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(54) **Title:** A METHOD FOR UTILIZATION AND/OR RECLAMATION OF DEGRADED, DESERT AND SEMI-ARID AREAS AS WELL AS A MULTI-COMPONENT COMPOSITION FOR USE IN THE METHOD AND A PROCESS FOR OBTAINING THE COMPOSITION USING WASTES

(57) **Abstract:** The invention relates to a method for utilization and/or reclamation of unproductive degraded, desert and semi-arid areas, optionally including an application directly onto the native soil of a protective bottom layer, adapted to the properties and structure of the soil, ensuring its stabilization and providing a support for a surface layer spread on said bottom layer, wherein according to the invention, as a surface layer a multi-component composition is used in the form of a balanced mixture of comminuted, waste fiber components, additional absorbent substances retaining water and seeds of various species of grass and other plants, as well as optionally fertilizers and/or mineral additives, which mixture provides favorable conditions for moisture accumulation and for growth and development of vegetation. The invention also relates to a multi-component composition for utilization and/or reclamation of unproductive degraded, desert and semi- arid areas, as well as a method for producing such a composition using waste. The invention contributes to the reduction of masses of wastes presently stashed away at landfills, garbage dumps or in an uncontrolled manner to water reservoirs such as rivers, lakes and seas.

WO 2021/006751 A1

A method for utilization and/or reclamation of degraded, desert and semi-arid areas, as well as a multi-component composition for use in the method and a process for obtaining the composition using wastes

The invention relates to a method for utilization and/or reclamation of degraded, desert and semi-arid areas, as well as a multi-component composition for use in the method and a process for obtaining the composition using wastes. The composition according to the invention is a new substrate for the vegetation of plants in degraded, desert and semi-arid areas subject to utilization and/or reclamation, and the process for obtaining the same contributes to the reduction of the volume of wastes thus far disposed in landfills and/or water reservoirs.

Green areas are indispensable elements of housing estates, urban agglomerations and desirable elements of industrial sites. Civilizational and economic development requires adaptation of soil conditions in the surroundings of the emerging buildings to the needs of decorative and crop plants. Due to a steady increase in number of urban and residential areas inhabitants, there is observed - on one hand an expansion of urban, industrial and residential buildings to the areas less and less attractive, including degraded, desert and semi-arid sites, and on the other hand – an increasing littering of the overpopulated regions.

Adaptation of unattractive areas for more demanding plants - both utility and decorative ones, for the permanent introduction of vegetation to such areas is a problem, as it requires a change of soil properties, providing a growing medium for plants, and supporting germination and further vegetation of plants by providing moisture necessary for this purpose.

For the plants their growth and development is possible under condition that each plant must be firmly attached to the ground, for which the plant's root is used. When the seedling finds a suitable medium or substrate in which it can root, the plant begins to grow. In areas deprived of soil suitable for plant growth, i.e. sandy and dusty soils where plants have no chance for rooting, badly rooted seedlings or plants are lifted even by the weakest wind, and are also washed away by every rainfall. In addition, the rain water is not retained in layers of sand. As a result of the large evaporation surface, the sandy soil immediately gets rid of water, while the sand itself is not a proper substrate for plant growth, because it does not have the necessary nutrients, and thus it does not allow vegetation. Other problems are associated with high ambient temperatures, which may

also be responsible for unproductiveness of surface soil layers as a result of accelerated decomposition of organic fractions contained in such substrate.

There is also a great demand for rapid development of green areas in the surroundings of residential buildings and urban buildings arising in areas attractive in terms of urban planning, but unfavorable from the point of view of vegetation.

Regardless of the problems outlined above, there is also a need for maintaining order and hygiene in overcrowded areas and to ensure safety for life and health of inhabitants in post-industrial areas.

At present, improper waste management is a serious problem both economic and ecological. On one hand, limited waste processing results in an increase of an environmental pollution - on land and in inland waters, seas and oceans, causing local environmental degradation and accelerating global, undesirable climate changes, and on the other hand, the masses of unprocessed wastes significantly reduce available quantities of global resources of industrial raw materials, especially fossil ones, therefore eliminating useful elements as well as processed and used raw materials from economic circulation (due to their dispersion at landfills and waste dumps). At the same time, it is also a big loss to recover energy from wastes by utilization of the same in incinerators without pre-segregation.

Earth - our planet and the living organisms inhabiting the same are at risk, because there is lack of vegetation in formerly cultivated or forested areas, which lack in turn, is not in favor of soil stabilization, causing their unproductiveness, erosion and gradual transformation into desert and semi-arid areas. As a result, the living space for wild animals shrinks. Lots of such areas are created as a result of robbery industrial activitiies, but also as a result of human civilization activities, mainly due to excessive deforestation and permanent acquisition of land for development or roads.

While developing the current comprehensive IZOLING technology, the innovative experience of the inventor of the present invention has been used, which are the subject of patents and patent applications discussed below regarding the use of waste, including for the production of substitute fuels.

In the Polish patent No. PL 180555 there is disclosed a replacement fuel made from municipal wastes in an admixture with combustible solid industrial wastes, preferably mine wastes, intended for firing rotary kilns in the cement industry. This replacement fuel also contains the addition of suitable chemically active substances and, optionally, an addition of a substance conditioning the fuel for pelleting or briquetting.

