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Bioremediation of Refinery Oil Contaminated Soil

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Abstract

Objective: In order to study low activity of petroleum-degrading strains. **Methods**: We added oil degrading strains to compost, the compost is made of soybean meal, corn flour, bran and sawdust, in the last, we added the oil degrading strains-compost contaminated soil. **Result:** The oil removal rates were determinated by gravimetric method. The oil removal rates of control group, oil contaminated soil + compost group and oil contaminated soil + oil degrading strains-compost group were 23.4%, 31.6% and 49.7% on 60th day, respectively. Compared with the control group, the oil removal rate of oil contaminated soil + oil degrading strains-compost group increased by 26.3%. **Conclusion:** The research indicates that oil contaminated soil + oil degrading strains-compost can improve petroleum-degrading rates.

Subject Areas

Environmental Sciences

Keywords

Bioaugmentation, Oil Contaminated Soil, Oil Degrading Strains-Compost, Petroleum-Degrading Strains

1. Introduction

Oil inevitably pollutes the soil during exploitation, transportation and processing [1] [2] [3]. The remediation of contaminated soil includes physical, chemical and biological ways at present [4] [5] [6]. The biological ways includes microbial remediation, phytoremediation and microbial phytoremediation [7] [8] [9]. Microbial remediation has become a hot spot of research, because of low cost, good effect and environment friendly [10]. Exogenous microbes are easy to lose their ability to degrade, due to low temperature, water content and nu-

trients, when oil degrading strains restore oil contaminated soil [11]. These factors restrict the application of bioaugmentation technology, and many microbiological intensive remediation technologies are still in the laboratory research stage [12]. To solve these problems, we added oil degrading strains to compost, the compost are made of soybean meal, corn flour, bran and sawdust, in the last, we added the oil degrading strains-compost to oil contaminated soil. The compost increases water retention and insulation ability of oil contaminated soil and improves the contact area between the oil and the microorganisms; therefore the activity of oil degrading strains is improved. We hope that the study can provide methods and theories for improving the effect of microbial remediation.

2. Materials and Methods

2.1. Oil Contaminated Soil Sample

The oil contaminated soil sample was collected from a petroleum refinery of Xinjiang in Northwest China in June 2017. After air-dried, the sample was sifted by a 2-mm sieve and stored at 4˚C.

2.2. Strains

Oil degrading microbes: G-40 and G-94 were isolated from Qiangjiang Guanghua Oilfield on June 2015, stored in the laboratory of College of Life Science, Yangtze University.

2.3. Compost

The compost is made of soybean meal, corn flour, bran and sawdust with 50% water, their quality ratio is 1:1:1:1.

2.4. Using Compost to Expand the Culture of Oil Degrading Strains

Mixed microbial liquid: Selected two strains stored on beef extract peptone agar medium and potato sucrose agar medium, respectively, the G-40 was cultured in beef extract peptone liquid medium at 37˚C at 150 rpm for 18h, the G-94 was cultured in potato sucrose liquid medium for 28˚C, 150 rpm, 18 h, centrifuged them for 2 min at 5000 rpm under 4˚C, washed each strain three times with stroke-physiological saline solution, adjusted optical density of each microbial liquid of 1.0 (600 nm) with stroke-physiological saline solution, mixed two microbial liquid to the same volume.

Compost experimental design: B1: compost, B2: compost + oil degrading strains. B1 and B2 were cultured in the laboratory.

2.5. Using Oil Degrading Strains-Compost to Restore Oil Contaminated Soil

The oil contaminated soil was disintegrated, mixed and sieved through the sixty mesh. After preprocessing, we appended the same quality oily sludge to flowerpot. Experimental design: C1: oil contaminated soil, C2: oil contaminated soil +

compost, C3: oil contaminated soil + oil degrading strains-compost.

2.6. Experimental Methods

Microbial quantities: Spread plate method [13], Hydrogen ion concentration: Potentiometer method [14], Oil removal rate: Gravimetric method [15].

3. Results and Analysis

3.1. Changes in Microbes of Compost

The changes in compost microbes of different treatment groups are shown in Figure 1. As can be seen from Figure 1, during the 0 - 10 days, the microbes of all treatment groups were increased, while the microbes of all treatment groups were decreased during the 30 - 60 days. During the 0 - 60 days, the microbes of oil degrading strains-compost were always more than control group.

3.2. Changes in Hydrogen Ion Concentration of Oil Contaminated Soil

The changes in hydrogen ion concentration of oil contaminated soil of different treatment groups are shown in Figure 2. As can be seen from Figure 2, during the 0 - 60 days, the hydrogen ion concentration of C1, C2 and C3 were no obvious difference.

