Hydrogen Sulphide Concentration While Pulling Pit Plugs and Power-Washing Rooms

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Summary

Six pig farms were studied to assess the barn worker exposure to hydrogen sulphide (H_2S) while pulling pit plugs and power-washing production rooms. Results indicate that plug pulling generated high concentrations of H_2S, reaching 1,000 ppm in some cases. All of the farms used in this study had plug pulling events that exceeded limits defined by the Occupational and Safety Regulations of Saskatchewan. The H_2S released when a plug was pulled did not follow a predictable pattern over time and within the room. Power washing generated lower H_2S concentrations than plug pulling but workers were exposed for a longer time period. Based on that study, swine barn workers may be exposed to H_2S concentrations that exceed acceptable limits when pulling pit plugs and power-washing. Personal monitors should be provided to all barn workers, training and standard operating procedures are needed so workers can learn how to deal with routine operations and emergency situations generating high H_2S concentrations.

All of the farms used in this study had events that released enough H_2S to pose a possible health risk.

Introduction

Hydrogen sulphide (H_2S) is a life threatening gas produced by the anaerobic degradation of liquid manure. As most swine barns are equipped with gutters accumulating manure, H_2S can be released when manure flows or is being mixed. Saskatchewan Labour regulates H_2S exposure in the Occupational Health and Safety Regulation and stipulates that a person should not be exposed to more than an average concentration of 10 ppm of H_2S for a period of eight hours (TWA: 8 hour time weighted average exposure limit) and an average of 15 ppm for a period of 15-min (STEL: 15-min time weighted average short term exposure limit). Saskatchewan Labour does not have a defined ceiling value for H_2S, but defines the level of H_2S immediately dangerous to life or health (IDLH) at 100 ppm – a level at which nobody should even be exposed to.

Recent events in Saskatchewan led us to believe that barn workers may be exposed to high H_2S concentrations while pulling pit plugs and power-washing rooms and monitoring was performed to evaluate this hypothesis.

Experimental Procedures

Six swine production sites were assessed to determine levels of H_2S exposure while workers performed specific manure management tasks in gestation, farrowing, nursery and grower-finisher rooms. The room concentration and distribution of H_2S were measured when pits were emptied (at the pit plug: 1 m from the floor level and within a 1 m radius of the plug). The concentration of H_2S was measured when workers were power washing rooms (worker chest level).

Results and Discussion

Results from four barns monitored in this study indicate that plug pulling generates high concentrations of H_2S. In some cases, the maximum recorded levels reached 1,000 ppm (Table 1). All of the farms used in this study had plug pulling events that could present health and safety risks to workers and exceeded limits defined by the Occupational

Table 1. Overall maximum H_2S concentrations obtained during the plug pulling events performed in the four farms and the number of events where the concentration obtained exceeded IDLH.

Barn section	Maximum H_2S concentration (ppm) [number of events with concentration higher than IDLH / total number of plug pulling events monitored]			
	Farm number			
	1	2	3	4
Farrowing	810 [7/7]	610 [5/8]	75 [0/8]	123 [1/8]
Gestation	1000* [6/7]	1000* [6/9]	79 [0/8]	66 [0/8]
Grow-Finish	202 [2/4]	494 [3/8]	452 [2/8]	61 [0/8]
Nursery	1000* [1/3]	280 [2/9]	69 [0/8]	51 [0/8]

* Maximum concentration that could be read by the H_2S sensor.

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Health and Safety Regulations of Saskatchewan.

The H_2S released when a plug was pulled did not follow a predictable pattern (Figure 1). In some cases, the maximum value was reached within less than four minutes after the plug had been pulled. In others, the concentration increased and went through a number of intermediate peaks before reaching the maximum.

While most of the highest concentrations were generally recorded at the plug or sewer hole, sometimes it was recorded elsewhere in the room (Figure 2). No predictable distribution pattern was observed for a specific location where the peak would be reached.

Power washing generated lower H_2S concentrations than plug pulling. As power washing generally takes time, in some cases, the STEL was reached shortly after the task started and was exceeded for a long period of time, which in some of the monitored events was more than 30 minutes.

