MANUFACTURING PROCESS AND PERFORMANCE EVALUATION OF THERMAL INSULATION COATINGS

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Degree of Master of Engineering

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Sri Lanka

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Dissertation submitted in partial fulfillment of the requirements for the degree Master of Engineering.

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Declaration:

I declare hereby that the following research work is my research work and the dissertation content does not incorporate without previous acknowledgements any academic materials which are heretofore submitted for any degree, diploma or certificate course in another university, institution, or higher education college to the best of my acquaintance, as well as the belief it does not incorporate any other academic materials previously submitted, written, or issued by other individuals or higher educational institutions except where the acknowledgment is made within the chapters in the report. Correspondingly, I hereby grant a nonexclusive right to continue, replicate, or distribute to the University of Moratuwa my dissertation works, in entirety or in part in printed or electronic versions or other mediums.

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C. S. K. Ranasinghe

The above candidate has carried out research work for the Master / Dissertation under my supervision.

Signature of the Supervisor:

Name of the Supervisor: Dr. H. K. G. Punchihewa Date: 25th November 2022

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Abstract:

Manufacturing organizations are using a considerable amount of energy for their daily manufacturing operations and more than 60% of their total energy use is for thermal applications. Therefore, systems that use thermal energy as the main energy input for manufacturing operations continuously emit thermal energy to the environment, raising significant environmental, financial, human factors, and safety issues. Therefore, preventing the dissipation of thermal energy from manufacturing systems to their surroundings has become a priority in answering some of the most critical challenges. This could be done by improving energy efficiency and creating a safe workplace. However, due to the drawbacks of traditional insulation methods due to uneven hot surfaces and organizational rules and regulations on carcinogenic insulation materials, most organizations are moving toward environmentally friendly alternatives. Therefore, thermal insulation paints play an important role in substituting traditional insulations.

This research aims to develop a thermal insulation paint by changing the type of pigment to minimize the thermal conductivity of the final coating mixture. A two-factor factorial design was designed that considered pigment volume concentration (PVC) and additive percentage (Sodium polyacrylate) as variable factors and the thermal conductivity as the response variable. For each variable, nine different combinations of paint samples were considered at three different levels. In this experiment, tile body powder was selected as the pigment, polyvinyl acetate (PVA) as the binder and sodium polyacrylate (NaPA) as the dispersing agent, and the thermal conductivity of the final coating layer against the selected coating substrate was measured. Then a numerical relationship was developed between the thermal conductivity (K) of the final insulation coating layer and the percentage of the weight of the two factors. The results revealed that the pigment type is the most influential factor for the insulation properties or thermal conductivity. Hence, there is an opportunity to continue the same procedure to evaluate the insulation properties while changing pigment types, especially considering ceramic base materials.

Keywords: Pigment, Pigments volume concertation (PVC), Thermal Conductivity (K)

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