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MELANIN: THE PHILOSOPHICAL STONE OF MOLECULAR BIOLOGY AND ITS IMPLICATIONS ON DISSOLVED OXYGEN LEVELS IN WATER AND FERTILITY OF AGRICULTURAL SOIL

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ABSTRACT

Two fundamental problems now are: the growing contamination of water throughout the world, and the progressive loss of fertility of agricultural soil.

The lack of revenue is a significant impediment to financing water. Water pollution is a key part of the climate change. Unless the water sector addresses efficiently the challenges inhibiting creditworthiness, new sources of revenue aren´t likely to flow to the water sector. There are two ways to pay for water infrastructure: tariffs and taxes. Worldwide, there is the cycle of "building" water infrastructure, and then "neglecting" it by not maintaining or repairing these assets because the resources aren't available.

Specifically, when local governments, water utilities, and other providers can significantly expands their collection systems efficiently, improves significantly water quality, reducing the non-revenue water, and decrease energy costs, then they can become viable, efficient, safe, and bankable service providers.

Current methods to improve water quality date back to the French Revolution, and to date they are carried out on a larger scale, with more sophistication, greater energy expenditure, more CO_2 emissions, greater production of toxic sludge, and yet, the quality of the water is not better, on the contrary it is declining as the contamination of the water continues to be incessantly, increasingly, cumulative and more and more complex.

Despite the centuries that have passed, one factor has gone relatively disregarded: the levels of dissolved oxygen in the water and in soil. The better the quality of the water, the higher the levels of dissolved oxygen, and vice versa. Which also applies to agricultural soil, because the more oxygen is present, the more fertile the soil and vice versa. Addressing the low levels of dissolved oxygen in the water, until now it seems that it is considered as something secondary, as if it were something accessory, something like a parameter that would even improve spontaneously as soon as the levels of contamination of the precious liquid improve. But this has not happened so far with any method and in any part of the world.

In addition to a lack of interest in developing processes to raise dissolved oxygen levels in the water and soil, there is the problem that the few available to date are too expensive. But the discovery of the unsuspected capacity of the human body to extract oxygen from water, dissociating it like plants; it means a light at the end of the tunnel.

Keywords: Hydrogen, contamination, dissolved oxygen, electrons, water pollution.

BACKGROUND

Despite all the attention on water and sanitation services, some 70% of our freshwater supply is used to grow food. Only a small percentage of that water is actually paid for, including irrigation schemes which are growing in importance as the world faces increasing populations, changing climates and food insecurity.

Food production grows geometrically, but population grows exponentially. Thereby, trying to increase food production, some countries actually prohibit charges or tariffs for irrigation services and, when tariffs are in place, like water and sanitation services, collection rates are low. According to recent analysis by the World Bank, irrigation covers only 6.5% of the land supporting agriculture. Yet it supports 40% of the world’s food and fodder output. Despite our growing hydrological changes, diminishing water resources, and increasing populations, why isn’t there more investment in sustainable irrigation systems?

Like water and sanitation services, the road to revenue to maintain and build more irrigation is through improved services. [[i]] Undoubtedly water losses need to be reduced, technology needs to be modified leaving behind centuries of backwardness in water treatment that are characterized by their less than mediocre results, great energy expenditure, high greenhouse gas emissions, and in the end tons of toxic sludge that we don't know what to do with.

In the case of the decreasing levels of oxygen in the agricultural soil, which leads to a decrease in soil fertility, which has been tried to compensate with the indiscriminate use of fertilizers, which in the end further decreases even more the already deficient oxygen levels in the topsoil, which are a key element in its fertility. Let's not forget that the formation of clays requires the presence of oxygen, but not from the atmosphere, but from the dissociation of water that occurs in living beings who live underground.

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The discovery that our body has molecules capable of dissociating the water molecule, like plants [ii], explains the importance of water in the different biological cycles, since living beings must take oxygen from the water, and not from the atmosphere, as it is believed. Therefore, the levels of oxygen in the land, sea, and air, take on unusual importance since they come from the dissociation of water that occurs inside living beings.

