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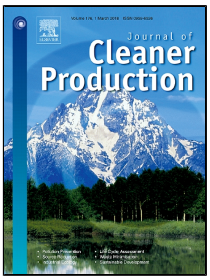

Life cycle impacts of three-way ceramic honeycomb catalytic converter in terms of disability adjusted life year

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Life cycle impacts of three-way ceramic honeycomb catalytic converter in terms of disability adjusted life year

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Abstract

Catalytic converters in vehicles reduce emissions while the use of platinum group metals (PGMs) in them have negative health impacts both in the PGMs mining stage and at the end-of-life PGM recycling stage. This study was conducted to weigh the production-recycling phase impacts and the use phase benefits of a three-way honeycomb catalytic converter by using the disability adjusted life year (DALY) indicator over its cradle-to-cradle life cycle. We have combined the environmental life cycle assessment (LCA) approach with a method to account the workplace impact on human health, which may be adopted in social LCA. In general, a catalytic converter causes more loss of lives (11 days) then it saves (4.5 days) under the egalitarian value perspectives for the baseline production scenario with 160,000 km functional life. Contrary to that, under the same scenario and service life, the catalytic converter saves lives (5.5 days and approx. 6 days for the hierarchist and individualist perspectives, respectively) than it causes loss (about 1 day and 0.6 days for the hierarchist and individualist perspectives, respectively). The geographical hotspot analysis reveals that, while the catalytic converter save lives in Sweden where it is used; it causes more loss of lives elsewhere in the world, particularly in South Africa and Russia. Overall, the DALY varies between 0.62 days and 11.3 days, mainly due to differences in value perspectives. The study showed that increased use of recycled platinum group metals, extended functional life of the catalytic converter may alter the health balance of the product system. This human health-focused cradle to cradle life cycle case study identified methodological issues that need further attention, like development of occupational DALY characterization factors (CFs) for the countries involved in the production of three-way ceramic honeycomb catalytic converter, and emission DALY CFs for PGEs during the use phase of catalytic converter. From scenario analysis, it is observed that, the rise of electric vehicles may drastically alter the social lives lost impacts of catalytic converter.

Keywords: Social life cycle assessment, Hotspot assessment, Catalytic converter, Life cycle sustainability assessment, and Vehicular emissions.