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Kristian OLESEN
Liquid Nano-Clay

https://www.youtube.com/watch?v=stc5MUIloP0

From sand to soil in 7 hours | Ole Morten Olesen | TEDxArendal

Water is a scarce resource that many of us take for granted, but unfortunately large parts of Earth's population do not have that luxury. Ole and his innovation team have tried to solve an enormous task: to turn sand into soil. Even more exciting – they believe they have solved the problem! Listen to Ole talk us through the concept behind turning deserts and sand dunes green. How their technology could change the face of the planet, and solve parts of the global environmental problem. Presenting the game-changing concept at TEDxArendal, he will show you the fascinating images of the green lush results! Ole Morten has an extensive background in R&D and is focused on "Desert Control" since the companys inception. He has been instrumental in developing and testing Liquid nano clay, which is a tool for turning sand into soil. This talk was given at a TEDx event using the TED conference format but independently organized by a local community.

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https://www.theengineer.co.uk/prize-winning-technology-to-make-the-desert-bloom/

Prize-winning technology to make the desert bloom
By Andrew Wad

Line in the sand: New technology could transform poor-quality sandy soils into high-yield agricultural land.

Through a combination of climate change, drought, overgrazing and other human activities, desertification across the world is on the march. It's a process defined by the UN as "land degradation in arid, semi-arid and dry sub-humid regions". Given that around 40 per cent of the Earth's land surface is occupied by drylands – home to around two billion people – the potential for desertification to impact the planet is huge. A recent report from the Economics of Land Degradation Initiative claimed that it's a problem costing the world as much as US$10.6tn every year – approximately 17 per cent of global gross domestic product.

The refugee crisis in Europe has highlighted the difficulties that arise when large numbers of people migrate. However, the numbers arriving from countries such as Syria, Lebanon and Eritrea pale in comparison to those that could be forced into exile by changing climate conditions. According to the UN's Convention to Combat Desertification (UNCCD), the process could displace as many as 50 million people over the next decade.

But one Norwegian start-up is developing a technology to wage a frontline battle with desertification. Desert Control is a Norwegian company set up by Kristian and Ole Morten Olesen, alongside chief operating officer Andreas Julseth. It was recently awarded first prize at ClimateLaunchpad, a clean-tech business competition that attracted more than 700 entries from 28 countries across Europe. The product that earned Desert Control top honours was Liquid NanoClay, a mixture of water and clay that is mixed in a patented process and used to transform sandy desert soils into fertile ground.

“The mixing process splits the clay particles into individual flakes and adds air bubbles on both sides of the flakes,” Ole Morten Olesen, CEO of Desert Control, told The Engineer. “The mix is then spread over the land and allowed to saturate down to root level – about 40-60cm deep. This requires around 40 litres of water and 1kg of clay per square metre.”

Olesen explained that his father Kristian, Desert Control’s chief technical officer, has been working on the process behind Liquid NanoClay since 2008. The treatment gives sand particles a nanostructured clay coating, completely changing their physical properties and allowing them to bind water. The process, which does not involve any chemical agents, can change poor-quality sandy soils into high-yield agricultural land.

According to Desert Control, virgin desert soils treated with Liquid NanoClay produced a yield four times greater than untreated land, using the same amount of seeds and fertiliser, and less than half the amount of water. It found that Liquid NanoClay acts as a catalyst for Mycorrhizal fungi when nourishment is available, with the fungi responsible for the increased yield.

Clay is a fundamental component of productive arable land, acting as a water-holder, providing elasticity, and allowing non-clay elements to bind to the soil. In the past, adding clay to dry land in order to improve its agricultural value has involved tilling clay into the soil. This requires large volumes of clay and substantial amounts of manual labour. The process of transforming sandy soil into fertile land can take between seven and 15 years. By comparison, Liquid NanoClay takes just seven hours to saturate into the land.

The water and clay is mixed on site using the patented process, then traditional irrigation systems such as sprinklers or water wagons are used to spread it across the sandy soil. The individual clay flakes bind to the surface of the sand particles with a Van der Waals binding, significantly increasing the ability of the soil to hold water and nutrients.

The cost of treatment per hectare is US$4,800, and requires a 15-20 per cent retreatment after four or five years if the land is tilled. If the soil is untilled, the treatment lasts for longer. Converting a piece of desert the size of a rugby pitch into fertile land for this cost seems like a pretty good deal.

“In just seven hours the soil is totally transformed,” said Ole Morten. “We use existing irrigation systems to apply the Liquid NanoClay, removing the need to till the land and use much greater volumes of water.”

The performance data for Liquid NanoClay is based on field tests that were conducted at the Agricultural Research Centre (ARC) in Ismailia in Egypt. White pepper was planted in test fields containing dry sandy soil. Fields treated with Liquid NanoClay gave an additional two months of harvest, compared to the fields that were untreated.

Following the initial harvest, the plants were then left without irrigation over winter and spring, when new plants were due to be sown. However, the original crops were found to be in such good condition that they could be used for another season.

“When we returned the following season, we were surprised that the pepper plants were looking so healthy,” said Ole Morten. “We had expected to have to replant, as they had been left over winter and spring without irrigation. But the old plants were in good enough shape that we could use them again in the next season.”

Unsurprisingly, some of the most vulnerable areas to desertification are in north and central Africa, around the edges of the Sahara. Other regions under threat include large parts of China and Mongolia, as the Gobi encroaches into the eastern parts of the Eurasian Steppe and the farmland it supports, as well as several regions in Australia.

When pitching Desert Control at ClimateLaunchpad, chief operating officer Andreas Julseth also focused in on the particular business opportunity available in Central Valley, California. Making up around 14 per cent of California's total land area, the valley is one of the world's most productive agricultural regions. However, since 2011, the state has been in the grip of one of the worst droughts on record.

"In 2014, the agricultural sector in Central Valley lost 165,000 hectares to fallowing," Julseth recently told the ClimateLaunchpad audience. "Fallowing means they ploughed the land but didn't sow any seeds, because there simply wasn't enough water available to sustain the land. They estimate this had a US$2.2bn impact on the agricultural industry."

