143z A Tool for Life Cycle Assessment of Recycling Residues from Waste Incineration in Road Constructions – Eartool

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The aim of this paper is to introduce the life cycle oriented PC-based tool for road construction and disposal of residues – EARTool (Environmental Assessment of Roads Construction and Residues). The objective of the tool is to evaluate the environmental performance of the various elements of roads construction and recycling residues from waste incineration in road construction. Life Cycle Assessment (LCA), which is used to assess the environmental impacts, is increasingly being applied to the evaluation of recycled materials strategies. Life Cycle Assessment methodology is applied to quantify and qualify the resource and energy consumption/production and the emissions released from a defined system, which the user can specify. The tool has been structured so that it can use data specific to an actual case thereby improving the accuracy and applicability of the results. At the same time, in order to allow the use of the model in an early stage where local data may be limited, a default data set is provided. EARTool supports to perform LCA on different types of road constructions (roads, parking areas and embankments) with virgin materials as well as residues. The model quantifies to resource consumption and emissions from the life cycle of road constructions starting with natural material extraction, upgrading of natural materials and waste incineration residues, transport of road building materials, construction of road, use and maintenance of road, disposal of road building materials and avoided resource extraction through recycling of residues. The tool is programmed in graphical layout. The features of the user interface include pull-down menus, mouse support and point click activation of many of the features. The tool supports multi languages and multi display themes. The impact assessment part of the model is divided into different categories such as flow, units, unit process dataset, impact properties and methods. These categories further include subcategories. Each flow belongs to a flow group which allows the user to develop a hierarchical system. The characterization values of the substances are also included in the substance flow. The quality of data describing the waste treatment technologies is specified in an indicator system and identified to the user in colors. Data used in the model has been derived from sources such as case studies, the Danish EDIP database and other material published in recognized journals. The data quality of the model is characterized by indicators showing different colors. The entered data can easily be modified, and replaced, and unwanted data deleted. The model provides the various ways in which the information contained in the database (embedded as well as user-defined) is presented to the user, shielded and/or protected from other users, and available for editing. Data protection considers both embedded data protection and user-defined data protection. The protection of embedded data can include complete inaccessibility to the data, view only, or copying/editing capabilities. The impact assessment calculations fully support ISO standard [ISO 14040-48] by providing inventory analysis and impact assessment, including characterization, normalization and weighting in a textual and graphical presentation of the waste system. All substances that are accounted for are defined in a database which can include an unlimited number of substances. The model further evaluates the contributions of each input and output to resource consumption and environmental impacts of the defined system. Environmental impacts are calculated from the inventory applying factors that characterize the specific potential impacts for each substance. The environmental impacts, which are calculated, are also defined by the database, and in principle an unlimited number can be included - defined by the users. The Danish EDIP97 method [Wenzel et al., 1997] is per default part of the model. The model is flexible to define other default methods and further environmental impact categories. Instead of evaluating a result consisting of several hundreds of resource material consumptions and substances emitted to air, water and soil, there are only a limited number of impacts to evaluate, when the life cycle impact assessment (LCIA) has been calculated. The interpretation of the scenario results whether being presented as impact categories, normalized impacts or weighted impacts is facilitated in EARTool by the possibility of tracking the impacts down to individual parameters, type of emissions, waste sources, material fractions as well as individual substances. EARTool supports to perform comparison of the environmental impacts of the disposal of residues in landfills and in different road constructions. Hence, the model makes it possible to make an assessment of the environmental impacts of recycling of residues in road constructions in two perspectives: (1) by comparing the environmental impacts on a single material basis (e.g. by comparing the environmental loadings of the use of gravel and bottom ash as sub base layer) and (2) by comparing the environmental impacts of the residues in a road construction with the total environmental loading in the life cycle of a road construction.

References: International Standard Organization (ISO) 14040 Series, 1997: Environmental management – life cycle assessment – principles and framework[14040], Goal and scope definition and inventory analysis[14041], Life Cycle impact assessment [14042], Life Cycle Interpretation [14043]. Wenzel, H., M. Hauschild and L. Alting, 1997. Environmental assessment of products, vol.1: Methodology, tools and case studies in product development, Kluwer Academic Publishers, Hingham, MA. USA.