When dissolved oxygen levels in water drop, which occurs for a variety of reasons, different life forms are significantly affected [iii], both in water and underground living beings (ryzoma) what affects the fertility of agricultural soil [iv]. Therefore, dissolved oxygen levels are a marker rather than an indicator of water quality and arable whey fertility. The indiscriminate use of pesticides, herbicides, and fertilizers, coupled with irrigation with water contaminated with industrial waste, solvents, metals, etc., substantially impair the ability of organisms to dissociate the water molecule, and said dissociation is the true source of dissolved oxygen both in the water and in the subsoil.

That is why the processes used to try to improve water quality, however complex they may be, and despite the large expenditure of energy they use, result in poor quality water and with increasingly lower levels of dissolved oxygen. Thereby, the story of building and building water treatment plants, only to abandon them, is a story that is repeated worldwide due to the high operating costs of these white elephants.

And in the field of agriculture, the levels of dissolved oxygen in the subsoil are also more important than previously thought. This results in lower crop yields, and even though fertilizers began to be used since the beginning of the 20th century to compensate for the infertility of agricultural soil, the long-term results have been disastrous. And it is that until now we are understanding that oxygen must come from organisms that live in the subsoil.

The population is growing rapidly, climate change is accelerating every day, and to top it off a looming food crisis, so the purpose of this work is to raise awareness of the great importance of oxygen levels in the different environments that harbor life, as well as to present a new method to raise dissolved oxygen levels both in water and on agricultural land, developed based on the biology of the human eye [v].

Dissolved oxygen levels and Water quality

Dissolved oxygen is known as a key component of freshwater, and it plays a vital role in everything from the livelihood of microorganisms, plants, and animals to the quality of water [vi]. When oxygen levels are less than 2 ppm, the water is defined as hypoxic, which may lead to the death of many aquatic organisms [vii]. High organic matter content and decay of organic matter result in the consumption of dissolved oxygen by microorganisms living in the water [viii]. The

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oxygen-depleted waters have been associated with the nutrient-rich discharges from settlements and food production–processing facilities located in their watersheds [ix].

Washing, tanning, greasing, and dyeing processes conducted in the leather plants can be described as the main sources which contribute to the nitrogenous–phosphorus compounds and EC contamination in the close freshwater habitat [x]. Monitoring the water quality of the entire watershed components is critical not only for ecosystem health but also for public health and thereby should receive more attention while making the sustainability and conservation plans.

Dissolved oxygen (DO) is one of the most important water quality factors. Maintaining the DO concentration at a desired level is of great value to both wastewater treatment plants (WWTPs) and aquaculture [xi].

Until now, there was no method that would raise dissolved oxygen levels efficiently, consistently, and without requiring too much energy. The problem is complex because dissolved oxygen concentrations were affected by upstream environmental conditions, where suitable upstream water quality improved downstream conditions and vice versa [xii]. Usually, there are serious negative effects of the city's urban activity on the rivers, lakes, and ponds´ water quality [xiii]. A significant decrease in water quality was also observed in the rural areas. A comparative analysis revealed that the urban water quality was significantly bad as compared with rural.

Water contamination by nutrients because of agro-genic domestic discharges and salinization of freshwater habitats because of industrial discharges are among the most significant environmental problems on the globe [xiv]. Anthropogenic processes and inputs, including domestic and agricultural runoff and industrial wastewater, are among the main factors determining the quality of aquatic habitats and a major source of organic pollutants [xv].Water quality assessment issues generally require the analysis of many parameters simultaneously, this complicates things due to the lack of uniformity in the methods used, the differences between the units of measurement that are reported, and in the sampling techniques used. Nitrate–phosphate contamination in freshwater is a serious problem today all over the world [xvi].

Usually, dissolved oxygen (DO) levels increase and salination (EC, TDS, and salinity) levels decrease in water from all components of the watershed during the rainy season, although extremely hypoxic and salinized conditions can be presented in some bodies 'water during both the dry and wet seasons.