In the desperate search for water, farmers in California have been digging ever deeper, employing oil-drilling equipment to reach the disappearing aquifers. Not only is this expensive, it is eradicating an ancient natural resource in a classic tragedy of the commons. Acting out of rational self-interest, the farmers are draining a communal water resource dry. Julseth believes Liquid NanoClay can help avert the impending tragedy.

"I believe that farmers will flock to us as soon as they see that they can reduce their dependency on water by at least 50 per cent," he said. "Put it this way – if they were using our product, the present drought would no longer be a problem. I also believe that land developers will use the opportunity to buy dry land, have us treat it, and then be able to sell it for eight to 10 times the purchasing price. Because that's the reality now – dry land goes for one-tenth what fertile land goes for."

"I believe that farmers will flock to us as soon as they see that they can reduce their dependency on water by at least 50 per cent. If they were using our product, the present Californian drought would no longer be a problem" -- Andreas Julseth, Desert Control

If Desert Control can successfully get Liquid NanoClay to market, the potential of the technology is enormous, with implications for fragile environments around the globe and the populations that inhabit them. Along with the testing that took place in Egypt, additional third-party verification is taking place at the Faculty of Natural Sciences at Imperial College London.

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https://www.desertcontrol.com/

Liquid NanoClay

Our patented Liquid nanoclay (LNC) mixture is sprayed directly on to dry, sandy land, creating a water-retaining network in the soil profile. 2. Save. water retention of up to 65% means less water required and huge cost reductions,

Safe, fast, easy. We mix clay with water in a special process.
No additional chemicals.
Save water, labor & costs.
reduces water usage by 50-65% compared to current irrigation norms.
lasts up to 5 years.
LNC is applied directly on top of dry, sandy land using traditional watering techniques (or direct injection into water irrigation systems).
The mix saturates the soil to a depth of 40-60 cm, retaining water like a sponge.
It's time to rejuvenate The planet

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http://climatelaunchpad.org/desert-control-keeps-improving/

Desert Control Keeps On Improving - ClimateLaunchpad

Aug 22, 2016 - About 900 tons of clay per hectare were required to have positive results. The labor required was enormous. Still, researchers had extremely positive results in terms of crop yield after adding 90-100 kilos of clay to every square meter.

Clay holds the key

The founders of Desert Control had spent three years in Egypt and Kuwait testing a product to enhance the reflection of sunlight from the surface of the desert sand. The results were excellent, but short-lived, making further development unfeasible.

While there, Kristian P. Olesen, an expert in fluid dynamics, had become intrigued by the concept of enhancing sandy soil. He'd been infected with the same curiosity and desire for a solution as had the scientists and engineers who lived in the region. He wanted to address the problem of desertification.

Like many before him, he thought the solution must be clay.

He developed and patented a mechanical process for disintegrating individual clay flakes into water. This mixture could be irrigated into dry sandy soil.

Kristian's son, Ole traveled to Egypt in the middle of January 2006 to discuss a simple test with Dr. Islam Wassif of Egypt's Desert Research Center.

Dr. Wassif was furious and happy all at once when he realized what the Desert Control team had accomplished. How could two hillbillies from Norway find a solution to something that had eluded his team for decades? At the same time, he was hopeful about what this development could mean for Egypt's future.

The first tests made examined the mixture's ability to slow and even halt the movement of sand. The thin treated layer stopped sand from moving in wind velocities of up to 27 meters per second. This was later tested with Dr. Wang Tao at the Cold and Arid Regions Environmental and Engineering Research Institute Chinese Academy of Sciences in Lanzhou, China.

Saving water

The research institutes in Egypt had done a lot of different work to enhance the growth potential of dry sandy soil. Research using clay had been done for at least 15-20 years. The expense and the amount of clay used made the project prohibitive.

About 900 tons of clay per hectare were required to have positive results. The labor required was enormous.

Still, researchers had extremely positive results in terms of crop yield after adding 90-100 kilos of clay to every square meter.

When the Desert Control team explained how their liquid NanoClay could be irrigated into the soils without any mechanical work, there was great enthusiasm. If only 10% of the water needed for irrigation could be saved, a statue of the ambassador would be built, Egypt's Minister of Agriculture Land and Reclamation Amin Abaza told Norway's ambassador.

"We know you're cheating"

The Desert Control team was brought in to prove the technology on an unused plot. The results were so positive that the scientific team monitoring the experiment refused to sign off on them. The test plot treated with Desert Control's Liquid NanoClay demonstrated a 416% higher yield than untreated plots.

"We know you're cheating," the Desert Control team was told. The results seemed scientifically impossible. Another test was ordered, this one observed by a whole team of scientists and overseen by Dr. Ahmed Yousry Kerdany. The results were repeated and the test was confirmed, Ole Olesen told ClimateLaunchpad.

"We had the same results as good American farm soil, in the Sinai. We ourselves didn't even know what was causing such great results."

In 2006, Dr. Wassif saw something surprising in the Liquid Nanoclay. A fungus had begun to grow in the sand treated with Nanoclay. Dr. Wassif knew its presence made the land more productive, but he didn't know what it was.

In 2014, the team figured out the secret to the high yields. It wasn't just that the mixture retained water and nutrients: it was that the mixture of clay and cow manure they used became a catalyst for a particular type of fungus: mycorrhizal fungi.

According to biologist Douglas H. Chadwick, writing in Mother Earth News, "Mycorrhizae, not plant roots, are the principal structures for most nutrient uptake in the plant kingdom." Chadwick explains:

"The outer walls of hyphae contain gluey compounds that cause fine particles of earth to clump together on and around the threads. This process is a major factor in building soil structure and making the ground less vulnerable to erosion. Mycelial networks also play a valuable role in sequestering carbon within microclusters of filaments. They limit their partner plants' exposure to heavy metals, such as lead, zinc and cadmium, by keeping those elements bound to the hyphae's sticky sheath. At high latitudes and high altitudes, mycorrhizal fungi scrounge nutrients from cold, rocky soils. In boggy regions, the hyphae buffer plant partners from the high acid content of peaty soils. In saline ground, the hyphae help safeguard their partners from high salt concentrations. Mycorrhizae can also protect plants from pests and diseases."

