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The irrigation of honey–plants crops with depolluted waters with ozone

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Abstract. Because traces of pollution of the cower were also found in the bee honey, at the irrigation of honey-plants-crops (*Helianthus annuus, Brassica oleifera* etc.) it is required to use water without polluants (nitrites, heavy metals, pesticides and others). Using the chemical reaction of nitrite oxidation in the study it is exemplified the calculation manner of the ozone quantity needed, to get this pollutant of the legal limit, assuming that at the chemical analysis of the water irrigation, that was found with exceeded value according to the water level. Similary to the water is posible to the other pollutants. The ozone used at the depolution is obtained now from the environmental air through well-developped technology well planned and commonly used. Ozone production facilities use the effect „Corona", being produced also in Romania.

Key Words: ozone, nitrites, polluted waters.

Introduction. Historical, archeological, ethnographic and linguistic proof is enough to testify that from the ancient times there was a preoccupation of our people to grow bees. Dromichete himself, one of the first leaders of the Union of the Geto-Dacian tribes from the left part of the Danube – IV-III century a. Ch. – era of the beekeepers (Sima 2003). Herodotus and Aelianus in their writings mention much later the thriving beekeeping of Dacia and of the North-Pontic territories neighboring Dacia (Sima 2003). Nowadays the bee is much appreciated in our country because we took care of it, protected it and appreciated not only her holly wax but also the other products of the beehive: honey, royal jelly, pasture, pollen, bee venom and propolis. We appreciated them for their extraordinary qualities that define a strict cleanliness of the beehive, a perfect organization of the colony, a constructive and thermodynamic efficiency and a self-sacrifice power oriented towards the good of the beehive. As it is shown afterwards the bee became an extremely sensitive and very exact sensor of the alteration of the air's and water's purity, of the degradation of the vegetation and of the plains', gardens' and orchards' fruits – by the produced honey in the areas where these degradations were registered, due to pollution of the environment.

The pollution of the vegetation and the consequences of the pollution of the honey. The map of the pollution of the vegetation in Romania is identical to the map of the social industrialization according to which each new industry that appeared before '89 radically modified the quality of the environment by the pollutant contribution of the industrial emissions (as main pollutant source) and by the pollutant contribution of the new urban communities (as secondary pollutant source) that have to serve the new industries (Zaharia 1999). These pollutants penetrated the vegetation by the air through the stomas or through the roots as the mineral and organic plats dissolved them in the water from their roots (Cordoş & Ristoiu 2010). We mention that in the reference bibliography there is no specification of the transportation of the pollutants in the plants or in their stems (Cordoş & Ristoiu 2010). Even though before 89 Romania's honey bee flora developed in an environment that was not polluted and that was significant as vegetation area and as diversity (Cârnu 1980). Nowadays as after '89 honey bee flora vegetation areas are *Helianthus annuus* (to obtain bio-diesel fuel and industrial vegetal oils) and here and there are small areas planted with medical or aromatic plants (used in the food industry, in the industry of natural supplements and in the cosmetics industry).

As the human being has always prioritised his nutrition his beliefs regarding his nutrition has always evolved. Nowadays, in many situations of globalisation – the human being realised that he must protect is life making sure that his nutrition is free of the waste and residues that gathers more and more on Earth, so the concepts of bio-food and bio honey appeared. May be there is polluted honey? Yes. Because in the bees' honey – researched more and more intensely due to its biological, pharmaceutical values and therapeutic principles – it was shown (2002-2003) some heavy metal pollution (Bratu 2003) – due to the pollution of the vegetation from where bees collect the nectar and the other substances that complete their activity in the beehive. Remark: traces of nitrite pollution were found in the brut oil, extracted from *H. annuus* (Cristea 2002) and there is a suspicion that these might be found in the bees' honey too.

Regarding the pollution of the bee honey the authors of this paper refer to the PhD Thesis of Bratu (2003) where, by determinations made according to the quality standards, the honey produced by the beehives from Copşa Mică area was analysed (an ex-industrialised area where non-ferrous metallurgy activities were executed). In this honey they found Zn, Pb, Cd – exceeding the permitted limits by the in force law. Moreover, the determinations highlighted the relation that existed between the content of the heavy metals found in the floral sources. They used as documentation sources the Reports of the Environmental Protection Agenda from Sibiu (Reports of the Environmental 2000-2002). The measurements attested the seriousness of the pollution phenomena that exists in that area, as the hearths where these were located can be found in the area of Copşa Mică (Cordoş et al 2010).

