THE USE OF RESPIROMETRY TO DETERMINE CO_2 EMISSIONS DURING BIORMEDIATION OF CONTAMINATED SOIL

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INTRODUCTION

The measurement of carbon dioxide as a result of soil respiration is a means of measuring carbon emissions and hence the environmental costs for biological remediation of soils (Mark, 1994). This study seeks to evaluate the sustainability of the use of Brewery Spent Grain in bioremediation.

The piece of work reported here seeks to determine emissions of C02 during the process. This information can then be used to cost the environmental impact of bioremediation with and without brewery spent grain..

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Figure 1 Hydrocarbon polluted soil removed from an underground tank being prepared for bioremediation treatment (**URL1)**

Measuring CO2 during the bioremediation process, in the field is difficult, due to the environmental conditions that make it impossible to capture the CO2 accurately. However, in the laboratory, using a common chamber method such as a closed flask, where there is no air-circulation, the CO2 efflux can be accurately measured by chemical titration after it has been absorbed into a solution.

Increasingly bioremediation is thought to be a safe, reliable and environmentally friendly option for the remediation of contaminated soils (Chaineau, et al., 1995) however, this may not be the case and increased emissions of carbon dioxide, when biodegradable materials are added to enhance the process, may be one of the potential environmental impacts

Therefore, the piece of work reported here will measure the CO2 efflux for diesel contaminated soil with and without the addition of Brewery Spent Grain.

Methods

In the study 2 kg of clean soil was treated by the addition of diesel (5 %) and then incubated in flask with and without brewery spent grain. Each treatment was replicated three times.

Soil only
Soil plus 5 % diesel
Soil plus 5 % diesel plus 10% by volume brewery waste
Soil plus 5 % diesel plus 20 % by volume brewery waste

Maintenance of the experiment entailed routine mixing of the soil in the flasks and spraying with water to maintain the soil moisture content.
Carbon dioxide emitted was collected in an Erlenmeyer flask containing excessive sodium hydroxide solution. The CO2 is absorbed and converted into an equivalent amount of sodium carbonate. The resulting mixture is titrated with standard HCI and CO2 emitted recorded as grams.

TPH was recorded on days 14, 28, 48 and 129.

RESPIROMETER RESULTS

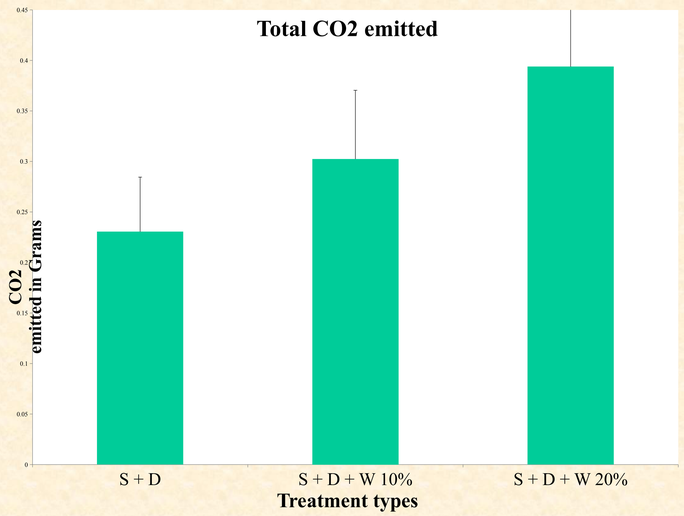

Figure 2 - measurement of CO2 in day 0, 14, 28, 42, 56, 77, 98 and 129

Treatment with brewery spent grain evolved a greater volume of CO**2** than treatment with diesel alone. The volume of CO2 was proportional to the amount of brewery spent grain added.

RESULTS – TPH ANALYSIS

Day / Treatment	Soil + Diesel	Soil + Diesel + Waste 10%	Soil + Diesel + Waste 20%
14	18.83%	39.29%	38.01%
28	41.12%	48.72%	43.88%
48	55.46%	56.58%	45.78%
129	85.32%	87.91%	91.32%

Figure 3- % degradation of the TPH over the period of 129 days for three different treatment types. Addition of brewery spent grain enhances the breakdown of TPH in the short term and could be used to shorten the time needed for the bioremediation process.

DISCUSSION & CONCLUSIONS

Bioremediation can be enhanced by the addition of organic wastes to contaminated soils (**Walworth., 1995**). However, addition of these materials may result in a greater volume of carbon dioxide being emitted and hence the process having a greater environmental impact, in terms of emissions of greenhouses gases.

The respirometer experiment was carried out to determine the volume of CO2 evolved in the presence and absence of brewery spent grain. This information could then be used to review the environmental costs associated with the process. The alternative disposal route for brewery spent grain is as a cattle feedstuff which may also result in carbon emissions hence in any environmental costing these emissions should also be evaluated.

The results indicate that addition of brewery spent grain causes an increase in emissions of CO2 this is to be expected as the microbes will break down the spent grain as well as the diesel contaminating the soil. In terms of enhancing the process the results for TPH indicate that addition of brewery spent grain increases TPH breakdown with the increase being greater at the start of the process.

Therefore the addition of brewery spent grain will be beneficial in terms of its ability to enhance the bioremediation process but could have a greater environmental impact in terms of release of greenhouse gas emissions. Emissions of CO2 will also be associated with the transport of the brewer spent grain to the site.

In terms of the calculation of environmental costs there is a need to ascribe actual values to the various factors costed (Defra, 2008). The adoption of respirometry technique described here could be one means of ascribing a value to environmental impacts .The quantitative measurement of CO_2 can then be added to the social and economic costs to determine how sustainable a remediation option could be (SURF-2011).

REFERENCES

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URL(1) : http://www.google.co.uk/search?q=contaminated+land+in+the+uk&hl