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DETERMINATION OF CHEMICAL ELEMENTS IN *Eucalyptus grandis*, MANURED WITH BIOSOLID, BY NEUTRONS ACTIVATION ANALYSIS

Natalina de Fátima Mateus[1] e Tufic Madi Filho[1,2]

[1]Universidade Cruzeiro do Sul (UNICSUL), São Paulo (SP), Brasil
Rua Galvão Bueno, 868
01506-000 São Paulo, SP
natalina.mateus@edunet.sp.gov.br

[2]Instituto de Pesquisas Energéticas e Nucleares
Av. Prof. Lineu Prestes, 2242
05508-000 São Paulo, SP
tmfilho@ipen.br

ABSTRACT

The biosolid is a mud resulting from the biological treatment of wasted liquids. It is considered as a profitable alternative and important to minimize the environmental impact generated by the sewages thrown in to sanitary lands, in forest cultures like the *Eucalyptus grandis*. The objective of this work was to detect which chemical elements are present in *Eucalyptus grandis* samples, fertilized with different quantities of biosolid. The eucalyptuses of Estação Experimental de Ciências Florestais of Itatinga were planted in March of 1998 and collected with five years old. The used biosolid was produced by Station of Treatment of Sewer of Barueri – SP, classified as kind B. For the determination of the presence and quantity of chemical elements in the eucalyptus samples, an analysis technique by neutronic activation (NAA) was used followed by gamma rays spectroscopy. The samples were irradiated in the Nuclear Reactor IEA-R1 of IPEN-SP, followed by the measure of induced gamma rays activity, using a Detector HPGe. The presence, mainly of Br, Mn, Na and K, was detected in all analyzed samples.

1. INTRODUCTION

In the modern world, there is a non controlled production of residues and many are the sources that spread them in the environment in an indiscriminate way. They can contain extreme large quantities of elements and other, highly polluting residues [1]. The final destiny of the sewage mud is a serious environmental problem faced nowadays, once the elements potential toxic presence is undeniable [2]. It is necessary to find solutions, urgently, for the treatment of generated residues and to minimize their production [1]. For this, some alternatives are being used and studied. The options may be: by controlling the residues in sanitary lands, for the production of fuel, ceramic bricks, concrete, ceramic glasses and also as the biosolid used as a fertilizer for the improvement or recovering of agricultural soils [2].

The biosolid is a mud resulting from the biological treatment of residues industrial and sanitary liquids, considered as a profitable alternative and important to minimize the environmental impact generated by the sewages thrown in the sanitary lands. It is used as fertilizer, mainly in forest plantings for the following aspects: it is a non-eatable culture; increases the biomass; releases nutrients gradually; elevates the pH; elevates the macro-nutrients concentration; and reduces the costs by application in large areas, compared with conventionalfertilizers [1]. On the other hand, the biosolid presents negative aspects, such as:

it provides non-balanced nutrients; it favors the presence of pathogenic organisms; and it makes possible the presence of toxic chemical elements and even heavy metals [1,3].

Research evaluates the possibility of biosolid be responsible or not for the availability of chemical elements even the toxics in the tree itself, damaging its metabolism and consequently the quality of its wood, as well as the possibility of soil, rivers and other live beings contamination[4,5].

Eucalyptus grandis has an excellent productivity potential due to its wood characteristics, such as: lightness, few cracks, white core, resistance to weather, and others. These characteristics allow a great number of utilities for eucalyptus nowadays. In eucalyptus cultures, the presence of pathogens and some elements may damage directly important aspects: the metabolism of the tree; the integrity of other living beings (mushrooms, for example), and in the utilization of wood, as in the whitening of the cellulose in the paper manufacture.

Therefore, for the safe use of biosolid, the Sewage Treatment Stations must follow the procedures of CETESB [8], which determine the limit values for the metals concentration in soils, mud and agriculture soils, and thus must also follow the current legislation about the subject.

