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NOTICE OF ENTITLEMENT

We, Biokat Corporation of 6 Aristides Street, GR-105 59, Athens, Greece being the applicant and nominated person in respect of Application No. 68051/94, state the following:-

The person nominated for the grant of the patent has entitlement from the actual inventor by reason of the following:
The Applicant is the Assignee of the invention from the inventor.

The person nominated for the grant of the patent:
is the applicant of the application listed in the declaration under Article 8 of the PCT.
The basic application listed in the declaration made under Article 8 of the PCT is the first application made in a Convention country in respect of the invention.

BIOKAT CORPORATION
By their Patent Attorneys
CULLEN & CO.

ALISON McMILLAN

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METHOD OF CULTIVATION OF COAL AND LIGNITE INFIELDS FORMED BY UNCOVERING (OPEN CAST MINING)

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(71) Applicant(s)
BIOKAT CORPORATION

(72) Inventor(s)
GEORGE N VALKANAS

(74) Attorney or Agent
CULLEN & CO , GPO Box 1074, BRISBANE QLD 4001

(56) Prior Art Documents
AU 18915/92
AU 83048/87
CH 600747

(57) Claim

1. A method for improving the fertility of soil for cultivation of plants in a greenhouse, the greenhouse being located in a field from which coal or lignite has been mined such that the field contains mined soil having a greater sulfur content, a reduced ability to retain water and a reduced fertility for cultivation of plants as compared to an initial soil present in the field prior to the coal or lignite having been mined, said method comprising:

a) treating the mined soil by mixing the mined soil with absorbent polymers that enhance the ability of the mined soil to retain water and by supplying the mined soil with nutrients which improve the fertility of the mined soil for cultivation of the plants; and

b) mixing calcium carbonate into the soil in an amount sufficient to prevent the sulfur in the soil forming sulfuric acid in amounts toxic to plants.

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(71) Applicant *(for all designated States except US)*: BIOKAT CORPORATION [GR/GR]; 6 Aristides Street, GR-105 59 Athens (GR).

(72) Inventor; and
(75) Inventor/Applicant *(for US only)*: VALKANAS, George, N. [GR/GR]; 14 Constantinopoleos Street, GR-151 32 Marousi (GR).

(74) Agent: KILIMIRIS, Tassos-Anastase; European Patent Attorney, 38 Ypsilantou Street, GR-115 21 Athens (GR).

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(54) Title: METHOD OF CULTIVATION OF COAL AND LIGNITE INFIELDS FORMED BY UNCOVERING (OPEN CAST MINING)

(57) Abstract

A method is described to utilize used open-cast lignite mines by installing greenhouses with technological products attaining water economy of 7-8 times, unlimited nutritional capacity by enclosing pesticides and nutrients in a system of resins so as to release elements gradually, and with addition of calcium carbonate so as to limit the creation of sulfiric acid by the action of ground bacteria without pollution of the soil and therefore of need to move the greenhouses. This constitutes an original solution of agricultural utilization of these toxic and infertile soils.

METHOD OF CULTIVATION OF COAL AND LIGNITE INFIELDS FORMED BY UNCOVERING (open cast mining)

Inventor: GEORGE VALKANAS

The invention describes a method of agricultural utilisation of lignite and coal fields resulting by the technique of uncovering. This method specially describes an original approach of introducing technological products in those fields, which promote water economy, water availability and nutritional efficiency in the soils of lignite and coal fields as they become after the extraction of the carbonaceous matter, introducing agricultural utilisation with massive operation of greenhouses.

The lignite and coal fields which result from the technique of uncovering after the extraction of the richer deposits and with the rejected earth stacked in heaps, form surfaces containing carbonous matter which in general are not equilibrated soils and do not show fertility. It also happens that these soil surfaces from recovering and from rejected agregates in heaps, contain also sulfur, usually in high amounts 0,5-3%. Sulfur contained in that soil is converted very rapidly to sulfuric acid through the oxidative action of thiooxidative bacteria which

oxidize sulfur.