Ole Olesen explained,

"The fungus existed in the cow manure we used. It was also in the ground. The clay created the right environment for the fungus to flourish."

He continued:

"Imagine trying to grow anything in glass beads. That is what sand is like. Water and nutrients flush right through. Wrap the beads in something like newspaper and the water and nutrients remain. That's what the fungus does to the sand. It creates a great environment for growth."

The possibilities are truly groundbreaking

Liquid Nano Clay is a truly exciting technology that could actually reverse desertification and revolutionize agriculture. Ole Olesen tells ClimateLaunchpad, "We consider the Gobi good farmland."

In addition,the surface temperature of plant-covered land is significantly cooler than that of bare sandy land. The Desert Control report states:

"Converting bare sandy soils to green plant covered land lowers the surface temperature around

15°C. This has a cooling effect of 320 – 360 MW/km2. Changing desert to the green land also reduces CO_2 emissions by between 15 – 25 tons/hectare."

The Desert Control team imagines growing energy (bio-fuels), reducing water usage for agriculture (the mixture retains water effectively), and even for usage in areas without enough freshwater. Where are they now?

Political upheaval got in the way of a full-scale implementation in Egypt. Desert Control is still working on its product, looking for two more large-scale verifications of the technology. We expect to hear more news from them soon as the results of tests come in.

US2010135733
INORGANIC, STATIC ELECTRIC BINDER COMPOSITION, USE THEREOF AND METHOD FOR THE PREPARATION OF SAID BINDER COMPOSITION

Inventor(s): OLESEN KRISTIAN P
Applicant(s): DESERT CONTROL INST INC

Abstract

The present invention relates to an inorganic, static electric binder composition for use as a texture stabilising element in masses of organic and/or inorganic particles and also as a filtering mass. One major use of the binder composition is to reclaim arid and hyper-arid deserts and to prevent desertification and the movement and advancement of sand dunes, in other words stopping wind erosion efficiently. Described is also a method for the preparation of the binder composition and the use thereof.

[0001] The present invention relates to an inorganic binder composition which displays static electric charge, more precisely a homogenised dispersion of clay particle consisting substantially of single flakes of clay and air bubbles dispersed in a fluid. The present invention also relates to a method for the preparation of said binder composition as well as use of the binder composition as a texture stabilising element in an organic or inorganic particle composition, such as soil and sand. The invention also relates use of the binder composition as a filtering mass for the purification of, for instance, air or water.

[0002] The main causes of desertification are wind erosion and the advancement of sand dunes. It is known from land areas exposed to strong drought that the earth surface is easily exposed to wind erosion when a protecting, unifying vegetation cover is removed by overgrazing, traffic flow and so forth. The mineral soil particles, substantially consisting of sand, lack the ability to remain closely connected and sand transport may arise. This may also arise under relatively humid conditions, for example in sand dune formations, where the sand's reduced ability to transport humidity from the underground by capaillary action leads to local drying in the surface with subsequent lack of opportunity for vegetation with shallow root system to establish growth. Both the lacking ability of the mineral soil to maintain a stable unifying structure as well as the sand soils lacking ability to bind humidity from underground reservoirs are major obstacles with relation to for example maintainance and increase of food production ability in drought exposed areas.

[0003] It is generally recognized that when soil particles are entirely unattached to each other the soil is known as structureless or as a single grained structure such as the case of sand dunes. When, on the other hand, the primary soil particles under favourable circumstances tend to group themselves and associate into small units or aggregates, the soil is termed aggregated. It has been shown, in the studies of sandy soil, that about 99.5% of the original particles are of a diameter of less than 0.5 mm, i.e. constitute wind erodible particles. It is also evident that the percentage of dry aggregates >0.8 mm is less than 0.2% of the soil matrix.

[0004] It is also known that the formation and maintainance of stable aggregates is an essential feature which is highly desirable, due to the fact that it ensures the most favourable conditions for tilth, cultivation, plant growth and conservation of soil against degrading factors.

[0005] An organic binding agent is generally known which is intended for addition to the uppermost layer of mineral soil, in order to thereby stabilize the structure, increase the ability for capillary transport of water as well as increase the binding of water on the soil particles. The disadvantages of this binding agent is that the organic material is rapidly decomposed by the bacterial cultures living in the mineral soil in those parts of the world where this binding agent has its major use.

[0006] The dry mixing of clay into sandy soils have been researched and used up till 1987 when it was a fact that it was a much too expensive treatment even with just positive practical results.

[0007] Generally known is also the fact that clay has an extensive ability to bind water and to establish coherent structures in dry condition. Dry clay soil is hard to crumble, and dry clay forms hard, durable structures, used for instance in sun dried building blocks. Clay has already been used in an effort to combat desertification and to increase the fertility of the soil. Clay has a twofold function when applied to the soil. It enhances water retention, reduces the wash-out of fertilizers and rehabilitates the soil with regard to ion exchange. Secondly, it provides growing plants with nutrients. The previous use of clay for this purpose has been the use of dry clay for mixing with the soil. Substantial amounts of clay were required and the mixing required a considerable amount of mechanical work. The problems so far has thus been price and availability.

[0008] The object of the invention is to propose a new and improved solution to the problems outlined above whereby sandy deserts may be reclaimed and desertification may be prevented with higher efficiency, with less clay and less mechanical work and thereby at reduced costs.

[0009] The object is achieved by the features disclosed below in the specification and in the following claims.

[0010] It is generally known that flakes of clay, which are the mechanical single units in clay, are negatively electrically charged and has a strong ability to bind, inter alia, water to the surface thereof.

[0011] The invention substantially relates to a negatively charged binder composition consisting of homogenised, negatively charges flakes of clay for the binding of positively charged particles in order to increase the adsorption and the absorption capability of for instance water, impurities in water and undesirable substances in or on a target object when the binder composition is added to the target object. The binder composition may be added to the target object for instance in an aqueous solution. The positively charged particles may for instance be water molecules.

