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LIFE CYCLE ASSESSMENT OF AN INDUSTRIAL LAUNDRY: A CASE STUDY IN THE ITALIAN CONTEXT

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Abstract – The high volumes of wastewater from industrial laundry with known toxicological concerns represent a relevant source of pollution for water bodies. Moreover, the unavailability of a detailed and specific Life Cycle Inventory (LCI) referring to the use of detergent within the laundry system could undermine the overall quality of the environmental assessment. This is related to the use of a substitutional product or proxy dataset for specific processes like the use of detergents. Laundry services are also known as highly energy consuming sites. This paper thus aims to make a Life Cycle Inventory (LCI) and Assessment (LCA) for an industrial laundry to provide the environmental profile for an Italian case study. The primary data input to finalize the LCI came from data collected directly from an Italian industrial laundry, integrated with literature, data provided from supporting databases (i.e. *Ecoinvent 3.8*), and data specifically obtained from the technical datasheets of detergents. The industrial laundry system considers the product's overall supply chain: extraction and manufacturing of raw materials, including the detergent, transportation and logistics, the industrial process associated with the laundry activity, wastewater treatment, recirculation packaging, and final disposal stages. The calculated environmental profiles refer to the functional unit of 1 kg of linen washed by a standard washing cycle. The system boundaries of this study include the production stages of the process. The analysed activities are the transportation for the delivery and collection of linen, the purchase of raw materials, and the sanitization and washing processes. *SimaPro 9.2* software and the *ReCiPe 2016 H* method are used for the LCA study. The baseline scenario has been compared with an alternative scenario introducing renewable energy technology (i.e. solar PV panel). The result shows a total impact of 12.77 mPt. The most impacting activities are the washing phase (4.62 mPt), the ironing phase (4.29 mPt), and the drying phase (1.56 mPt). The greatest impact in the washing phase is caused by the use of detergents and washing products. It is observed that most of the impacts fall into the categories of 'Global Warming, Human Health', 'Fine Particulate Formation', 'Carcinogenic Human Toxicity', 'Non-Carcinogenic Human Toxicity', 'Fossil Resource Scarcity'. The midpoint category with the highest impact is 'Fine Particulate Formation' with a value of 5.18 mPt. The alternative scenario introducing renewable energy technology (i.e. solar PV panel) reduces the impact by 19.7 %. Sensitivity analyses have been performed to evaluate the LCA model's uncertainty, with specific reference to the washing agents, the transportation of raw materials, and the energy consumption.

Keywords – Energy; industrial laundry; LCA; water