments control treaties and IHL has intensified [13], no new international agreements have been introduced in recent years with regard to NLWs.

Designed to regulate the lethal and destructive weapons used in interstate conflicts in the 20th century, the IL constraints now do not reflect the completely changed nature of the conflict. "In a world where characteristics of adversaries are constantly changing and the difference between peace and war becomes increasingly blurred through low intensity asymmetrical conflict and terrorism, countries often enter a grey zone in which not even the highest international bodies, such as the UN Security Council, are sure of which legal framework applies". [4] "Quickly the gap between the reality of armed conflict and the laws of war widened to an embarrassing and depressing abyss. In addition, the development of international humanitarian law produced some strange conclusions: certain bullets were outlawed but nuclear weapons were not". [10]

In general, the IL still seems insufficiently adapted in respect to NLWs: some NLWs are banned although more human than others; the legal status of some NLWs (both new and used for decades) under certain conditions remains unclear, as a result of lack of regulations or unclear wording in the existing regulations. This can lead to absurd situations in which use of conventional weapons, causing massive death and destruction, prove to be preferable to non-lethal force.

The ambiguities concerning non-lethal weapons

The most significant and frequently discussed paradox in the international regulations is related to the riot control agents (RCAs)[1]: the use of RCAs is permitted in peacetime against civilians, but is prohibited in armed conflicts (both against combatants and civilians).

"In other words, chemical riot control agents are lethal enough to fall under the Chemical Weapons Convention of 1993, but in domestic affairs during times of peace, when human rights law is the applicable legal regime, these same riot control agents are accepted as a riot suppressant against often innocent civilians". [4]

This legal and moral paradox affects both fighters and civilians. The enemy combatants can be killed, but not even temporarily disabled. "As Donald Rumsfeld [U.S. Defense Secretary] once complained "in many instances, our forces are allowed to shoot somebody and kill them, but they're not allowed to use a nonlethal riot-control agent"". [14] As far as civilians are concerned, "It would, of course, be a tragic irony if nations used lethal means against noncombatants because non-lethal means were banned by an international convention". [15]

[1] Riot control agents (RCAs) are non-lethal substances which rapidly produce sensory irritation or disabling physical effects. Most commonly used are tear gas (most widespread at present is 2-chlorobenzalmalononitrile, known as CS) and pepper spray (oleoresin capsicum, known as OC, or its synthetic analogue) delivered by various spray devices, grenades, frangible projectiles, etc. The effect of CS usually disappears within 15 min and of OC within 2 h following termination of exposure. The RCAs has been successfully used over the world by police and other forces maintaining the law and order during the last 5-6 decades.

The author of [4] proposes three explanations of this paradox: 1) the "slippery slope" argument: the introduction of chemical RCAs on the battlefield could result in easy use of more dangerous chemicals on the battlefield, namely chemical weapons; 2) the sanctity of national sovereignty and the lack of regulation in the human rights law paradigm; 3) the main and initial purpose of RCAs is controlling the civilian population during times of riot, while their purpose during armed conflict focuses on controlling actions of enemy combatants and granting protection to the civilian population. "Logically, an agent to be used against the civilian population is in strong contradiction to the very essence of the International Humanitarian Law regime". [4]

The restrictions on chemical NLWs came mostly from the Chemical Weapons Convention (CWC) of 1992. Each State Party to CWC "undertakes never under any circumstances: (a) To develop, produce, otherwise acquire, stockpile or retain chemical weapons, or transfer, directly or indirectly, chemical weapons to anyone; (b) To use chemical weapons; (c) To engage in any military preparations to use chemical weapons; (d) To assist, encourage or induce, in any way, anyone to engage in any activity prohibited to a State Party under this Convention". The CWC defines chemical weapons as "toxic chemicals and their precursors, except where intended for purposes not prohibited under this Convention, as long as the types and quantities are consistent with such purposes". CWC defines those purposes not prohibited under the Convention as peaceful research, protective purposes, military purposes "not connected with the use of chemical weapons" and "law enforcement including domestic riot control purposes". The toxic chemicals are defined as "any chemical which through its chemical action on life processes can cause death, temporary incapacitation, or permanent harm to humans or animals". Under CWC a RCA is "any chemical not listed in a Schedule, which can produce rapidly in humans sensory irritation or disabling physical effects which disappear within a short time following termination of exposure". Parties to the CWC also agree to not use RCAs "as a method of warfare". [16]

The CWC leaves many ambiguities on a number of important questions. According to the experts, the main confusions came from the lack of definitions for the "method of warfare" and "law enforcement". Since a borderline between warfare and law enforcement has not been drawn, there are intensive international debates whether "law enforcement" extends beyond the borders of a country and whether the CWC prohibits the use of RCAs in situations such as counterinsurgency operations, peacekeeping and humanitarian assistance. It is generally accepted that CWC permits the use of RCAs by military forces for law enforcement purposes during non-traditional military operations sanctioned by IL, however some experts bring legal and policy arguments supporting that UN forces should refrain from using them.