The Polish patent No. PL 176529 discloses industrial energetic fuel being a mixture of waste fuels containing up to 80 % by wt. of coal sludge and up to 60% by

wt. of organic fiber wastes or up to 30% by wt. of refinery wastes, less than 0.3% by wt. of filter wastes from sewage treatment plants and 2.5% by wt. of liquid soap or starch and up to 1.5% by wt. of glycol, wherein the fuel containing refinery wastes contains up to 20% by wt. of lime milk.

From the Polish patent specification No. PL 189243 a method for obtaining fuel from composts produced on the basis of drained sewage sludge from a sewage treatment plant is known, characterized in that the crushed compost is subjected to vibrations and moved by an oscillating motion within a vibrating conveyor during drying, and after drying up to 30% of moisture, the compost is concentrated and mixed in an amount of up to 40% by wt. with fine coal in a minimum amount of 60% by wt., and after that it is arranged in prisms or molded into molds in the form of briquettes of permanent shape. The fuel thus obtained is a valuable product with high energy values for use in municipal boiler rooms with fixed or mobile grates.

In addition, a solid fuel based on fine coal, which is a mixture of fine coal and an addition of organic residues after pressing vegetable oil, preferably rapeseed oil, and fine cereal and/or rapeseed straw, is known from the Polish Patent No. PL 196620, which fuel is characterized in that it contains 95% by wt. of fine coal and up to 60% by wt. of organic residues after pressing the vegetable oil, preferably rapeseed and up to 60% by wt. of cereal and/or rapeseed straw. This fuel has in its composition up to 3% of phosphoric acid compounds. The fuel does not require consolidation and is fed directly to the burners before or after mixing the ingredients.

The Polish patent no. PL 206204 describes fuel intended for boilers, in particular with fluidized combustion, and a method for manufacturing this fuel. The fuel is an aerobically fermented mixture of one (1.0) part by wt. of dehydrated sludge from sewage treatment plants with a dry matter content in the range of 10-50% by wt. and 0.5-10 parts by wt. of solid biological wastes. Biological waste is at least one waste material from the group consisting of cut grass, hay, wood clippings, leaves, chips, rape straw or other biological wastes from agricultural crop production, with the exception of cereal straw, or mixtures thereof. The method consists of mixing one (1.0) part by wt. of dewatered sludge from a sewage treatment plant with a dry matter content in the range of 10-50% by wt. with 0.5-10 parts by wt. of solid biological wastes, and then subjecting the mixture to an aerobic fermentation for 6-8 days, or carried out in a controlled manner for 2-4 days. The fuel after mixing all the ingredients is granulated in a rotary granulator.

The Polish patent no. PL 206166 discloses a system of complex use of wastes from forestry and sawmill production for the production of renewable fuel and the production of heat and electricity. Sawdust, bark and other wastes from sawmill production obtained in the woodworking process are mixed with wastes from forestry

production and comminuted in a chopper to the size of wood chips. Oversized boards and logs are separated in the separator and comminuted in a hammer mill. The resulting moist sawdust is dried in a sawdust dryer. Part of the dry sawdust is fed to the Pelle production line, and the remaining part is used as fuel in a gas turbine. The dry sawdust intended for combustion is fed to a pressure sawdust combustion chamber with an integrated cyclone system separating fly ashes and feeding purified flue gas to the gas turbine. Wastes from sawmill production and forest wastes are burned as fuel in the pre-fireplace equipped with a step grate.

Solid fuel, in particular from waste materials, is known from the Polish patent application No. P-303083. Solid fuel is a mixture of energy factor, optionally acting as a binder and carrier, with the amount of carrier in the fuel being not less than 10% by volume. The energy factor is a selected and comminuted preferably to a particle size not exceeding 5 mm, plastic or a mixture of plastics. Polyethylene and/or polypropylene and/or polystyrene and/or polyethylene terephthalate are used as the materials. Preferably, ground plant waste and/or pumice and/or ashes and/or slag are used as the carrier. Preferably the carrier contains additional components reacting with harmful gases, it may also contain small admixtures of flammable substances.

From the Polish patent application No. P-309476 a method is known for the degradation of raw municipal wastes or selected plastic wastes, especially of the PET type, by combustion in grate boilers and a fuel based on such wastes and coal, for combustion in grate boilers. The method of waste degradation is characterized in that the part of municipal waste constituting the fragmented hard fraction separated from raw municipal wastes or shredded selected plastic wastes, especially of the PET type, is mixed with energetic coal dust, whereto optionally lime-based refining agents are added, especially waste Carbide lime and the mixture is burnt in industrial boiler rooms, power plants or heating plants. The soft fraction remaining from raw municipal wastes is biodegradable. The fuel contains a hard fraction of municipal wastes separated from raw municipal wastes, preferably in an amount not exceeding 3 parts of this fraction per 7 parts of fine coal dust or selected plastic wastes, especially of PET type, preferably in an amount not exceeding 1 part of such wastes per 10 parts of energetic fine coal, as well as fine coal and optionally an additive of lime-based refining agent.

