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Should composting in polyethylene sleeves with forced aeration be considered a practical solution during disease outbreaks in poultry farming?

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Abstract

Mass depopulation is one of the immediate acts taken during disease outbreaks in poultry worldwide. The carcasses and the infected litter can be managed on-site or off-site, mainly through burial or composting. On-site treatment methods are preferred to minimize disease spread during transportation, although on-site composting has adverse outcomes due to potential malodor emissions. On-site open windrows operated within the poultry house appears as a preferred method in USA and Australia. However, pathogens eradication may not be complete if thermophilic temperatures are not achieved throughout the entire pile, even after several turnings. Composting in polyethylene sleeves with forced aeration was considered in the present study as an alternative for in-house composting following mass depopulation in disease outbreaks. We demonstrated that such sleeves could be constructed manually and therefore do not require special emergency machinery. Regarding sanitary considerations, the main advantage of aerated sleeves is the potential to maintain high thermophilic temperatures within the entire biomass. In a side study on carcass parts co-composted with the litter in lab reactors, we found mass losses of about 60%, 40%, 60%, and nearly 100% for rib bones, skins, breast

muscles, and hearts and livers, respectively, during 30 days at 50 °C under constant aeration. Visually, most of the carcass parts were degraded, and the typical carcass odor had disappeared by the end of the 30 days. We then demonstrated in lab reactors the effect of temperature (40, 50, 60 °C) and aerobic/anaerobic conditions on the degradation of whole broiler carcasses and the successful elimination in most cases of pre-inoculated Avian flu, Newcastle, and *Salmonella Infantis* at 50 and 60 °C. The method taken for mass destruction also has practical implications for biomass management. In that case, the use of water-based foam, as compared to dry methods, totally affects the water balance in the sleeve along the process. We developed a calculator to estimate excess water inside the sleeve based on lab-scale experimental degradation rates, mass losses, and biomass water holding capacity. This calculator can predict the water balance for different relevant scenarios, such as packing the entire biomass of the poultry house (60 m^3) in one or two sleeves and assuming a total biomass degradation of 30% during one month (1% daily). Aeration (water evaporation) was considered in a range of 100-300 m^3 h^{-1} for different time fractions. Various conditions have been analyzed for mass destruction cases by means of water-based foam or dry methods. The water balance in the sleeve during composting is a critical element that will affect the ability to achieve good aeration conditions and other operational issues. Excess water is expected in some scenarios, when wet methods are used. Some excess water can be absorbed by adding sawdust or wood chips or splitting the biomass into several sleeves assisted with increased ventilation, as long as the composting material does not cool down too early.

Keywords: Mass mortality, Mass depopulation, Mass destruction, Enclosed composting, Water balance, Pathogens