An interesting fact is that although the most states-party agree that the use of RCA in international and noninternational armed conflict is prohibited, the USA national policy permits the use of RCAs "in defensive military modes to save lives". [17]

The long-term use of RCA has proven their effectiveness in dispersing crowds and controlling their behavior. RCAs have many advantages, compared to other means used for law enforcement purposes, owing to their immediate and short-duration effect with very low probability of causing permanent damages and death. „In some instances, being able to use RCA in a theatre of war may be both more humane and more effective than the use of other weapons". [9] However, the prohibition of the use of RCAs in times of armed conflict poses significant tactical and practical obstacles in creating a more humane environment on the battlefield. "In the War on Terror, and in other asymmetrical wars of our time, the distinction between combatants, civilians, and civilians taking direct participation in hostilities, becomes increasingly difficult. The line of appropriate use of chemical riot control agents is becoming thinner and thinner. Through the civilian disguise of many combatants in contemporary conflicts, civilians are often used as involuntary human shields and become victim of collateral damage. By re-entering riot control agents into the modern battlefield, this collateral damage can be minimized leaving the perpetrator temporarily incapacitated and allowing for a timely removal of the perpetrator by armed forces from the battlefield without putting civilians in harm´s way". [4]

A number of experts believe that the International law is outdated and argue that it is necessary certain restrictions to be revised in a way to allow for wider development and employment of NLWs, including RCAs, in the contemporary conflicts context. Others insist on maintaining the status quo with the argument that abating restrictions on RCA will probably lead to development and use of advanced lethal chemicals rather than to improving the non-lethal capabilities. Another concern is that amendments in the International law may lead to further restrictions to NLWs: "to press for an amendment to the CWC or even to assert a right to use RCAs as a method of warfare risks impairing the legitimacy of all NLW". [18] There are also views that RCAs should be prohibited in both times of armed conflict and times of peace - such position reveals "lack an understanding of the benefits and necessity of riot control agents as a tool of protecting public order". [4]

Another ambiguity is connected with the means of delivery of RCAs. While development of RCA munitions for use in armed conflict is prohibited, the CWC parties may manufacture, acquire and utilise delivery systems to distribute appropriate types and quantities of RCAs for law enforcement. However, the CWC does not specify the types of prohibited RCA delivery means. "This ambiguity has potentially dangerous consequences, allowing divergent interpretations, policy and practice amongst States Parties to emerge". [19] Such consequences could be: employment in armed conflict; potential use in chemical weapons programs; proliferation to and misuse by a range of non-state actors; employment of inherently inappropriate munitions in law enforcement; misuse to facilitate large scale human rights abuses by state or non-state actors. [19] A wide range of munitions and systems for delivery of RCAs at extended distances and/or over wide areas are developed or are in the process of development over the world. While the hand-held delivery systems comply with the CWC requirements, the large-calibre artillery munitions, cluster munitions, rocket propelled grenades and other means currently at the market do not seem to be designed for law enforcement purposes. Variety of remotely controlled delivery means is also available including "indoor fixed installation RCA dispersion devices; external area clearing or area denial devices; automatic grenade launchers; multiple munition launchers; delivery mechanisms on unmanned ground and aerial vehicles". [20] The report [20] concludes that it is critical for the international community to determine constraints upon these devices under IL and regional human rights law to guard against misuse. "If left unregulated the continuing research and development activities in this area could eventually lead to the production, proliferation and use of fully autonomous weapons systems".