As could be expected, the variables of industrial factors (EC, TDS, salinity, sulfate, DO, chloride, pH, and phosphate) were decreased significantly in the rainy season, while the variables of agricultural factors (nitrite and nitrate) were increased significantly in this season. The unconscious use of pesticides and fertilizers must be avoided, discharges of industrial wastewater

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without any treatment must be prevented, and discharges of municipal sewage without any treatment must also be prevented. The oxygen saturation of the water as an assessment of organic pollution [xvii].

Dissolved oxygen control strategies for water treatment

Dissolved oxygen (DO) is one of the most important water quality factors. Maintaining the DO concentration at a desired level is of great value to both wastewater treatment plants (WWTPs) and aquaculture [xviii]. During the last two decades, more and more attention has been paid to environmental concerns and sustainable development than ever before due to climate change, scarcity of resources such as drinking water and pollution. Among all these issues, the issues of water and aquatic environments are particularly severe. The issues of water and aquatic environments are particularly severe [xix].

Research activities for water treatment have subsequently increased in recent years, especially research interest in dissolved oxygen (DO) control for energy saving and efficiency improvement [xx]. Dissolved oxygen refers to the molecular oxygen dissolved in water. It is an important water quality parameter, whose concentration will affect many reactions or processes that need to take place in water. DO plays a crucial role in wastewater treatment and aquaculture. Wastewater treatment plants (WWTP) play a vital role in wastewater treatment, improving the water quality of urban discharged water bodies, conserving water sources, and reducing chemical oxygen demand (COD) and ammonia nitrogen emissions, since good water resources and environment are extremely important to ensure global sustainable development [xxi].

it is still difficult to control and operate the WWTP to achieve satisfied effluent requirements under the lowest energy consumption, because of the extensive uncertainties and nonlinearities existing in it [xxii]. As a critical variable, appropriate DO concentration can stimulate microorganisms to degrade organic matter and oxidize a variety of toxic compounds. Thereby, in the WWTP, DO control is one of the topics of most concern, when it comes to providing proper DO to maintain the biomass activities in the aerated process [xxiii]. DO control has become a part of wastewater treatment process, the effects of which will not only relate to the power energy consumption but also influence the effluent water quality, since a low effluent quality can cause significant ecosystem problems in receiving water bodies [xxiv].

Modern aquaculture has the features of high density, intensification, and industrialization, developing with reduction in natural aquatic resources and increase in human consumption demand for aquatic product [xxv]. DO is a key water quality factor in modern aquaculture, low levels of which can cause production problems linked to slow growth or death of fish, while high levels of which (so far) can cause increase of power costs of aeration systems [xxvi]. Reasonable prediction and control of DO is essential for aquaculture development due to its characteristics of

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nonlinear, large time delays, and instability [xxvii]. Only when the prediction and control of DO is realized accurately, the expected production and aeration costs can be balanced [xxviii]. The proposals of various prediction and control models, such as neural networks, fuzzy control and MPC, provide new approaches for the difficulty prediction and hard to reach control of DO in aquaculture.

Therefore, there is still a relative lack of comprehensive reviews on DO control strategies in the community. Accomplishing an accurate DO control is of vital importance in many aspects. According to the continuous development of the control systems and different DO control requirements, different control approaches have been adopted in the past decade. Conventional control methods are the most widely used control methods in practical industrial and agricultural applications (On/Off). PID control, namely proportional-integral-derivative control, is a feedback control and has three terms (P, I, D) whose functionality covers the ability to deal with transient and steady-state responses [xxix]. Model predictive control was initially proposed in the petrochemical industry, aiming to solve problems which are difficult for classical PID control to deal with [xxx]. Intelligent control is a control mode or a control system that can effectively overcome the high complexity and uncertainty of the controlled object and environment and achieve the desired goal [xxxi]. All trying to maintain high or at least restore the adequate levels of dissolved oxygen in the water, but this does not happen, at most between 8 and 15% of energy expenditure is saved, but the effect on dissolved oxygen levels, usually very depleted in polluted water, they hardly respond to such strategies.

