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Analysis of air flow around the painting line for dust reduction : An experimental and numerical study (Article)

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Abstract

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The repair of paint work defects in the painting production process is done by running the parts through the painting process again. It is done together with the requisite quality control routines and involves a very large proportion of the operating costs. The dust defect which ranges between 40% to 50% is found to be the top and highest rejection at the painting line . Hence, this paper is focused to identify the effectiveness of applying Computational Fluid Dynamic (CFD) to identify the air flow and the turbulence pattern to investigate the movement and the dust particle concentration in painting line . Renormalization Group (RNG) k-ε turbulence model is used in CFD to predict the particles' movement and concentration. Five new models including the current painting line design are proposed and tested. The painting line model labelled as Model F is found to be the best model to minimize and reduce the dust particle concentration inside the painting line environment with 96.01% of percentage particle is flushed out at air velocity of 0.1 m/s. Along with results from numerical simulation using CFD, the experimental data is also collected using an air flow meter in a small-scale model painting line . Both data from experiment and CFD simulation are analysed and compared in order to measure the effectiveness of the result. The average relative error for Model F is recorded at 4.76%. The results from this study is recommended to be considered as one of the benchmarks for future design of automotive painting line . © 2020 PENERBIT AKADEMIA BARU-All rights reserved.

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