Malodorants (malicious substances) are another group of chemical NLWs which status under the IL is subject to debates. According to some experts malodorants are not considered toxic chemicals under the CWC since they not cause death, temporary incapacitation or permanent injuries. Many believe that malodorants can be classified as riot control agents: "The definition of RCAs appears to include malodorants as odorants that affect behavior and act as sensory irritants, similar to other RCAs". [21] However, some malodorants which imitate toxin chemical agents and the natural malodorants which are derived from biological entities, should be considered under the BTWC. "Malodorants composed strictly of synthetic chemicals would be defined as RCA and the CWC bans the use of such agents during a war. However they may still be used by the military in operations other than war such as when responding to incidents of civil unrest". [22] Malodorants have also been developed for use by police in crowd control.

A part of legal debates are connected to chemical agents against materials (intended for changing fuels and lubricants properties, corroding materials, structures embrittlement, etc). Some conclude that all of them (lethal or non-lethal) are totally out of the scope of

the CWC because they are not intended to be used against humans or animals. This, however, seems to be an incorrect reading of the CWC. An anti-material chemical weapon is covered by CWC if toxic chemicals used to erode a material or worse its properties can result in death, temporary incapacitation or permanent damage. According to [11] the effect of a chemical weapon is important, not the intent of using it. The correct reading of the CWC does not completely prohibit the use of anti-materiel chemical weapons as they could be used in very specific situations (e.g. secret actions of special forces) where toxic chemicals affecting materials do not affect humans or animals. “What is important is that the CWC drastically narrows the potential tactical and strategic sphere of action of non-lethal anti-material chemical weapons”. [10]

Another largely discussed group of chemical substances are so called “incapacitating agents” (ICAs) or “calmatives”. Unlike RCAs which act peripherally on the eyes, mucous membranes and skin, causing sensory irritant effects that disappear for a short time, the ICAs are intended to cause more prolonged effect, acting on the central nervous system. Many of these substances have a narrow safety range (marge between the effective and the fatal “dose”). “When considered as a complete weapon system in an operational context, uncontrollable variables such as the size, health, age, etc., of the target population, secondary injury, and requirement for medical aftercare, introduce further challenges to the development of a safe incapacitating chemical agent”. [23] ICAs are not defined by the CWC, but are considered to be toxic chemicals and should be regulated accordingly. While it is clear that their use in armed conflict is absolutely prohibited under the CWC, there are different interpretations concerning the law enforcement. “The CWC does not explicitly allow ICAs to be used in law enforcement (it does not even mention ICAs), but the most logical reading of the Convention is that it also does not explicitly prohibit such use”. [24] Although the CWC and some other areas of IL do not offer unambiguous interpretations on the use of ICAs, the Convention on Psychotropic Substances of 1971 requires that the manufacture, export, import, distribution, trade, storage, use and possession of controlled medicines should be limited to "medical and scientific purposes". “This legal framework leaves little room, if any, for the legitimate use of toxic chemicals as weapons for law enforcement other than the use of riot control agents, as defined in the CWC”. [25]

CONCLUSION

Non-lethal weapons offer a real perspective of making armed conflicts more human through minimizing destruction, fatalities and unnecessary injuries both of combatants and civilians. Although the same objective is the foundation of International law, the IL is one of the main factors limiting the NLWs development and use.

The IL still seems insufficiently adapted in respect to NLWs. Some indistinct formulations lead to contradictory interpretations and give rise to doubts about the legitimacy of NLWs use under certain conditions, thus generating paradoxes in which use of conventional weapons causing massive death and damage prove to be preferable despite the availability of NLWs fully suited to achieving the intended military objectives.

Amendments to CWC are needed to better clarify the use of chemical NLWs through defining the terms “method of warfare” and “law enforcement”. CWC also should define positively what chemicals can be used as RCAs instead of negative definition “any chemical not listed in a Schedule” in order to prevent the use of dangerous chemicals under the category “RCAs”. To achieve its ultimate objective, the IL should allow for wider development and use of NLWs, focusing not on technology but on the methods by which weapons could be used.

References

[1] Coppernoll, Margaret-Anne. The Nonlethal Weapons Debate. Military Press, Spring 1999.

[2] Greenberg, S. and R. Boorstin. People On War: Civilians in the line of fire. International Committee of the Red Cross. Public Perspective, Nov./Dec. 2001, p. 18-21.

[3] Epps, V. Civilian Casualties in Modern Warfare: The Death of the Collateral Damage Rule. Georgia Journal of International and Comparative Law, 2013, pp 307-355.

[4] Knoechelmann K. The Legal Paradox of International Chemical Riot Control Regulations, The Legal Paradox of International Chemical Riot Control Regulations, 2012.