The ozone as decontaminant. Example of calculation of the necessary ozone quantity to decontaminate the waters used for irrigations. The ozone (O_3) participates in the nature by its strongly oxidant reactions being the 3rd oxidant according to its oxidant power, after the halogens and oxygenated water. Its general obtaining from oxygen is reversible: $3O_2 \leftrightarrow 2O_3$ and demonstrates its great instability, as it decomposes instantaneously in 3 oxygen atoms which can be used as decontaminants. At least 8 chemical reactions are known based on which the ozone is obtained (Negoiu 1985); as energetic contribution (electrochemical, thermal or photonic) the consumption is 141.93 kJoule/ozone molecule. This destroys by oxidation the pollutants from the waste waters of the food industry (slaughterhouses, sheep, pig farms etc.) from the swimming pools or from the waters that feed the big urban areas (Meghea et al 2000). As it is not a selective decontaminant, in the waters treated with ozone (it is more soluble in water than the oxygen: 44.7 vol. ozone in comparison with 3.11 vol. oxygen) this destroys not only the inorganic pollutants (nitrite, heavy metals) but also the microbiologic pollutants (fungus, coliforms, candida, staphylococci, streptococci). In the industry of gold extraction the ozone is used to destroy the CN group from cyanide freeing gold for Gold Corporation!! Regarding the nitrite this appears in the drinking water from the surface water that is already polluted with nitrites; in the irrigation water these appear from the waste water of the animal farms and from the agricultural fertilizers that have already saturated the cultivable soils and from the rural area's waste water. The nitrates transform easily in nitrites at an ambient temperature and enter the human body by the drinking water or by food. These ones in the human body mix with the free radicals that are the "waste" of the human biochemistry, having a great affinity towards them. So we have some very stable chemical combinations which make more difficult the intercellular or intracellular changes, affecting the immunity. The affected cells by the combinations of the free radicals and nitrites are the forerunners of the severe oncology diseases and the most affected are children who as smaller as they are the lower their immunity is. This is the reason why the nitrites must be removed from the waters that are drunk or from the food that is eaten by people. In the following we will exemplify the steps of the calculation of the ozone quantity necessary for the decontamination of the irrigation water.

1. The chemical analysis of the water is made by a Laboratory authorised by the competent states organs and so we obtain the Report of the analysis of the water which is used for the irrigation of the agricultural crops. In its content we mention the constant values of the constituents of the analysed water and the admitted limits by the water laws (In Romania the water law is Law 311/2004).

2. We make the difference between the measured value and the legally admitted value for the constituents that exceed the value of the legal limit and we note the obtained results with X_1, X_2, X_3..........X_n; these differences are the pollutant of the analysed water; these differences are expressed in grams.

3. We write the oxidation equation for each contaminant and based on this equation we calculate the corresponding ozone quantities expressed in grams used for the oxidation of each pollutant: Y_1, Y_2, Y_3..........Y_n (Meghea et al 2000).

4. We sum up these ozone quantities and we obtain the total ozone (Q) quantity necessary for the destruction of the pollutants that exceed the legal limit: $Q = Y_1 + Y_2 + Y_3 + \ldots\ldots\ldots + Y_n$, expressed in grams for 1 litre of water, that is for 0.001 m^3 of water, so: $Q = (Y_1 + Y_2 + Y_3 + \ldots\ldots\ldots + Y_n) \times 10^{+3}$ grams of ozone for 1m^3 of water → $Q = (Y_1 + Y_2 + Y_3 + \ldots\ldots\ldots + Y_n) \times 10^{+3}$ grams O/m^3 water.

5. We multiply the ozone quantity necessary to decontaminate 1 m^3 of water with 0,02 Kwh (0,02 Kwh is the quantity of electric energy that will be consumed for production of 1gram (mol) ozone and get quantity of electic energy which will consume for decontamination of Q grams of ozone, for 1 m^3, of water; $P = Q \times 0.02$ kwh/1 $m^3$of water.

6. We multiply the value P with 0,5 RON/1 kwh and we obtain the cost of the decontamination with Q grams of ozone of 1 m^3 the analyzed water. (Remark: 0.5RON/ kwh = the average approximate present value of one kwh of electric energy). $P1 = P \times 0.5$ RON/kwh $= (Y_1 + Y_2 + Y_3 + \ldots\ldots\ldots + Y_n) \times 10^{+3} \times 0.02 \times 0.5$ RON/kwh x h x m^3.

7. The oxidation reaction is very quick; with a good approximation we consider that it takes 1 second.

8. We know from the project of the adduction of the irrigation water the debit D in m^3/sec. In 24 hours the calculated debit of the adduction will be $D1 = D \times 24 \times 3600$, expressed in m^3/24 h.

9. We calculate the cost of the decontamination with ozone and the debit of the irrigation water for 24 hours:

$$C_{decontaminated} = (Y_1 + Y_2 + Y_3 + \ldots\ldots\ldots + Y_n) \times 10^{+3} \times 0.02 \times 0.5 \times D \times 24 \times 3600$$

$$C_{decontaminated} = (Y_1 + Y_2 + Y_3 + \ldots\ldots\ldots + Y_n) \times D \times 3.6 \times 10^{5} \text{ RON/24h}$$

where: $Y_1 + Y_2 + Y_3 + \ldots\ldots\ldots + Y_n$ = the decontaminator quantities that exceed the legal limits, in grams, D = the adduction debit in m^3/s.

Conclusions. Traces of contamination of the vegetation were discovered in the bees honey even though the beehives were situated at 8-25 km distances from the pollutant outbreak.

The bees proved to be an extremely sensitive and very exact sensor of the pollution degree of the environment.

Even though the decontamination with ozone is relatively expensive its effects are measured in years of healthy life, experienced by those who consume honey produced by the beehives that are situated near melliferous vegetation irrigated with decontaminated water.

Ozone is produced by a sure and actual technology; from this technology does not result toxic secondary components after the oxidation reactions.

Machines and equipment to obtain ozone are produced nowadays in Romania too.

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