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Sludge Implant for Prevention of Desertification and Removal of Carbon Dioxide

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***Abstract*— Bacillus *Pasteurii* have been getting much attention recently as part of the anti-desertification measures, producing calcium carbonate ions and organic supply. This study focuses on the sludge implants to prevent desertification and reduce carbon dioxide. Absorption of sewage sludge was made of moisture around the roots of plants that mimic the structure over time, and it slowly melts *Bacillus Pasteurii* to supply organic matter to the sludge implants. Sludge implants are cured in a screw shaped. Implants were easily transplanted in the sand because of its screw-like shape; desertification has been used as one of the treatments.**

Keywords*— *Bacillus Pasteurii, Carbon Dioxide, Desertification, Global warming, Implant, Microorganism, Sludge

I. INTRODUCTION

Cities are becoming more urbanized and industrialized; likewise, sewage generation is also increasing day by day. Sewage is a mixture of domestic and industrial waste and it should be adequately treated before it is discharged into rivers, estuaries or coastal waters. Otherwise it can damage our environment, including fish and other aquatic life. Most of the cities have operational sewage treatment facilities such as Seoul, Incheon, Busan etc. Purification, proper collection, treatment and discharge of waste water, and correct disposal or re-use of the resulting sludge help to protect and improve water quality in South Korea. Once of the methods of purification the sewage microorganism, sewage sludge is generated as a byproduct. Proper taking care of our environment is vital for the survival of humanity; therefore, sewage sludge is strictly prohibited both locally and internationally. When the sewage sludge from the sewage treatment process that produces calcium carbonate is fed to the microorganism, Bacillus Pasteuri, we would be able to achieve two goals of sewage sludge degradation and prevention of desertification. Furthermore, carbon dioxide which accumulates and creates the green house effect, the representative trapping effect, can be obtained through calcium carbonate produced by Bacillus Pasteurii.

Bacillus Pasteurii easily contact or is attached with the soil, and it is easy to design too. When it meets the soil, it absorbs the moisture contained in the soil and on the roots of plants like a cup of roots and threads of sludge implants. The role of mixing flour in sludge and sludge implants is to enhance the strength of the structure, as well as moisture absorption, depending on the degree of sludge that is gradually exposed. Sludge implant experiments will show us the effects of the growth of Bacillus Pasteurii and sludge samples containing mix when they are placed to the increasing number of Bacillus Pasteurii. Through this research paper, we would be able to know how to prevent desertification with carbonate calcium produced form Bacillus Pasteurii that also has the ability to absorb and store carbon dioxide. The purpose of this research will suggest a method that could provide an effective means of the actual processing on finding advantage from sewage sludge.

II. RESEARCH MOTIVE

Sewage life formations collectively occur in the drainage, sewage, and rainwater. There are domestic sewages that occur at home, in the factory or work place drainage, groundwater, etc. Especially when it rains, the rainwater gathers the sewage in roads' drainage way. Depending on the situation, the sewage contains large amount of pollutants and sewage treatment. It either pollutes the water or cleans the environment with sewage treatment.

We have gathered sewage and collected them inside a pipe conduit to send it to the sewage treatment plant. Furthermore, lump of sewage treatment were formed through gravitational settling or chemical treatment process by dehydration, and the collected sediments of lumps is what we called sewage sludge. The sewage sludge was previously removed by landfill or ocean dumping, which are now banned for causing another environmental pollution.

The best way to handle the sewage sludge is to use it for fuel development or as a fertilizer. The sewage treatment method that we are studying is not only to prevent desertification but also to show that carbon dioxide air processes incidental effect. The feasibility of this study was confirmed through series of our research studies and experimentations.

