

SAFE TREATMENT OF EXPIRED MEDICINES

Blagovesta Vladkova¹, Luka Arbaliev¹, Veronika Karadjova²

¹University of Mining and Geology "St. Ivan Rilski", 1700 Sofia, b_vladkova@yahoo.com

²University of Chemical Technology and Metallurgy, Sofia, vkar@mail.bg

SUMMARY: Every household has medicaments that have become time-expired. In this case, the following issues arise: what to do with these medicaments, how medical waste is treated, and what potential environmental impacts such medicines would have. In an attempt to answer these questions, a study was carried out in two directions. In the first direction, matters of administrative nature were clarified, such as correspondence with institutions, structures and organisations involved in this activity, as well as public awareness of the approaches applied. An experimental part was also carried out, namely experiments with soils contaminated with drugs and tracking the development of crops in such soils.

Keywords: time-expired medicaments, waste treatment, safety, environment, health, sustainable development

БЕЗОПАСНО ТРЕТИРАНЕ НА МЕДИКАМЕНТИ С ИЗТЕКЪЛ СРОК НА ГОДНОСТ

Благовеста Владкова¹, Лука Арбалиев¹, Вероника Караджова²

¹Минно-геоложки университет "Св. Иван Рилски", 1700 София, b_vladkova@yahoo.com

²Химико - технологичен и металургичен университет, София, vkar@mail.bg

РЕЗЮМЕ: Почти във всяко едно домакинство се случва да се съберат лекарства, които с времето са остарели и срокът им на годност е изтекъл. В такъв случай възниква въпросът какво да се направи с тези медикаменти, как се третира отпадъците, какви биха потенциалните въздействия върху околната среда. В опит да се отговори на тези въпроси бе направено проучване в две направления – приложна част, състояща се в кореспонденция с ключови държавни структури и организации, изясняване на проблема и предложения за увеличаване на степента на информираност на населението; експериментална част – извършване на практически опити със замърсени с лекарства почви и проследяване развитието на посеви в такива почви.

Ключови думи: медикаменти, третиране на отпадъци, изтекъл срок на годност, здраве, околна среда, устойчиво развитие

Introduction

The problem with the collection and treatment of waste from household chemicals (empty packs of detergents, paints, varnishes, etc.) as well as expired medicaments is particularly relevant. The trend in recent years is for the flow of such waste to be managed. Thus, and the culture of separate collection of waste was imposed on the population.

This article is part of a conducted overview of the current status of the topic for the treatment of pharmaceutical waste from the households. The material discusses two directions—results of correspondence with key institutions (the Ministry of Health, BDA /the Bulgarian Drug Agency/, etc.) as well as the completed experimental part [31, 32].

The correspondence with different control authorities has shown gaps in the algorithms for providing information to the community. People are not responsible and committed to the common culture of treating household waste (household chemistry, old medicines, etc.). The lack of a single media bearer and the low information of society as a whole contribute to this situation, too.

The experiment aims to trace how the soil composition contaminated with expired medicines changes and, subsequently, to monitor the crops to be planted in this soil and their growth. It has been found that different medicaments affect the composition and the properties of the soil solution

and, consequently, the growth of crops. Conducting of such tests is topical, both in environmental and in agricultural aspects, as it makes it possible to obtain information of the ongoing processes in the soil [1, 2].

Setting the Experiment

For the represent studies, an approach was chosen in which plots were used separately with soil from a random uncovered area which is not prepared or pre-treated. The soil was placed in monolithic containers (pots) whose volume and height were adapted to the needs of talking samples.

Seven pots of soil were prepared (Fig. 1), in five of them the selected medicaments were placed (pots № 8, 10, 11, 12, and 13) and in one of the pots a mixture of the powdered medicaments was placed. In the last pot (№14), only soil from a randomly selected uncovered area was placed, which served as a benchmark.



Fig. 1.

During the experiment, several types of expired medicaments which the authors have at their home

"pharmacy" were selected arbitrarily. Their composition and properties are described in Table 1 [1].