In this work, the method used for the determination of elements presence in the eucalyptus samples was the Neutron Activation Analysis. It is a sensitive technique for the analysis of multi-elements in a qualitative and quantitative way [9, 10, 11]. This analysis consists of pumping a certain material followed by the measure of radioactivity induced. In general, the irradiation is done and the result is measured using a spectrometry of gamma rays emitted by each radioisotope. This is a non destructive analysis method that allows, in some cases, to determine the concentrations of 20 to 40 elements, in a single sample.

2. OBJECTIVE

The objective of this work is to study the application viability of biosolid as manure. To evaluate if the biosolid used results in an increase or not of the chemical elements level absorbed by the tree we compared samples of eucalyptus fertilized with different aliquots of biosolid (10, 20, 40 ton.ha^{-1}) with samples of non fertilized material [10]. To determine the chemical elements the Neutrons Activation Analysis Method was used.

3. MATERIALS AND METHODS

To carry out this work, the eucalyptus plantation of the 'Estação Experimental de Ciências Florestais' in Itatinga, linked to 'ESALQ' of 'Universidade de São Paulo – USP' was used. It is a region of 830m^2 of medium altitude, located between the parallels 23°02'01" and 23°02'30", South latitude and the meridians 48°37'30" and 48°38'34", Greenwich West longitude [12]. In this region, the weather is mesothermic humid (Cwa), with a dense vegetation, soil kind Latossol Red - Yellow type with relief softly waved and texture medium-sandy dystrophic psamitico (sand = 830 g.kg^{-1}, silt = 50 g.kg^{-1} and clay = 120 g.kg^{-1}, in the layer of 0-20 cm) [12,13].

The eucalyptuses were planted in March, 1998, in a system of minimum cultivation in casualized blocks. Nine kinds of treatments were applied to the plantations, where we

considered only four, with dose variations of biosolid: the first treatment without addition of biosolid; the second, third, fourth with 10, 20 and 40 ton.ha^{-1} of biosolid respectively, with addition of mineral potassium. Trees with good fenotipic profile were selected: straight trunk, healthy aspect and very uniform top [12]. The eucalyptus were collected with 5 years old to generate the samples that were prepared with several cuts procedures and in the sequence grinding and sieving, until we obtained eucalyptus wood dust.

The biosolid used for the experiment was produced in the 'Sewage Treatments Station' of Barueri and classified as kind B (SENEA, 1999; Cetesb, 1999; EPA) [1, 14, 15]. It had organic material content around 300 g.kg^{-1} and relation C:N of 4.3 humidity around 60% and pH (in water) equal to 12 [16].

For the determination of elements presence in eucalyptus samples, we used the Neutron Activation Analysis followed by Gamma Ray Spectroscopy. The samples were irradiated with neutrons flux of the Nuclear Reactor IEA-R1 of Instituto de Estudos Energéticos Nucleares – IPEN – São Paulo, followed by the measure of induced gamma rays activity, using an HPGe detector.

4. CALCULATION OF CHEMICAL ELEMENTS CONCENTRATION:

For the calculation of quantification of elements found in the samples, the Formula of the Fraction of the Isotope [10] we used:

$$F = \frac{C_{OBS}.M.\lambda}{N.\sigma.\varepsilon.m.f.\Phi f_{\gamma}.(1-e^{-\lambda t_i}).e^{-\lambda t_e}.(1-e^{-\lambda t_c}).F_c} \quad (1)$$

Where: Cobs = observed counting; M = element atomic mass; λ = decay constant; ε = measures system efficiency; N = 6.02 10^{23} (Avogadro Number); σ = cross section, in cm^2; m = sample mass, in grammes; f = fraction of target isotope; F = Fraction of isotope in the sample, when the sample is a compound; fg = fraction of gamma decay; ti= irradiation time; te= waiting time between the end of irradiation and the beginning of counting; tc= counting time; Fc = correction factor.

5. RESULTS

The Figure 1 presents the elements γ spectrum identified in the samples: (1-1) – without biosolid, (4-7) 10 ton.ha^{-1}, (8-10) 20 ton.ha^{-1}and (9-5) 40 ton.ha^{-1}.