III. THEORETICAL BACKGROUND OF STUDY

A. Sewege Sludge

Sewage treatment can eliminate sands, sticks and debris in sewage and also by microorganism; it can decompose, eliminate and purify organisms and wasted materials. As human's life become more comfortable, people wastes huge amount of food waste as well as detergent which cause serious water pollution. Also, as economy growths, the waste water from the factories leads to the water pollution. Since many countryside people moves to city, city becomes humongous which makes environmental pollution inevitable. Because of the people's selfishness, the Earth's water suffers which

eventually would damage our lives. Therefore, sewage treatment is critical to protect sanitation from bacteria as well as water quality.

Sludge originates from the process of treatment of waste water. Water waste comes from the toilet, sink, factory etc., then flow to the sewage treatment plant to be assembled for the purification of microorganism and organic substances, once treated, the clear water freely flow into rivers. We periodically eat a lot of food, human food waste increase in bulk resulting sewage microorganism that forms solid, semisolid, or liquid muddy looking and this is what we called Sewage Sludge. Since 2012 in the Republic of Korea, sewage sludge was 8,400 tons a day occurs based on a 15 ton truck 560 worth of 200,000 annual amounts. Sewage material discharged will be placed with sewage sludge. These sewage sludge disposal costs per ton of 5-6 million won per year estimated at 170 billion won. Sewage sludge is not easy to handle, the moisture content is high during the throw in the land and ocean, therefore, the amount was considerable. The issue in the Korean sewage sludge has come forth since marine waste emission is prohibited. In London last year, parties from 39 countries attended the convention that prohibits nations' marine waste disposal emissions. Korea achieved the marine emission proportion decrease from 72% in 2003 to 28% in 2010, which the government promoted policy regarding marine emissions for compliance with the London Protocol. Since January 2011, the Prevention of Marine Pollution Act changed, that sewage sludge discharged into the sea has been completely banned.

B. Bacillus Pasteurii Generating Calcium Carbonate

Microorganisms called microbes that are present in the soil generate minerals such as calcium carbonate. The generation of a certain microorganism is precipitated in the voids within the soil and it makes the ground more virtuous and useful. This useful microorganism is referred to *Bacillus Pasteurii* that are easily found in pH alkaline environment of 9.0 degree. The formation of Bacillus Pasteurii calcium carbonate process is as follows.

$$CO(NH_2)_2 + 2H_2O \rightarrow 2NH^{4+} + CO_3^{2-}$$

$$CO_3^{2-} + Ca^{2+} \rightarrow CaCO_3 \quad (1)$$

As the formula states below, urease activates the elements of the hydrolysis reaction, the production of carbon dioxide and ammonia, the increase the pH of the surrounding as $CaCO_3$ mineral ions, $Ca^{2+}$and $CO_3^{-2}$by ionic bonds to induce Urease generated by microbes such as Sporosarcina Pasteurii himself on the outside surface of the minerals, such as calcium carbonate. The precipitation process is called MICP (Ramachandranet al, 2001).

C. Gram Staining

Fundamentally, cell wall structure is different between the stained positive and negative gram bacteria. To maintain the size and the shape of bacteria, the cell wall plays a role in preventing cell rupture due to osmotic. The most basic way to classify bacteria was to look at the difference due to the structure of the cell wall of the stain gram, pink purple negative gram bacteria, Gram staining positive gram bacteria are observed.

The method of Gram Staining is as mentioned below.

1. Smear the badge of cement in the slide glass, allow it to process

2. Dried the smear medium. After the flame, process lowly 2-3 times (fixed)

3. Dye crystal violet solution for 1 minute, and then wash after. Close the slide glass upside smear, the opposite parts of water, and the dye should be removed.

4. Once the water is removed, then put three gram of iodine solution for 1-min will help to immerse.

5. Put the iodine gram solution, after wash in the same manner. Then allow decolorization by using alcohol for 30 seconds.

