Comparison of Biochar and Conventional Solid Waste Treatment

University of Colorado Boulder

College of Engineering and Applied Science Active Learning Program
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Traditional Cycle of Municipal Solid Waste & Management Scenarios

The traditional process of the municipal solid waste (MSW) management leads to negative environmental impacts (*Figure 1*). These environmental impacts are mostly due to the organics that make up 62% of MSW composition. Two management scenarios are depicted in *Figure 2,* where municipal solid waste was evaluated to quantify environmental impacts of different waste management strategies, which may provide opportunities for pollution reduction.

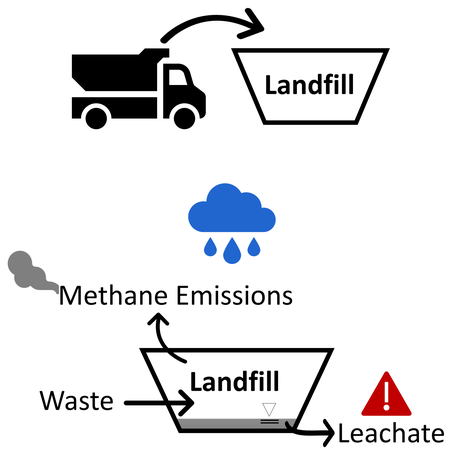

Figure 1. Traditional process of municipal solid waste

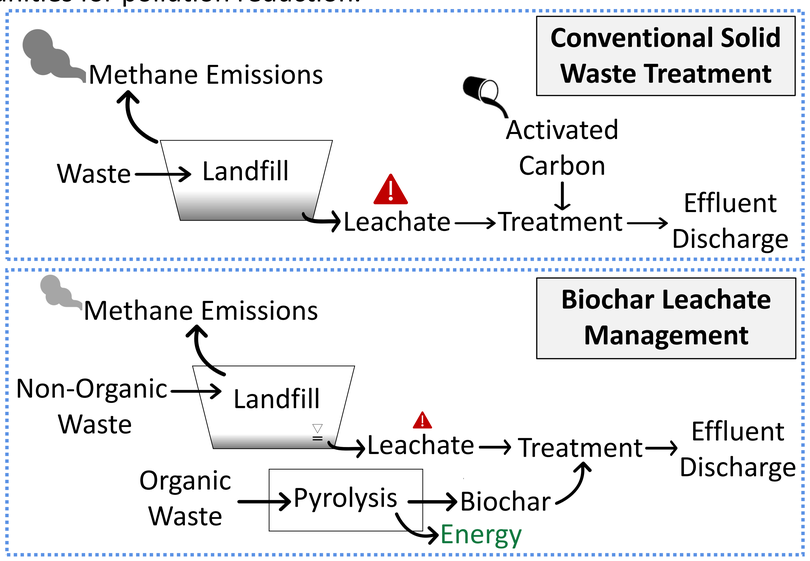

Figure 2. Two management scenarios of municipal solid waste

The Pyrolysis Process

Figure 3 and *Table 1* show the multistep pyrolysis process and the high dose wood biochar pyrolysis values that have been calculated respectively.

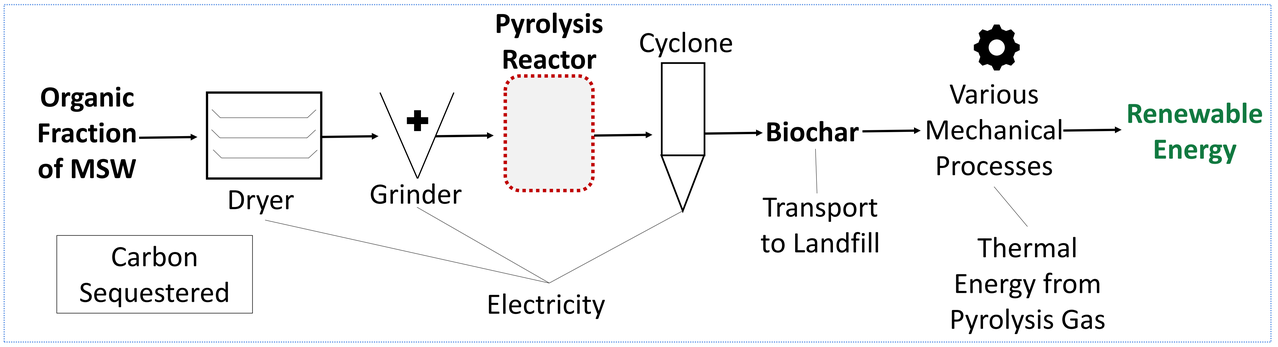

Figure 3. The pyrolysis process for the organic fraction of municipal solid waste

Table 1. The life cycle pyrolysis values for wood biochar (per timeframe)