Table 1.

medicine	Composition	Undesirable medicine effects	Quantity
Medicament (film-coated tablets)	Atenolol 50 mg Additional ingredients: lactose monohydrate, wheat starch, microcrystalline cellulose, sodium starch glycolate, gelatin, talc, silicon dioxide, magnesium stearate, sparing white	Rash or itching, swelling of the face and / or difficulty in breathing, pain in joints, with or without fever, redness, severe diarrhea with bleeding	6 g
Medicament (tablets)	Magnesium citrate 600 mg Magnesium 98.6 mg Other Ingredients: sucrose, powdered cellulose, citric acid, xanthan gum, calcium kakonoat, sodium cyclamate, flavoring materials, coloring agent E 104	Diarrhea	21 g
Medicine 3 (eye drops - solution)	20 mg Dorzolamide like (Dorzolamidovhidrochlorid) and 5 mg Timolol (as Timololovmaleat). excipient substances mannitol, hydroxyethyl cellulose, sodium citrate, sodium hydroxide, benzalkonium chloride, water for injections	Facial swelling, itchy skin, difficulty breathing, hives, burning and stinging eyes, change in taste, burning sensation in the eye, itching of the eye, blurred vision, headache, dizziness,	5 ml
Medicine 4 (powder solution for injection)	Cefazolin sodium 1.048 g	Nausea, vomiting, loss of appetite, diarrhea, oral candidiasis, fever, skin rashes, in patients with renal insufficiency, nephritis, hepatic reaction and others.	1 g
Medicine 5 (hard capsules)	Cefaclor 500 mg as (cefaclor monohydrate). Other Ingredients: натриев нишестен глюколат, магнезиов стеарат, желатин, титанов диоксид, еритрозин, индигокармин	Rash or itching, swelling of the face and / or difficulty in breathing, pain in joints, with or without fever, redness, severe diarrhea with bleeding	4 g
Medicine 6 (Mixture of powdered pharmaceutical forms)	Atenolol, Magnesium Diasporal, Cefazolin, Medoctor		10.2 g

Note: The names of the medicaments used for the studies are not indicated to avoid conflict with the manufacturer

Conducting the experiment

Sample preparation

The first stage of the preparation of the samples was powdering the tablet forms of pharmaceutical products and the preparation of a powder mixture. Such a preparation is not applicable to the capsules which are in manufactured in a powder form and the drops - they come in a liquid form [1].

The next step is the weighing of the medicaments to determine the exact quantities to be placed in the soil studied (Figure 2).



Fig. 2. Sample preparation

The samples (medicaments) were placed in soil under normal atmospheric conditions on 30th March 2018. The sites prepared for testing are shown in Figure 3.

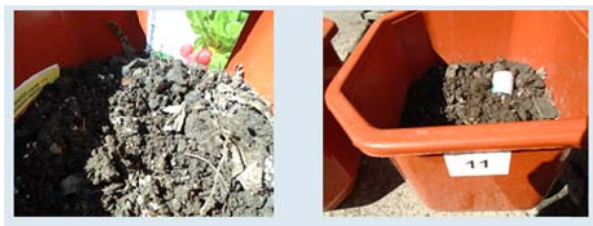


Fig. 3. Sowing the seeds of radishes

On 2nd April 2018, the pots with the time-expired medicament samples were planted with radish seeds (fig. 3). The experience with the planting of crops aimed to check the effect of medicines on the plants. The sowing was chosen due to the rapid growth of the radishes and its large contact surface with the soil.

The contents of the pot and the precise amounts of medicaments therein are presented in Table 2.

Table 2.
Distribution of the drugs in the individual pots with samples

Number of sample pot	Medicinal product	Quantities placed in the soil
Pot №8	Medicinal product 1	4 g
Pot No. 9 (mixture)	A mixture of the medicinal product 6	10.2 g
Pot №10	Medicinal product 2	14 g
Pot №11	Medicinal product 4	0.2 g
Pot №12	Medicinal product 5	3 g
Pot №13	Medicinal product 3	5 ml
Pot No. 14 benchmark sample	BENCHMARK- Free of medicinal products	no

Figures 4, 5, and 6 illustrate a crop image material and show the growth of the crops at different stages of the study, tracking the effect of the medicaments or lack of such (pot 14) on the radishes.