The soils of lignite and coal fields which are formed with the technique of uncovering are considered problematic and toxic and are faced internationally with two technical solutions.

a. The solution of covering the fields with fertile top-soil in a depth of 0.8 to 1.20 m which makes a very expensive and laborious approach, which, in spite of these difficulties, is the technical solution in application today.

b. The solution of removing the top-soil before the operation of the uncovering technique of the carbonaceous deposit. Top-soil is collected in rolls and is kept in covered shelters until the field deposits are exhausted; then it is placed on the surface of the resulted field. This solution is technically and ecologically correct; however, it is not followed in practice because it is a solution of high sensitivity and of high cost.

Thus, the restoration of the soils resulting after mining carbon, lignite or peat deposits is difficult. To improve those to fertile soils is a solution in search since those fields do not improve naturally.

These coal or lignite fields apart from the above, face problems because of soil instability and of non retaining water. They are also charged continuously

by urban acid precipitates. In case of operation of the thermoelectrical plants for long that charge may result to neutralising all the alkalinity of the soil to form acidic paths or areas.

It is estimated that the 60% at least of the sulfur in the carbonaceous matter after burning to produce electricity will precipitate as a gas or in the form of flying ash on the lignite or coal mining area. They make quantities which on operating fields give the following charges (on tons/y).

T A B L E

lignite field	burned lignite	flying ash	SO2	NOx
Megalopolis, Greece	15.000.000	60.000	200.000	150.000
Ptolemais, , Greece	45.000.000	120.000	300.000	500.000

All the above acid precipitates are burdening the ground of the district and neutralize soil alkalinity in a continuous action. But alkalinity is marginal and the final result will be to form acid areas and paths. It is recognized that the sulfur contained in the soil of lignite fields attains high values and with agricultural activity the biological oxidation of sulfur to sulfuric acid will accelerate with destruction of the soil functioning, shown by analysis made in Megalopolis, Greece, lignite field.

T A B L E

Results from the oxidation of soil samples in the lignite field of Megalopolis, Greece

(oxidation of the soil samples with 30% H2O2)

Number of sample	pH resulted
1	1.80
2	6.20
3	7.10
4	4.80
5	4.10
6	1.50
7	4.20
8	2.90

The agricultural utilization of coal and lignite fields, which are formed with uncovering, is not therefore, feasible today because natural fertility is not available and the solution in use today of fields with soil depth of 0,80-1,20 m. is of high cost and does not offer a possibility, since it is difficult to find much fertile soil to transfer.

The operation of thermoelectrical plants on the other hand is to continue with mining coal or lignite by uncovering the deposits and burning them to produce more and more airborne precipitates.

On the other hand it is imperative to create

agricultural employemnt for the local population with satisfactory income, and this is only possible through greenhouses, which shall also operate together with the power plants.

Supplementary heating with the warm cooling waters which make vast quantities in these areas will be offered, reducing costs. However greenhouses require humus and water retainability. It is experienced that the operation of greenhouses leads to soil contamination and in 2 to 4 years greenhouses need be transferred on new grounds. These conditions, however, cannot prevail in greenhouses operating in coal and lignite fields since they need to be constructed with high technical quality and the transfer shall be very costly.

The proposed solution in order to improve those toxic fields and to introduce greenhouse operation is highly original and very profitable. It is a solution based on the above requirements that leads to programmed production, to stable and high water retainability and operate so that nutrition is available according to existing needs biologically controlled, with complete utilization regulated to be slowly consumed so that there is no soil deterioration and materials are not rejected in the

environment.

According to a broad form of the invention there is provided a method for improving the fertility of soil for cultivation of plants in a greenhouse, the greenhouse being located in a field from which coal or lignite has been mined such that the field contains mined soil having a greater sulfur content, a reduced ability to retain water and a reduced fertility for cultivation of plants as compared to an initial soil present in the field prior to the coal or lignite having been mined, said method comprising:

a) treating the mined soil by mixing the mined soil with absorbent polymers that enhance the ability of the mined soil to retain water and by supplying the mined soil with nutrients which improve the fertility of the mined soil for cultivation of the plants; and

b) mixing calcium carbonate into the soil in an amount sufficient to prevent the sulfur in the soil forming sulfuric acid in amounts toxic to plants.

