Anaerobic peat moss water treatment (A.P.W.T)

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Key words: Bio sand, Peat moss, Carbon, Gibberellin, Irrigation system

Abstract

Clear water and food supply are the base of a chain of issues that face the whole world. Hunger, malnutrition and high rate of death are all consequences of the main challenge, as 1.2 billion person suffer from hunger all over the world. The main challenge of the project is improving irrigation process by providing clear water suitable for irrigation, modifying both the irrigation system and the plants to increase the production. Purifying Sewage water by Down flow Anaerobic Peat moss Blanket (DAPB), using a modified drip irrigation system and inserting "Gibberellin" hormone for increasing the rate of the plant growth are believed to be useful solutions to achieve the main challenge. The project produces more amount of crops with higher efficiency and a little cost, so it meets the design requirements of any project (Production, efficiency and cost). The prototype of the project represents the water treatment process (Anaerobic Treatment) and tests the percentage of the purification of water (The efficiency). The results showed that the treated water TDS was less than 1000 mg/l (ppm) when it was measured by TDS Meter, so it is suitable for irrigation. In conclusion, test results showed that this project is the perfect solution to the challenge addressed.

Introduction

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Clear water is a huge problem that the whole world is facing as for example in Africa, Egypt 600 m3 per capita / year is only the rate consumed which is much less than the rate in all over the world (1000 m3 per capita / year). As shown in (fig.1) a huge amount of water was used for agriculture in Africa. In addition to clear water issue, another problem appears which is food supply, as a result other challenges occur which are pollution, recycling and increasing the industrial base. There are many prior solutions applied in the whole world in order to stop the catastrophe of lack of clear water and food supply, For example The High Dam in Egypt which consists of a reservoir capacity of 132 km3, the Aswan High Dam provides water for about 33,600km of irrigation land. It serves the irrigation needs of both Egypt and Sudan, controls flooding but it also had bad effects as it led to a lack of soil fertility and a lack of fish resources. The solution addressed in this paper consists of three

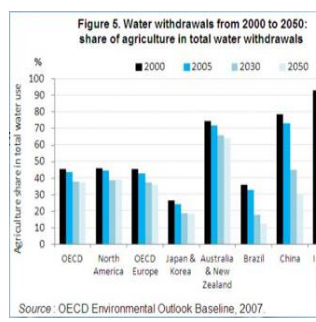

fig (1)

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parts, the first part is treating sewage water by using bio sand and peat moss blanket, sewage water was chosen to treat because it only represents a small percent of reused water as shown in (fig.2) so the percent needs to be increased. The wastewater enters from the top of a huge container and flows downwards, the water first passes through a container of bio sand which consists of gravel, pebbles, activated carbon and sand, then it passes through a container of peat moss blanket, and finally it becomes suitable for irrigation. The second part is a modified system of drip irrigation which delivers water to the root of the plant directly by a network of pipes under the Earth's surface so it saves water, time and money. The third part is modifying the plant as a hormone called "Gibberellin" is going to be inserted into the plant which modifies the plant to grow faster so the production is increase. The project achieves all the design requirements which are:

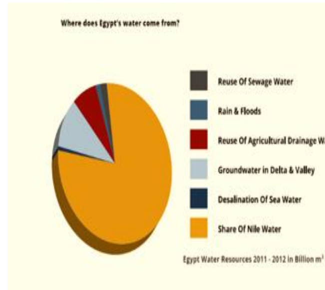


fig (2)

Cost: the project cost is reduced by using the modified drip irrigation system which saves water and money compared to other ways of irrigation because there isn't any amount of wasted water.

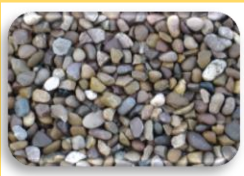
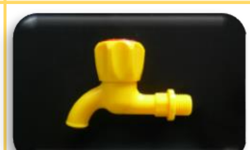
Production: the production of the project is increased by using "Gibberellin" hormone which makes the plant grow faster than usual.

Efficiency: the efficiency of water is increased by treating it using bio sand and peat moss which decreases the amount of TDS in water so the efficiency increases.

