

## Parametrical Analysis of Stain Removal Performance of a Washing Machine: A Case Study of Sebum

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**Abstract :** A washing machine is mainly used for removing any types of dirt and stains and also eliminating malodorous substances from textile surfaces. Stains originate from various sources from the human body to environmental contamination. Therefore, there are various methods for removing them. They are roughly classified into four different groups: oily (greasy) stains, particulate stains, enzymatic stains and bleachable (oxidizable) stains. Oily stains on clothes surfaces are a common result of being in contact with organic substances of the human body (e.g. perspiration, skin shedding and sebum) or by being exposed to an oily environmental pollutant (e.g. oily foods). Studies showed that human sebum is major component of oily soil found on the garments, and if it is aged under the several environmental conditions, it can generate obstacle yellow stains on the textile surface. In this study, a parametric study was carried out to investigate the key factors affecting the cleaning performance (specifically sebum removal performance) of a washing machine. These parameters are mechanical agitation percentage of tumble, consumed water and total washing period. A full factorial design of the experiment is used to capture all the possible parametric interactions using Minitab 2021 statistical program. Tests are carried out with commercial liquid detergent and 2 different types of sebum-soiled cotton and cotton + polyester fabrics. Parametric results revealed that for both test samples, increasing the washing time and the mechanical agitation could lead to a much better removal result of sebum. However, for each sample, the water amount had different outcomes. Increasing the water amount decreases the performance of cotton + polyester fabrics, while it is favorable for cotton fabric. Besides this, it was also discovered that the type of textile can greatly affect the sebum removal performance. Results showed that cotton + polyester fabrics are much easier to clean compared to cotton fabric

**Keywords :** laundry, washing machine, low-temperature washing, cold wash, washing efficiency index, sustainability, cleaning performance, stain removal, oily soil, sebum, yellowing

**Conference Title :** ICCPE 2022 : International Conference on Chemical and Process Engineering

**Conference Location :** Amsterdam, Netherlands

**Conference Dates :** November 03-04, 2022