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Water Split Behaviour in Cylindrical and Conical Cyclones

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Extended Abstract

Cyclones of various designs are in use in the mineral industry to separate particles based on size and/or density. Apart from mineral industry they are also used in the chemical industry, food processing industry, power plants etc. It is, therefore, clear that cyclones have wide spread applications and naturally research work towards understanding the actual separation mechanism inside a cyclone has been a major topic amongst all those relevant areas. However, development of suitable mathematical models towards tailor-made designs of cyclones is still lacking due to the complexities associated with it.

Even the understanding of water split behaviour in cyclones of various designs is not yet properly understood but this is an essential part of any water based process. The models developed so far on the water split behaviour in cyclones are empirical in nature. Moreover, in majority of these models, cone ratio (ratio between spigot and vortex finder diameter) has been used as a variable which may sometime generate misleading information. This issue has already been highlighted in a technical note to be published in an international journal (Minerals Engineering).

Considering all the above-mentioned facts an attempt has been made to understand the water split behaviour in cyclones of two different geometries by developing suitable mathematical models. A Vorsyl separator, mainly used by the coal preparation industries, and a conventional hydrocylone have been used to represent cylindrical and conical cyclones respectively for the experimental data generation purposes. The selected diameters of both the cyclones were 76 mm and attempts were also made to use identical operating conditions for ease of comparison. The experimental data generated were first regressed to develop suitable mathematical models. Then attempts were made to provide hydrodynamic justifications for the water split behaviour in both the cyclones. It has been found that the flow rates through overflow openings at various operating conditions for both the cyclones vary exponentially with the centrifugal force (G force) differential created in between the spigot opening and the cylindrical portion. The exponent is also found to be almost constant in both the designs. This important finding, we believe, will help in better cyclone designs.

The details of the experimental procedure, development of the empirical models and the methodology adopted towards the establishment of the new hydrodynamic correlation are the subject matters of this presentation.