The concept of fuzzy control theory was firstly proposed by Professor L. A. Zadeh in 1965 and by Professor E. H. Mamdani, who developed the world's first fuzzy controller, and achieved success in control of laboratory steam engine a few years later [xxxii]. Thereby, fuzzy control has gained popularity and acceptance through its successful application in more and more industries and fields, although it has received lasting controversy in academic circles because of its lack of requirement of an accurate mathematical model. The result of fuzzy inference is still fuzzy and cannot be directly used as a control output, it is necessary to perform a defuzzification operation to obtain the entity of control output to act on the controlled object.

Through the input and output data of the controlled object, neural network control uses neural network learning algorithms to continuously acquire the knowledge of the controlled object, to realize the prediction and estimation of the system model, to generate control signals and make the output as close as possible to the desired trajectory [xxxiii]. Hybrid control methods could always get better results by benefiting from the qualities of integrated methods.

The DO control strategies mentioned above explore from a theoretical point of view how to reduce the aeration energy consumption and operating costs of WWTPs, as well as how to

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achieve better effluent quality, more effective nitrogen removal and reduction of N_2O emissions. In practice, there are many real limitations and difficulties that prevent the full-scale implementation of these strategies. The obstacles may lie in lack of hardware conditions and support, inaccurate data acquisition and processing and inappropriate description of the transport phenomena in reactors, for example, such as the lack of flexibility in the actuators (air supply systems, pumps) and fault detection and correction of sensors. It is urgent and necessary to solve these limitations and obstacles, otherwise, the quality of water will continue to decline throughout the world in the coming years, with its disastrous consequences for human health as well as the environment.

Dissolved oxygen concentrations in aquaculture

Dissolved oxygen is an essential water quality factor for animals to survive and breathe in water, and suitable DO concentration is a critical element to ensure the healthy growth of fish in aquaculture. Industrial aquaculture develops gradually because of its good characteristics of high economic benefits and friendly environment. As industrial aquaculture, which is the collection of instrument, biological engineering, and water treatment technology, is different from traditional natural aquaculture, the abnormal changes of some survival factors such as DO concentration will lead to the large-scale death of cultured organisms [xxxiv].

The prediction models are very complicated and difficult for real application. Not clear about the influence of some input factors on the dissolved oxygen content. Therefore, not able to determine which input factors are relevant. Unfortunately, the models are not able to add some correlated parameters like light intensity, chlorophyll, wind power and turbidity as the input of the model. Their prediction accuracy usually decreases rapidly during sunrises and sunsets.

Even though establishing such intelligent monitoring and control systems may require huge initial investment, it is still extremely worth developing and extending smart aquaculture across the regions.

DO control plays an important role in the municipal wastewater treatment plants and in modern aquaculture, but we are far from reaching an adequate control in this regard, if we rely on the usual designs and available control models.

Current treatment plant designs are like those of the last century (Figure 1), only larger, still requiring substantial amounts of energy, and generating large amounts of toxic sludge.