From the Polish patent application No. P-381786 there are known an alternative fuel and a method for producing the fuel from sewage sludge and separated municipal waste fractions, which consists of drained sewage sludge of a hydration level of about 80% in an amount of 25-50%, sorted municipal waste fractions of the organic nature in an amount of 10-20% and biomass constituting rape straw and/or sawdust and/or wooden chips in an amount of 50-75%. The method for producing such an alternative fuel is characterized in that sludges drained in the wastewater treatment process and

shredded organic waste fractions segregated from municipal waste after drying are mixed with the shredded second biomass intermediate product. The mixture is subjected to drying, milling and further evaporation. After obtaining a homogeneous loose mass, it is subjected to granulation, followed by rapid cooling.

Also technologies aiming to introduce vegetation to hostile areas, such as degraded post-industrial areas, as well as desert and semi-arid areas - also in hot and dry climatic zones, were the subject of interest of the present inventor.

The Polish patent No. PL 182379 discloses a mass for covering municipal wastes in landfills, consisting mainly of waste fibrous materials, which contains from 20 to 80% by wt. of shredded waste paper, from 10 to 70% by wt. of shredded fabrics and nonwovens, and also addition of water, disinfectants and adsorption agents, and optionally also plant seeds, especially grass seeds.

The Polish patent No. PL 186343, in turn, discloses a method of biologically activating the reclamation mass made of waste fiber materials, which during production is retrofitted with a colloidal adsorber, preferably kaolin, moderator, preferably alkaline and/or acidic sodium phosphate and sodium bicarbonate, and also a fertilizer artificial or organic, as well as traces of bacteria and/or colonies of protozoa, followed by the addition of plant especially grasses seeds, selected according to the purpose of the mass.

By the method according to the Polish patent No. PL 187755, industrial areas, especially sludge basins, may be subjected to reclamation using sleeves made of biodegradable perforated nonwoven fabric, filled with ground waste paper (20% - 80% by wt.), wood and/or peat (15% - 30% by wt.) and/or polystyrene (1% - 5% by wt.) and woven and nonwovens (10% - 70% by wt.) with an addition of seeds and cuttings of hemp wicker (Salix viminalis) and/or cane (Phargamites australis) in quantities from 1500 to 2000 pieces per 100 m^2 (1 are) of the reclaimed area with an admixture of artificial fertilizers, which are left on the edge of the reclaimed area until the vegetation process begins in them, and thereafter they are distributed on the surface of the reclaimed area, maintaining a distance between adjacent sleeves equal to 75% to 150% of the sleeve diameter.

The Polish patent No. PL 213509 describes a method of reclamation of various degraded deprived of soil areas, the method being based on the use of waste materials that previously – in available recycling technologies, were useless. The method allows to start green vegetation in extremely difficult areas not previously reclaimed due to the high costs and lack of effective measures, and at the same time contributes to the reduction of waste by about 30% when introducing their selection.

The aim of the present invention is to develop a comprehensive technology enabling adaptation of degraded, desert and semi-arid areas to the needs of residents,

including the way of utilization and/or reclamation of such areas as well as the multi-component composition for use in this method, as well as the method of its production using wastes, in which there are used not only the energy value of waste materials traditionally used as fuel in power plants, but also the mineral potential of these materials.

A method for utilization and/or reclamation of unproductive degraded, desert and semi-arid areas, optionally including an application directly onto the native soil of a protective bottom layer, adapted to the properties and structure of the soil, ensuring its stabilization and providing a support for a surface layer spread on said bottom layer, in which method according to the present invention as the surface layer a multi-component composition is used in the form of a balanced mixture of comminuted waste fiber components, additional absorbent substances retaining water and seeds of various species of grass and other plants, as well as optionally fertilizers and/or mineral additives, which mixture provides favorable conditions for moisture accumulation and for growth and development of vegetation, and additionally after spreading the surface layer, it is sprayed with water, optionally with an addition of organic fertilizer of plant origin, produced from aloe, with sea algae, humic acids and molasses from sugar cane as additives in presence of functional microorganisms, and also in the periods of subsequent land care, the addition of the same fertilizer is used for watering plants.

In the method according to the invention, the surface layer is additionally "grafted" with trace amounts of beneficial bacteria and/or colonies of protozoa, preferably "Ema" - active Effective Microorganisms, adapted to the climate and type of plants and the native soil.

A multi-component composition for the utilization and/or reclamation of unproductive degraded, desert and semi-arid areas, according to the invention is a balanced mixture of comminuted waste fiber components, additional absorbent substances retaining water and seeds of various species of grass and other plants, and optionally fertilizers and/or mineral additives, to be spread as a surface layer directly on the reclaimed native soil or on an additional bottom layer separating the surface layer from the native soil, creating conditions for the accumulation of moisture and for the growth and development of vegetation.

Preferably, the mixture contains comminuted fiber components, which are selected fibrous waste materials - natural and artificial, previously subjected to pre-comminution and followed by thorough fiberisation.

Preferably the mixture contains, as additional water retaining substances, waste fibrous sanitary materials such as sanitary napkins and disposable diapers, previously

comminuted, saturated with water and disinfected by mixing with a disinfectant, preferably with chlorinated lime.

In the composition according to the invention, the comminuted fibrous components constitute 92-97 % by wt., while the waste fibrous sanitary materials such as sanitary napkins and disposable diapers, previously comminuted, saturated with water and disinfected constitute 3-8 % by wt. based on the total weight of the composition.