3.3. Changes in Oil Removal Rates of Oil Contaminated Soil

The changes in oil removal rates of different treatment groups are shown in Figure 3. As can be seen from Figure 3, the oil removal rates of C1, C2 and C3 were 23.4%, 31.6% and 49.7% on 60th day, respectively. Compared with the control group, the oil removal rates of C2 and C3 increased by 8.2% and 26.3%. Compared with C2, the oil removal rate of C3 increased by 18.1%.

4. Discussion

The study manifests that compost can expand the culture of oil degrading strains, we added oil degrading strains-compost to oil contaminated soil, which

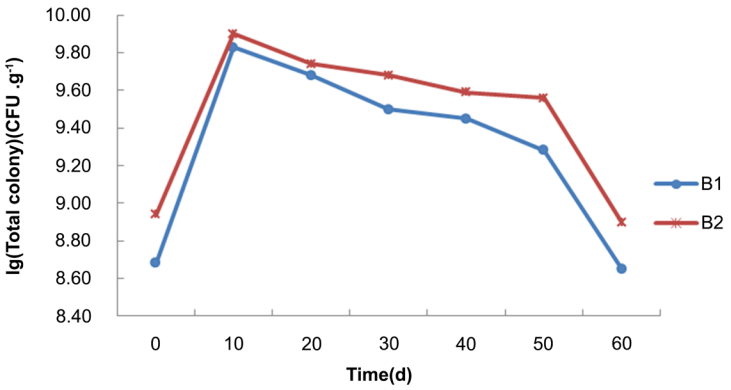

Figure 1. Changes in the number of microbes of different treatments.

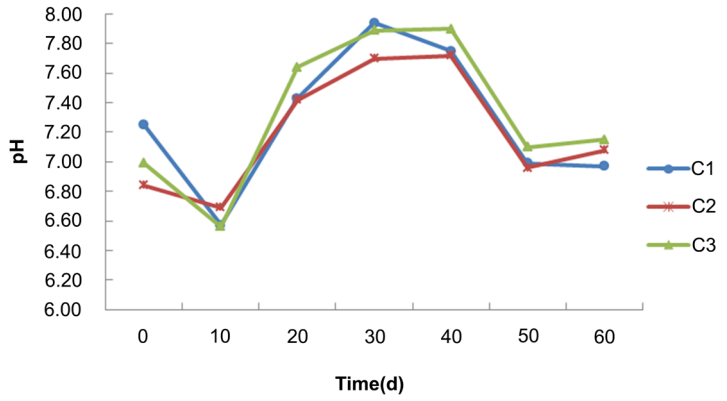

Figure 2. Changes in hydrogen ion concentration of different treatments.

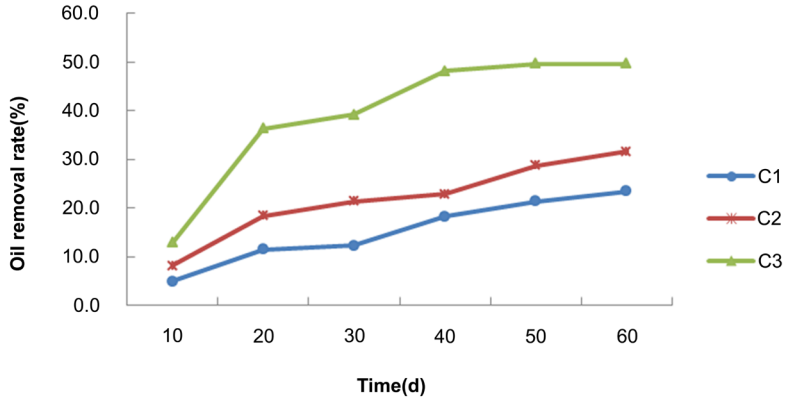

Figure 3. Changes in oil removal rates of different treatments.

can remove the oil of soil better. It is possible that compost is to increase water retention and insulation ability of oil contaminated soil and improve the contact area between the oil and the microbes; therefore the oil removal rate is increased. Wang added nutrients, corn straw and biochar to improve soil properties and decrease petroleum hydrocarbon, the oil removal rates were 27.44% - 50.30% [16]. Wang had natural compost, surfactants added compost, mixed strains added compost to degrade oil and their oil degrading rates were 68%, 88% and 80%, compared with natural compost, the mixed strains added compost increased by 12% [17].

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