Fig. 4. Image of the crops from 12th April 2018



Fig. 5. Image of the crops from 26th April 2018.



Fig. 6. Image crop of radishes on 8th May 2018

Analysis of soil samples

The study of structure and properties of the soil solution gives valuable information on ongoing soil processes and is of important theoretical and practical importance [3-5, 10, 11].

In a study of soils in practice, a number of analyses can be carried out and their selection depends on the needs. Analyses may include:

1. Microbiological indicators
2. Physiochemical Indicators:
 - Determination of pH
 - Determination of total and organic carbon
 - Determination of total nitrogen (Kjeldahl)
 - Determination of nitrate nitrogen, ammoniac nitrogen and total soluble nitrogen
 - Determination of phosphorus
 - Determination of carbonates
 - Analysis of metals
 - Determination of water and acid-soluble sulphates
 - Determination of total sulphur
 - Determining the mechanical structure
 - General exchangeable acidity/Free hydrogen
 - Determination of mercury
 - Determination of the specific electrical conductivity
 - Bulk density
 - Dry matter/moisture content

Two methods of analysis were selected to study the effects of the selected medicaments on the soil solution - for the determination of pH and metals which are not notably expensive and at the same time provide information on the changes occurred as a result of the medicaments [4-9].

The tests carried out complied with the requirements for soil sampling, namely:

- Soil samples were taken in dry weather;
- The samples were taken from a depth of 0-30 cm;
- The transportation and storage of the test sample was carried out in a way which ensured steadiness in the composition of the sample taken for analysis from the time of collection at the time of testing (Fig. 7).

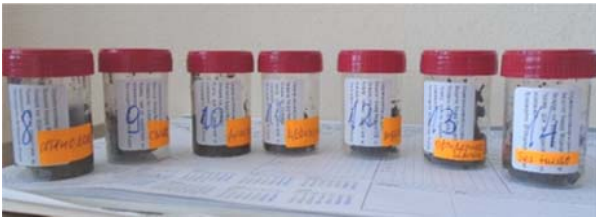


Fig. 7.

Study of pH

To study the pH of the soil samples, a soil solution was taken which passed through the following three stages (Fig. 8, Table 3):

- 1. Taking of soil samples and preparation of bulk monoliths.
- 2. Preparation of a soil solution.
- 3. Analysis of the resulting solution composition.



Fig. 8.

Table 3. Results from the pH analysis of the test samples

Sample-benchmark No. 14 * pH = 7.20, No 14 ** pH = 7.22						
Sample	8*	8**	9*	9**	10*	10**
pH	6.88	6.90	7.10	7.10	7.07	7.09
Sample	11*	11**	12*	12**	13*	13**
pH	6.98	6.91	7.02	7.02	7.10	7.11

Note: The numbering of the samples is as follows:

The first and the second sample of the different tested soils taken at an interval of 30 days are marked with * and **, respectively. In such a way, the change of pH is monitored over time and under the influence of the atmospheric conditions.

Analysis of metals

The test samples were prepared by the method of acid dissolution of the sediments, sludge and soils to comply with procedures and preparation for analysis by means of atomic-emission spectrometry with inductively coupled plasma (ICP-AES) [9, 11]. Samples prepared by this method were analysed by ICP-AES, with the *Prodigy* High Dispersion ICP-OES apparatus (Fig. 9 and 10).