The invented solution includes:

a) The utilisation of processed polymeric products which in soil retain water in high amounts (200-300 times their weight). The retained water is quantitatively disposed to serve nutritional needs of the plants since it is molecularly enclosed and does not evaporate neither infiltrates into the ground. That way water is offered continuously; water economy up to 10 times is achieved. In addition these products advance feeding by ionexchange and absorption - desorption of unlimited capacity; thus they act as fertility promoters which by programming can lead to high quality and quantity in food products.

b) The utilization of fertilisers, soil pesticides, and trace metals etc coated in a

non-water-soluble form and are biodegradable in soil.

Products of the above type a) and b) are in the market today like the polyacrylamides used as water superabsorbants and coated feeding elements fertilisers, but these are not meeting the above

requirements in operating green houses in toxic coal and lignite fields.

The above solutions have been studied and realised by the same inventor through the products that the same inventor has developed, viz. the coated fertilisers of trade name Bioval-BRF described in the US Patent 5137 563 and the processed polymers of trade name Hydroval-X described in the ~~relevant~~ Greek patent No. 1001620.

The processed polymer products derived mostly from recycled polymers retain water up to 250 times their weight available for plant growth in repeated action to last in soil for many years up to 30 years. The coated fertilisers etc are consumed in soil according to the existing biological activity which is advanced by the action of Hydroval-X.

With that pair of technological products continuous nutrition and plant growth in soil is advanced with continuous water offer, water economy and the ability to consume all the nutrients in Bioval-BRF. Therefore no material charges will be created on soil, so as to need replacement. Thus, with this original and highly profitable solution, conditions are formed by which the greenhouse can operate without transposition after 2 to 4 years, which in fact makes a special

condition in those fields, where the electricity producing plants still operate and airborne acidic precipitates are produced.

However the soil of coal or lignite fields, where the proposed greenhouses are to operate is unstable and contains sulfur. Thus, by introducing plants to grow and biomass production, it will be oxidised to sulfuric acid. Also, in the intensive operation the greenhouses introduce, those events will be accelerated. The invention copes with it as follows: The soil in the greenhouse is mixed with pulverised calcium carbonate in quantity and in depth to create safety in operation without risk for destroying the greenhouse production by acidic contaminates.

E X A M P L E 1

The soil where the Greenhouses are to be erected is excavated in depth of 1,5 m, width of 25 m, length of 60 m. The soil of excavation is mixed with 1% to 2% calcium carbonate in pulverised form and the hole formed is filled with soil mixed with calcium carbonate leaving an upper layer of 30 cm. The rest of the excavated soil having calcium carbonate is thoroughly mixed with Hydroval-X I o/oo w/w and with Bioval-BRF 5 o/oo w/w and used to fill up the upper empty part of 30 cm depth. On the conditioned ground a Greenhouse of sofisticated design is then erected having to use heat supplied by the thermoelectrical

plants in form of warm cooling water of steam turbines.

E X A M P L E 2

Lignite soil of Megalopolis, Greece, which after H2O2 oxidation has shown acidity pH 6,5 is treated according to Example 1 and in a Greenhouse erected on it with heating network supplied by the cooling water supplied by the thermoelectrical plants operating at stable temperature of 30°C and saturated humidity. The Greenhouse soil is planned and parallel to it a Frame containing not treated lignite soil is placed and in both were planted tomato infant plants with irrigation applied every 3 days.

Green House Soil			Frame Soil
6 days	15	cm growth	3,8 cm
12 days	20,3	cm growth	7,1 cm
20 days	31	cm growth	10,2 cm
40 days	39	cm growth	12,2 cm

tomato plants rich in flowers	no flowering occurred
dry biomass weight 122gr/plant	32 gr/plant

i.e. four times speed and development.

E X A M P L E 3

In lignite soil of Ptolemais, Greece, which by oxidation (H2O2) gave pH 5.8 growth of tomato was organised as in Example 2

The following results were obtained

Green House Soil	Frame Soil
6 days growth 15 cm	4 cm
12 days growth 22 cm	6 cm
20 days growth 34 cm	all plants were
	destroyed
40 days growth 43 cm	

tomato plants rich in flowers

dry biomass produced 129 g/plant

E X A M P L E 4

On Ptolemais lignite soil, which after oxidation (H2O2) gave pH 6,8 lettuce plants are placed in Greenhouse soil and in Frame the Greenhouse operates at 30° and is irrigated every 2 days

Green House Soil	Frame Soil
6 days 16 cm growth	6 cm
12 days 21 cm growth	11,2 cm
20 days 35 cm growth	16 cm
40 days 46 cm growth	20,1 cm
dry biomass production	
32 gr/plant	10,5 gr/plant

E X A M P L E 5

In the greenhouse soil of example 4 the conditions for water economy were studied. After 12 days of growth the plants were left without irrigation. Wilting occurred in 42 days of growth. In between

growth was regular without differences to occur. It is thus observed a possibility for water economy up to 7 times not effecting growth.