[0012] The clay particles may be provided in any form obtained by a homogenisation process which divides the clay into single flakes or particles consisting of a few coherent flakes of clay dispersed in a liquid, for instance water, whereafter the flakes of clay, after an application process, covers the surface of particles. The clay flakes have a surface diameter of from about 25 to 2000 nm, and a thickness from about 1 to 10 nm, adjusted to the particle structure of the target object. In order to increase the stability in the homogenised dispersion of clay flakes air may suitably be added in the form of microscopic bubbles which will give a weak cation bonding to the clay flakes. The result is that the mixture is stable until it comes into contact with cations of higher electrical charge/potential/valence. A single flake of clay in water will thus in reality consist of the solid particle and a cloud of air ions which neutralise the particle, surrounds it and is bonded by the charge of the solid particle.

[0013] The binder composition is applied, for instance on soil, by ordinary watering techniques in such an amount that the soil is moist down to the relevant root depth or to the depth required for stopping wind erosion.

[0014] The binder according to the invention has the desirable property that it hardens by drying and by heating combined with drying.

[0015] The application of the binder on soil particles result in an increased ability to attract and transport humidity with the aid of the clay particles humidity binding capacity, caused by the negative polarity, as well as the increased capillary transport ability, caused by the microscopic voids between the clay flakes. This increases the ability of plants to grow in the soil. This results in a better food access and increased absorption of carbon dioxide. The increased growth of plants also further the Albedo value of the soil, which means that the reflection of incident radiation is increased and that the temperature of the earth surface is reduced. (The Albedo or solar reflectance is a measure of a material's ability to reflect sunlight (including the visible, infrared and ultraviolet wavelengths) on a scale of 0 to 1. An Albedo value of 0,0 indicates that the surface absorbs all solar radiation and a 1,0 Albedo value represents total reflectivity.) Measurements have shown that in desert surroundings, with an air temperature of 32° C. and sea temperature of 28° C., the temperature measured over a sand surface was 51° C. which transformed to 34° C. over an area covered with grass. The ground surface temperature reduction achieved by greening was thus in the range of 17° C.

[0016] The dehydration makes the treated surface of the soil hard, which means that the surface to a greater extent will endure the load of traffic, wind and so forth without loosening of single particles, which causes the structure to collapse, the roots of plants to be destroyed and the soil, for example humus particles and other nutrient particles, to be carried away by the wind.

[0017] With the supply of water in the form of rainfall, irrigation or a change in the balance between evaporation and capillary transport of humidity from the underground, the soil is structure again softens.

[0018] In one embodiment of the present invention the binder composition may be mixed with a plant nutrient dissolved, or dispersed, in liquid before application on the soil, in order to increase the growth of plants.

[0019] The binder composition according to the invention may be applied by homogenising the mixture in water and thereafter applying this on the soil to be treated.

[0020] The soil particles may for instance be sand particles, humus particles, coarse plant remains, carbon particles and so forth, which in mixture or each on its own constitute a substantial part of the soil and which preferably should be bonded together so that no movement is taking place under normal stress levels applied on said particles.

[0021] In a first embodiment the invention relates to a binder composition for use as a structure stabilizing element in masses of organic and/or inorganic particles, comprising a homogenised mixture of clay, whereby the clay particles principally are separated into single flakes of clay.

[0022] The binder composition preferably comprises air micro bubbles bonded to a considerable part of the clay flakes.

[0023] The binder composition is preferably a liquid based dispersion, preferably based on water.

[0024] The binder composition preferably comprises at least one plant nutrient.

[0025] The binder composition preferably comprises one or more dispersion agents.

[0026] Another feature of the invention relates to a method for the preparation of a binder composition, whereby the method comprises the steps of homogenising a dispersion of clay and a liquid in a homogenisation device in order to make a dispersion of clay flakes and to introduce a clay flake dispersion and to introduce gas micro bubbles in the dispersion of clay flakes.

[0027] The gas micro bubbles are preferably added during the dispersion process. The gas is micro bubbles are preferably air micro bubbles.

[0028] The dispersion of the clay flakes is preferably put into a substantially laminar flow, for thereafter to be put into a turbulent flow caused by a substantial change of direction.

[0029] Alternatively, the clay flakes are put into a substantially laminar flow movement, thereafter they are put into a turbulent flow movement caused by a substantial change of direction, whereafter the flakes again are put into a substantially laminar flow for thereafter again to be put into a turbulent flow caused by a substantial change of direction.

[0030] The change of direction is preferably in the range 45-135 degrees.

[0031] The method according to the invention preferably also comprises the step of introducing at least one dispersant to the dispersion of clay flakes.

[0032] The method further comprises the preferable step of adding at least one plant nutrient to the dispersion of the clay flakes.

[0033] A further embodiment of the present invention relates to the use of a clay flake dispersion according to the invention as a water- and particle binding agent and a capillary transport enhancing agent for a soil mass as well as a plant protection agent.

[0034] The treated layer of sand particles have the ability to filter out unwanted positively charged impurities, for example salt in seawater, cleaning contaminated water.

[0035] The filter mass will typically consist of a particle structure which is pretreated with the clay flake dispersion in such a way that the particles are covered with clay flakes as done for stopping wind erosion in sandy deserts. This method uses approximately 13% of the amount of clay used in the old dry mixing method and achieves the same benefits together with an immediate binding of the sand particles.

[0036] The process for the preparation of the binder composition according to the invention may be carried out in any suitable device.

[0037] The present invention also relates to the use of the above binder composition as a filtering mass.

[0038] In this embodiment of the invention the binder composition is used to increase the adsorption- and absorption ability of for instance water, impurities in water and unwanted substances in or on a target object when the binder composition is brought into contact with the target object.

[0039] When the binder composition is used to remove unwanted substances from a target object this is done by filtration of a fluid containing the unwanted substances through the binder composition which is prepared with the wanted structure in such a way that the unwanted substances are retained in the binder composition.

[0040] A preferred embodiment of this aspect of the invention relates to use of the clay flake dispersion as disclosed above for the preparation of a filter mass for purification of water and air, including desalination of sea water. The filter mass may typically consist of a particle structure which is pretreated with the clay flake dispersion in such a way that the particles are covered by clay flakes.