Fig. 9. Preparation of the samples by the method of acid dissolution



Fig. 10. The *Prodigy* HighDispersion ICP-OES Apparatus

Table 4.
Results from the ICP-OES analysis of the test samples in mmol / l

element	Sample							
	8*	8**	9*	9**	10*	10**	11*	11**
Barium / Ba	4.982	4.443	5.831	7.011	5.342	6.339	5.311	5.568
Cadmium / Cd	0.446	0.387	0.203	0.205	0.205	0.249	0.215	0.219
Chromium / Cr	2.880	3.129	1.379	1.351	3.458	3.804	3.001	3.255
Copper / Cu	6.715	6.130	4.479	4.653	4.506	5.796	4.719	4.546
Lead / Pb	7.020	6.315	4.458	4.580	5.264	6.042	5.357	6.994
Manganese / Mn	8.253	7.209	8.175	8.089	6.024	7.057	7.533	7.555
Nickel / Ni	0.270	0.412	0.322	0.333	0.304	0.399	0.356	0.386
Sodium / Na	7.759	7.718	7.442	7.312	5.388	6.913	7.343	7.156
Strontium / Sr	0.822	0.736	0.674	0.692	0.566	0.682	0.576	0.572
Cobalt / Co	0.144	0.149	0.184	0.186	0.186	0.174	0.167	0.184
Aluminum / Al	93.71	95.02	115.6	120.4	98.01	122.5	114.1	115.1
Calcium / Ca	689.1	578.6	366.8	356.3	284.2	337.9	279.6	287.6
Iron / Fe	264.8	235.3	416.5	439.5	267.8	334.6	407.3	408.6
Magnesium / Mg	100.1	88.93	87.78	85.71	62.51	77.77	66.60	74.31
Potassium/K	11.16	11.32	14.59	15.08	12.08	15.04	12.54	14.07
Zinc / Zn	44.60	40.69	41.27	44.64	36.45	43.94	40.92	39.74
Arsenic / As	0.073	0.062	0.097	0.083	0.086	0.122	0.098	0.113
Sulfur / S	7.158	7.357	8.320	9.460	8.520	10.93	10.92	11.71
Phosphorus / P	6.739	6.229	8.100	8.427	7.918	8.584	8.782	9.154
Tin / Sn	0.149	0.133	0.062	0.053	0.067	0.118	0.076	0.083

Element	Sample					
	12*	12**	13*	13**	14*	14**
Barium / Ba	5.591	5.819	6.300	5.642	5.475	5.418
Cadmium / Cd	0.204	0.198	0.172	0.165	0.275	0.267
Chromium / Cr	1.895	1.890	2.551	2.517	2.192	2.464
Copper / Cu	4.330	5.101	3.610	3.642	4.032	3.987
Lead / Pb	5.818	5.782	4.583	4.212	4.676	4.716
Manganese / Mn	6.911	6.878	7.718	7.221	7.468	7.437
Nickel / Ni	0.366	0.358	0.275	0.278	0.319	0.312
Sodium / Na	7.177	8.616	6.172	6.907	4.758	5.664
Strontium / Sr	0.525	0.541	0.692	0.684	0.704	0.582
Cobalt / Co	0.159	0.152	0.119	0.112	0.168	0.160
Aluminum / Al	128.3	125.3	106.7	106.1	109.8	109.7
Calcium / Ca	266.2	275.7	342.5	326.9	346.4	327.8
Iron / Fe	424.7	435.9	305.7	297.0	365.1	357.4
Magnesium / Mg	70.52	70.05	74.91	70.31	71.65	74.48
Potassium/K	13.61	14.47	13.08	12.86	13.80	13.37
Zinc / Zn	45.25	44.74	38.24	36.02	39.38	39.68
Arsenic / As	0.084	0.091	0.090	0.085	0.081	0.071
Sulfur / S	11.68	11.91	10.61	10.31	10.48	10.30
Phosphorus / P	8.673	8.806	7.223	7.025	8.071	8.245
Tin / Sn	0.066	0.104	0.073	0.074	0.066	0.062

The change in the content of some of the heavy metals in the studied soils against the reference soil is presented graphically in Figure 11.