5.

THE CLAIMS DEFINING THE INVENTION ARE AS FOLLOWS:

1. A method for improving the fertility of soil for cultivation of plants in a greenhouse, the greenhouse being located in a field from which coal or lignite has been mined such that the field contains mined soil having a greater sulfur content, a reduced ability to retain water and a reduced fertility for cultivation of plants as compared to an initial soil present in the field prior to the coal or lignite having been mined, said method comprising:

a) treating the mined soil by mixing the mined soil with absorbent polymers that enhance the ability of the mined soil to retain water and by supplying the mined soil with nutrients which improve the fertility of the mined soil for cultivation of the plants; and

b) mixing calcium carbonate into the soil in an amount sufficient to prevent the sulfur in the soil forming sulfuric acid in amounts toxic to plants.

2. The method as claimed in claim 1, wherein the sulfur content in the mined soil is between about 0.5 - 3% by weight prior to introduction of the pulverized calcium carbonate, said calcium carbonate being introduced into the mined soil in an amount of about 1 - 2% w/w.

3. The method as claimed in claim 1 or claim 2, wherein the polymers retain water in amounts of about 200 - 300 times more than a weight of the polymers.

4. A method as claimed in any one of claims 1 to 3, wherein the polymers are polyacrylamides.

5. A method as claimed in any of claims 1 to 4, wherein the nutrients comprise fertilizers which have a water insoluble coat, which are biodegradable and which are released gradually into the soil.

6. A method for cultivating a field comprising improving the fertility for cultivating plants in a field according to the method as claimed in any one of claims 1

to 5 and cultivating the plants.

7. The method as claimed in claim 6, wherein the greenhouse is maintained at a temperature conductive for the cultivation of the plants at least in part by cooling warm water from a thermoelectric plant.

8. The method as claimed in any one of claims 1 to 7 in which the polymers promote water economy and biologically controlled feeding of the plants, said polymers advancing water economy of the treated soil up to 10 times with unlimited feeding efficiency and with ion exchange and absorption - desorption of the nutrients.

9. The method as claimed in claim 8, wherein substantially all the feeding of the plants is controlled by the polymers, soil acts as a support for plant growth and the soil is not deteriorated or polluted such that it is suitable for cultivating plants in the greenhouse for an extended period.

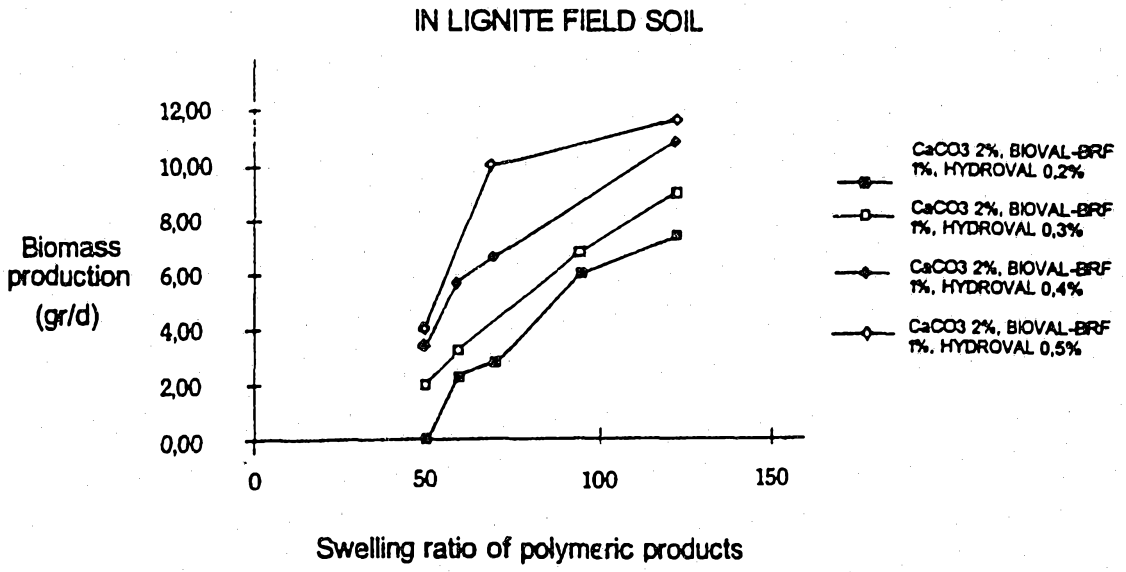
10. A method for cultivating a field from which coal or lignite has been mined, substantially as hereinbefore described with reference to the Examples.

