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Correction of water interference in gas chromatographic measurements of N_2O and CO_2 of soil origin

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For environmental protection and economic reasons it is important to study the greenhouse gas emission of agricultural origin. Since microbial transformations of carbon and nitrogen cycles of soil result in significant gas emitting processes, it is sensible to perform experiments in which the nitrous oxide (N_2O) and carbon dioxide (CO_2) production of soil origin is investigated. In literature field (Oorts et al., 2007), greenhouse (Notas et al., 2002) and microcosm experiments (Hantschel et al., 1994; Mørkved et al., 2006) are reported and the amount of the released gases is usually measured by gas chromatography using thermal conductivity detector (TCD) for the measurements of CO_2 and electron capture detector (ECD) for the analysis of N_2O. The detection of both gases might be interfered by water vapour which is also present in gas sample. Although in the present research team's micro and mesocosms experiments have been carried out since 2001 in Hungary this interfering effect was generally observed, in literature only a few references can be found dealing with this problem (Kolb, 1999). The water vapour can be removed from gas samples by the application of a cryogenic trap, a backflush or a complex valve and precolumn system (Akimoto et al., 2005) built in the gas chromatograph. However, the application of these tools does not reduce analysis time and may cause additional difficulties e.g. CO_2 might also freeze out. Therefore materials were tested which might have provided suitable solutions for these problems as well. Drierite and Nafion were applied in precolumns in a HP

5890 Series II gas chromatograph coupled to 2 or 4 metres long Porapak-Q columns. “Home made” precolumns filled with Drierite and Perma Pure produced MD-Series Nafion dryer were built in the gas chromatograph in different experiments. According to the results, although Drierite absorbed water vapour, it also adsorbed some of the CO_2 and N_2O from gas samples, so due to this problem and the difficulties of the preparation of the precolumns it was not utilized in further experiments. In the second experiment with Nafion, the water molecules permeated from the gas stream carrying the analysed gas samples to a counter-flowing purge gas stream through the Nafion membrane without significant CO_2 and N_2O loss of the samples, successfully reducing the water content of the samples to such an extent which resulted in a relatively stable baseline at ppm level in the case of ECD and the elimination of interfering water peaks in both cases of ECD and TCD. By the means of Nafion, the measurement processes carried out by manual sampling could been accelerated successfully and the gas chromatograph and the analytical columns could been protected from the disadvantages of the presence of water vapour in the gas samples as well. The improved analytical technique ensures more reliable and effective opportunities for studying the greenhouse gas emission of soil origin. In future experiments the possible limiting factors of the application of Nafion and other type of Nafion dryers are planned to be investigated.

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