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ORIGINAL ARTICLE

"Death may come on like a stroke of lightening ..."

Phenomenological and morphological aspects of fatalities caused by manure gas

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Abstract Due to the decomposition of biological material, hydrogen sulphide (H_2S) is produced. In low concentrations, the well-known smell of "rotten eggs" is associated with H_2S. In higher concentrations, H_2S is an odourless and colourless gas that may cause rapid loss of consciousness, neurological and respiratory depression and imminent death—"... like a stroke of lightening".

Hydrogen sulphide poisoning is an un-common incident that is often associated with colleague fatalities. In this study, 4 fatal accidents with 10 deceased victims are reported and the morphological and phenomenological aspects are presented. In these cases, the morphological findings, namely, discolouration of the livores, pulmonary pathologies and sub-mucosal or sub-serosal congestion bleeding were found in nearly all cases. Also the impending threat for colleagues, first aid helpers and professional rescue teams is demonstrated.

The suspicion of a fatal H_2S intoxication should be based on a precise scene analysis with respect to the possibility of life-threatening H_2S intoxication for the helpers, the typical scent of rotten eggs, which may be noted on the corpses and the abovementioned morphological findings. The diagnosis should be confirmed by a qualitative and, if possible, quantitative analysis of H_2S.

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Introduction

"Death may come on like a stroke of lightening, as in HCN poisoning, but usually there are first symptoms of irritation of the nervous system, which occur even earlier than the formation of H_2S–hemoglobin."—This vivid description of the lethal effects of hydrogen sulphide (H_2S) was given by Alice Hamilton in 1925 [12]. Hydrogen sulphide—also known as manure gas—is one of several gases produced by the decomposition of biological material and a by-product in industrial plants [10].

Whilst in industrial sites the safety management of hazardous by-products is a matter of course and accidents are quite rare, they are reported more commonly in rural areas due to manure pits—even despite the safety regulations of employer's liability insurance associations and government safety organisations [3, 4, 7, 16–20, 23]. In agricultural operations, manure pits are very common as they are an economical method of handling animal excrements. Storage pits are also common in biogas plant operations. Due to decomposition, different gases are formed. These gases are used in biogas plants. On average, the concentrations of these gases are approximately 60 vol.% methane (range 50–80 vol.%), approximately 38 vol.% CO_2 (range 20–50 vol.%) and small amounts of other gases like O_2, N_2, NH_3, CO and H_2S (range 1–5 vol.%) [4]. Even in these low percentages, H_2S can reach a toxic concentration of 4000 ppm and above. Under anaerobic conditions—typical of most pits—hydrogen sulphide is given off [2, 3, 15, 26, 30]. The physical and chemical properties and the principal hazards of hydrogen sulphide are given in Fig. 1 [5].