

CERTIFICATION OF APPROVAL

**A Study on Extension of Useful Annular Area of a Swirling
Fluidized Bed Distributor**

by

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CERTIFICATION OF ORIGINALITY

This is to certify that I am responsible for the work submitted in this project, that the original work is my own except as specified in the references and my acknowledgement, and that the original work contained herein have not been undertaken or done by unspecified sources or persons.

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ABSTRACT

Swirling Fluidized Bed (SFB) in the present condition has shortcomings, especially massing particles at the periphery. Only small percentage of available annular area can be utilized in the swirling process. Expanding the useful annular area is a challenge. One solution proposed by Raghavan to overcome this is by having lower gas velocity at inner radius and thus varying swirl velocity from the inner radius to the outer periphery. To achieve this condition, new distributors must be designed, fabricated, and tested. Two novel concepts were generated, one is by having distributor with twisted blades, and the other one is by having rows of slanted tubes. By evaluation, the distributor with twisted blades is superior to those with multiple slanted tubes. Accordingly, three different configurations of the blades (neutral, forward twisted, and backward twisted) will be fabricated. The method of fabrication selected is by having the material cut using Electric Discharge Machine and then twisted manually using a lathe machine. The fabricated distributor then installed to existing SFB apparatus to run set of experiments. The experiments were conducted using four different particles, they are: two spherical particles and two irregular particles. The bed weight was varied starting from 1000 g, 1500 g, to 2000 g. The result shows distributors with forward twisted blades and backward twisted blades are superior to distributor with straight blades in terms of utilization area and lower bed pressure drop. The distributor with forward twisted blades provides the least bed pressure drop while the annular area utilization is the same as backward twisted blades distributor. The forward twisted blades distributor gives only slight difference in pressure drop when it is being used for different particle sizes and shapes. The flow regime for shallow bed (1000 g) in distributor with twisted blades described to have packed regime, minimum fluidization (bubbling and slugging), and swirling, but there is no sign of particle elutriation. This is quite different with the flow regime for deeper bed (1500 g) which has packed regime, minimum fluidization, swirling, and particle elutriation. The annular area utilization renders the highest on both distributors with twisted blades with 96% - 100% of available annular area compared to 76% - 84% for distributor with straight blades.

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Abbreviation and Nomenclature

D_i	inner diameter of annular distributor
D_o	outer diameter of annular distributor
CAD	Computer Aided Design
CNC	Computer Numerical Controller
SFB	Swirling Fluidized Bed
EDM	Electric Discharge Machine
l	length
d	diameter
l/d	length and diameter ratio
g	gram
kg	kilogram
cmh	cubic meter per hour
kW	kilowatt
HP	Horse Power
PVC	Poly Vinyl Chloride
ID	Inner Diameter
OD	Outer Diameter
mm	millimeter
cm	centimeter
m/s	meter per second
ΔP	pressure drop (mm of water)
b	bubbling
sl	slugging
sw	swirling
$sw.r$	rigorous swirling