High Dose Wood Biochar Pyrolysis Values

Transport to WWTP	Electricity for grinding	Carbon sequestered	Electricity for charring	Electricity for drying	Net thermal energy from pyrolysis gas
$2.17 * 10^8$ tkm	$3.20 * 10^8$ $MJ\ electricity$	$3.93 * 10^9$ $kg\ CO_2\ eq.$	$7.30 * 10^8$ $MJ\ electricity$	$4.58 * 10^8$ $MJ\ electricity$	$2.04 * 10^{10}$ MJ

Recreated using Thompson et. al [2016]

Acknowledgments

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Composition of Municipal Solid Waste

Figure 4 and *Figure 5* show the most common and relative breakdown of the organic fraction of MSW respectively. The composition of the waste can be predictive of leachate and methane pollution emissions.

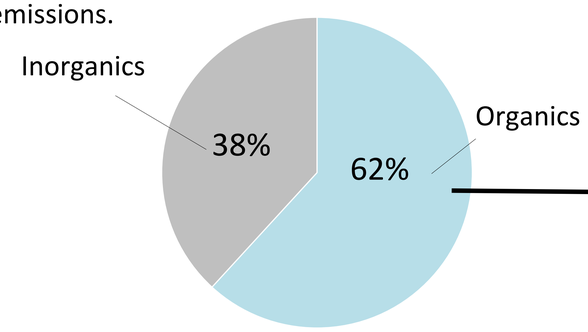

Figure 4. Composition of overall MSW

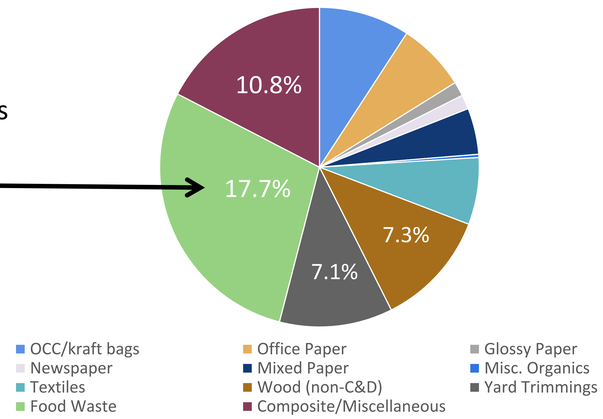

Figure 5. Composition of organic waste

Leachate Characterization Using Literature and Experimental Data

Properties of the most common landfill waste (decay rates, methane yield, moisture content, and carbon storage factor) were calculated (*Table 2*).

Table 2. Calculated municipal solid waste characteristics

Decay Rates	Methane Yield	Moisture Content	Carbon Storage Factor
0.05 $[yr^{-1}]$	99.6 $[m^3 CH_4\ (dry\ Mg\ Refuse)^-]$	20.0 %	0.12 [Kg C dry Kg]

Life-Cycle Assessment

LCA methodologies following the ISO 14040 framework will assess the two management scenarios (*Figure 6*), biochar and conventional solid waste treatment, to compare their respective environmental impacts. Also, other alternatives will be considered in the future.

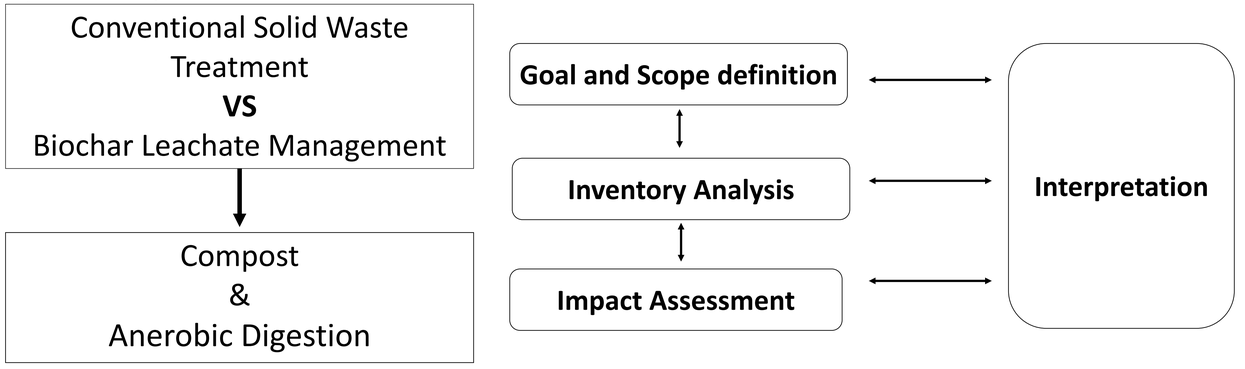

Figure 6. Life-Cycle Assessment will be used to evaluate the environmental impacts of conventional solid waste treatment versus biochar leachate management.