

論文 / 著書情報
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(博士課程)
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論文要旨

THESIS SUMMARY

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Department of			Academic Degree Requested	Doctor of
学生氏名 :	YUK Sokunsreiroat		指導教員 (主) :	丹治保典
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要旨 (英文 800 語程度)

Thesis Summary (approx.800 English Words)

This doctoral dissertation is titled “Isolation and characterization of nitrate-reducing bacteria which enhance souring and steel corrosion in crude oil well environment”, and consists of six chapters.

Chapter 1, General introduction. Oil fields contain a variety of microbes that can be implemented for secondary oil recovery by water flooding. Injection water containing sulfate can enhance growth of sulfate-reducing bacteria (SRB) in the reservoir, resulting in the production of hydrogen sulfide (H₂S) in a process known as souring. To mitigate reservoir souring, injection of nitrate was applied to promote the growth of nitrate-reducing bacteria (NRB) to control the growth of SRB. Therefore, it is of particular interest to detect the presence of NRB and stimulate its activity for controlling souring. NRB can also cause microbiologically influenced corrosion (MIC). However, the effect of nitrate addition on reservoir souring and corrosion of carbon steel by NRB are still not well understood. The objectives of this study were to screen NRB strain from oil field water (OFW) and to investigate its souring and carbon steel corrosion activities.

Chapter 2, Isolation and genomic analysis of isolated NRB. NRB was isolated from OFW. According to 16S rRNA gene sequence, NRB isolate belonged to genus *Marinobacter* and was named *Marinobacter* YB03. The whole genome sequence of *Marinobacter* YB03 was determined (accession number AP019537). For nitrate metabolism of YB03, based on genome analysis, the gene sets encoding for dissimilatory nitrate reduction and denitrification were found on the draft genome of YB03. For sulfur metabolism, the YB03 has the gene sets encoding for assimilatory sulfate reduction.

Chapter 3, Characterization of nitrate-reducing bacteria, *Marinobacter* YB03. The substrate range of YB03 by utilization of crude oil components, BTEX (Benzene, Toluene, Ethylbenzene, o-,m-,p-xylene), alkane mixture (C₆-C₁₀), alkane mixture (C₁₁-C₁₆) and VFAs (volatile fatty acids) was investigated. Only toluene and m,p-xylene were efficiently consumed in the aromatic fraction. The toluene and m,p-xylene concentration were continuously decreased and consumed by day 35 and 42, respectively. The alkane fraction was the least favorable substrate for YB03, and longer chain alkane became the most unfavorable. Therefore, the hydrocarbon preferences as substrate for YB03 were toluene and m-,p-xylene in the BTEX mixture and crude oil. The consumption of VFAs was observed when VFA mixtures were used as a substrate. Among the four of VFAs (Acetate, Lactate, Formate, Propionate), acetate was the most favorable. The 5mM of VFAs was entirely consumed by day 14.

Chapter 4, Contribution of YB03 to biological souring. Experiment describing in this chapter, nitrate was added at the concentration of 27mM. The medium used was natural seawater (sulfate concentration of 27mM). SRB isolated from OFW and named *Desulfotignum* YB01 was also used. Six conditions were performed: YB01,

YB03 and co-culture of (YB01+YB03) with and without nitrate addition. Under the YB01 condition, an increase in sulfide and a decrease in sulfate were observed. Compared with the (YB01+NO₃⁻) condition, no significant decrease in sulfate and sulfide production were observed. The addition of nitrate was able to repress biological souring caused by YB01. However, the production of sulfide was observed, while sulfate was reduced in the YB03 culture with nitrate addition. Thus, the addition of nitrate to YB03 culture could not control biological souring. This was confirmed by continuous sulfide production and sulfate reduction. For co-culture of (YB01+YB03) regardless of nitrate addition, sulfate reduction and sulfide production were also observed.

Chapter 5, Microbiologically Influenced Corrosion (MIC) of carbon steel by YB03. In the abiotic condition, the corrosion rate was similarly observed with or without nitrate addition. Thus, it shows that the addition of nitrate did not accelerate chemical corrosion. The highest corrosion rate was observed in the YB03 condition, followed by the (YB03+NO₃⁻) condition. I can summarize the effect of corrosion rate calculated by the weight loss in the following order: YB03 > (YB03+NO₃⁻) > NO₃⁻ > control. Based on the surface analysis of coupon, the corrosion behavior of carbon steel caused by YB03 could be divided into two different phases: from day 30 to 60, the corrosion observed was general corrosion, and at day 90, pitting corrosion was observed.

Chapter 6, Conclusion. In this study, NRB was isolated from oil field water named *Marinobacter* YB03. The carbon sources and electron donor preferences of YB03 were toluene, m,p-xylene and VFAs. This bacterium could not control souring caused by nitrate- and sulfate-reducing bacteria, *Desulfotignum* YB01. The ability of the YB03 to promote souring and corrosion was confirmed. Pitting corrosion was observed at day 90 in the conditions with and without nitrate addition.

備考：論文要旨は、和文 2000 字と英文 300 語を 1 部ずつ提出するか、もしくは英文 800 語を 1 部提出してください。

Note : Thesis Summary should be submitted in either a copy of 2000 Japanese Characters and 300 Words (English) or 1copy of 800 Words (English).

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