The prototype represents the sewage water treatment process, demonstrates each stage and the function of it and measures the amount of TDS after treating water.

Materials

Materials used

200g Fine sand	625g Gravels	500g Peat moss	125g Activated carbon	TDS meter
				
2 Plastic containers	Wooden stand	2 Tapes	250ml Silicon glue	Litmus paper
				 Tab (1)

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Methods

In order to make a suitable prototype to output a well-organized true results, the following steps have been made:

The bio-sand tank (with a tap) was constructed at a workshop. Then, differently-sized gravels were added to provide support then sand is added later (size gradually decreases as ascending). After that, a layer of activated carbon separated the two components. At last, a layer of cotton was applied between every two layers to provide better filtration. During the second stage of construction a variety of plastic tanks were connected with a grid of pipes and taps. At the very end, a wooden stand was constructed to provide a stand that can carry the whole system as shown in (fig.3)

fig (3)

Test plan

There were two tests made PH and TDS:

The first one is PH: it was made by putting the litmus paper into the treated water and comparing its color with the scale. To measure the acidity of the water, if it less than 7 it is an acid solution, if it is more than 7 it is a base solution, if it equals 7 so it is pure water, the range of PH of water to be available for irrigation is from 6 to 8.

The second one is TDS: it was made by using a TDS meter by putting it in the water and reading the measurement. TDS measure total amount of dissolved salts in water, the range of TDS to be available for irrigation from 500 to 100 mg/L, unlike drinking water that requires from 0 to 500 mg/L as a TDS measurement. The TDS of the water used in the treatment process was 1450 mg/L as shown in (fig.4)

fig (4)

Results

Firstly, the PH test has been done three times by using the litmus paper, then the results were recorded before and after the treatment process as shown in (fig.5) and started examining it. In the first test the PH was 5.2 before purifying it and it became 6.8 after the purification process. In the second test, the PH was 5.5 before purifying it and it became 6.3 after the purification process. In the third test, it was 5.8 before purifying it and it became 6.4 after the purification process. The average of the results was 5.5 in the PH scale before the purification process and it turned to be 6.5 after the purification process so it can be used in irrigation.

fig (5)

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Secondly, the TDS test, it has also been done three times by using the TDS meter, then the results were recorded before and after the treatment process as shown in (fig.6) exactly like what have been done in the PH test and started examining the results. In the first test the TDS was 1426 before purifying it and it became 912 after the purification process. In the second test, the TDS was 1493 before purifying it and it became 876 after the purification process. In the third test, it was 1397 before purifying it and it became 860 after the purification process. The average of the results was 1439 in the TDS meter before the purification process and it turned to be 885 as shown in (fig.7) after the purification process so certainly the purified water is suitable for irrigation.

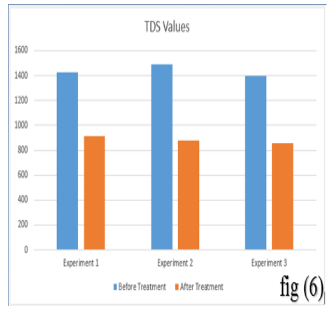

fig (6)

fig (7)

Analysis

After passing the sewage water to the container of the bio sand which contains (gravels, pebbles, activated carbon, sand and cotton) as shown in (fig.8), it has been passed throw the peat moss and the PH and the TDS of the water have been calculated after the treatment by using the PH meter and the TDS meter. The law of PH has been used to calculate the PH of the water after the treatment:

PH = - log (H+), H is the molarity of the Hydrogen. When the PH was calculated before the treatment it was 5.5 PH, but after the treatment it was 6.5 PH, it means that this water after the treatment can be used in the agriculture because the water that can be used in the agriculture has PH value between 6 and 8. The TDS of the water before treatment was calculated and its value of 1450 mg/L, but after the treatment its value was 885 mg/L. It means that this water after the treatment can be used in agriculture because the TDS value of water that can be used in agriculture should be between (500:1000 mg/L), so the design requirement of increasing the efficiency of our project has been achieved. Also the “Gibberellin” hormone has been used to increase the rate of growth of rice (the plant that is used in the project), as shown in (fig.9).