[0041] In practice the desalination of sea water may be carried out of preparing a layer of sand on a mesh, this is treated with the clay dispersion and when the layer is filled with salt remains, this can be flushed into the ocean or the salt can be used for other purposes.

[0042] Below a non-limiting example of a preferred embodiment will be described, which is shown in the enclosed figures, wherein

[0043] FIG. 1 shows an example of a non-swelling clay particle composed of a plurality of flakes;

[0044] FIG. 2 shows the basic particle- and crystal structure in synthetic laponite clay;

[0045] FIG. 3 shows aggregates of non-swelling flakes of clay which are mixed in water;

[0046] FIG. 4 shows typical flake structures when swelling flakes of clay are dissolved in water;

[0047] FIG. 5 shows a section through a single grain of sand covered by single flakes of clay according to the invention;

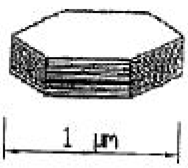

Fig. 1

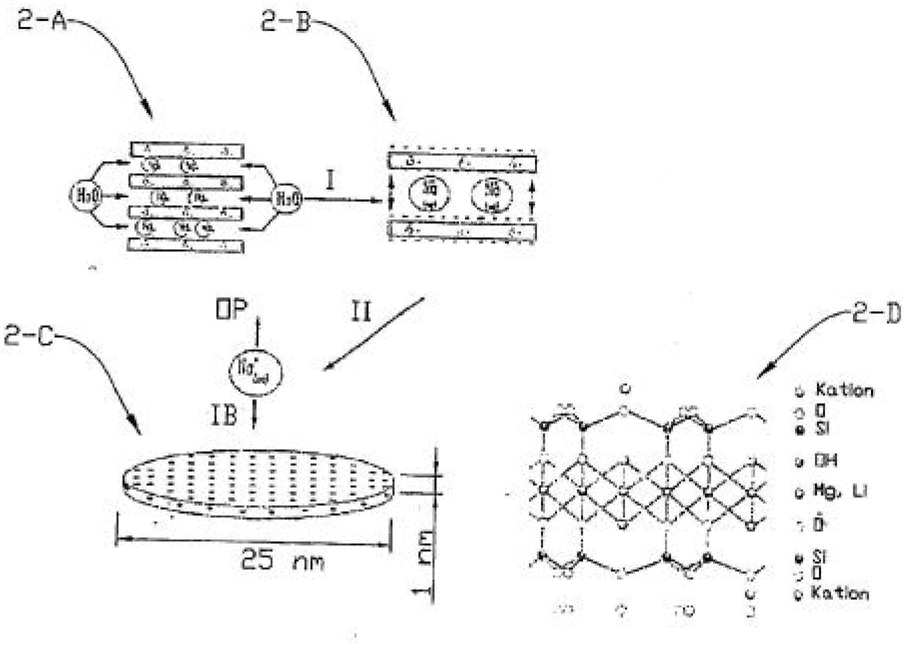

Fig. 2

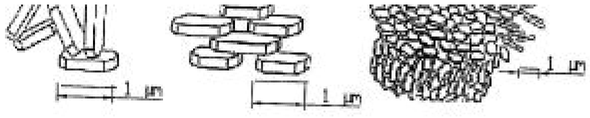

Fig. 3

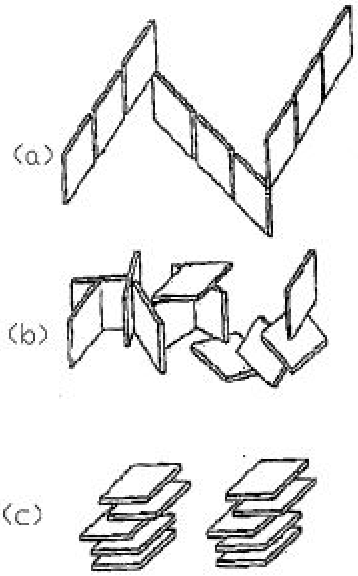

Fig. 4

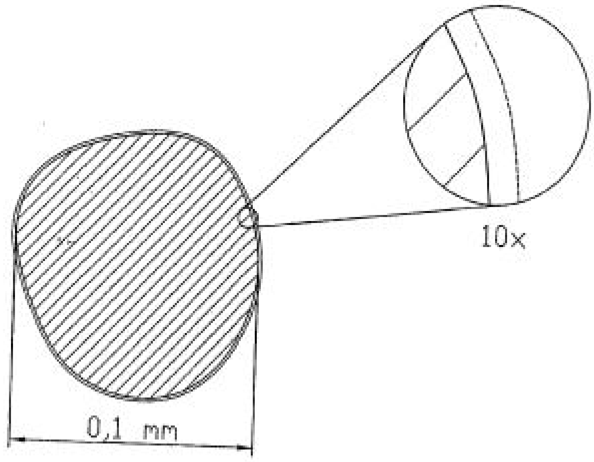

Fig. 5

[0048] FIG. 1 shows an example of a clay particle of a non-swelling clay type. The transverse dimension is about 1 μm. A particle may contain up to 1200 flakes. Examples of non-swelling clays are kaolin and illite.

[0049] In FIG. 2 the numeral 2-A shows a part of a particle stack of a swelling synthetic clay of laponite type before hydratisation. A hydratisation process I results in the swelling of the clay particle stack, shown in magnification in 2-B. A separation II of the hydrated clay particle stack 2-B provides individual clay flakes 2-C, here shown in increased magnification. The metal ion bonding to the surface of the clay flake is illustrated by the sodium ion Na(+), whereas the osmotic pressure leads to a weakening of the metal ion bonding. A magnified section 2-D schematically shows the molecular structure in the clay particle and at its surfaces.

[0050] Laponite is an example of a triochtahedral smectite.

[0051] Non-swelling clay can not be separated be hydratisation solely. When the clay particles are exposed to considerable mechanical stress, for instance considerable shear forces by turbulent flow in accordance with the inventive method for homogenisation of a clay flake dispersion, or by using a suitable homogenisation device, a stack of non-swelling clay flakes may be separated. It is obvious that also swelling clay flakes may be separated in this manner.

