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STUDY ON THE RECYCLING OF ZN-C AND ALKALINE BATTERIES AND THE REUSE OF MICROELEMENTS IN AGRICULTURE

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Abstract

The purpose of this study was to research the possibilities of recycling Zn-C and alkaline batteries as well as the possibilities of recovering the component microelements, determining their ability to be reused in agriculture as fertilizers to combat the deficiency of microelements in corn crops. To carry out this study, we dismanted several types of batteries, we established the rate of metal, plastic, paper and residue.We determined the composition of residue and the possibility of using it in agriculture.

Key words*: corn crops, microelements,recycling, residue, Zn-C batteries.*

INTRODUCTION

Tons of Zn-C batteries are discarded every year in the world without being recycled. Because batteries contain a series of heavy metals and toxic chemicals, if they are disposed with household rubbish, they lead to soil and water contamination. The zinc-carbon dry cell container is a zinc box provided with a layer of aqueous NH4Cl or ZnCl2 paste impregnating a paper layer separating the zinc box from a mixture of carbon (graphite) and manganese oxide (MnO2) -packed around a carbon rod.

Manganese (Mn) is an essential plant mineral nutrient, playing a key role in several physiological processes, particularly photosynthesis. Manganese deficiency is a widespread problem, most often occurring in sandy soils, organic soils with a pH above 6 and heavily weathered, tropical soils. It is typically worsened by cool and wet conditions. Numerous crop species have been reported to show high susceptibility to Mn deficiency in soils, or a very positive response to Mn fertilization. The impact of Mn deficiencies on these crops includes reduced dry matter production and yield, weaker structural resistance against pathogens and a reduced tolerance to drought and heat stress. In cereals, Mn deficiency can cause pale green or yellow patches in younger leaves. Mn contributed greatly to plant tolerance of different environmental stress factors such as winter hardiness, salinity and drought.

Zinc is an essential microelement to the growth and normal development of crops, the impact of this element's deficiency on plant growth and subsequently on its productivity is very high. Zinc has an important role in corn crop because: it stimulates synthesis of growth hormones and proteins; it occurs in the production of chlorophyll and carbohydrate metabolism; it supports calcium transport within plants; it is necessary in cell proliferation processes; it determines the growth of leaves and internodes as well as the process of grain formation.

Symptoms of zinc deficiency at corn are: the presence of a white or yellowish band in the central of the leaves, weak development of the root system, slow growth, small leaves, short intervals, late blooming and up to a 40% reduction of production.

The availability of zinc is affected by several factors including: organic matter content of soil, soil pH, soil conditions, soil compaction and the quantity of phosphorus in soil.

The study of the accumulation of micronutrients according to the stage of plant development plays a great importance for

subsidizing fertilizer application strategies and the minimum quantity for maintaining soil fertility. Corn plants accumulate nutrients as follows: Zn> Mn> Cu> B.

Figure 1. Deficiency of Zn at corn crop

The total amount of nutrients required to produce one ton of corn is: 0.0009 kg B; 0.019 to 0.02 kg Cu; 0.042 to 0.046 kg Mn; 0.100 to 0.194 kg Zn (Mousavi et. al., 2012).
According to a study carried out on the research site of Azad-Isfahan Islamic University on the evaluation of the effects of microelement's spraying on cereals, it was concluded that spraying microelements at plant height was effective (Safyan et. al, 2012).
The purpose is to correct or prevent Zn and Mn using the elements extracted from recycled Zn-C batteries.

MATERIALS AND METHODS

Because the municipal solid wastes are treated mainly by landfill, incineration and composting the components from disused battery permeate to soil or water, lead to polluting and jeopardizing the ecological environment. Nowadays, as we know the system for recycling battery is still not perfect, so what we can do to prevent pollution is recicle alkaline and Zn-C batteries, by recovering and reusing microelements.
To carry out this study we use: elelectronic balance Precisa model XT 120A, drying stove model Merrmet, Mixer mill 200, Pellet press PP 25, X-ray fluorescence spectrometry (XRF) using a Quant'X ARL spectrometer (Thermo Scientific, USA).
The batteries were dismantled, separated and was weighed each component (metal, plastic, paper, residue), were left in the drying stove and crushed into the mill to obtain fine granulation, were made pills (adding of Bindemittel) on the Pellet press and analyzed at XRF.

