Journal of Research in Environmental Science and Toxicology Vol. 7(1) pp. 1-2 August, 2018
DOI: http:/dx.doi.org/10.14303/jrest.2018.015
Available online http://www.interesjournals.org/JREST

Commentry

Production and efficiency of denitrification reagent refined from biodiesel fuel byproduct of crude glycerol

Toshihiro Takeshita

Faculty of Engineering, Fukuoka University, Japan

This article deals with a recycling of crude glycerol discharged from biodiesel fuel, BDF, manufacturing and provides a solution for recovering recyclable substances from the crude glycerol and finding their promising usages. The objective of this research is to recover glycerol from the crude glycerol and to investigate the possibility for using the recovered glycerol for denitrification. The crude glycerol is a byproduct in the making of BDF from fresh or used vegetable oil and methanol by alkali-catalyzed esterification reaction, and that is mainly consisted of unreacted vegetable oil and methanol, free glycerol and caustic alkalis. There has been considerable research on the recycling of the crude glycerol by microbial conversion and chemical conversion. However, many of the research were tried to recycle it directly as a raw material. As the crude glycerol contained a lot of contaminants as previously noted and was hard to handle without any treatment, a simple treatment of dilution with water and neutralization with hydrochloric acid was taken place in order to separate the crude glycerol into the two liquid layers according to the chemical properties. The upper layer was the separated oil containing less amount of water and salts, while the lower layer was a glycerol solution containing plenty amount of glycerol, methanol and neutral salts in water, and then each liquid layer was collected, respectively. According to the investigations, as the obtained glycerol solution contained a high amount of biodegradable organic substances as compared to little amount of the total nitrogen, it was used in the biological denitrification process of an excreta treatment facility as an alternative denitrification reagent instead of 50% methanol which was made from fossil fuels such as natural gas. Denitrification efficiency was firstly evaluated on the different denitrification reagents such as the glycerol solution, commercially used 50% methanol and BDF byproduct of crude glycerol using activated sludge obtained from an excreta treatment facility. The experimental data on the denitrification reagents was shown in Figure 1. The glycerol solution and the 50% methanol represented almost the same denitrification

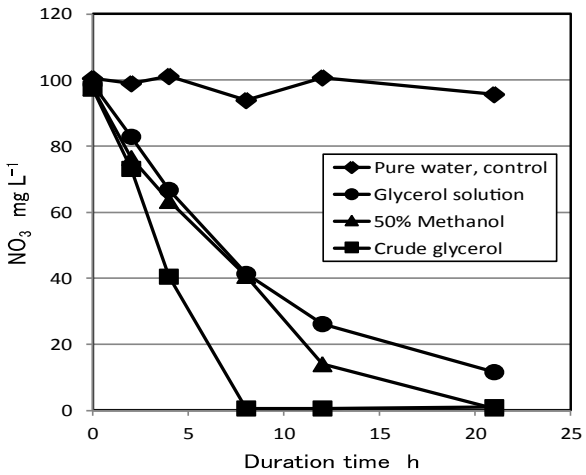

Figure 1. Denitrification efficiency evaluated on different denitrification reagents using activated sludge obtained from an excreta treatment facility.

profiles. On the other hand, the crude glycerol showed the highest denitrification efficiency in the three denitrification reagents. Here, as a denitrification reagent is usually added an excess amount to the biological denitrification treatment process in order to remove nitrate completely, the biodegradability on the denitrification reagents was secondly evaluated. The experimental data on the biodegradability was shown in Figure 2. The glycerol solution showed the highest biodegradability in the three denitrification reagents and that was completely degraded, while the crude glycerol remained plenty amount of biologically undecomposed organic matter. Judging from these results, the glycerol solution was satisfied with the efficiency required for the biological denitrification treatment while the crude glycerol was ill-suited for the treatment because of its weak biodegradability. On the other hand, the separated oil, of which higher heating value, HHV, was about 1.5 times higher than that of the crude glycerol, was used in an industrial furnace as a

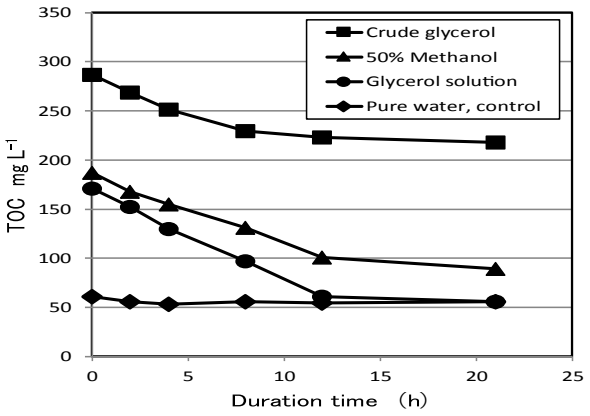

Figure 2. Biodegradability evaluated on the different denitrification reagents by measuring TOC.

burner fuel without any treatment or mixed with refined waste lubricant oil. The HHV of the separated oil was 37.3 kJ/g in average and that was equivalent to 97% of fresh vegetable oil, and also to 83% of the heavy oil or the refined lubricant oil. Here, if the separated oil is also used in an excreta treatment facility as an alternative fuel for making compost from dehydrated cake or incinerating sludge, it can serve as an energy source and contribute to the reduction of carbon dioxide emissions. In conclusions, the followings were verified that the glycerol solution obtained from the crude glycerol can be used as an alternative denitrification reagent instead of the commercially used 50% methanol in activated sludge obtained from an excreta treatment facility, and the separated oil can be used as burnable fuel because the HHV of the separated oil was 37.3 kJ/g and was equivalent to 97% of the fresh vegetable oil. Through this treatment, the crude glycerol can be completely recycled without discharging any byproduct. Moreover, it is considered that the rinsing water, which is arisen from the purification of crude BDF with hot water in the BDF manufacturers applying wet method, can be also recycled by using it on behalf of dilution water in this treatment process. Now the glycerol solution is adopted in several excreta treatment facilities in Japan and the number is growing. The present issues in practical applications are to stabilize the producing quality and to improve the conveying efficiency of the glycerol solution (Aggelis, 2009; Pagliaro and Rossi, 2010).

ACKNOWLEDGEMENT

The author would like to thank the Danish Development Agency (DANIDA) for financial support via Haramaya Camel Dairy Project.

REFERENCES

Aggelis G (2009). Microbial Conversions of Raw Glycerol. Nova Science Publishers, Inc.

Pagliaro M, Rossi M (2010). The Future of Glycerol. 2nd Edition, RSC Publishing.