[0052] FIG. 3 shows typical clay flake structures when a non-swelling clay is mixed with water. The water is not capable of penetrating in between the single flakes and the stacks will remain intact. Different structures may be formed by the single flakes of non-swelling type when these are mixed with water.

[0053] FIG. 4 shows different clay flake structures which are formed when clay flakes are dispersed in water. The structures are surrounded by a cloud of ions. Typical flake structures formed by swelling clay are: (a) edge against edge (chain structure), (b) surface against edge (house of cards) and (c) surface against surface (as a deck of cards).

[0054] FIG. 5 shows a section through a single grain of sand surrounded, according to the invention, by single flakes of clay with a thickness of 1 nm and a transverse dimension of 25-400 nm. When the grain of sand has a diameter of 0.1 mm between 1000 and 13000 flakes are required to cover the circumference with flakes of clay of the given magnitude. In order to cover the whole surface of the grain of sand about 50.000.000 flakes of a transverse dimension of 25 nm, about 3.000.000 flakes with a transverse dimension of 100 nm and about 200.000 flakes with a transverse dimension of 400 nm are needed.

[0055] A binder composition according to the invention is provided by treating a dispersion of clay and water in a mechanical homogenisation device with a very high turbulence index, for example the one described above, for thereby to split the normally smallest components of the clay into single flakes. In order to keep the mixture stable air is also supplied to the dispersion, so that micro bubbles of air bind to the single flakes of clay, and neutralise the negative polarity of the clay flakes. The air bubbles increase the stability of the mixture and thereby prevent sedimentation. Sedimentation may also be prevented when the dispersion after homogenisation is kept in motion with the aid of for instance a rotation device.

[0056] Said micro bubbles have a diameter of from about 1 nm to about 20 μm.

[0057] In an alternative embodiment of the binder composition one or more additives are added, for example plant nutrients, in dispersion or solution. Added in dispersion form, the particle diameter must be less than 20 μm in order for the substance to be able to be watered down in the sand together with the rest of the mixture.

[0058] In a further embodiment of the binder composition a dispersion agent is added in order to keep the binder composition homogeneous for a sufficient time. Without any salt present, the air bubbles stabilize the mixture for 2-4 days.

[0059] Application of the binder composition on the particle mass to be treated may for instance be accomplished by spraying, flooding or by sinking in the particle mass. The particle mass may be sand, gravel, humus, aggregates for the production of building materials, for example raw materials for the production of bricks, etc.

[0060] The amount of binder composition used is adjusted according to the particle mass to be treated. In order to improve the properties of sand a few grams of the binder composition (based on dry matter) is used per kilogram of sand.

[0061] Below the invention will be illustrated further by the following non-limiting examples.

EXAMPLES

[0062] Two types of experiments have been carried out.

[0063] The first one were pot experiments aimed at comparing the effect of different levels of both suspended kaolin and dry mixing kaolin on wheat grain germination percent and physical properties, the second one was wind tunnel experiments aimed at studying the effect of suspended kaolin on threshold velocity and soil loss by wind erosion.

Germination Experiments

[0064] This experiment was carried out under greenhouse conditions in order to compare the effect of different levels of kaolin either in suspended form or as a powder, i.e. dry mixing with soil, on the germination rate of wheat grains.

[0065] The experimental treatments included the following:

control, i.e. without kaolin application,
two levels of kaolin, i.e. 2.5% (of soil mass to root depth—7 kg=175 gram clay) (T1) and 5% (of soil mass to root depth—7 kg=350 gram clay) (T2) applied as dry mixing.
four levels of kaolin, i.e. 1% (of suspension weight—0.9 kg=9 gram) (T3), 1.5% (of suspension weight—0.9 kg=13.5 gram) (T4), 2% (of suspension weight—0.9 kg=18 gram) (T5) and 2.5% (of suspension weight—0.9 kg=22.5 gram) (T6) applied as suspended kaolin. The suspension applied to field capacity=900 ml.

[0069] The pots were arranged according to completely randomised design, and each treatment was replicated three times. The total number of pots was 7·3=21 pots.

Experimental Procedure

[0070] After application of the above mentioned treatments, 20 grains of the local wheat variety (Triticum vulgari var Sakha 93) which is recommended for desert areas—were sown in each pot. The pots were irrigated up to the field capacity level. The amount of the applied water was 900 ml. Thereafter they were watered with amounts sufficient to compensate the depleted moisture. Such amounts ranged between 100 to 150 ml. Germination began after 4 to 6 days at which the rate of germination was followed up and recorded.

[0071] After 20 days from sowing the vegetative parts of the plants were harvested and dried in a ventilated oven at 70° C., thereafter the dry weight was recorded.

[0072] Soil penetration resistance for each of the applied treatments was measured by using a computerised electrical Penetrometer after harvesting.

[0073] These tests were conducted in relatively small pots and the studied soil is mainly sand. Penetrometer readings were taken at every 3 cm intervals. Because the penetration resistance is strongly affected by soil moisture content, soil samples were taken at each tested depth to determine the soil moisture content at the time of measurements. Thereafter the soil samples were collected from each pot to determine soil aggregates, field capacity, and wilting percentage.

Experimental Results:

[0074] The given percentages in all the report give percent value which seems to be % of the same objects, but as shown in brackets is of different objects: 5% (of total soil weight 7 kg=350 gram clay) dry kaolin and/or 5% (of the applied water suspension 0.9 kg=45 gram clay) suspended kaolin. The amount of clay used in the suspension is 13% of the amount used in the dry mixing, the old method. The suspended clay bind the particles as soon as applied and the dry mixing, old method must have water applied before it had any binding abilities, dry clay particles is dangerous for humans when inhaled into the lungs. The remarkable result is thus that this method uses approximately 13% of the amount of clay used in the old dry mixing method and achieves the same benefits together with an immediate binding of the sand particles.

Germination Rate and Seedlings Dry Weight:

[0075] Table (1) shows that the application of kaolin either by mixing dry or suspended kaolin with any level increased germination percent after four days from sowing as compared to the control treatment. After six days from sowing the same trend was obtained with the exception of applying suspended kaolin with 1% level. The best levels were 2.5% for dry mixing and 1.5% suspended clay, respectively.

