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Evaluation of Solid-Gas Separation Efficiency in Natural Gas Cyclones

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Abstract : Objectives/Scope: This paper proposes a mathematical model for calculating the solid-gas separation efficiency in cyclones. This model provides better agreement with experimental results compared to existing mathematical models. Methods: The separation ratio efficiency, ɛsp, is evaluated by calculating the outlet to inlet count ratio. Similar to mathematical derivations in the literature, the inlet and outlet particle count were evaluated based on Eulerian approach. The model also includes the external forces acting on the particle (i.e., centrifugal and drag forces). In addition, the proposed model evaluates the exact length that the particle travels inside the cyclone for the evaluation of number of turns inside the cyclone. The separation efficiency model derivation using Stoke's law considers the effect of the inlet tangential velocity on the separation performance. In cyclones, the inlet velocity is a very important factor in determining the performance of the cyclone separation. Therefore, the proposed model provides accurate estimation of actual cyclone separation efficiency. Results/Observations/Conclusion: The separation ratio efficiency, ɛsp, is studied to evaluate the performance of the cyclone for particles ranging from 1 microns to 10 microns. The proposed model is compared with the results in the literature. It is shown that the proposed mathematical model indicates an error of 7% between its efficiency and the efficiency obtained from the experimental results for 1 micron particles. At the same time, the proposed model gives the user the flexibility to analyze the separation efficiency at different inlet velocities. Additive Information: The proposed model determines the separation efficiency accurately and could also be used to optimize the separation efficiency of cyclones at low cost through trial and error testing, through dimensional changes to enhance separation and through increasing the particle centrifugal forces. Ultimately, the proposed model provides a powerful tool to optimize and enhance existing cyclones at low cost.

Keywords : cyclone efficiency, solid-gas separation, mathematical model, models error comparison
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