Table 1. Types of batteries and its content

Name of battery	Tipe of battery	Heavy metal added	Positive electrode	Negative electrode
Duracel	alkaline	No	MnO2	Zn
Toshiba	alkaline	Pb,Ni	MnO2	Zn
Eveready	alkaline	No	MnO2	Zn
Varta	alkaline	No	MnO2	Zn
Huatai	alkaline	No	MnO2	Zn
Aerocel	alkaline	No	MnO2	Zn
Panasonic	Zinc carbon	No	MnO2	Zn

RESULTS AND DISCUSSIONS

Global development must entail it an increased attention battery recycling management at the end of its duration of use.
If, in the past, most alkaline and zinc-carbon batteries were dumped or incinerated, nowadays we have ecological options for recovering valuable raw materials and for keeping environment safe of heavy harmful metals.
We chose many types of battery, we weighed and dismantled them and separated each components. After that we weighed the metal, plastic, paper and residue. At some of them we could not separated the paper as well as it should been done because of the electrolyte.
The percent of plastic is highest than the others batteries on Panasonic battery and lower than the others on Huatai battery. Also on Panasonic battery the percent of metal that represents the case is highest than the others and on Huatai battery percent of metal that represents the case is lower than the others.
During a several days, we work in the labs of 1 December 1918 University to carry out this study. We put the samples of residue on watch glass and left them in the drying stove until they had constant weight. Next we crushed them into the mill to obtain a fine granulation so we could mixt them with Bindemittel as follow: we added to 5 g of Eveready and 5 g of

Duracel 2,5 g of Bindemittel, to 5 g of Toshiba, Huatai and Aerocel we added 1,5 g of Bindemittel, to 5 g of TDK , Varta we added only 1 g of of Bindemittel and to 3 g of Panasonic, Eastpower and 2,4 g of GP we did not added something. From the samples with Bindemittel we made pills on the Pellet pressand the ones without we put them in capsules and analized it all on XRF.

Table 2. Types of batteries and its contents

Name of battery	Average weight of battery (g)	Average weight of plastic (g)	Average weight of metal (g)	Average weight of residue (g)
Duracel	32,7244	0,9906	9,4421	19,7877
Toshiba	8,4525	0,4809	3,0815	4,2030
Eveready	16,8509	0,2283	5,1233	11,4993
Varta	17,1859	0,3100	4,5814	12,2945
Huatai	8,3820	0,1130	1,9716	6,2974
Aerocel	7,1056	0,1544	3,8732	3,1139
TDK	16,3141	0,4791	5,7340	10,1010
Eastpower	12,2179	0,5586	3,8077	7,8516
Panasonic	28,8117	1,1237	11,7934	14,4978

Table 3. Content of positive electrods

Name of battery	Mn(g)	Zn(g)	C(g)
Duracel	13.05	6.23	78.85
Toshiba	22.95	6.57	62.53
Eveready	13.42	4.66	79.52
Varta	18.12	10.69	68.85
Huatati	17.54	7.15	69.55
Aerocel	23.6	4.09	96.1
TDK	18.89	15.42	66.28
Eastpower	10.41	13.28	73.51
Panasonic	17.33	9.51	65.19

The main component of residues is carbon followed by Manganese and Zinc. We want to recover Manganese and Zinc and apply them as fertilizer for corn crops. Except for Toshiba battery the others batteries can be used in agiculture.

CONCLUSIONS

After the research we have made we conclude that we can use batteries as fertilizer to corcrops except Toshiba that contains Pb and Eastpower that contains almost one percent of Al and one of Fe. This metal could pollute the environment and lately our lives.

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