D. Nitrogen Fixation

There is 78 percent nitrogen present in our atmosphere, but the plants do not directly use nitrogen from the atmosphere. The plants' roots directly absorb the ammonium (NH_4^+) or nitrate (NO_3^-) ions from the soil. Clues to independent living microorganisms that fixed air in a glass of nitrogen fixed in the soil by microorganisms and organic nitrogen compounds to change the process of biological nitrogen fixation, and aerial nitrogen as nitrogen azotoqacter general and nitrogen-fixing blue-green algae, such as public order as nitrogen fix Rhizobium symbiosis with other organisms and cross-tree Radium (clostridium) and Rhizobium nitrogen-fixing blue-green algae, etc.

Legumes and Rhizobium symbiosis by nitrogen fixation is well known as fix nitrogen Rhizobium formation process that is achieved through a few steps of the complex process. Rhizobium on legumes fibril intrusion through the intracellular on the part of the cortex is reached. Pass bacterial infection Saga is formed to reach the cortex part, and cell proliferation occurs from there. Root Nodule center in the state of occurrence of vascular plants of the surrounding cells receive stimulation for tillering and regaining the ability to promote differentiation of nodulation by causing the formation of an organizational system. Nodulation position is likely to be formed in the highest concentration of reducing sugars, which usually occurs in the roots of plants. Fixed nitrogen can be fixed after a constant with the organizational structure of the Root Nodule. Rhizobium nitrogen fixation of nodule fresh weight increases when you go, good organization of steroid, and Root Nodule in red hemoglobin pigment, when a lot of starch accumulation is fixed.

Impart airborne nitrogen fixed by a 2/3 to get 1/3 of the nitrogen needed for those living from the soil, the legumes, 2/3 of the total nitrogen in the aboveground. For the remaining 1/3 in the underground, therefore fixed nitrogen is mainly aboveground. Also it may vary depending on several environmental factors and nitrogen fixation of legumes in which legumes are not the same. In the Theoretical Investigation, the plant for the production of calcium carbonate, and calcium carbonate production using sewage sludge in the soil were all part of the experiment with the nitrogen-fixing Bacillus Pasteurii research, using sewage sludge in the soil. We think that growing legumes can create a sustainable ecological environment.

IV. SLUDGE IMPLANTS

Sludge Implant can be made by following procedure. First, mix the sewage sludge with the flour and calcium chloride ($CaCl_2$) in proper proportion to the gravity to make the dough. Next, make the dried dough into a cylindrical frame. Then, add proteolytic enzymes in the dough by mixing. Next, include the sewage sludge to proteolytic enzymes to make the dough. Mix the seeds of legume and coat the gravity flour to the sewage sludge dough. Finally, paste the dough coated seeds, proteolytic enzymes, and cylinder including whole dried sludge, and then dried the sludge screw shaped made implants. The gravitational flour make the structure of the sludge plants as well as the moisture absorption can collapse depending on the structures, and the sludge implants can switch roles.

A. Sludge Implant Graft

Rain or moisture contained in the soil sludge sucks implants. Sludge microorganisms in the production process and keeping the process implant tiny holes made by the capillary to serve as water holes are being soaked. Water sludge Incursion accelerate the absorption of water by the osmotic pressure between the sludge and the sludge is melted and slightly melted the soil will be. Sludge implant will absorb the moisture of the soil to keep the roots of plants, and the same principle as the role. Proteolytic enzyme protein contained in the flour protein contains in the sludge and the sludge gets off the melted water absorption by decomposing seafood produce. Proteolytic enzymes produced by protein degradation products to be fed, basil, and calcium carbonate production. In calcium carbonate, calcite is the raw material. Sand, debris, sludge, mix calcite are the basis of the soil when it is created, coating and coated seed germination. Legumes grow well in poor soils, as well as using nitrogen, protein synthesis, so the food source of basil can be continuously provided.

The sludge implants desertification process is where transplanted sewage sludge will be able to handle the waste. The basil made of calcium carbonate in an increasing green space to store carbon dioxide, as well as to prevent the desertification of carbon dioxide because you can plants can stored in and contribute to help stop global warming.