In the composition according to the invention, the comminuted selected fibrous components and waste comminuted fibrous sanitary materials are evenly dispersed throughout the whole mass and after spreading on the bottom protective layer or directly on the native soil provide a layer of hygroscopic mass able to retain water and favor rooting of plants germinating in it, while being well aerated due to a random orientation of individual fibers and their mutual entanglement.

A method of manufacturing a multi-component composition for utilization and/or reclamation of unproductive degraded, desert and semi-arid areas, according to the invention is characterized in that selected waste fibrous materials - natural and artificial, are subjected to initial comminution, followed by proper fiberisation and combining with fibrous sanitary wastes, such as sanitary napkins and disposable diapers, previously comminuted, saturated with water and disinfected by mixing with a disinfectant, to form a homogeneous pulp, in which the comminuted selected fibrous components and comminuted waste fibrous sanitary materials have a random orientation of individual fibers, which fibers are evenly dispersed throughout the composition mass and mutually entangled with each other, and then obtained homogeneous fiber mass is retrofitted with seeds of various grass species and other plants, as well as optionally with fertilizers and/or mineral additives and optional additional supportive components.

According to the invention, after the comminutation of waste fibrous sanitary materials, a thin (and comminuted) film not able to absorb water is separated from the hygroscopic fraction, of which film external coatings and edges of sanitary products such as sanitary napkins and disposable diapers are made, preferably by blowing pieces of the same from the surface of the hygroscopic mass during its soaking and disinfection or by separation on a sieve.

According to the invention, in the method the comminuted and fiberized selected waste fibrous materials are combined with waste fibrous sanitary materials, previously comminuted, saturated with water and disinfected in a ratio of 92-97 % by wt. of waste fiber materials and 3-8 % by wt. of waste fibrous sanitary materials after separation therefrom of the film not able to absorb water.

The whole of the multi-component composition for the utilization and/or reclamation of unproductive degraded, desert and semi-arid areas in accordance with

the invention may be is additionally enriched with non-toxic ashes obtained in effect of combustion of residues left after separation of the selected waste fiber materials from municipal and industrial wastes, optionally with the addition of green, wood and/or mine wastes.

According to the invention, the resulting multi-component composition for the utilization and/or reclamation of unproductive degraded, desert and semi-arid areas, is capable of retaining water due to the hygroscopic properties of comminuted waste fiber sanitary materials present in it, optionally with the addition of a hydrogel – as their equivalent and replacement, traditionally used for such purposes, and provides for good aeration of the substrate layer, favoring germination and growth of plants, which good aeration results from random orientation of individual fibers and their mutual entanglement.

According to the invention, the comminutation and fiberization of fibrous materials is carried out in suitable low- and high-speed mills, and chlorinated lime is preferably used as a disinfectant.

The invention is explained in the following detailed description and in the working examples.

Detail description of the invention

The present invention relates to the comprehensive IZOLING technology useful for the utilization and/or reclamation of unproductive degraded, desert and semi-arid areas in all climate zones, ensuring the restoration of biodiversity in unproductive and unproductive areas, and in the longer term the stabilization and development of the entire ecosystem, i.e. flora and fauna, in including animals living in the wild nature, birds, insects.

It should be emphasized, however, that areas developed and/or reclaimed using the present invention cannot be used for a period of 2-4 growing seasons directly for cultivation of edible plants, including those used as feed. After this period, soil chemical tests should be carried out and the land should further used according to the results of the tests.

The currently developed IZOLING technology allows revitalization of degraded, desert and semi-arid terrains, enabling their greening and gradual return of vegetation. Plants can root in the composition according to the invention spread directly on the unproductive native soil or on a known protective layer, which in their composition contains components accumulating water from which both germinating and developing plants can use it, and additionally the composition according to the invention can also be retrofitted with fertilizers and other supportive components. The composition

according to the invention based on a pulp is hygroscopic and it also retains morning dew and prevents evaporation of such a moisture available in the morning.

It should be emphasized that plants rooting in the surface layer of the composition according to the invention strengthen its structure by penetrating between the comminuted fibers and by gradually producing a durable turf.

The IZOLING technology is a comprehensive solution. At the beginning it is necessary to examine the area requiring greening. This study includes soil chemical analyzes, selection of vegetation according to the results of these analyzes, as well as climatic and hydrological conditions prevailing in the area. Then, as required, the composition of the multi-component composition according to the invention for utilization and/or reclamation of the target area is specified, taking into account the components necessary for the development of the previously selected vegetation. Depending on the circumstances specific to a given area, a team of specialists in revitalization may recommend a preliminary covering of the soil in a selected area with a known protective layer and the distribution of the composition according to the invention as a surface layer. After determining all the process parameters, the revitalization team then carries out all the necessary steps and maintains the area for the first three vegetation seasons.

As already mentioned, the method of managing unproductive degraded, desert and semi-arid areas optionally includes applying directly to the native soil a known protective layer adapted to the properties and structure of the substrate, ensuring its stabilization and providing support for the surface layer, distributed on this protective layer, according to the present invention, a multi-component composition being in the form of a balanced mixture of ground, waste fiber components, additional water storage substances and seeds of various species of grass and herbs, as well as optionally fertilizers and/or mineral additives is used as the surface layer, which creates favorable conditions for moisture accumulation and vegetation growth and development. This surface layer can additionally be "grafted" with trace amounts of beneficial bacteria and/or colonies of protozoa, preferably the "Ema" Effective Active Microorganisms adapted to the climate and type of plant and substrate (native soil).