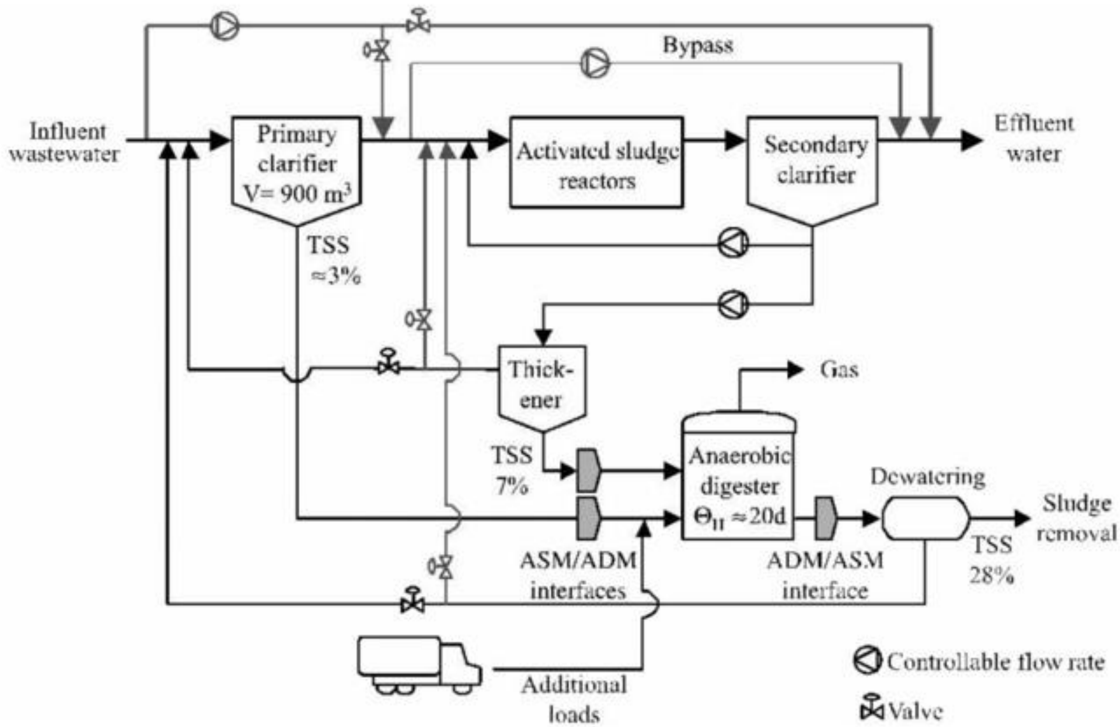

Figure 1: Plan layout for WWTP BSM2 [xxxv].

For both WWTPs and modern industrialized aquaculture plants, aeration energy consumption accounts for the largest proportion of the total plant energy consumption [xxxvi]. Improving aeration control technologies and strategies to reduce aeration energy consumption has become a research direction for many scholars. However, the application of digital technology cannot reshape efficiently dissolved oxygen levels in WWTP.

A new model of WWTP

By having a new material that constantly raises oxygen levels in the water, whose development was based on the biology of the human eye [xxxvii], we can redesign the layout of processes currently used, in a simpler way (Figure 2), optimizing the use of our new material, marketed under the trade names of QBLOCK™ and QCET™.