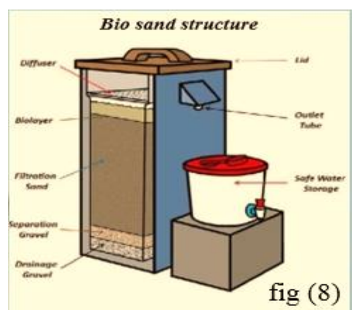

fig (8)

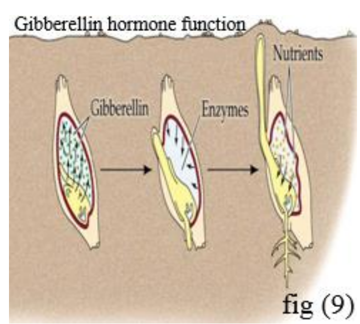

fig (9)

In the project, one of other design requirement is reducing the cost of the water used of irrigation. The cost is reduced by water management as there is a whole new system of irrigation rather than the methods usually used. The system consists of a group of pipes connected to a big tank full of water, these pipes go under the earth's surface and open directly at the roots of the plants, these pipes are electronically prepared to pump water into the roots directly when the plants need to be Irrigated as shown in (fig.10) by connecting the system to sensors which are put into the soil to measure the soil moisture as shown in (fig.11), this way of irrigation will save time, water, money and give both the plants and the soil the suitable amount of water to grow properly with no over needed amount of water and without spoiling the soil and it's much better than the flood irrigation or other irrigation systems used because there isn't any amount of wasted water so the cost is reduced. The results showed us that the project solves many problems that which are: the plenty of the sewage water, traditional old ways of irrigation, water pollution and food supply.

fig (10)

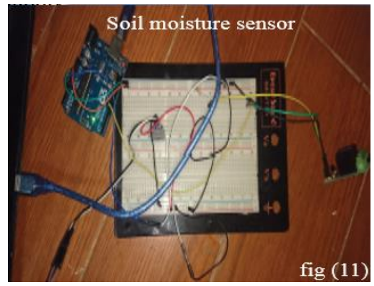

fig (11)

Conclusion

After specifying the grand challenge and the consequences of it, Hunger, malnutrition and high rate of death, a lot of researches have been done in order to find a suitable solution which has low cost and high efficiency to solve this grand challenge its consequences of it as a result. A solution has been chosen and a prototype has been constructed, to make sure that this solution will meet the design requirements. After performing the test plan on the prototype and analyzing the results, it appeared that the solution succeeded in achieving the design requirements of producing clean water that meets the quality of water used in irrigation, and has high efficiency with an average measure of TDS which is 885 mg/l (ppm). The results showed that the treatment part with the other parts of the solution, irrigation system and hormone inserting, are able to solve clear water and food supply grand challenge.

Recommendation

In the future, instead of using peat moss to purify water shale is going to be used to reduce the cost and improve the efficiency as the efficiency of shale is 90% while the efficiency of peat moss is 70% as shale is a pure organic material and nearly has no percent of salts as shown in (fig.12) so the efficiency will be increased by 20%, also shale is cheaper than peat moss as it's available in the earth in quarries and near mountains with large quantities unlike peat moss which needs to be extracted from the sea but it was not available in this project because it would take a long time to travel to a quarry or a mountain to get the shale and there wasn't

fig (12)

enough time so instead peat moss was used as it gave us a near efficiency compared to the efficiency of shale and it's also better than compost.

Another recommendation for the future is using "Ethylene" as a hormone instead of "Gibberellin" as it is more efficient but it wasn't used because preparing the hormone requires high temperature and technology which weren't available neither at the time nor at the place the project was made, so "Gibberellin" was used instead.

fig (13)

The idea can also be applied on a large area by making a connected sewage system which collects all the water at the end in a large box, then the polluted water passes through two stages: the bio sand stage and the peat moss layer stage as shown in (fig.13) to be purified. After purifying it, the treated water will be collected in another big tank which is connected to the network of pipes that go under the surface of the earth to irrigate the plants according to the modified irrigation system. So this project is a practical centralized project which can be applied in the real world on a large area.

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For further information

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