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# Environmental Impacts Assessment of Power Generation via Biomass Gasification Systems: Life Cycle Analysis (LCA) Approach for Tars Release

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**Abstract :** Statement of the Problem: biomass gasification systems may be relevant for decentralized power generation from recoverable agricultural and wood residues available in rural areas. In recent years, many systems have been implemented in all over the world as especially in Cambodgia, India. Although they have many positive effects, these systems can also affect the environment and human health. Indeed, during the process of biomass gasification, black wastewater containing tars are produced and generally discharged in the local environment either into the rivers or on soil. However, in most environmental assessment studies of biomass gasification systems, the impact of these releases are underestimated, due to the difficulty of identification of their chemical substances. This work deal with the analysis of the environmental impacts of tars from wood gasification in terms of human toxicity cancer effect, human toxicity non-cancer effect, and freshwater ecotoxicity. Methodology: A Life Cycle Assessment (LCA) approach was adopted. The inventory of tars chemicals substances was based on experimental data from a downdraft gasification system. The composition of six samples from two batches of raw materials: one batch made of tree wood species (oak+ plane tree +pine) at 25 % moisture content and the second batch made of oak at 11% moisture content. The tests were carried out for different gasifier load rates, respectively in the range 50-75% and 50-100%. To choose the environmental impacts assessment method, we compared the methods available in SIMAPRO tool (8.2.0) which are taking into account most of the chemical substances. The environmental impacts for 1kg of tars discharged were characterized by ILCD 2011+ method (V.1.08). Findings Experimental results revealed 38 important chemical substances in varying proportion from one test to another. Only 30 are characterized by ILCD 2011+ method, which is one of the best performing methods. The results show that wood species or moisture content have no significant impact on human toxicity noncancer effect (HTNCE) and freshwater ecotoxicity (FWE) for water release. For human toxicity cancer effect (HTCE), a small gap is observed between impact factors of the two batches, either 3.08E-7 CTUh/kg against 6.58E-7 CTUh/kg. On the other hand, it was found that the risk of negative effects is higher in case of tar release into water than on soil for all impact categories. Indeed, considering the set of samples, the average impact factor obtained for HTNCE varies respectively from 1.64 E-7 to 1.60E-8 CTUh/kg. For HTCE, the impact factor varies between 4.83E-07 CTUh/kg and 2.43E-08 CTUh/kg. The variability of those impact factors is relatively low for these two impact categories. Concerning FWE, the variability of impact factor is very high. It is 1.3E+03 CTUe/kg for tars release into water against 2.01E+01 CTUe/kg for tars release on soil. Statement concluding: The results of this study show that the environmental impacts of tars emission of biomass gasification systems can be consequent and it is important to investigate the ways to reduce them. For environmental research, these results represent an important step of a global environmental assessment of the studied systems. It could be used to better manage the wastewater containing tars to reduce as possible the impacts of numerous still running systems all over the world.

**Keywords :** biomass gasification, life cycle analysis, LCA, environmental impact, tars
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