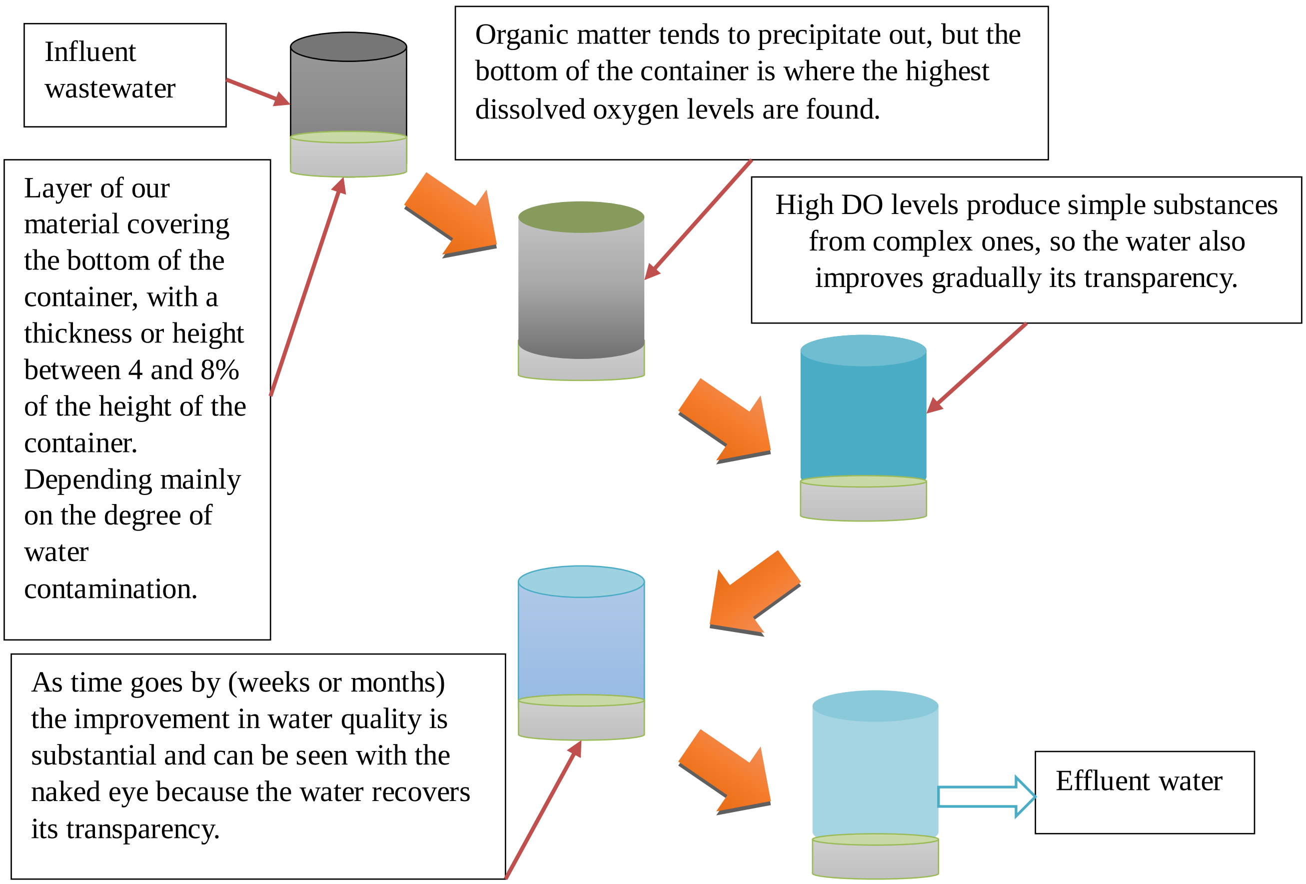

Figure 2: Among the main differences between our new method, based on the biology of the human eye, and traditional methods, is that our system does not require electricity to work. The stages take place in a single container. It is not necessary to be transferring the water, the process was only outlined for clarity. The half-life of our new material is 25 years.

High dissolve oxygen levels, like electrolysis produces simple substances from complex substances. Electrolysis can be viewed as a symmetrical catalytic process with respect to catalytic reactions of synthesis of complex substances [xxxviii] from simple ones.

The possibilities of our new method are significant, since there was no known way to raise dissolved oxygen in water constantly, both day and night, and even less without wasting electricity. The effect of elevated dissolved oxygen levels in polluted water is surprising. For example, bad odors disappear after a few weeks (2 to 4). Although the processes involved with the high levels of dissolved oxygen in the water and its pollutant do not happen instantly, the advantage is that they do not require electricity, so in the worst case, just let time pass. The ductility of our newest material allows its application in existing treatment plants, with which

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existing resources can be optimized and substantially reduce the high energy costs that the operation of a current water treatment plant requires.

Figure 3: The photograph shows the remarkable transparency of the water in the water tank after 10 months, the bottom of which houses our new material. The water not only improves its quality but also remains in good condition for months or years, basically due to the high levels of dissolved oxygen. Electricity is not required in any way. At most electricity would be required to transfer the water, when necessary, but our method itself does not need it.

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Figure 4: The 4 previous photographs exemplify some prototypes as well as the distribution they may have. They are prototypes of different form, capacity, and size, all of them containing, inside, a layer of our new material (QBLOCK™). Simply let time pass, and the high levels of dissolved oxygen do their complex cleaning work, day, and night. In addition to notably improving the quality of water, these designs allow us to preserve it for a long time (months or years) without decreasing its quality.