In parallel to the revitalization team's operations, the production of multi-component compositions for the utilization and/or reclamation of unproductive degraded, desert and semi-arid areas is carried out by the method of the invention.

Here, the first step is to organize the acquisition of waste materials for the production of compositions according to the invention, as well as to utilize the residues after selecting useful fractions of materials from municipal wastes and municipal waste water.

The basic component of the composition according to the invention is a fibrous material obtained from waste nonwovens and fabrics made of natural and/or artificial fibers, the acquisition of which should be organized as an alternative to the paid deposit of such materials in landfills by entities involved in waste management. A special kind of natural fibrous material are cellulose packaging materials made of paper and cardboard, as well as waste paper, which can be useful in comprehensive IZOLING technology.

Another important secondary raw material for the production of the compositions according to the invention are waste fibrous sanitary materials such as sanitary napkins and disposable diapers, containing moisture absorbing substances - as a replacement for hydrogels providing plants with prolonged access to moisture. These materials are nuisance constituents of municipal waste, but are highly useful in the solution according to the present invention. Therefore, it is necessary to organize collection of such waste or its selection from municipal wastes.

Some fractions of mixed municipal wastes are processed into stabilizer by two-stage mechanical-biological processing - first by fermentation with anaerobic bacteria and then aerobic treatment, while from separately collected fractions - biowaste fractions and green wastes are subjected to aerobic composting. The products of such municipal and green waste treatment can be used to form an insulating layer on native soil subject to utilization and/or reclamation by the method according to the invention. Also dehydrated sewage sludge from municipal sewages can be managed in accordance with the present invention, in the form of an IZOMIX mixture containing the composition according to the invention and sewage sludge.

As mentioned above, from the Polish patent application No. P-381786 A1, alternative fuel is known from drained sewage sludge and separated municipal waste fractions of an organic nature and from ground waste biomass (rape straw, reed, sawdust, chips and the like), subjected to drying, milling and further evaporation to obtain a homogeneous loose mass, which is then granulated and quickly cooled. The composition of this fuel can vary within wide limits.

Both the above-mentioned alternative fuel and stabilizer, which despite processing is still waste, combined with fiber pulp unsuitable for use in the reclamation process of degraded, desert and semi-desert areas by the method of the present invention usually have a high energy value - about 15-19 GJ, so they can be utilized as an energy factor. The incineration of such waste leaves ash, which requires testing - primarily for the presence of heavy metals, and in the case of its composition that does not endanger the safety of the natural environment, humans and animals, this ash may optionally be

used as an addition to the multi-component composition according to the invention - also as a substitute for fertilizer, after retrofitting with missing micronutrients.

It should be emphasized that the above discussed wastes cannot be directly used in reclamation processes, mainly due to the bacteriological threat that may be eliminated during combustion process.

The heavy metal content eliminates the ash obtained as a fertilizer replacement in the composition according to the invention. The threat of the presence of heavy metals in the ash occurs mainly when the material for combustion contains materials such as batteries, electrical equipment, fluorescent lamps, household chemicals and plant protection products - herbicides and pesticides.

Municipal wastes, on the other hand, include wastes of animal and plant origin, household wastes, packaging waste from paper, cardboard, plastics, as well as contaminated textile waste from industrial plants, such as work clothes, textiles from textile plants, residues from upholstery factories, from scrapping companies. This type of waste products contain many elements and substances needed for vegetation in its chemical composition. However, they do not always meet ecological and phytosanitary standards and require thermal utilization. The content of mineral components in ashes obtained after burning the discussed types of municipal wastes is comparable with their content in artificial fertilizers, and even higher and more diverse. It should be emphasized that combustion eliminates virtually all toxic contaminants from the indicated textile wastes from industrial plants, due to high temperatures and the necessary air (oxygen) supply to the combustion zone. For complete safety, however, it is necessary to conduct an analytical ash control for the presence of substances harmful to human and animal health and to the environment, before using the ashes in the solution according to the invention. Based on the research carried out in the course of work on the present invention, it was found that under the same conditions, plants growing on a substrate with the addition of ash thus obtained, when compared to plants growing on a substrate with the addition of artificial fertilizer, developed comparatively well, but their stems and leaves had slightly higher green mass than the same plants growing on a medium enriched with fertilizers.

The technology currently developed utilizes a whole range of chemical components contained in wastes that has not been used or processed so far. Such wastes includes wastes that is currently stored in specially prepared landfills - in troughs isolated from the native ground with PEHD foil, from where they are never extracted for disposal, so they are irretrievably lost. According to the present invention, they can be used in 96%, also taking into account their energy value. Chemical processes occurring at high temperature during combustion, with the possible addition of

limestone powder, favorably affect the quality of ash obtained. It should be noted that the ash utilized in the composition according to the invention is added as a fertilizer in an amount of 3.5 to 13 % by wt.