[5] Non-Lethal Weapons Program. US Dept. of Defense.

[6] Alexander, J.B. An overview of the future of non-lethal weapons. J. Medicine, Conflict and Survival, Vol. 17, Issue 3, 2001, pp 180-193.

[7] Customary international humanitarian law. International Committee of the Red Cross, October 2010.

[8] Henckaerts, J.-M. Study on customary international humanitarian law: A contribution to the understanding and respect for the rule of law in armed conflict. Cust. Law, vol. 87, 2005.

[9] Castan B. The Chemical Weapons Convention and Riot Control Agents: Advantages of a “Methods” Approach to Arms Control. Duke Journal of Comparative & International Law, Vol 22:267, 2012, pp 267-290.

[10] Fidler, David. The International Legal Implications of “Non-Lethal” Weapons, Indiana University Maurer School of Law, 1999,

[11] Coleman, S. Possible Ethical Problems with Military Use of Non-Lethal Weapons. Case Western Reserve Journal of International Law. Vol.47, Issue 1, 2015.

[12] Koplow, D. Tangled up in Khaki and Blue: Lethal and Non-Lethal Weapons in Recent Confrontations, Georgetown University Law Center, USA, 2005.

[13] The Future of Non-lethal Weapons: Technologies, Operations, Ethics and Law. Editor Nick Lewer, Routledge, UK, September 2017, 200 p.

[14] Allhoff F. The Paradox of Nonlethal Weapons. Future Tense, Michigan, USA, November 2012.

[15] Non-Lethal Technologies: Military Options and Implications. Report of an Independent Task Force. Council on Foreign Relations, USA, 1995.

[16] Convention on the Prohibition of the Development, Production, Stockpiling and Use of Chemical Weapons and on Their Destruction. Geneva, 3 September 1992.

[17] Executive Order 11850--Renunciation of certain uses in war of chemical herbicides and riot control agents of Apr. 8, 1975.

[18] Nonlethal Weapons and Capabilities. Report of an Independent Task Force Sponsored by the Council on Foreign Relations, 2004.

[19] Crowley M. Drawing the line: Regulation of “wide area” riot control agent delivery mechanisms under the Chemical Weapons Convention, Bradford Non-lethal Weapons Project & Omega Foundation, 2013.

[20] Crowley M. Tear Gassing By Remote Control; The development and promotion of remotely operated means of delivering or dispersing riot control agents, Bradford Non-lethal Weapons Project & Omega Research Foundation, UK, December 2015.

[21] Sutherland R.G. Chemical and Biochemical Non-lethal Weapons: Political and Technical Aspects, SIPRI Policy Paper, No 23, Stockholm International Peace Research Institute, 2008.

[22] Ellison H. Handbook of Chemical and Biological Warfare Agents, CRC Press, USA, 2008, 762 p.

[23] Royal Society, Brain Waves Module 3: Neuroscience, conflict and security, The Royal Society, London, 2012, ISBN: 978-0-85403-938-8.

[24] Chemical weapons and law enforcement under international law. ILPI Weapons of Mass Destruction Project. International Law and Policy Institute, December 2016.

[25] ICRC position on the use of toxic chemicals as weapons for law enforcement. 06-02-2013 Statement.

БЕЗОПАСНОСТЬ ЭКОНОМИЧЕСКОЙ СИСТЕМЫ КИТАЯ – САМООРГАНИЗАЦИЯ И ГАРМОНИЗАЦИЯ

SAFETY OF ECONOMIC SYSTEM OF CHINA - SELF-ORGANIZATION AND HARMONIZATION

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Abstract: *The main issues are considered in this topic: the security of China's economic from the point of view of self-organization and harmonization and based on the methodological harmonization author analyzed the economy as a system. In the end, we concluded that self-organization is a possible direction for the development of complex economic systems, which is based on the unity of the processes of self-organization and disorganization, complexity and diversity, etc.*

KEYWORDS*: ECONOMIC GROWTH, SELF-ORGANIZATION AND HARMONIZATION, ECONOMIC SECURITY, SYSTEM DEVELOPMENT.*

1. Введение

Миром нашим управляет множество не сугубо сложных законов, под влиянием которых он находится в таком предельном состоянии – вечно неравновесном, от одного состояния превращается в другое, от хаоса в порядок. Причем если привлекаем внимание к эволюции Вселенной, то обязательно обнаружим, что процесс ее эволюции дискретный, она развивается в непродолжительной форме. Каждый эволюционный, эпохальный порыв с разрушительным характером разбивает старое, ранее существовавшее состояние, в результате чего сама Вселенная превращается в другую, с новым состоянием. Начало – Большой взрыв, хаос, беспорядок, мир представился совершенно в ином виде, тем не менее он продолжал существовать, и более того в наше время усиливается тенденция глобализации. Объясняется это только одним – сила самоорганизации и гармонизации.

