Carbon dynamics of paper, engineered wood products and bamboo in landfills: evidence from reactor studies

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Summary:

Background

There has been growing interest in the development of waste-specific decay factors for estimation of greenhouse gas emissions from landfills in national greenhouse gas inventories. Although engineered wood products (EWPs) and paper represent a substantial component of the solid waste stream, there is limited information available on their carbon dynamics in landfills. The objective of this study was to determine the extent of carbon loss for EWPs and paper products commonly used in Australia. Experiments were conducted under laboratory conditions designed to simulate optimal anaerobic biodegradation in a landfill.

Results

Methane generation rates over incubations of 307–677 days ranged from zero for medium-density fibreboard (MDF) to 326 mL CH4 g-1 for copy paper. Carbon losses for particleboard and MDF ranged from 0.7 to 1.6%, consistent with previous estimates. Carbon loss for the exterior wall panel product (2.8%) was consistent with the expected value for blackbutt, the main wood type used in its manufacture. Carbon loss for bamboo (11.4%) was significantly higher than for EWPs. Carbon losses for the three types of copy paper tested ranged from 72.4 to 82.5%, and were significantly higher than for cardboard (27.3–43.8%). Cardboard that had been buried in landfill for 20 years had a carbon loss of 27.3%—indicating that environmental conditions in the landfill did not support complete decomposition of the available carbon. Thus carbon losses for paper products as measured in bioreactors clearly overestimate those in actual landfills. Carbon losses, as estimated by gas generation, were on average lower than those derived by mass balance. The low carbon loss for particleboard and MDF is consistent with carbon loss for Australian wood types described in previous studies. A factor for carbon loss for combined EWPs and wood in landfills in Australia of 1.3% and for paper of 48% is proposed.

Conclusions

The new suggested combined decay factor for wood and EWPs represents a significant reduction from the current factor used in the Australian greenhouse gas inventory; whereas the suggested decay factor for paper is similar to the current decay factor. Our results improve current understanding of the carbon dynamics of harvested wood products, and allow more refined estimates of methane emissions from landfills.

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