According to the IZOLING technology, which additionally uses solutions according to Polish patent No. PL 213509 and Polish patent application No. 394653 A1, the present invention can be supplemented with a fertilizer replacement in the form of ashes from the incineration of unsuitable municipal wastes, which cannot be used directly in the reclamation processes of the present invention, being highly profitable due to obtaining energy from the thermal utilization of this sort of wastes, whereby the resulting ash is properly mixed and additionally equipped with the missing nutrients, it becomes an excellent product supplying plants with necessary minerals, supporting vegetation and growth. Acquiring energy in the process of burning the mentioned wastes is an additional positive solution according to the invention, in addition to the benefits of using ash as a source of mineral components needed by plants.

After confirming that the ash does not contain ingredients dangerous for the environment, humans and animals, according to the invention the missing mineral components in amounts necessary are optionally added and the whole is used to fertilize the fibrous, multi-component composition according to the invention after spreading it on the site subject to reclamation or is introduced into the composition during its manufacturing.

In the absence of the ash or when the ash is available in insufficient amounts for the purposes of producing the composition of the invention, to be used in the processes of revitalization, greening and/or reclamation of desert, semi-arid and degraded areas based on IZOLING technologies, the method of producing compositions according to the invention employs an addition of artificial fertilizers available in market.

The manufacturing of the composition according to the invention and its use according to the invention requires a rigorous selection of the wastes used as well as careful testing of the components and the finished composition, since there is usually no information about the components used for making various objects, which after fulfilling their roles, were thrown in the trash. It is known that manufacturers often, especially in the past - are not or were not aware of the harmful effects of some commonly used components.

The invention is further illustrated by the following working examples.

Example 1. Pre-comminuted and fiberisated wastes of fibrous components and comminuted waste fibrous sanitary materials in the form of used disposable diapers and sanitary towels were flooded with chlorinated water for hygienic purposes. The whole was mixed to the extent that ensures uniform distribution of components in the obtained

pulp intended for utilization and/or reclamation of degraded, desert and semi-arid areas with sandy and dusty native soil.

The composition obtained from waste fibrous materials was spread on the native soil of the revitalized area in two layers. As the first layer, 3-8 cm thick, a semi-fluid composition obtained as above, containing waste comminuted and fiberisated fibrous materials in an amount of 30 to 80% by vol. is spread directly on the leveled native sandy soil. Irrigation tubes were introduced into this layer before it thickened, evenly distributed over the entire covered surface. After thickening of the first bottom layer, the composition obtained as above, with a thickness of several to 6-8 cm, the composition obtained as above, containing wastes comminuted and fiberisated fibrous materials from nonwovens and fabrics made of natural and artificial fibers in an amount of 65-85% vol., waste pulverized cellulose products in an amount of 15-45% vol. and crushed and disinfected used disposable diapers in an amount that guarantees the introduction of about 150g per 2 m^2 of water-absorbing component contained in them, and in the event of a shortage of such waste fibrous sanitary materials, the addition of a hydrogel is necessary. After applying the surface, second dry layer, the whole was wetted with water and irrigated according to the prevailing weather conditions. After emergence of plants to a height of 5-10 cm, optionally 50 grams of dry fertilizer per 1 m^2 was applied. Water or optionally a water colloid of ash without ingredients dangerous to the environment, humans and animals were introduced into the irrigation pipes.

The whole spread mass was additionally sprinkled with water and then tamped to eliminate empty spaces.

Example 2. The mass of wastes not suitable for manufacturing the composition to be spread directly on dusty native soil was incinerated in a cement plant. Obtained ash was tested for content of ingredients dangerous to the environment, people and animals. After ascertaining the absence of hazardous contaminants, the ash was wetted, mixed with the comminuted and fiberisated waste fibrous materials, retrofitted with a 30-40 dkg/m^2 hydrogel or a suitable mass from comminuted and disinfected used disposable diapers. The whole composition was provided with seeds of a mixture of various grasses and plants.

The resulting composition was spread as a 5-10 cm thick layer and additionally sprinkled with clean water. Directly on the native soil, a bottom layer was spread in the same manner as in Example 1, i.e. in the form of a semi-liquid pulp made from comminuted waste cellulose products as in Example 1, in an amount of 75% by vol., with the addition of comminuted waste plant pulp and/or biological waste from forestry industry, from municipal pruning or tobacco wastes in an amount of 15% by vol. While mixing the already wet composition, up to 5 % by wt. of ash - free from ingredients

dangerous to the environment, people and animals, obtained from municipal waste and waste industrial cellulosic products, wastes of fibrous materials from textile industrial plants, waste in the form of work clothes, jute bags, fiber filters, waste from upholstery factories, polyethylene film, waste from farming in the form of straw, waste from plant mass from forestry, from processing of plant products in the form of wood chips or sawdust and wood pulp. Irrigation tubes were introduced into this bottom layer.

The whole spread mass was additionally sprinkled with water and then tamped to eliminate empty spaces.

Example 3. A mixture of 15% by wt. of cellulose products selected from municipal wastes, 5% by wt. of fibrous materials from natural and artificial fabrics selected from municipal and industrial wastes, 5 - 10% by wt. used disposable diapers, 2-4% by wt. of polyethylene film wastes, 23% by wt. of plant biomass wastes from forest management and processing of plant products, including wood processing, was introduced into a shredder, and then into a high-speed mill with rotary knives, and mixed and ground to particles of 1-50 mm in size. The resulting mixture was then further mixed on the same device with the addition of 10% by wt. of powdered ash, previously analyzed for the absence of components hazardous to the environment, humans and animals. After mixing and wetting the mass with water up to 50% by wt., a granular product was obtained, which was distributed in the reclaimed area, after additionally equipping this mass with plant seeds, addition of EMa activators and a hydrogel, when the climatic conditions required it.

