
LIFE CYCLE ANALYSIS OF CLEANROOM COVERALLS: REUSABLE AND DISPOSABLE

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Cleanroom garments serve a critical role in such industries as bio-based product and semiconductor manufacturing. These textiles are in reusable and disposable types. In this report, the supply chain, manufacture, use, and end-of-life phases for reusable and disposable cleanroom coveralls are compared on a life cycle basis (cradle-to-end-of-life). Thus the starting point is natural resources in the ground (fossil materials, ores, etc.). The entire supply system to manufacture a final coverall is included. The use phase (laundry/wastewater treatment and sterilization) and the end-of-life phase (landfill for disposable coveralls and reuse in other industries for reusable coveralls) are included to provide a complete life cycle profile. The cleanroom coverall is defined as a single-piece, long-sleeve zip up garment (size XL) and does not include a hood, gloves, or booties. The life cycle results are for a functional unit of 1,000 cleanroom coverall uses. For the reusable coveralls, this is 20 new coveralls and 50 cycles while for the disposable coveralls this is 1,000 new coveralls. One type of reusable coverall was investigated (woven polyethylene terephthalate (PET) coveralls, 370 g each). Two types of disposable coveralls were investigated (nonwoven high density polyethylene (HDPE) coveralls, 158 g each and nonwoven polypropylene (PP) coveralls, 225 g each). Selecting the reusable cleanroom coverall system has a 34-59% lower process energy consumption, 23-56% lower natural resource energy consumption, and 27-57% lower CO₂ eq emissions when compared to selecting the disposable cleanroom coverall systems. The total water consumed (blue water) indicates that the reusable system is 73-77% lower (an improvement) over the comparable disposable coverall systems. For the cradle-to-end-of-life cycle of the two disposable cleanroom coveralls examined, the flash spunbonded HDPE coverall is 38-43% lower in process and natural resource energy consumption (an improvement) and hence environmental impact for energy-associated emissions including CO₂ eq than the spunbond-meltblown-spunbond PP coverall. In addition, water consumption for the flash spunbonded HDPE coverall is about 12% lower than the spunbond-meltblown-spunbond PP coverall.