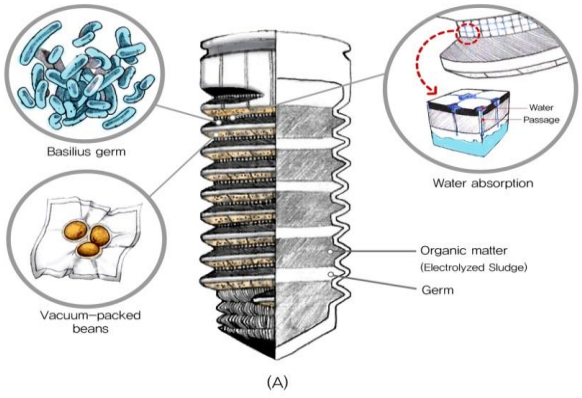


Fig. 1. Schemetic Design of Sludge Implant

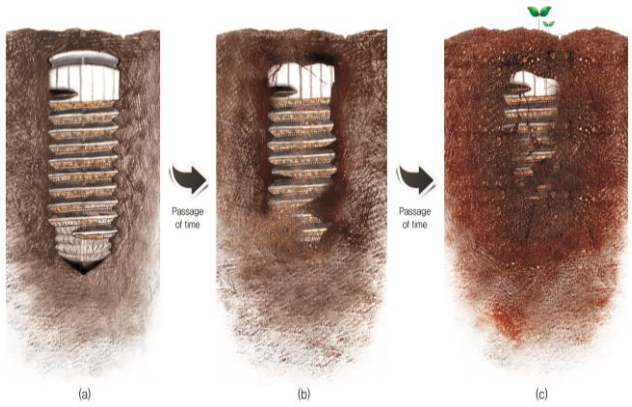


Fig. 2. Sludge implants after transplantation shows the process of dissolving into the soil to absorb moisture.

V. EXPERIMENTS AND RESULTS

Our sludge implants actually work with the following established hypothesis: 1. Protein in the sewage sludge must be included. 2. Sewage sludge should multiply basil as a product of the decomposition. 3. Sewage sludge should produce calcium carbonate basil as a product of the decomposition of sludge. 4. Sludge implants should be able to absorb moisture. Experiments were carried out in order to verify the operability of the sludge implants.

A. Protein in the sewage sludge must be included

1) Preparation

Sewage sludge, peptone (5%), distilled water, test tubes, test tube stand, and dropper

2) Experiment Method

In a 500mL size of the cylinder, put 1gram of copper sulfate, then fill up to 100ml of distilled water. In the same way, put 5g of sodium hydroxide; fill up to 100mL distilled water. Mix resulting 1% copper sulfate aqueous solution with the 5% sodium hydroxide mix reagents. Put the reagent in a test tube containing distilled water and sludge.

3) The Experiment Result

As we can observe from Figure 3, color of diluted sludge turned purple in the test tube. Therefore, we can conclude that proteins were detected in the sewage sludge, actually.