The whole spread mass was additionally sprinkled with water and then tamped to eliminate empty spaces.

Example 4. The procedure was carried out as in Examples 1-3, spreading the bottom and surface layers one after the other, with the only difference that as the bottom layer applied directly to the native soil, with a thickness of a few to several tens of centimeters, there was used a semi-fluid pulp made of waste comminuted fibrous materials and absorbent mass obtained from comminuted and disinfected disposable diapers, with an addition of EMa activators, seeds and other waste components indicated above, in an amount of up to 70 - 90% by vol. as well as from an aqueous solution of fermented stabilized sewage sludge or colloid enriched with manure from poultry farming in an amount of up to 5 - 30% by vol. and 3% to 5% by wt. ashes after burning fibrous materials that are not suitable for preparing the composition for reclamation due to chemically polluting components. The next layer was dry applied after thickening of the first layer, up to several centimeters thick, consisting of up to 80% by vol. from comminuted waste fibrous materials obtained from natural and/or artificial fabrics and fibers, comminuted waste cellulosic materials including waste packaging products in an

amount of up to 80% vol. and containing alternatively a hydrogel in an amount of 50-500g per m^2

An absorbent mass was obtained from used disposable diapers PAMPERS and sanitary towels. These materials were fed by conveyor belt to the high speed crushing machine. Then, the obtained milling was directed to the mixer with comminuted and fiberisated waste fibrous material through a trough with a disinfecting liquid, where the particles of a film not able to absorb water from which the external coatings and edges of sanitary products such as sanitary napkins and disposable diapers, the particles being located on the surface of the fluid were separated from absorbent material, preferably by blowing them away from the hygroscopic mass or by means of a sieve that separates the lighter film from the absorbent material. As a disinfecting liquid, water was used with the addition of disinfectants, including chlorinated lime. Absorbing (hygroscopic) mass particles after absorbing the liquid settled on the bottom of the trough from where they were fed by a metal conveyor to a mixer with fiberisated fibrous wastes.

The whole spread mass was additionally sprinkled with water and then tamped to eliminate empty spaces.

Example 5. The procedure was carried out as in Examples 1-3, the only difference being that for watering of the mass tamped aiming to remove voids therein, an aqueous solution of the soil and foliar fertilizer *TRIPLUS ALOE VERA*® was used instead of plain water. The aqueous solution in a concentration of 5% by volume was used (prepared by diluting 0.5 liter of the fertilizer with water up to 100 liters), in an amount of 2 liters/1m^2.

In addition, for daily care of the lawns and other areas covered with green plants, grown on the land reclaimed according to IZOLING and IZOMIX technologies – once a month (during flowering once every 14 days) for watering the grass/plants an aqueous solution of the organic fertilizer *TRIPLUS ALOE VERA*® of plant origin, was used in a concentration of 0.3% by vol. (prepared by diluting 0.3 liter of the fertilizer with water up to 100 liters), in the amount of 2 liters/1m^2, in other cases using just water for watering.

TRIPLUS ALOE VERA® is a foliar and soil organic fertilizer of plant origin, containing basic nutrients (nitrogen, phosphorus and potassium), made from aloe, with the addition of marine algae, humic acids and sugar cane molasses, with the participation of functional microorganisms and is approved for marketing and use in Poland and in some countries outside the European Union on all soil types.

As a result of this additional care, plants have better tolerated periods of dryness, grew more luxuriantly and bloomed more abundantly.

Claims

1. A method for utilization and/or reclamation of unproductive degraded, desert and semi-arid areas, optionally including an application directly onto the native soil of a protective bottom layer, adapted to the properties and structure of the soil, ensuring its stabilization and providing a support for a surface layer spread on said bottom layer, **characterized in that** as the surface layer a multi-component composition is used in the form of a balanced mixture of comminuted waste fiber components, additional absorbent substances retaining water and seeds of various species of grass and other plants, as well as optionally fertilizers and/or mineral additives, which mixture provides favorable conditions for moisture accumulation and for growth and development of vegetation, and additionally after spreading the surface layer, it is sprayed with water, optionally with an addition of organic fertilizer of plant origin, produced from aloe, with sea algae, humic acids and molasses from sugar cane as additives in presence of functional microorganisms, and also in the periods of subsequent land care, the addition of the same fertilizer is used for watering plants.
2. The method according to claim 1, **characterized in that** the surface layer is additionally "grafted" with trace amounts of beneficial bacteria and/or colonies of protozoa, preferably"EMa" - active Effective Microorganisms, adapted to the climate and type of plants and the native soil.
3. A multi-component composition for the utilization and/or reclamation of unproductive degraded, desert and semi-arid areas, **characterized in that** it is a balanced mixture of comminuted waste fiber components, additional absorbent substances retaining water and seeds of various species of grass and other plants, and optionally fertilizers and/or mineral additives, to be spread as a surface layer directly on the reclaimed native soil or on an additional bottom layer separating the surface layer from the native soil, creating conditions for the accumulation of moisture and for the growth and development of vegetation.
4. The composition according to claim 3, **characterized in that** the mixture contains comminuted fiber components, which are selected fibrous waste materials - natural and artificial, previously subjected to pre-comminution and followed by thorough fiberisation.
5. The composition according to claim 3, **characterized in that** the mixture contains, as additional water retaining substances, waste fibrous sanitary materials such as sanitary napkins and disposable diapers, previously comminuted, saturated with

water and disinfected by mixing with a disinfectant, preferably with chlorinated lime.