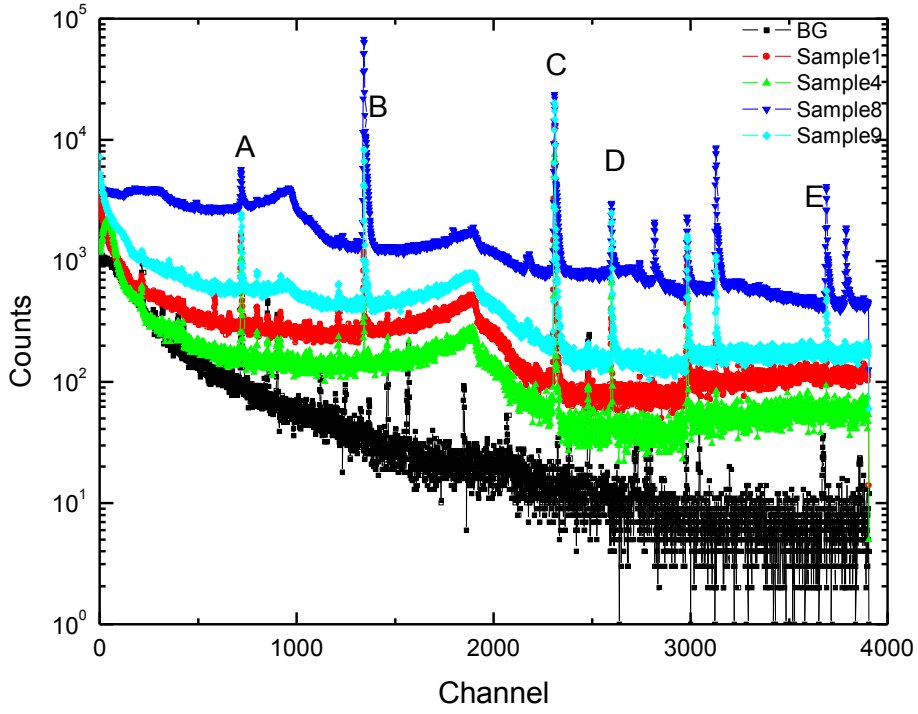

Figure 1 – Sample gamma spectra. Samples: (1) without biosolid; (4) 10 ton.ha^{-1}; (8) 20 ton.ha^{-1}; (9) 40 ton.ha^{-1}. Energy: A=554,34 keV; B=846,75keV; C=1368,55 keV; D=1524,70 keV; E=2112,60 keV.

The Figure 2 presents the elements mass in each sample determined using the gamma spectrometry.

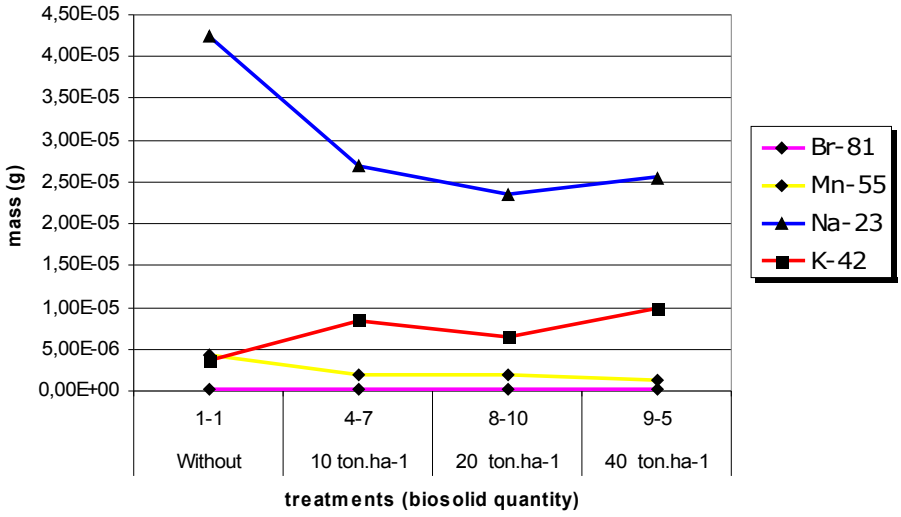

Figure 2: Mass of elements found in the samples.

6. CONCLUSION

The difference between the elements masses in the samples, in this first study, not allows to estimate the biosolid influence used as manure.

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