Shortcomings of LCA – Examples from Waste Management

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Based on the goals of waste management, the requirements for the assessment of waste management systems are discussed. “Classical” evaluation methods such as LCA fail to address issues relevant to waste management.

The goals of waste management, as they are stated e.g. in the Austrian Waste Management Act, comprise (1) the protection of men and the environment, (2) the conservation of resources, and (3) after care free landfills (precautionary principle). Methods to evaluate waste management systems must be able to judge to what degree these three objectives are met.

In European countries, the primary goal of protecting men from waste derived hygienic hazards has been met since the beginning of the 20ieth century. Thus, the criteria “hygiene”, which was the main reason for introducing modern waste management, is not included in today’s waste management assessments. In contrast, in developing countries, the protection of men is still the main problem of missing waste management. Under such circumstances, it is necessary to use criteria that are able to evaluate to which degree a waste management system protects human life from hygienic threats, and traditional LCA must be amended by health assessments.

While for short time periods, the goal to protect the environment is well covered by LCA methodology, waste management causes two long term issues: (1) landfills are stocks of hazardous materials that demand control and maintenance for hundreds to, possibly, thousands of years. The fate of substances in landfills is determined by both, pretreatment as well as envelope. While a rigid pretreatment such as mineralization followed by stabilization can render an inert residue that may be safely disposed of in e.g. underground salt mines, all man made envelopes are subject to erosion and weathering. They are able to confine wastes for time periods of decades to centuries, but they are prone to release substances as soon as they are damaged which is inevitable on the long run. Thus, assessment methods that cover only the time frame of “confinement” will not yield the same results as methods that cover the whole lifetime of a landfill. For a comprehensive evaluation, it is necessary to follow selected indicator substances through waste management to the very “final sink”, that is a place on the planet where substances have a long residence time of > 10.000 years. Also, various waste treatment methods may lead waste derived substances to different sinks, some of them appropriate (environmentally safe such as chlorides to oceans or heavy metals to underground storage sites) and others hazardous (heavy metals and brominated flame retardants in recycling products). A methodology is needed that can discriminate processes according to their power to direct substances to proper sinks.

(2) If pollutants are recycled in recycling goods (e.g. Cadmium or brominated flame retardants in recycling plastics), an unknown future hazard is being created. Waste treatment processes that are able to concentrate pollutants and eliminate them in specific residues instead of dispersing them in products or emissions have no advantage yet when evaluated by “classical” assessments. On the contrary, they are likely to produce hazardous residues that have to be disposed of at high costs. It is thus necessary applying a metric to analyze the power of concentration or dilution of treatment processes. Recently developed entropy based techniques to determine the efficiency of a process to concentrate substances (“substance concentration efficiency” SCE) allow to discriminate between such processes.

It is recommended to include both issues, the power to concentrate as well as the “final sink” aspect, into future evaluation of waste management systems