DATED this 2nd day of July 1997

BIOKAT CORPORATION

By their Patent Attorneys

CULLEN & CO.


IN LIGNITE FIELD SOIL
Biomass production (gr/d)
12,00
10,00
8,00
6,00
4,00
2,00
0,00
0
50
100
150
Swelling ratio of polymeric products
CaCO3 2%, BIOVAL-BRF 1%, HYDROVAL 0,2%
CaCO3 2%, BIOVAL-BRF 1%, HYDROVAL 0,3%
CaCO3 2%, BIOVAL-BRF 1%, HYDROVAL 0,4%
CaCO3 2%, BIOVAL-BRF 1%, HYDROVAL 0,5%

INTERNATIONAL SEARCH REPORT

Internal Application No
PCT/GR 94/00012

A. CLASSIFICATION OF SUBJECT MATTER
IPC 5 A01G9/24 C05G3/04 C05F11/02 C05D3/02 A01G1/00

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
IPC 5 A01G C05G C05F C05D

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practical, search terms used)

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category *	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	CH,A,600 747 (KARL BUSER, OLTEN) 30 June 1978 see the whole document ---	1,5,6
X A	DE,A,41 05 595 (LAUSITZER BRAUNKOHLE AG) 10 September 1992 see claims 1-4 see column 1, line 45 - column 4, line 14 ---	2 4
A	DE,C,37 13 055 (VSESOJUZNYJ NAUCNO-ISSLEDOVATEL'SKIJ.....) 1 December 1988 see claims see column 3, line 56 - column 7, line 11 ---	1-3,6
A	EP,A,0 140 795 (SAID) 8 May 1985 see claims --- -/--	1,3,4,6

[X] Further documents are listed in the continuation of box C.

[X] Patent family members are listed in annex.

* Special categories of cited documents :

"A" document defining the general state of the art which is not considered to be of particular relevance

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"&" document member of the same patent family

Date of the actual completion of the international search	Date of mailing of the international search report
27 July 1994	04. 08. 94

Name and mailing address of the ISA	Authorized officer
European Patent Office, P.B. 5818 Patentlaan 2 NL - 2280 HV Rijswijk Tel. (+31-70) 340-2040, Tx. 31 651 epo nl, Fax (+31-70) 340-3016	RODRIGUEZ FONTAO, M

Form PCT/ISA/210 (second sheet) (July 1992)

International Application No
PCT/GR 94/00012

C.(Continuation) DOCUMENTS CONSIDERED TO BE RELEVANT

Category *	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	DATABASE WPI Section Ch, Week 8119, Derwent Publications Ltd., London, GB; Class L02, AN 81-33443D & JP,A,56 028 689 (MITSUBISHI HEAVY IND KK) 20 March 1981 see abstract	1-3

INTERNATIONAL SEARCH REPORT

ormation on patent family members

Interna al Application No
PCT/GR 94/00012

Patent document cited in search report	Publication date	Patent family member(s)		Publication date
CH-A-600747	30-06-78	NONE		
DE-A-4105595	10-09-92	NONE		
DE-C-3713055	01-12-88	NONE		
EP-A-0140795	08-05-85	FR-A-	2550783	22-02-85
		AU-B-	551926	15-05-86
		AU-A-	3205084	21-02-85
		DE-A-	3467156	10-12-87