[0076] From the statistical point of view the difference between germination rates under 2.5% of dry application and those under 1.5% of suspended kaolin treatments were not significant.

[0000]

TABLE (1)
The effect of different levels and methods of kaolin application on wheat grain germination

[0000]
TABLE 2
The effect of different levels and methods of kaolin application on dry weight of wheat seedlings
Method of Dry Mixing Suspended Application level Kaolin Kaolin Control treat.

Penetration Resistance:

[0078] As mentioned above, the penetration resistance is strongly dependent on the amount of moisture retained in the soil (i.e. layer under test). Therefore, the amount of soil moisture was measured in soil samples taken very close to the penetrometer cone at the time of measuring soil resistance. The obtained data of soil moisture in the tested depths (0-5, 5-10 and 10-15 cm) is given in table (3). This table shows that the soil moisture content at the time of measurement was almost similar either in respect to the applied treatments or in the tested depth in each pot. Therefore, the obtained variations in soil resistance expressed by the penetration resistance data are mainly related to the influence of the kaolin treatments, i.e. the levels and methods of application. In other words, under the conditions of the current study, the variation in soil resistance can be explained only on the basis of the kaolin treatments because the influence of soil moisture on resistance is negligible, as shown in table (3)

[0000]

TABLE 3
Soil moisture content (w/w) at time of Penetration resistance measurement under the conditions of applied treatments

[0079] Regarding the influence of the application level it has been shown that the penetration resistance is linearly associated with the application level. In other words, mixing dune sand with kaolin at a rate of 5% dry or 2% suspended kaolin (w/w) has resulted in increasing the penetration resistance from about 0.4 to 1.40 Mpa/cm<2>. This remarkable impact is favourable for both plant production as well as environmental requirements. These low values of soil strength do not impede root growth of most of the cultivated crops while improving the soil bearing capacity and thus trafficability.

Wind Tunnel Experiments

[0080] These experiments focus on the study of the relation between wind velocity and soil loss or threshold velocity, i.e. the velocity required to create soil particle movement, under different levels of binder, i.e. kaolin, suspension.

[0081] The capacity of the binder according to the present invention to reduce the soil loss by wind was measured in wind tunnel experiments. The experiments were carried out at the “Cold and Arid Regions Environmental and Engineering Research Institute, The Chine Academy of Sciences” in China. The tunnel was an open-circuit type through which air was forced by a blower to the test section with dimensions of 1.0 m width, 0.6 m height and 16.23 m length. Air was sucked from ambient through a bell shaped entrance by the blower to the entrance section and then proceeded to the exit. Before reaching the test section, the flow passed through a diffusor followed by a convergent nozzle and wind simulator component.

[0082] The test section was equipped with traverse mechanism to measure the flow velocity profile at different levels. The diffusor floor was equipped with a sand trap mechanism in order to collect sand transported and the air left through a vertical duct to the outside air.

[0083] The following table shows the test results obtained.

[0084] It is evident that at any wind velocity the soil loss decreased by increasing application levels, but the percent reduction varied according to the wind velocity. The highest reduction occurred with 5% suspension and 3 L/m2 or more and 10% suspension and 1 L/m2 or more, at wind velocity of 27.5 m/s with 100% reduction. It is also evident that the threshold velocity increased by increasing the binder suspension.

[0085] Tests performed in the windtunnel belonging to:

[0086] COLD AND ARID REGIONS ENVIRONMENTAL AND ENGINEERING RESEARCH INSTITUTE, THE CHINESE ACADEMY OF SCIENCES

[0087] China 26.-27.10.2006:

[0000]
Windtunnel tests of the effect of DESERT CONTROL INSTITUTE Inc's clay suspension
Added gr after gram % At wind
Tray Tray + Added suspension Control weight gr After wind- Sand % reduction velocity

Results

[0088] The results show that increasing kaolin levels increased threshold velocity, in other words the velocity required to create soil particle movement increased by adding suspended kaolin at any level. As mentioned the threshold velocity is the lowest wind velocity which create movement of the soil particles.

[0089] It is also evident that at any wind velocity soil loss decreased by increasing application of kaolin levels, but the percent reduction varied according to the value of wind velocity. The highest reduction occurred with 5% suspension and 3 L/m2 or more and 10% suspension and 1 L/m2 or more, at wind velocity of 27.5 m/s with 100% reduction.

[0090] It is evident from the above experiments that the present invention allows the use of clay of moderate quality and at the same time gives improved results and just using an average of 13% of what was used in the old method of dry mixing. Or as said above to stop wind erosion efficiently by 1 L water/m2 using 100 gram clay per litre has never been done before.

[0091] The obtained results also indicate that the applied treatments significantly increase the adhesion and cohesion forces within the soil matrix, with consequent decrease in soil erodibility and hence erosion losses.

[0092] The most recent results obtained by applying 0.5-1 litre suspension per m2 with a percolation depth of 0.5-1 cm have demonstrated that by the application of 9% suspended kaolin, without pre-watering of the ground, the increased soil moisture in the soil surface layer (i.e. 0-10 cm) increased by 24%. Screening experiments have indicated that this increase seems to be exponentiental.

[0093] It will be obvious for a person skilled in the art that the electrostatically binding properties of the binder composition is of use in all areas where it is desirable to fix small entities, for example microscopic particles, atoms, viruses, bacteria and other cellular structures, to a medium, in order to remove unwanted substances or add wanted substances to change the properties of the medium, as described above and as claimed in the following patent claims.

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https://www.researchgate.net/post/How_to_make_nanoclay_Any_suggestion_to_synthesize_it

How to make nanoclay? Any suggestion to synthesize it?

How one can easily make nanoclay by biological or reduction methods? Does anyone know of such methods?