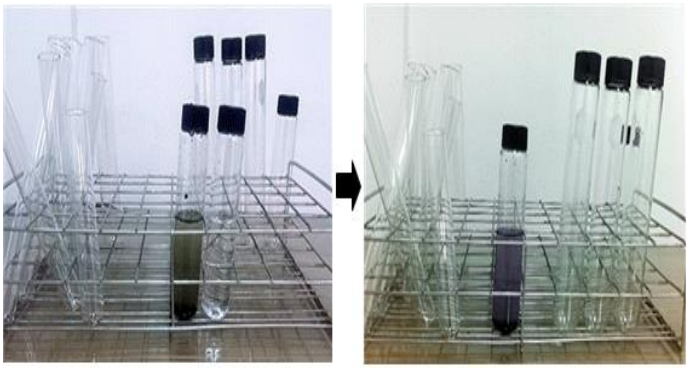
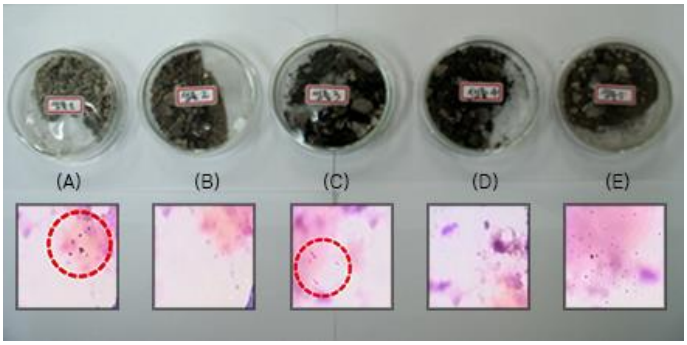


Fig. 3. Change of color into purple

Fig. 4. Gram Positive Results from Sample A and C



B. Check the presense of Bacillus Pasteurii by Gram Stain

1) Preparation

Dye (crystal violet solution, gram iodine solution, alcohol acetone solution safranine solution), soil samples, sludge, glass rod, Shah Allee, microscopes, slides, glass, distilled water

2) Experiment Method

Prepare samples of concrete and soil samples from five different regions. Tag samples from A to E, and extract certain amount and dye it with stain gram. Dye sludge samples in the stain gram. Find samples of positive gram reactions.

3) Experiment Result

As we can observe from Figure 4, we founded gram positive reaction in A, and gram negative reaction in C.

C. Supply Bacillus Pasteurii to Sludge

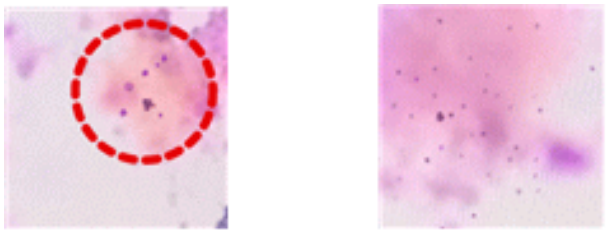
1) Preparation

Dye (crystal violet solution, gram iodine solution, alcohol acetone solution safranine solution), soil samples, sludge, glass rod, Shah Allee, microscopes, slides, glass, distilled water, sewage sludge, concrete samples A, B, C, D, and E.

2) Experiment Method

Mix concrete sample A with sludge and store it at a room temperature for 10 days. Then, dye the mixture in stain gram and observe it by microscope

3)Experiment Result



Sample A "Sample A" mixed with sludge

Fig. 5. Growth of Bacillus Pasteurii within the sludge

After 10 days of nurturing, in the mixture with sample A and sludge, we could observe more microorganism than in the sample A alone.

D. Generate Calcium Carbonate by using Bacillus Pasteurii

1) Preparation

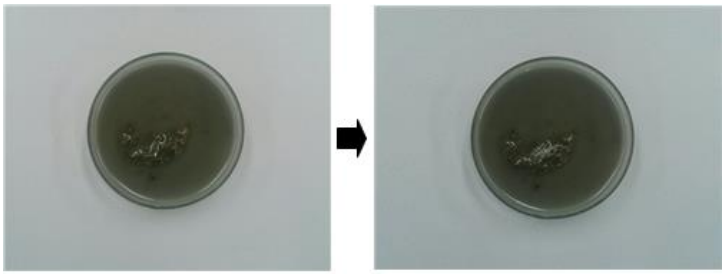
Sludge, soil samples, test tubes, and hydrochloric acid