С точки зрения Гегеля – мир есть гармония гармонии и дисгармонии. И несомненно, что вплоть до нашей эпохи в природе, в самой Вселенной, как в одной такой общей системе господствует процесс такого рода, что все ее элементы взаимодействуют друг на друга, без всякого внешнего толчка, исходя из этого постоянно формируются новая организация и организация с новым состоянием, упорядоченным и гармоничным. Сама же система становится от беспорядочной самоорганизованной, подвержена влиянию попарно различных, противоположно направленных стремлений и сил.

В основе любой системы лежит единство процессов самоорганизации и дезорганизации, сложности и разнообразия. Поэтому весьма актуальной темой является изучением данного процесса в экономической системе любой страны, в том числе и Китая.

2. Предпосылки и средства для решения проблемы

Содержание понятия «самоорганизация» требуется уточнить – под ней понимается способность сложной системы трансформировать свои характеристики без внешних воздействий, под влиянием целевых установок и внутреннего потенциала системы. Система считается самоорганизующейся, если она без целенаправленного воздействия извне обретает новую структуру. Процесс самоорганизации начинается с нестабильного и неустойчивого состояния системы, которое служит основой (базисным состоянием) эволюции.

Самоорганизация не создает новые объекты, она создает новые состояния объектов, ответственна за увеличение сложности структур и за увеличение простоты. Ибо сложное, обладая тем преимуществом, что имеет больше степени свободы. Однако оно, в сравнении с более простым и более подвержено деформациям, и более уязвимо со стороны внешних возмущений, поскольку имеется больше каналов воздействия на него чем на простое. Самоусложнение и самоупрощение является собой в форме две стороны одной метали, что обеспечивает авторегуляцию устойчивости и надежности системы. Под ней также понимается процесс приведения составляющих системы к единой мере под воздействием внутренних сил - источников самоупорядочения, самопроизвольного накопления информации и пр. [1].

Казалось бы, что экономика страны функционирует, выполняет свою задачу под влиянием государства, организаций и отдельных людей, и между экономической системой и понятием самоорганизации никакого общего не найдётся, поскольку человек сам совершает какое-либо действие и оказывает на экономику влияние. Однако по мере углубления познания, предстает перед нами иной, но правдивый факт, неподлежащий сомнению, что экономика любой страны, в том числе и экономика Китая, будучи системой сложной целостной, двигается по своим законам, а люди, правительство или организация всего лишь элементы-клеточки данной системы, мы не управляем ей, а её элементами, совершенное нами действие влияет на них, система усложняется, превращаясь от порядка в хаос либо наоборот упрощается, от хаоса, деформации в порядок и стабильность.

Самоорганизация выступает как свойство проявления внутренней активности системы, её развития (эволюции). Развитие является процессом непрерывного положительного изменения основных результирующих показателей,

характеризующих состояние системы. Например, основными показателями, характеризующими развитие экономической системы, выступают: валовой внутренний продукт (ВВП), индекс человеческого развития (ИЧР), валовой национальный доход (ВНД) и др. Данный процесс обусловливает необратимые изменения в открытых системах, направленные на снижение энтропии и увеличение порядка и самоорганизации [3].

3. *Решение рассматриваемой проблемы*

Следует акцентировать внимание на экономическую систему Китая, ее стабильность и безопасность, и на то, каким образом достигнуть состояния гармонии в целом и гармонии между ее составляющими частями. Перейдем к конкретному контексту.

Предпринятая китайским правительством в 1978 году в Китае политика по реформе и поднятию открытости коренным образом на деле не создала новую систему, а лишь экономика перешла к новому состоянию. Иными словами, экономика Китая в плановой форме выполняла свою функцию до 1978 года, как простая система, подчинявшая планам и приказам правительства и с менее динамичностью; после 1978 года началось выполнение новой политики, система усложнялась в каком-то плане, даже можно назвать её уязвимой, ибо повысился удельный вес влияния от внешних факторов, усилилась тенденция хаоса, зато система стала динамичнее, обретав достаточную свободу, и гармоничнее. Обоснованием служит то, что гармония – это вовсе не тот случай, когда в системе существует и можно существовать только единственная сила, подавляющая и доминируя над всем другим.