Implications

Swine barn workers may be exposed to H_2S concentrations that exceed acceptable limits when pulling pit plugs and power-washing rooms. Locations of peak H_2S concentrations vary within the room. A worker pulling the plug and walking away from it may not be in a safer position if staying in the room, and the same comment applies to a bystander. Monitors should be provided to all swine barn workers as H_2S may be present in other areas than where the plug is pulled (ex: transfer pit room, plug popping situations). Training and standard operating procedures are needed so workers can learn how to deal with routine operation and emergency situations generating high H_2S concentrations. Further research is needed to improve the design of swine buildings and manure management systems to prevent H_2S exposure.

Acknowledgements

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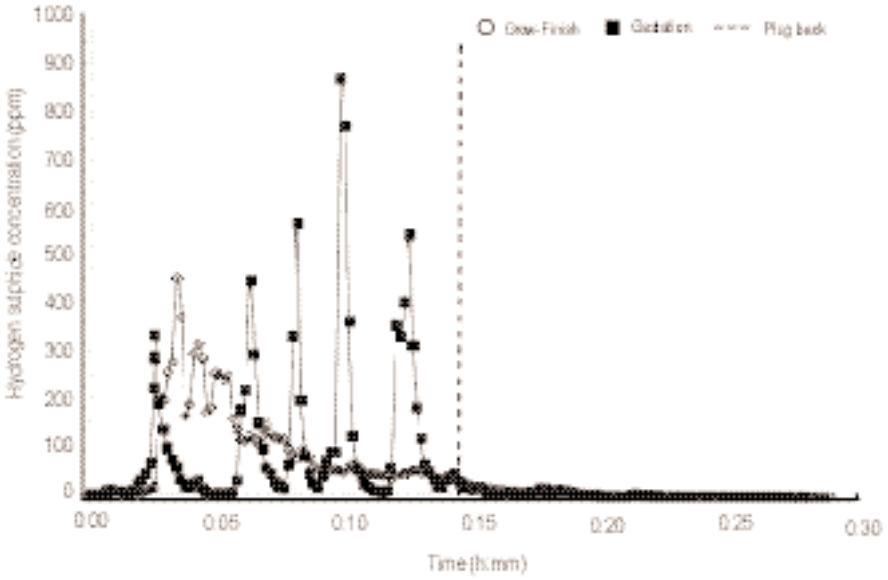

Figure 1: *Hydrogen sulphide concentration during plug pulling events performed in a grower-finisher room and a gestation room during the summer and winter period, respectively.*

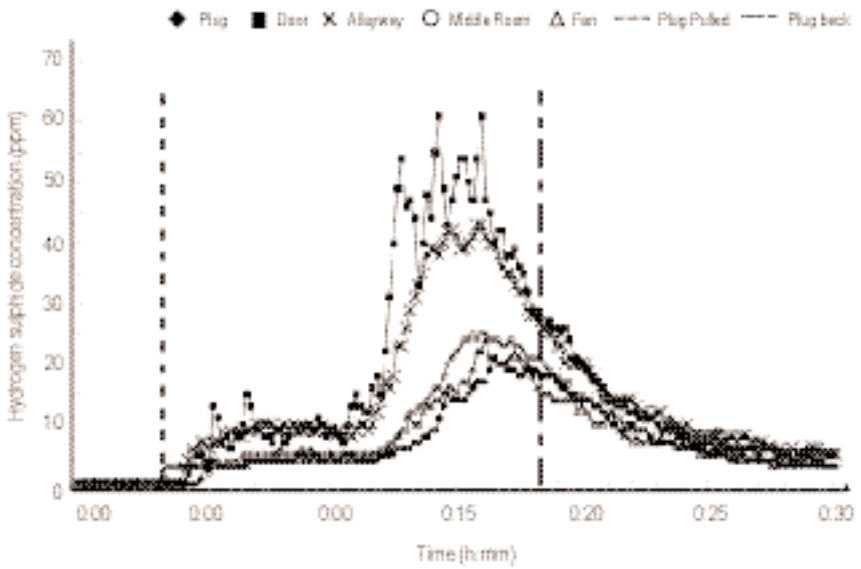

Figure 2: *Hydrogen sulphide concentration distribution within the room during a plug-pulling event in a grower-finisher room during the summer period.*