Our material and our prototypes do not require any electricity during the processing, or add chemicals, or recharging of any kind, to perform their function. The transfer of water can be carried out according to the needs and use of water.

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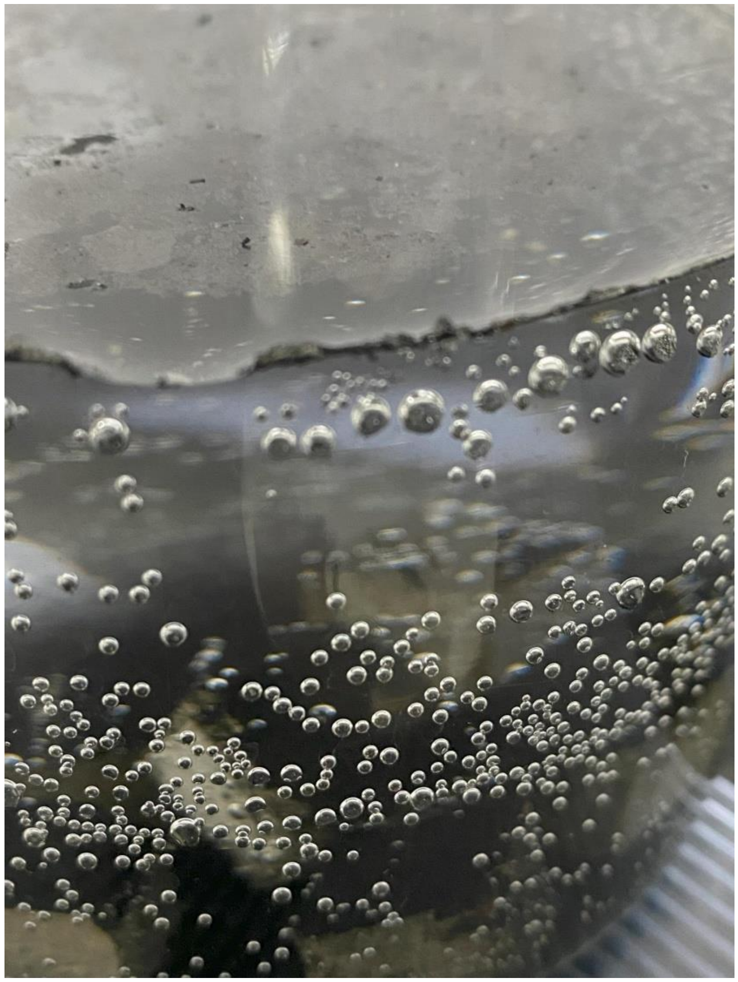

Figure 5: Under certain experimental conditions, it is possible to visualize, even with the naked eye, the bubbles coming from our new material, based on the biology of the eye. Bubbles are usually microscopic in size (invisible to naked eye).

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Figure 6: When our innovative material is applied in fish tanks, the water remains surprisingly clean for months, making frequent replacement unnecessary, since variables such as dissolved oxygen, pH and temperature are kept within optimal limits. Without any electricity.

Figure 7: Close-up of the previous photograph, where algae growth can be seen on the top of a QBLOCK™.

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High dissolved oxygen levels in agricultural soil significantly improve its fertility.

The progressive loss of fertility that is occurring throughout the world is worrisome, even in countries that use advanced farming techniques. And said decrease in crop yields has not been offset by the disproportionate increase in the use of fertilizers. Although at first, they seemed to work, in the end they have contributed to worsen the progressive impoverishment of the soil.

And starting from the fact that the formation of clays requires the presence of oxygen inside the soil [[xxxix]], we carried out a series of experiments (Figures 8 -16) in harsh environment whose results were encouraging, one of the most demonstrative being the one carried out on pumice stone, of volcanic origin, and which was It is considered one of the most hostile environments for growing food, since even its characteristics are close to the soils that we can find on other planets, and even very similar to lunar soil.