Гармония – это многоразличие, противостояние двух сторон единой сущности. «Как следует из предыдущего, непреложный факт реальности состоит в том, что в мире в целом и в каждой его "клеточке" существует противостояние двух сторон единой сущности: светлых и темных сил (начал), созидания и разрушения, жизни и смерти, порядка (организации)...» [2].

О гармонии говорится и в даосизме, «Одно рождает два (Инь и Ян), два рождает три, три рождает всю тьму вещей, все вещи несут в себе Инь и обнимают Ян...», смысл объясняли по-разному, истолковываем мы так: из единого (начала) посредством пустоты возникает два как универсальный порождающий принцип. Из двойки посредством вездесущности неналичия появляется три как принцип разнообразия сущего, а тройка дает жизнь всем вещам. Инь и Ян противостоят друг другу, причем они и тяготеют друг к другу. К примеру, в элементарной физике, если электрон принято рассматривать как ту самую «единицу», то электрическое напряжение, будучи разностью потенциалов, разделяет на положительное и отрицательное, как Инь и Ян, эти два противоположные между друг другом, однако за счет различия и тяготения возникает электрический ток, который безусловно, является одним из важнейших неотъемлемых составляющих нашей цивилизованной жизни.

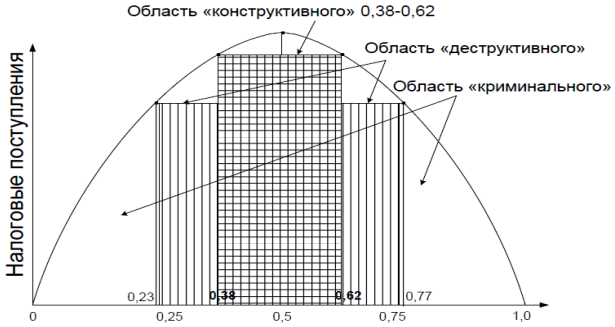
4. *Результаты и дискуссия*

Развитие современных государств неизбежно связано с эффективным обеспечением собственной экономической безопасности. Экономическая безопасность - состояние экономики, при котором обеспечивается достаточно высокий и устойчивый экономический рост; эффективное удовлетворение экономических потребностей; контроль государства за движением и использованием национальных ресурсов; защита экономических интересов страны на национальном и международном уровнях. Одним словами, сама система экономики способно обеспечивать свои внутреннюю и внешнюю гармонии, быть самоорганизованной при возмущении всяких видов фактора.

На основании вышеизложенного о гармонизации и самоорганизации, можем делать замечание о том, что экономика должна руководствоваться гармоничными соотношениями чтобы достичь балансового, организованного состояния. Несоблюдение этого основополагающего правила приводит к нарушению принципов устойчивости искусственных суперсистем, в том числе системы экономической безопасности, возникновению макроэкономических диспропорций, созданию условий для трансфера кризиса [4].

В состав экономической безопасности входят такие элементы, как финансовая и экологическая безопасность, безопасность промышленности и торговли и пр., приводим примеры: уровень налогообложения и индекс Джини. С одной стороны, мы узнаем обстоятельство экономической безопасности Китая в некоторых планах, посредством анализа данных, с другой стороны в этих примерах показано, что важно соблюдать некие правила, упомянутые в высшем тексте – правила, доказаны математическим методом и широко принятые в мировой практике, связанные с гармонией, в частности, с золотым сечением.

Пример 1. Уровень налогообложения страны, или как называется параболическая модель А. Лаффера:



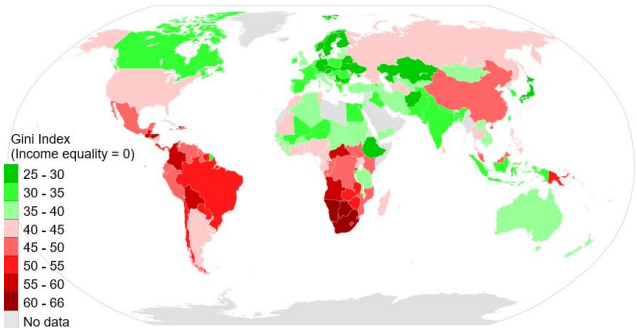
Назначение ставки налога больше нуля приводит к росту налоговых поступлений. Рост ставки налогов обеспечивает рост доходов государства в результате налогообложения. В определенной точке налоговые поступления становятся оптимальными (максимальными), а затем уменьшаются до нуля. Таким образом, максимальные налоговые поступления находятся между 0 и 100 %.