Reda Gado / National Research Center, Egypt

Firstly you have to determined The Cation Exchange Capacity (CEC) which can be determined for the raw clay sample by saturation with 1 N solution of sodium acetate trihydrate ($CH_3COONa \cdot 3H_2O$) for long time at pH 8.2, then washing for several times by ethanol 95 % to get rid the excess sodium ion. The reacted sodium (Na^+) with the clay sample was extracted by reaction with 1 N ammonium acetate solution followed by sodium determination using flame photometer in the extracted solution .

Since the mEq equal to mg*valence of surfactant divided by its molecular weight, the amount of CEC will be changeable according to the molecular weight of each surfactant.
5g of clay was dispersed in 300 ml of distilled water for 24 h at room temperature using a magnetic stirrer and then a desired amount of surfactant according to CEC and M.Wt of surfactant was slowly added. The concentration of surfactant can be varied from 0.5 to 5.0 according to the CEC of clay. The reaction mixtures were stirred for 5 h at 80 oC. Consequently, the cation exchange reaction occurs rapidly. The resulting organoclay suspension was mixed further for 12 h. All products were washed until free from bromide anions and dried at 90oC. Finally, the resulting material was ground using SFM-1 Desk Top Planetary Ball Miller (MTI) for 3 hours, in order to obtain a nanoscale powder. The organo nanoclay product was stored in bottle .

US2015210824
NANOCOMPOSITE MICROGELS, METHODS OF MANUFACTURE, AND USES THEREOF

Nanocomposite microgel particles containing a three-dimensional network, containing a water-swellable nanoclay and an organic network polymer. The nanocomposite microgel particles include primary nanocomposite microgel particles having a mean diameter of 1 to 10 micrometers. Also disclosed is a method of manufacture for the nanocomposite microgel particles

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Patents: Mycorrhizal Fungi Culture

Method for preserving arbuscular mycorrhizal fungi
CN106754375

Culture medium for glomus mosseae and culture method
CN106635831

Method of planting plant symbiotic mycorrhizal fungi
CN106605524

SYSTEM AND METHODS FOR CONTINUOUS PROPAGATION AND MASS PRODUCTION OF ARBUSCULAR MYCORRHIZAL FUNGI IN LIQUID CULTURE.
MX2016002468

Wild efficient expanding propagation method for arbuscular mycorrhizal fungi
CN106508419

Method for collecting mycorrhizal fungi through using tissue culture seedling of sterile blueberry
CN106434349

Mycorrhizal fungi locellus culture apparatus
CN205993154

Method for layered culture and enrichment of arbuscular mycorrhizal fungi spores
CN106190944

Method for storing arbuscular mycorrhizal fungi
CN105532411

Artificial cultivating method for advantageous symbiotic mycorrhizal fungi of Castanea henryi (Skam) Rehd. et Wils.
CN105087400

MICROORGANISM MIXTURE OF ARBUSCULAR MYCORRHIZAL FUNGI AND MASSILIA SP. RK4 PROMOTING PLANT GROWTH UNDER SALT STRESS CONDITION AND USES KR101563349

MASS MULTIPLICATION OF ARBUSCULAR MYCORRHIZAL FUNGI USING AEROPONIC SYSTEM
IN946DE2012

Compartment culture device for conducting pure culture of arbuscular mycorrhizal fungi through artificial culture media
CN204291868

Method for promoting sprouting of arbuscular mycorrhizal fungi spore and growth of hypha
CN103981100

Phlegmariurus phlegmaria mingchegensis mycorrhizal fungi, method for production of huperzine A from the same, and application
CN103834577

METHODS FOR CULTURING MYCORRHIZAL FUNGI, UTILIZATION METHOD THEREOF AND SUBSTANCE FOR CONTROLLING GROWTH OF MYCORRHIZAL FUNGI
JP6030908

MYCORRHIZAL FUNGI CULTIVATING APPARATUS
KR101321652

Quick-breeding method of directly inducing and mycorrhizal seedlings of ledum plant mycorrhizal in test tube
CN102499084

METHOD FOR CULTURING VA MYCORRHIZAL FUNGUS
JP5275436

Method and device for culturing inoculant of arbuscular mycorrhizal fungi
CN101608159

METHOD FOR CULTURING MYCORRHIZAL FUNGUS

JP4979551

Fungal media and methods for continuous propagation of vesicular-arbuscular mycorrhizal (VAM) fungi in root organ culture
US6576457

Production of mycorrhizal fungi
US4294037

METHOD FOR PROLIFERATING VA MYCORRHIZAL FUNGI
JPH05153863

CULTIVATION OF MYCORRHIZAL FUNGUS AND PREPARATION OF FRUIT BODY OF THE FUNGUS
JPH03183416

MYCELIUM ISOLATION CULTURE FOR MYCORRHIZAL FUNGI
JP2001103957

INFECTION OF MYCORRHIZAL FUNGUS BY GRAFTING METHOD
JPH1042694

METHOD FOR PROLIFERATING VESICULAR-ARBUSCULAR MYCORRHIZAL FUNGUS AND APPARATUS THEREFOR
JP2832257

ARTIFICIAL INOCULATING METHOD FOR MYCORRHIZAL FUNGI
JP2791543

METHOD FOR PROLIFERATING VA MYCORRHIZAL FUNGUS
JPH06335383

Improvements in or relating to the production of mycorrhizal fungi
GB2043688

METHOD FOR IN VITRO PRODUCTION OF MYCORRHIZAL FUNGI MYCOCALLUS AND MYCORRHIZED BIOLOGICAL SUPPORT OBTAINED THUS
WO2005000008

Method for producing axenic vesicular arbuscular mycorrhizal fungi in association with root organ cultures.
EP0209627

Process for the production of mycorrhizal fungi.
EP0015103

Method and compositions for stimulating vesicular-arbuscular mycorrhizal fungi
CN1077767

Method for producing bush mycorrhizal fungi preparation
CN1255528

Method for preparing exotrophic mycorrhizal fungi preparation for large waste land in mine area
CN1236050

Culture of ramaria mycorrhizal fungi by using glass bead as culture medium
CN1354252

MANUFACTURE AND USE OF ADSORBENT FOR THE INOCULATION OF PLANTS WITH VASCULAR-ARBUSCULAR MYCORRHIZAL FUNGI
CA1270454