Figure 8: Purified water and a block of our material in the shape of a gray hemisphere (bottom) were placed in a transparent plastic container with a hermetic seal.

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Figure 9: Then the pumice earth was added until saturation. At first it seemed to mix but then pumice sand precipitated.

Figure 10: Pumice earth was applied until our block of material was completely covered.

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Figure 11: Our material was placed at the bottom of the container, and then it was completely covered with pumice earth, also placing some pumice stones on the surface. Purified water was then added until the layer of pumice was completely moistened, but by the next day the water had separated from the pumice almost completely. The photograph was taken in May 7, 2022.

Figure 12: Once the characteristics of the purified water that was used were determined, we followed the experiment through periodic photographic records. The photo shows the photograph taken in September 2022.

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Figure 13: Six months later, in November 2022, we began to detect the first signs of organic carbon (green dots) in the photographic records.

Figure 14: The following month (December 2022), the presence of organic carbon (green spots) continued to increase.

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Figure 15: In early February 2023, the presence of organic carbon continued to increase.

Figure 16: In April 2023, it is already an explosion of life.

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The appearance of organic carbon was very slow at first, since from the time we started the experiment in May 2022 (Figure 8, 9, 10) to November 2022 (Figure 13), almost six months passed in which we detected small green spots that denoted the appearance and presence of organic carbon. But as time went by, the process accelerated (Figure 14, 15), and by April 2023, life was literally exploding (Figure 16). We evaluate our experiment only with photographic records, since on the one hand we consider them sufficient for our purposes. And on the other hand, it allowed us to evaluate the process properly without the need to take repeated samples of the water or from the pumice soil, which could have introduced unnecessary biases in the results of the experiment, which is still ongoing to date.

This experiment demonstrates that the levels of dissolved oxygen in the water and inside the arable land are essential for soil fertility, even in adverse environments such as pumice soil, of volcanic origin.

CONCLUSION

More than 20 years into the 21st century, dissolved oxygen levels (DO) control strategies for wastewater treatment processes and aquaculture have changed. Various advanced control strategies including model-based predictive control, intelligent control and hybrid control have been proposed to save aeration energy, improve control efficiency and nitrogen removal, as well as increase the effluent quality in WWTP and the health index of cultured fish in aquaculture. The main efforts have been focused on method development using simulation models so far, only a few advanced control models have gotten successful implementation, while PID controllers are still the most widely used and effective control method in engineering practice. However, dissolved oxygen levels in water or agricultural soil cannot be significantly changed by digital algorithms. The good news about this important problem is that Nature shows us the way to go [Solís Herrera et al, 2022]

Thus, managing dissolved oxygen levels represent a new and more efficient option in water management and treatment compared to current processes, allowing significant energy savings and greenhouse gas emissions, not to mention substantially improving water quality. Reducing the formation of sludge by 95%.

Regarding agriculture, optimizing the levels of dissolved oxygen in the subsoil will allow us to recover and preserve the fertility of the arable soil, minimizing the use of fertilizers and other toxic agrochemicals for the environment and for human health.

We want to draw readers' attention to the importance of focusing on dissolved oxygen levels as a marker of agricultural soil fertility and water quality, since it is the primordial element for the cycles of biology, since they all seem to start with the dissociation of water. In this work we

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present a general panorama, since our discovery about the unsuspected capacity of the human body to dissociate the water molecule, like plants; It was in 2002, during an observational, descriptive study about the optic nerve and the three main causes of blindness in the world (Glaucoma, diabetic retinopathy, and macular degeneration), which began in 1990 and ended in 2002. It included the records digital ophthalmology tests of six thousand patients [[xl]].

Explaining our discovery in detail is beyond the purpose of this article, since our first publication in this regard was in 2009, and to date we have published more than 100 articles in various indexed journals, so the interested reader can track them on the internet.

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