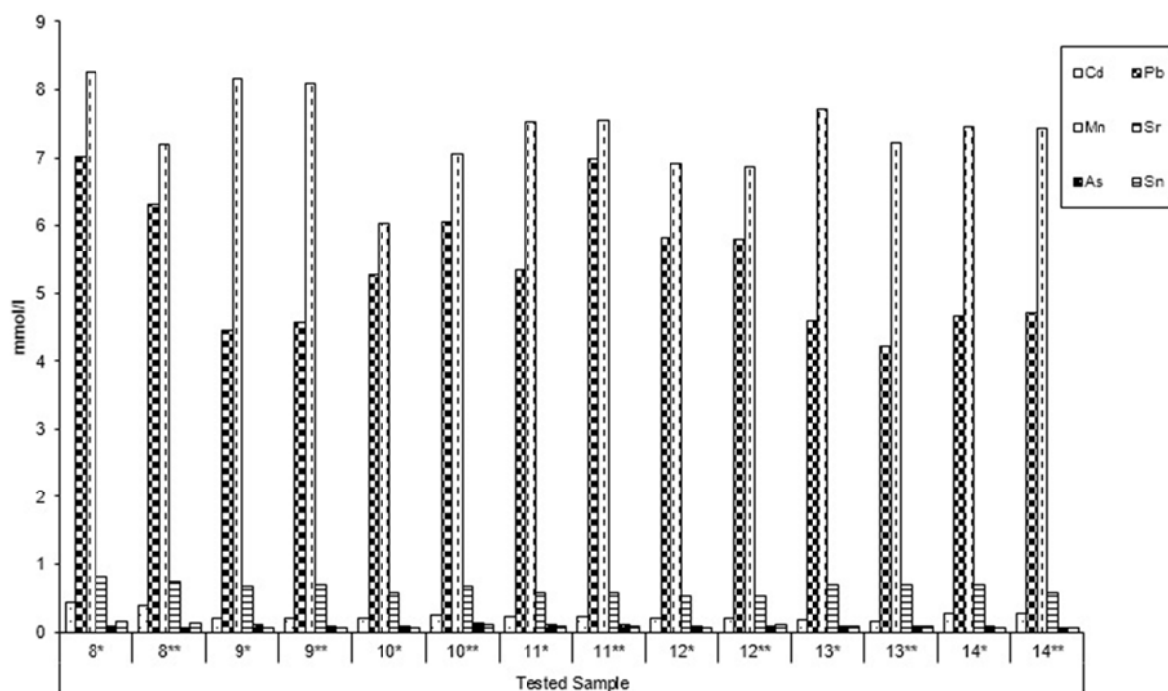


Fig. 11. Content of some heavy metals in the tested soils, compared to the soil-benchmark

Outcomes of the chemical analysis made:

- It has been found that the chemical composition of the soil solution in the tested soil is influenced by the composition of the medicament product.

- From all the studied soil samples in samples №9 and №13, the pH values are close to the basic of the used soil-benchmark pH = 7.22. In the other samples tested, the pH values ≤ 7, i.e. a lowering the pH was observed. The lowest value was recorded with the samples №8 (active component Atenolol) and №11 (active ingredient cefazolin sodium) (pH ≈ 6.90)

- From the medicaments included in the experiment, medicaments with highest content of heavy metals such as Cadmium (Cd), lead (Plumbum (Pb)), Manganese (Manganum (Mn)), Tin (Stannum (Sn)), and Strontium (Sr) were observed in soil sample №8 compared to sample №14 which is the benchmark soil.

- The obtained values shall not be compared to the acceptable benchmarks for the metal content and pH in the soil but they aimed to find a change in the composition of soils containing medicaments relative to the benchmarked soil.

- There is a difference in the growth of the crops, depending on the soil composition containing medicaments. Samples №9 and №13 were with better growth. Insufficient development of the plants was observed in the sample №10 (Fig. 6).

Conclusion

The effect on the environment when disposing of time-expired medicaments should not be overlooked. In any case, this affects the quality and composition of the soil, and there is a danger from the passage of harmful substances in groundwater. The results from the chemical analyses (pH and

metals) provide the basis from which the team can further expand their studies and conduct a more detailed research on the impact of medicinal products on the composition and properties of the soil and on crop growth.

Broader research and detailed analyses are needed to establish the precise degree of influence of medicaments on the soil composition and properties (and the ongoing soil processes). The studies presented in the present work may be the beginning of in-depth and comprehensive experiments with contaminated soils with medicaments. They should be conducted on an experimental site and with larger quantities of medicaments.

As a result of the conducted survey, notifications and suggestions to different institutions were submitted. Thus, the authors hope to have made the first steps towards improving the culture of the population in the field of waste treatment.