6. The composition according to claim 3, **characterized in that** the comminuted fibrous components constitute 92-97 % by wt., while the waste fibrous sanitary materials such as sanitary napkins and disposable diapers, previously comminuted, saturated with water and disinfected constitute 3-8 % by wt. based on the total weight of the composition.

7. The composition according to claim 3, **characterized in that** the comminuted selected fibrous components and waste comminuted fibrous sanitary materials are evenly dispersed throughout the whole mass and after spreading on the bottom protective layer or directly on the native soil provide a layer of hygroscopic mass able to retain water and favor rooting of plants germinating in it, while being well aerated due to a random orientation of individual fibers and their mutual entanglement.

8. A method of manufacturing a multi-component composition for utilization and/or reclamation of unproductive degraded, desert and semi-arid areas, **characterized in that** selected waste fibrous materials - natural and artificial, are subjected to initial comminution, followed by proper fiberisation and combining with fibrous sanitary wastes, such as sanitary napkins and disposable diapers, previously comminuted, saturated with water and disinfected by mixing with a disinfectant, to form a homogeneous pulp, in which the comminuted selected fibrous components and comminuted waste fibrous sanitary materials have a random orientation of individual fibers, which fibers are evenly dispersed throughout the composition mass and mutually entangled with each other, and then obtained homogeneous fiber mass is retrofitted with seeds of various grass species and other plants, as well as optionally with fertilizers and/or mineral additives and optional additional supportive components.

9. The method according to claim 8, **characterized in that** after the comminutation of waste fibrous sanitary materials, a thin (and comminuted) film not able to absorb water is separated from the hygroscopic fraction, of which film external coatings and edges of sanitary products such as sanitary napkins and disposable diapers are made, preferably by blowing pieces of the same from the surface of the hygroscopic mass during its soaking and disinfection or by separation on a sieve.

10. The method according to claim 8, **characterized in that** the comminuted and fiberized selected waste fibrous materials are combined with waste fibrous sanitary materials, previously comminuted, saturated with water and disinfected in a ratio

of 92-97 % by wt. of waste fiber materials and 3-8 % by wt. of waste fibrous sanitary materials after separation therefrom of the film not able to absorb water.

11. The method according to claim 8, **characterized in that** the whole of the multi-component composition for the utilization and/or reclamation of unproductive degraded, desert and semi-arid areas is additionally enriched with non-toxic ashes obtained in effect of combustion of residues left after separation of the selected waste fiber materials from municipal and industrial wastes, optionally with the addition of green, wood and/or mine wastes.

12. The method according to claim 8, **characterized in that** the whole is additionally "grafted" with and contains "Ema" – active Effective Microorganisms, adapted to the climate and the types of plants and the native soil.

13. The method according to claim 8, **characterized in that** the comminutation and fiberization of fibrous materials is carried out in suitable low- and high-speed mills, and chlorinated lime is preferably used as a disinfectant.

14. The method according to claim 8, **characterized in that** the resulting multi-component composition for the utilization and/or reclamation of unproductive degraded, desert and semi-arid areas, is capable of retaining water due to the hygroscopic properties of comminuted waste fiber sanitary materials present in it, optionally with the addition of a hydrogel – as their equivalent and replacement, traditionally used for such purposes, and provides for good aeration of the substrate layer, favoring germination and growth of plants, which good aeration results from random orientation of individual fibers and their mutual entanglement.

INTERNATIONAL SEARCH REPORT

International application No
PCT/PL2020/000021

A. CLASSIFICATION OF SUBJECT MATTER
INV. A01G24/20 A01G24/22 A01G24/28 A01G24/30 A01G24/35
A01G24/00 C05F9/00 C05F11/00 C05F11/02 C05F11/04
C05F11/06 C05F11/08

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)
A01G C05F

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 practicable, search terms used)
EPO-Internal, WPI Data

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X Y	US 2005/023714 A1 (MANNER D LEE [CA]) 3 February 2005 (2005-02-03) paragraph [0005] paragraph [0012] - paragraph [0019] paragraph [0038] paragraph [0039] paragraph [0046] paragraph [0118] - paragraph [0120] paragraph [0128] claims examples 2,4	1,3-8, 10,11,14 2,12

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

[X] See patent family 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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"P" document published prior to the international filing date but later than the priority date claimed

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"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone

"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art

"&" document member of the same patent family

Date of the actual completion of the international search	Date of mailing of the international search report
26 November 2020	08/12/2020

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1

INTERNATIONAL SEARCH REPORT

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C(Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
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X	WO 91/17227 A1 (LEONE DEMETRIO [CH]) 14 November 1991 (1991-11-14) page 1, paragraph 1 page 3, paragraphs 2,3,5 page 4, paragraph 1 page 5, paragraphs 3,4 claims -----	1,3,5
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