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ORIGINAL PAPER

The application of continuous pneumatic jig for solid waste separation

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Abstract

This study investigates the use of continuous pneumatic jigging as an efficient technique of solid waste separation, with a focus on the different materials of copper wire and rubber insulator. The research investigates the effect of several parameters on separation efficiency, such as air flow, pulse rate, vibrational force, and bed thickness. The 7-min experiment, which included the simultaneous use of jigging and vibration, gives light on the subtle relationships that govern particle movement. The results of the air flow and pulse rate investigation highlight the importance of concentration criteria and density discrepancies in obtaining appropriate separation. The usage of small particles refines the process for greater efficiency. A persuasive case is presented in the analysis of the vibrational impact for the efficacy of lower air flow rates coupled with higher vibrational force. This is consistent with the minimal fluidization velocity notion, emphasising the critical role of effective fluidization in particle separation performance. The analysis of bed thickness emphasises the significance of proportional modifications in air flow rate to maintain optimal separation efficiency. The research finishes with a synthesis of these findings, emphasising the attractive prospects of pneumatic jigging for solid waste separation, notably with copper wire and rubber insulator materials. The implications for waste processing scenarios, notably in the beneficiation or pretreatment of waste electrical and electronic equipment prior to recycling, are discussed. This research lays a foundation for further exploration and application of pneumatic jigging in sustainable waste management practices.

Keywords Continuous pneumatic jigging · Physical separation · Solid waste recycling

Introduction

The 21st-century surge in information technology has undeniably propelled global productivity and economic expansion to unprecedented heights. Yet, this meteoric rise has cast a looming shadow of environmental challenges, triggering a complex array of issues that infiltrate every facet of our ecosystem (Rahman and Aziz 2022; Razali et al. 2020). Landfills burgeon with discarded tech, emitting toxic compounds into the air and seeping contaminants into water sources, exacerbating air and water pollution respectively. Simultaneously, the voracious demand for resources has fuelled rampant deforestation, habitat destruction, and an alarming depletion of our natural reserves (Isa et al. 2017; Japar et al. 2020a; Suhaila et al. 2018).

In response to this urgent call for action, researchers worldwide have fervently embarked on exhaustive studies and initiatives, meticulously dissecting, and analyzing the multifaceted layers of these challenges (Japar et al. 2019; Hairunnaja et al. 2023a, b).Their collective efforts aim to not only understand the breadth of the issues but also to

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