References

- [1] Лука Арбалиев: “Безопасно управление на медицински и фармацевтични отпадъци от аптеки и болници” - дипломна работа за получаване на ОКС „Магистър“, МГУ, Катедра „РВ и ТБ“, София, юли, 2018 г. / (Luka Arbaliev, Master thesis, “Bezопасno upravlenie na medicinski i farmacevtichni otpadaci ot apteki i bolnitzi” University of Mining and Geology, Sofia, July, 2018)
- [2] Цецка Симеонова: “Състав и свойства на почвения разтвор при различни начини на земеползване”, Автореферат на дисертация за даване на образователна и научна степен “Доктор”, ИП “Н.Пушкарв” – София, 2010 г. / (Tzetzka Simeonova, PhD-Thesis, “Sastav i swoistwa na pochvenia raztwor pri razlichni nachini na zemepolzvaneto” N. Pushkarov, Sofia, 2010)

- [3] Stela Georgieva, Petar Todorov, Emilia Naydenova, Electrochemical behavior of biologically active cycloalkanespiro-5-hydantoin, Analytical and bioanalytical electrochemistry, 2, vol.9, 2017, 214-231.
- [4] Angelina Stoyanova-Ivanova, Denitsa Mitkova, Stela Georgieva, Victoria Vitkova, "Lipid bilayers as biocompatible model systems – does the acidity of the aqueous solution alter the membrane elasticity?", Advances in Natural Science: Theory & Applications, Volume 1 No. 1 2012, 29-35.
- [5] Denitsa Mitkova, Angelina Stoyanova-Ivanova, Stela Georgieva, Petar Todorov, Nikolay Kozarev, Yury A. Ermakov, Victoria Vitkova, „Charged Lipid Bilayers in Aqueous Surroundings with Low pH”, Advances in Planar Lipid Bilayers and Liposomes, Chapter one, Volume 18, 2013, p. 1-20.
- [6] T. Nedeltcheva, M. Hristova, St. Georgieva, L. Vladimirova, Spectrophotometric determination of Cu (II) by the system I - starch in the presence of Fe (III), Journal of the University of Chemical Technology and Metallurgy, 42, 4, 2007, 427-430.
- [7] Kristina Gartsyanova, Stela Georgieva, Assessment of the anthropogenic pollution of the Chepinska River, Proceedings of National conference with international participation "Natural Sciences 2017" (NCNS2017) (2017)-online;
- [8] S Georgieva, K Gartsyanova, V Ivanova and L Vladimirova, Assessment of Physical-Chemical Characteristics of Surface Water from Key Sites of the Mesta River: State and Environmental Implications, IOP Conf. Series: Materials Science and Engineering 374 (2018) 012093 doi:10.1088/1757-899X/374/1/012093
- [9] D. Ilieva, A. Surleva, G Drochioiu, M. Murariu, M. Abdulah, Evaluation of ICP-OES Method for Heavy Metal and Metalloids Determination in Sterile Dump Material", Solid State Phenomena, Vol. 273, pp. 159-166, 2018
- [10] G. Drochioiu, A. Surleva, D. Ilieva, L. Tudorachi, R. Necula, Heavy metal toxicity around a closed barite mine in Tarnita-Romania, 16th International Multidisciplinary Scientific GeoConference SGEM 2016, www.sgem.org, SGEM2016 Conference Proceedings, ISBN 978-619-7105-62-9 / ISSN 1314-2704, June 28 - July 6, 2016, Book3 Vol. 2, 525-532 ppDOI: 10.5593/SGEM2016/B32/S14.069
- [11] M. Zaharia, G. Drochioiu, D. Ilieva, A. E. Butnariu, A. Surleva, Heavy metal toxicity and decontamination: tarnita closed mine pollution case, SGEM2017 Vienna GREEN Conference Proceedings, Vol. 17, Issue 43, 397-404 pp; DOI: 10.5593/sgem2017H/43/S19.050
- [12] <http://sembodja.bg/wp-content/uploads/2016/02/Указание-за-вземане-на-почвени-проби.pdf>, 02/2016