2) Experiment Method

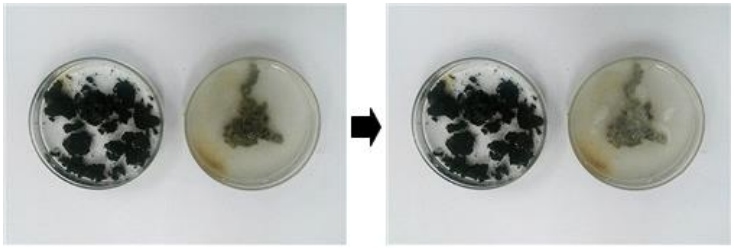
Fill schale with sludge and sludge mix with "sample A". Observe foaming after the gradually addition of hydrochloric acid to sample A mixed with sludge. After 10 days, observe foaming after the gradually addition of hydrochloric acid to sample A mixed with sludge. In each schale, add hydrochloric acid gradually with pipette.

3) Experiment Result

As we can see from Figure 6, Bacillus Pasteurii actually created Calcium Carbonate by having urease reaction.



(BEFORE) (AFTER)



(BEFORE) (AFTER)

Fig. 6. Generation of Calcium Carbonate from Microorganism

E. Sludge Implant can absorb adequate amount of water

1) Preparation

Sewage sludge, gravity flour, distilled water, calcium chloride, rubber gloves, mask, tank, beaker, and paper cups

2) Experiment Method

Mix sewage sludge and gravity flour with distilled water. Put calcium chloride in dough and mix evenly. Then, put the batter into the paper cups and form it. Dry it 5 days in the temperature room. If the dough hardens, extract sample and soak it. Observe the surface of the sample under a microscope.

3) Experiment Result

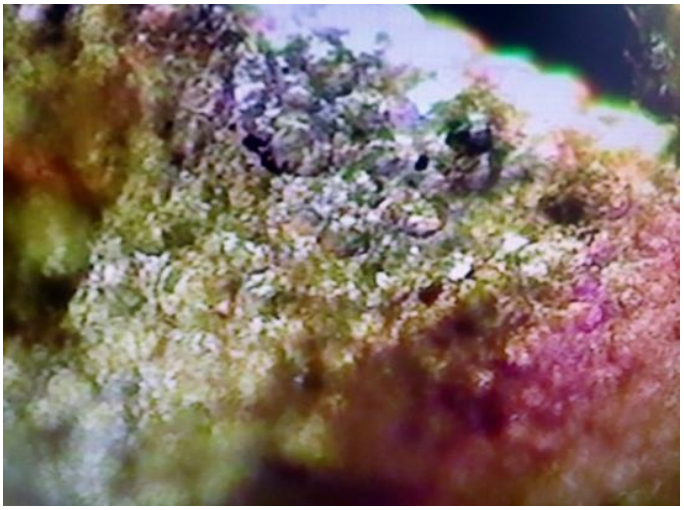


Fig. 7. Photos of sewage sludge mixed with gravity flour in a microscope

Even we hardened the dough, when we soaked it, the water still permeated inside the dough. Over time, the rust flour from the surface started to disintegrate. Microscopic cracks were observed when the surface of the sample was placed under the microscope.

VI. INTERPRETATION OF RESULTS

Through my experiments, I have observed the following: There are the protein components in sewage sludge. Microorganisms in concrete debris with stained gram were confirmed of having positive reaction with stain-gram but it is not sure whether it is Bacillus Pasteurii or not since we didn't conduct the genetic analysis of the microorganisms. Also, it is found out that microorganisms increase more when nurtured with sewage sludge. Through experiments, it is confirmed that the sludge implant absorbs moisture in the surroundings and melts down. Furthermore, by the foam produced from the reaction between hydrochloric acid and sample, we could see the formation of calcium carbonate. From various experiment results, I found out that this sludge implant is feasible. However, if we get an opportunity to conduct further research, it is necessary to buy Bacillus Pasteurii and design and make a real model of this sludge implant. It would be wonderful to go to desert, plant this implant and change the ground into grass
field. If it is successful, it would be innovative to have various environmental effects so we can also get a patent of this idea.

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