А. Лаффер рассмотрел случай, когда ставка налогов в 50 % обеспечивает максимальные налоговые поступления. Если ставку налогов поднять больше 50 %, налоговые

поступления уменьшатся, т. е. налоговая выручка начнет снижаться, хотя ставки налога возрастут. Того же эффекта можно достигнуть, уменьшая ставку налогов [5].

В данном случае в Китае ставки главных налогов: налог на прибыль предприятия – 25%; НДС – 17%; подоходный налог – от 3% до 45%, размер зависит от уровня заработной оплаты лица. Хотя все эти данные теоретически находятся на рациональном диапазоне, и официально министерство финансов неоднократно заявляет, что в стране оптимальная налоговая система, количество видов налога соответствует практической ситуации, однако существующий в ней «теневой состав» нельзя игнорировать, иными словами – на деле высокое количество разновидных налогов, в этом плане наблюдается дисгармония.

Пример 2. Индекс Джини:



Согласно информации в Википедии, коэффициент Джини является числом между 0 и 1, где нулю соответствует полное равенство (когда каждый имеет одинаковый доход), а единице — абсолютное неравенство (когда один человек имеет все доходы, а все остальные — нулевой доход).

Если мы акцентируем внимание на общий доход страны, например, ВВП, ВВП на душ населения, то обнаружим второй вид дисгармонии социально-экономической системы в Китае: неравенство доходов между населением, неравенство между регионами внутри страны. Пекинский университет ранее опубликовал отчёт под названием «Развитие народного благосостояния в Китае 2015». В отчёте говорится, что коэффициент Джини доходов китайских граждан, то есть показатель степени расслоения общества, в Китае в 80-х годах составлял 0,3. В настоящее время он уже достиг 0,45. А коэффициент Джини личного состояния китайских семей стал еще больше в настоящее время.

Также в отчёте отмечается, что 1% самых зажиточных китайских семей обладают одной третьей частью всех национальных богатств, в то время как 25% семей с самыми низкими доходами имеют всего около 1% национальных богатств.

5. *Заключение*

Проведенное исследование позволило получить некоторые эмпирические выводы, суть которых отражают следующие положения. Были разработаны элементы, дополняющие и качественно обогащающие теоретическую базу теории самоорганизации, а также формального описания развития экономической системы Китая с точки зрения самоорганизации и гармонизации, исследовал экономику страны как систему, провел анализы по вопросу экономической безопасности Китая со стороны экономических показателей – уровень налогообложения и индекс Джини, неоспоримый факт в том, что в экономической системе Китая проявляются факторы дисгармонии и нестабильности, оказывающие негативное влияние на общество. Однако страна занимает дело по достижению своей цели. Всегда существует дисгармония, и всегда важнее гармонии достичь.

6. *Список литературы*

1. Сороко Э.М. Золотые сечения, процессы самоорганизации и эволюции систем: Введение в общую теорию гармонии систем. Изд. 4-е. - М.: Книжный дом «ЛИБРОКОМ», 2012. С. 132.

2. Сороко Э.М. Закон структурной гармонии систем в локальных универсумах природы и общества. 1997. С. 19 – 20.

3. Гречко М.В., Курочкин В.Н. Самоорганизация социально-экономических систем: концептуальные основы, аксиоматика // Национальные интересы: приоритеты и безопасность. 32 (2015) С.36 – 45.

4. Егорова-Гудкова Т.И. Мировоззренческо - методологические аспекты проектирования устойчивых экономических систем: закон золотого сечения // «Академия Тринитаризма», М., Эл № 77-6567, публ.21173. 2015. С. 9.

5. Егорова-Гудкова Т.И. Мировоззренческо - методологические аспекты проектирования устойчивых экономических систем: закон золотого сечения // «Академия Тринитаризма», М., Эл № 77-6567, публ.21173. 2015. С. 15.