- [13] <https://www.naas.government.bg/data/image/Lab/Ukazanie%20za%20vzemane%20na%20pochveni%20probi2017.pdf>, 09. 2017
- [14] <http://www.globaltest-bg.com/testing/анализ-на-почви/>, 20.05.2018
- [15] <http://eea.government.bg/bg/labs/vtr/instrumental>, 25.04.2018
<http://www.eurotest-control.bg/uslugi/izpitvane/pochvi>, 14.01.2018
- [16] <https://sites.google.com/site/poushkarov/home/vzemane-na-pochveni-probi>, 12. 2017
- [17] <http://pudoos.bg/2016/05/>; Пилотни модели за екологосъобразно събиране и временно съхранение на опасни битови отпадъци от домакинствата; ПУДООС; 28.11.2016 г. / "Pilotni modeli za ekologosobrazno sabirane I wremenno sahranenie na opasni bitovi otpadaci ot doamkinstwata", PUDOOS, 28.11.2016
- [18] <http://www.balbok.com/bg/about/Sybirane-na-opasni-otpadytsi-ot-domakinstvata>; Сайт на „Балбок Инженеринг” АД; Събиране на опасни отпадъци от домакинствата; 07.09.2017 г. Site of Balbok Engeneering, Sabirane na opasni otpadaci ot domakinstwata, 07.09.2017
- [19] <https://fakti.bg/bulgaria/94218-iznasame-opasni-otpadaci-za-prerabotka-v-chujbina>; Изнасяне на опасни отпадъци за преработка в чужбина; Публикувана: 29 Април, 2014 / Iznasjane na opnsi otpadaci za prerabotka w chujzbina, 29.04.2014
- [20] <https://noharm-global.org/issues/global/treating-pharmaceutical-waste>; 12.2017
- [21] https://www.actualno.com/sliven/otvarjat-punkt-za-sybirane-na-opasni-otpadyci-v-sliven-news_570529.html; Мобилен събирателен пункт за безвъзмездно приемане на опасни отпадъци от домакинствата и последващото им третиране; 23.10.2016 г. „Mobilnen sabiratelnen punkt za bezwazmezno premame na opasni otpadaci ot domakinstwata i posledwasto tretirane”, 23.10.2016
- [22] <https://www.sofia.bg/documents/20182/283420/2017-12-22>; Сайт на Столична община; График на мобилен събирателен пункт за 2018 година; 22.12.2017 г. Stoliczna obstina, Grafik za mobilnen sabiratelnen punkt za 2818, 22.12.2017
- [23] Практическо ръководство за безопасно управление на отпадъците от лечебните и здравни заведения, Авторски колектив от Национален център по обществено здраве и анализи, София 2017 г. Praktichesko rakowodstwo za bezопасno uprawlenie na otpadacite ot lechebnite zdrowni zawedenia, Awtorski kolektiv na Nacionalen centar po obstestweno zdrowe I analizi, Sofia, 2017
- [24] Анализ на състоянието и прогноза за вида, количествата и източниците на отпадъците, образувани на територията на страната, както и за отпадъците, които е вероятно да бъдат обект на трансграничен превоз от или до националната територия; Оперативна програма Околна среда 2007-2013 г. Analiz na sastojniето i prognoza za wida, kolichestwoto i iztochnicite na otpadaci, obrazuwani na teriotoriata na stranata, kakto I za otpadacite, koito verojatno da badta obekt na transgranichen prevoz ot ili do nacionalnata teritoria, Opeativna programa okolna sreda 2007-2013
- [25] Закон за управление на отпадъците Обн., ДВ, бр. 53 от 13.07.2012 г., в сила от 13.07.2012 г., изм., бр. 66 от 26.07.2013 г., в сила от 26.07.2013 г.; изм. с Решение № 11 от 10.07.2014 г. на КС на РБ - бр. 61 от 25.07.2014 г.; бр. 98 от 28.11.2014 г., в сила от 28.11.2014 г., бр. 14 от 20.02.2015 г., изм. и доп., бр. 105 от 30.12.2016 г. / Zakon za uprawlenie na otpadacite, obn. DW, br. 53 ot 13.07.2012
- [26] Национален доклад за състоянието и опазването на околната среда в Република България през 2009 г,

