BIOPOLYMERS SYSTEMS FROM LEATHER WASTES FOR AGRICULTURE

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A large number of tanneries are facing serious problems regarding waste disposal, the more so as their storage in landfills leads to negative effects on the ecosystem. Organic biopolymers are a source of raw material for agriculture, whereas the composition of protean wastes provides sufficient elements to improve the composition and remediation of degraded soils and plants can exploit some elements, such as nitrogen, calcium, magnesium, sodium, potassium etc. As a result of the existing large quantities of organic waste, it is known from technological practice that from processing one tonne of raw hide, 75% is discarded, of which 50% can be used as organic fertilizer. Protean biopolymers were obtained by means of an innovative enzymatic procedure of processing protean waste, which in combination with other polymers (polyacrylamide, acrylic, maleic, cellulose, starch, etc.) will be used in agriculture. This scientific paper presents the characterization of protean biopolymers by methods specific for morpho-structural analysis (UV-VIS, IR spectroscopy, thermal analyses, X-ray diffraction, microscopy, etc.). The novelty of this work is this process of biochemical combination of synthetic polymers with organic biopolymers from tanneries with applications in agriculture.

Keywords: biopolymer, protean wastes, tannery, soil, structural analysis.

INTRODUCTION

Recent studies carried on in Central and Eastern Europe showed that in these countries, the main degradation processes induced by human activity consist in reduced soil fertility, crust-formation, water and wind erosion, landslides and chemical pollution.

Many industries, including leather industry, are faced with high expenditure for solid organic waste treatment and disposal. Therefore, the tannery protein wastes are required to be subjected to biochemical treatments with the view of recycling in the agriculture.

The use of untanned wastes presents a special interest, because it provides almost total fleshing waste discharge while obtaining qualitatively and economically valuable products.

The main target of this scientific paper is investigating the development possibilities for various multicomound systems of biodegradable polymers and studying the effects of these complex products on the structure and chemical and physical characteristics of degraded or contaminated soils (having a poor level of organic matter or submitted to a strong erosion process).
EXPERIMENTAL

Protean biopolymers were obtained by means of an innovative enzymatic procedure of processing protean waste, which in combination with other polymers (polyacrylamide, acrylic, maleic, cellulose, starch, etc.) will be used in agriculture.

The novelty is based first of all on the fact that the promoted technologies have as a starting point obtaining of new complex products by processing tannery organic wastes which can be applied in agriculture. Complex characteristics of proteic wastes from the leather industry are approached by accurately determining waste hide chemical composition and various possibilities of recovery and recycling using biotechnologies.

Using untanned wastes from tanneries is of particular interest because it offers the opportunity to eliminate nearly all wastes from fleshing, while obtaining qualitatively and economically valuable products.

Figure 1. FT/IR-ATR spectra of biopolymer samples (BOP1- hydrolyzed leather waste, BAZ- protean biopolymers 5, 10, 50% synthetic polymer)

Soil conditioning consists of improving the physical properties by using substances with varied origins, known in literature as “soil conditioners”. Soil contamination represents a moderate increase in the concentration of certain substances which are not harmful for plant growth and development, but which can represent the initial phase of the pollution process. Decreasing the effects of soil weathering/contamination/pollution involves the use of certain methods which contribute to a decrease in the intensity of the negative effects of the degradation of soil fertility and of the effects of contamination or pollution.

The process of biochemical combination of synthetic polymers with organic biopolymers from tanneries has innovative applications in pedology. Gelatin hide wastes were obtained from SC Pielorex Jilava, Ilfov county tannery. In this study, wastes from bovine hide shavings and trimmings are treated by chemical and enzymatic process.

ICPI together with the National Research & Development Institute for Pedology, Agrochemistry and Environment Protection Bucharest and the R&D Institute for Plant Culture and Protection Bucharest have tested protean biopolymer systems on degraded soils and for greenhouse and field plant growth.
In general terms, polyelectrolytes and other polymer classes, contribute to the improvement of soil properties, through one or more of the following effects:

- an increase in the aggregation of soil structural elements in weathered soils;
- prevention of crust formation in the period between sowing and spring, especially for plants with small seeds, which are very vulnerable;
- an increase in resistance to water and wind erosion of soils located on slopes and coarse grained soils (less than 12% clay).

Micromorphology analyses were conducted on a glazed, loamy-clayish chernozem, on leossoide deposits in the north area of Bucharest, on which the protean biopolymers (BAZ.50) was applied. The micromorphology analysis on thin sections of the way of distribution in the soil of bioenhancer (BAZ.50) and its relationship with different components of soil was made possible using a new technique to mark the conditioner with three types of dyes (hematoxylin, fluorescein isothiocyanate).

The bioenhancer (BAZ.50) was experimented on a culture of peas (annual vegetable), to improve the land through soil enrichment with biologically fixed nitrogen and to allow early release of land. The land was then prepared for sowing barley. Beside the nutrients in the soil, it has been shown that peas need nitrogenous fertilizers, especially in the first stage of development.
Subsequently, it grows at the expense of the fixed nitrogen in the air by bacteria that form nodosities on the roots. The most suitable soil reaction for growing peas is neutral or slightly alkaline, which requires that the soil for pea culture be moderately amended with limestone, but not directly, only predecessor plants. In the blooming phenophase, the nodosities on the roots of peas were counted from the treatment before sowing with bioenhancer (BAZ.50) (0.5 kg/m²).

Treatment of soil with bioenhancer (0.25-0.5 kg/m²) “very significantly” influenced the number of nodules developed on plant roots. Roots and organic remainders accumulated in the soil by the peas are an important source of nutrients and energy for soil microorganisms and their decomposition results in a significant amount of elements, especially nitrogen, necessary for nutrition of superior plants.

The scientific paper contributes both to recovery of poor and degraded soils in agriculture and to reduction of environmental pollution by exploiting sludge which is currently disposed of in landfills.

CONCLUSIONS

Biopolymers have been obtained by an innovative enzymatic procedure of processing protean waste resulted from leather processing, which in combination with other polymers (polyacrylamide, acrylic polymer, maleic polymer, cellulose, starch, etc.) can be used for remediation of degraded/eroded soils and growth of greenhouse and field plants.

All instrumental analyses (UV-VIS, IR spectroscopy, thermal analyses, X-ray diffraction, microscopy, etc.) have highlighted both reticulations between the protean polymer and the synthetic one, and the order of the polymer structure, which is due to the enzymatic hydrolysis process.

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REFERENCES