- Изпълнителна агенция по околна среда; 2009 / Nacionalen doklad za sostojaniето I opazawaneto na okolnata sreda w Republika Bulgraia prez 2009, Izpalnitelna agencia po okolna sreda, 2009
- [27] Конференция на страните по Базелската конвенция за контрол на трансграничното движение на опасни отпадъци и тяхното депониране; Програма на Обединените нации за околна среда; Шеста среща Женева 9-13 Декември 2002 г. / Conferencia na stranite po Baselskata convencia za control na transgranichnoto dwizhenie na opasni otpadaci I tjahnoto deponirane, Programma na Obedinenite nacji za okolna sreda, 6 sresta Geneva 9-12 decemvri 2002
- [28] Наредба № 28 от 9 Декември 2008 г. за устройството, реда и организацията на работата на аптеките и номенклатурата на лекарствените продукти; обн. ДВ бр. 109 от 23 Декември 2008 г., Министерство на здравеопазването / Naredba 8 ot 9 dekemvri 2008 za ustrojstvoto, reda I organizaciata na rabotata na aptekite I nomenklaturata na lekarstvenite produkti, obn. DW, br. 109 ot 23.12.2008
- [29] Наредба №28 от 14 Декември 2000 г. за условията и реда за унищожаването, преработването или използването за други цели на лекарствата; Обн. ДВ. бр.106 от 22 Декември 2000 г., Министерство на здравеопазването, Naredba 28 ot 14.12.2000 za usloviata I reda za unistozhavaneto, prerabotwaneto ili izpolzwaneto za drugi celi na lekarstwata, obn. DW, br. 106 ot 22.12.2000
- [30] Наредба №4 от 5 Април 2013 г. За условията и изискванията за изграждането и експлоатацията на инсталации за изгаряне и инсталации за съвместно изгаряне на отпадъци; Обн. Бр. 36 от 16.04.2013 г. В сила от 20.04.2013 г., Министерство на околната среда и водите/ Naredba 4 ot 5 april 2013 za usloviata I iziskwaniata za izgrazhdaneto I exploataciata na instalacii za izgarjane I instalacii za savmestno izgarjane na otpadaci, obn. DW, br. 36 ot 16.04.2013
- [31] Национален план за управление на отпадъците 2014-2020 г; Оперативна програма Околна среда 2007- 2013 г.; Министерство на околната среда и водите, Август 2014 г. София Nacionalen plan za upravlenie na otpadacite 2014-2020, Operativna prgrama Okolna sreda 2007-2013, Ministerstwo na okolnata sreda I wodite, august 2014
- [32] Наредба № 1 от 09.02.2015 г. за изискванията към дейностите по събиране и третиране на отпадъците на територията на лечебните и здравните заведения; обн., ДВ, бр. 13 от 17.02.2015 г., Министър на здравеопазването и министър на околната среда и водите, Naredba 1 ot 09.02.2015 za iziskwaniata kum deinostite po sabirane I tretirane na tpadacite na teritoriata na lechebnite I zdrawnite zawedenia, obn. DW, br. 13 ot 17.02.2015, Ministar na zdraweopazwaneto i minstar na oklnata sreda i wodite
- [33] Ралица Ангелова „Балбок Инженеринг” АД, Петър Трайков Столична община: Практически опит в събирането на опасни битови отпадъци в България Въпроси, свързани с управление на риска при събиране на опасни отпадъци” ППП по Проект „Проучване и разработване на пилотни модели за екологосъобразно събиране и временно съхраняване на опасни битови отпадъци” „Опасни битови отпадъци-добри практики и опит” 24 Септември 2013 г. София., Ralitza Angelova, Balbok Engeneering, Petar Traikov, Stolichna obstina-Prakticheski opit w sabiraneto na opasni bitowi otpadaci w Bulgaria, Waprosi, swarzani s upravljenieto na riska pri sabirane na opasni otpadaci, PPP po proekt Prouchvane I razrobotwane na pilotni modeli za ecologosaobrazno sabirane I wremenno sahranjawane na opasni bitowi otpadaci, “Opasni bitowi otpadaci- dobri praktiki I opit”, 24.09.2013
- [34] news7.bg;http://botevgrad.com/news/55213/Nezakonnosmetishte-za-lekarstveni-otpadaci-iznikna-v-gorata-kray-Botevgrad/#gallery; Незаконно сметище за лекарствени отпадъци;09.05.2014, 07:25